BIOCHEMICAL EVALUATION OF PROCESSED *KARAYA* GUM TREE (*Sterculia setigera* Del.) SEED MEAL AND ITS UTILISATION IN DIETS FOR WEANED RABBITS

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PhD/SAAT/2016/903

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY (PhD) IN ANIMAL PRODUCTION

JUNE, 2023

ABSTRACT

This research was carried out to investigate the feasibility of replacing the conventional feed ingredient (maize) with a cheaper *Karaya* gum tree seed meal(KGTSM) in the diets of rabbits. Three processing methods (boiling, fermentation and roasting) were used to detoxify the seeds. In experiment II, nine (9) diets were formulated (T1 to T9) in which 5 % and 10 % of the diets were replaced with the test ingredients (boiled, fermented and roasted KGTSM) in placeof maize. A total of 108 weaned rabbits were randomly distributed into nine treatment groups of 12 animals per treatment; with three replicates of four animals per replicate in 3 X 3 factorial arrangement in a completely randomized design model. The experiment lasted for 12 weeks after two weeks adjustment period. Daily feed intake (DFI), average daily weight gain (ADG), total weight gain (TWG) and feed conversion ratio (FCR) were significant ($P<0.05$) across the treatments. At 5 % levels of inclusion of the KGTSM, animals on diet containing fermented KGTSM (T5) had higher (20.00 g) daily weight gain, total body weight gain and lower (3.22) feed conversion ratio followed by animals on 5 % boiled KGTSM (T2) (19.70 g)while animals on 5 % roasted KGTSM (T5) had the least body weight gain (19.11 g). At higher levels of inclusion (10 %), animals on boiled KGTSM (T3) had higher (18.75 g) daily weight gain and lower (3.43) FCR than animals on fermented (18.57 g and 3.53) and roasted (17.90 g and 3.80) KGTSM. Similarly, at 5 % level of inclusion, apparent nutrient digestibility was significantly ($P<0.05$) higher (80.63 % - 80.65 %) in 5 % fermented KGTSM dietfollowed by roasted KGTSM but at 10 % levels of inclusion, boiled KGTSM diet had significantly($P<0.05$) higher nutrient digestibility. Haematological parameters were significantly ($P<0.05$) different between the treatments but all the values were within the normal range for rabbits. Values for serum biochemical indices were also significantly ($P<0.05$) different between the treatments. With the exception of globulin which had values below the normal range, all other parameters were within the normal range for rabbits. Significantly ($P<0.05$) higher (70.50 %) dressing percentage (D %) was obtained in 10 % boiled KGTSM while least (66.17 %) D % was in10 % roasted KGTSM. Parameters for sensory evaluation of rabbit meat that include palatability, colour and acceptability were significant ($P<0.05$) between the treatments while flavour, juiciness and tenderness were not significant ($P>0.05$). Cost of feed per kg was least in 10 % boiled KGTSM. Similarly, among the diets containing processed seeds, profit per animal was higher (₦769.26) in5 % roasted than in boiled (₦753.64) and fermented KGTSM (₦764.50). At 10 % levels of inclusion, animals on diet T3 (boiled KGTSM) had higher (₦768.82) profit than T6 (fermented KGTSM) (₦760.08) and T9 (roasted KGTSM) (₦743.98). In experiment III, boiled KGTSM was used as replacement for dietary maize at 25 %, 50 %, 75% and 100 %. From the results obtained, ADG was higher in diet containing 25 % (17.00 g) (D2) followed by 0 % (16.80 g) D1 and 50 % boiled KGTSM (16.60 g) (D3). FCR was lower (2.90) in D1 and D2 followed by D3 (3.04). However, FCR was not significantly ($P<0.05$) different from D1, D2 and D3. Gain (profit) was higher (₦681.76) in D3 than in other treatments (D1 = ₦ 618.58, D2 = ₦ 625.11, D4 = ₦ 596.63 and D5= ₦ 588.71). Total feed intake was lower in D2 (among the treatments fed diets with boiled KGTSM) with corresponding higher weight gain. All the values were significantly ($P<0.05$) different between the groups. It could therefore be concluded that KGTSM can be used to replace maize in the diet of weaned rabbits. However, boiled KGTSM gave better results and profit at 50 % inclusion levels. Boiled KGTSM could replace maize up to 50 % level.

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ABBREVIATIONS, GLOSSARIES AND SYMBOLS

%	Percentage
µg	Microgramme
µL	Micro Liter
ADG	Average Daily Gain
$AgNO_4$	Silver Nitrate
Alkalo.	Alkaloid
ALP	Alanine Phosphatase
ALT	Alkaline Aminotransferase
ANFs	Anti-Nutritional Factors
ANOVA	Analysis of Variance
AOAC	Association of Analytical Chemicals
AST	Aspartate Aminotransferase
B	Boiled
BAS	Basophils
Bili	Bilirubin
BKGTSM	Boiled *Karaya* Gum Tree Seed Meal
Ca	Calcium
$CaCl_2$	Calcium Chloride
Cdif	Cost Differential
CF	Crude Fibre
CF/BG	Cost of Feed Per Body Gain
CF/kg	Cost of Feed Per Kilogramme
CFC	Cost of Feed Consumed

Cm^3	Centimetre Cube
CP	Crude Protein
CPR	Cost of Producing Rabbit
CWR	Cost of Weaned Rabbit
D	Diet
D %	Dressing Percentage
DFI	Daily Feed Intake
Dl	Decilitre
DM	Dry Matter
dm^3	Decimetre Cube
DW	Dressed Weight
EDTA	Ethylene Diamine Tetra Acetic acid
EE	Ether Extract
Eos	Eosinophils
F	Fermented
Flavo.	Flavonoids
F. leg	Fore Leg
FBW	Final Body Weight
FCR	Feed Conversion Ratio
Fe	Ferros (Iron)
FKGTSM	Fermented *Karaya* Gum Tree Seed Meal
G	Gramme
g/dl	Gramme Per Decilitre
GE	Gross Energy

GPS	Geographical Positioning System
H_2O_2	Hydrogen Peroxide
H_2SO_4	Hydrogen Sulphate
Hb	Haemoglobin/Hbc – Concentrate
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
IBW	Initial Body Weight
Intest	Intestine
H. leg	Hind Leg
K	Potassium
Kcal	Kilo Calorie
Kcal/Kg	Kilo Calorie Per Kilogramme
KCl	Potassium Chloride
KGTS	*Karaya* Gum Tree Seed
KGTSM	*Karaya* Gum Tree Seed Meal
$KMnO_4$	Potassium per Manganate
KOH	Potassium Hydroxide
L	Litre
LOS	Level of Significance
LSD	Least Significance Difference
LW	Live Weight

LYM	Lymphocytes
MCH	Mean Corpuscular Haemoglobin
MCHC	Mean Corpuscular Heamoglobin Concentration
MCV	Mean Corpuscular Volume
ME	Metabolizable Energy
Ml	Milligramme
Ml/Kg	Milligramm Per Kilogramme
MM^3	Milimetres Cube
MON	Monocytes
Na	Sodium
Na_2CO_3	Sodium Carbonate
Na_2SO_4	Sodium Sulphate
NaOH	Sodium Hydroxide
NCRI	National Cereal Research Institute
NEU	Neutrophils
NFE	Nitrogen Free Extract
NH_4OH	Ammonium Hydroxide
Nm	Nanometer
NS	Not Significant

^{O}C	Degree Centigrade
P	Phosphorus
Pb	Lead
PCV	Packed Cell Volume
PH	Hydrogen Concentration
PPM	Parts Per Milligramme
PR	Percentage Reduction
Prof.	Profit
P-value	Probability Value
R	Roasted
RBC	Red Blood Cells
RCF	Reduction in Cost of Feed
RCFC	Reduction in Cost of Feed Consumed
RHSM	Raw Hibiscus Seed Meal
RKGTSM	Roasted *Karaya* Gum Tree Seed Meal
Ro	Raw
RoKGTSM	Raw *Karaya* Gum Tree Seed Meal
SAS	Statistical Analysis System
SEM	Standard Error of Mean
Stand. Dev.	Standard Deviation
S.Pri	Selling Price
SW	Slaughtered Weight
TFI	Total Feed Intake

TWG	Total Weight Gain
Vit	Vitamin
WBC	White Blood Cells
Zn	Zinc

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

The average Nigerian does not consume enough protein of animal origin that nourishes the body,which is also needed for tissue development and repair, and for healthy living because animal production in Nigeria has not been able to meet the protein need of the increasing Nigerian population (Ekumankama, 2000; Igwebuike *et al.,* 2003). This has led to serious malnutrition, especially among the vulnerable groups such as children and the low income populace that form the majority in the society (Taiwo *et al.,* 2003). To address this problem, the use of mini livestock,such as rabbit, for meat production and the adoption of a feeding strategy that maximizes the use of under-utilised feed resources and wastes in our environment have been suggested (Balogun *et al.,* 2000; Igwebuike *et al.,* 2003).

According to Ibitoye *et al.* (2010), the domestic rabbit, when compared to other livestock, is characterized by early sexual maturity, high prolificacy, relatively short gestation period, short generation interval, high productive potential and rapid growth. They have good ability to utilize forages and fibrous plant materials and agricultural by-products, have more efficient feed conversion, low cost per breeding female and higher profitability for small-scale system of production. The meat is nearly white, fine grained, palatable, high in good quality protein, high in caloric content and contains high percentage of minerals than other meats (Ibitoye *et al.,* 2010). Rabbit is an alternative source of protein with simple biological characteristics and has short breeding cycle (Hasanat *et al.,* 2006). It is easy to manage compare to other livestock (Aderinola *et al.,* 2008). It also has low cholesterol compared to cattle, sheep, goat and poultry (Okon and

Olawoyin, 2007). Considering these qualities, the potential of rabbits calls for development of rabbit industry (Malik *et al.,* 2011).

Prices of conventional feedstuffs are increasing daily due to high demand. Conventional protein and energy feeding ingredients for non-ruminants, including rabbits, have become very scarce andexpensive because of the competition between man and this group of livestock. The use of non- conventional plant protein especially from tropical legumes as an alternative to conventional sources had been advocated by animal nutritionists (Wafer *et al*., 2021). Rabiu *et al*. (2021) had also recommended the use of unconventional feedstuffs in animal feeds to reduce cost of feed. Increased feed cost could lead to total insecurity, unemployment, hunger and poverty (Omole, 2011). In view of this, there is far reaching awareness among livestock nutritionists of the need to look for alternative sources of feed ingredients which are nutritionally adequate, cheap and found locally to reduce cost of meat production and to reduce the competition between livestock and humans (Ijaiya *et al.,* 2002).

There are seeds of wild leguminous and non-leguminous species produced during dry seasons which are usually wasted that may be beneficial to livestock. Many wild species of plants are available for use but very few have been extensively promoted and utilized for feeding animals. Many other species, especially of leguminous trees, are still marginally known. These potential legumes might be of great importance, especially where there is pressing need for food sources of high energy and quality protein for man and livestock.

Among the numerous lesser-known plants, in which the seeds remain relatively unexplored for feeding animals is *Karaya* gum tree (*Sterculia setigera* Del.). *Karaya* gum tree is well known by different indigenous cultural communities in Nigeria. It is

called *Ose-awere, Kukuki, Kokongiga, Bo'boli, Sugubo, Ufia* and *Ompla* in Yoruba, Hausa, Nupe, Fulani, Kanuri, Igala and Idoma languages respectively. It is a multipurpose savanna tree with a wide ecological spread in tropicalAfrica, and is found mostly in the wild (Zaruwa *et al.,* 2016). The natural distribution is from Senegal to Cameroon in West Africa, east wards to Eritrea, and south wards to Angola (El-Bassir *et al.,* 2015). The tree is found in open savanna woodlands, oftencharacterized by stony hills (Agishi, 2004; Adelakun *et al.,* 2014).

There is dearth of information on the use of *Karaya* gum tree seeds as ingredient for rabbit feed. Some previous studies (Adelakun *et al.,* 2014; El-Bassir *et al.,* 2015) concentrated on the use of the seeds as ingredient in fish feed. Edeoga *et al.* (2005), Tor-Anyiin *et al.* (2011) and Hamidu (2012) determined the phytochemical constituents of the plant parts. Nutritionally, *Karaya* gum tree seeds have been reported to contain high crude protein, fibre, carbohydrate, fat and minerals,and rich in sodium, iron, zinc and manganese (Zaruwa *et al.,* 2016). El- Khalifa (2007) reported that the seeds contain 24.10 % crude protein, 25.25 % fat, 25.65 % fibre and 11.12 % nitrogen freeextract while Idu *et al.* (2008) reported 21.40 % crude protein, 21.03 % nitrogen free extract and11.58 % fat. Adelakun *et al.* (2014) reported 26.03 % fat, 45.27 % nitrogen free extract, 13.39 %crude protein, 6.15 % crude fibre and 3.95 % ash respectively.

Presence of anti-nutritional substances such as phytate, oxalate, tannin, hydrocyanide and nitrate in some seeds hinder animals from benefiting from them nutritionally (El-Mahmood *et al.,* 2008). Hamidu (2012) had reported *Karaya* gum tree seeds to contain active metabolites such as tannins, flavonoids, saponins, phenolics and glycosides. Processing methods such as cooking, toasting, fermentation and soaking have been reported to reduce the anti-nutritional factors in seeds (Antevy*et al*., 2017). Wafer *et al*.

(2021) in their study on the use of Jatropha (*Jatropha curcas*) seed mealas replacement for soya bean in growth performance of grower rabbits had also stated that processing methods such as cooking, toasting, fermentation and soaking reduced anti- nutritional factors in seeds.

1.2 Statement of the Research Problem

The cost of conventional feed ingredients such as maize, groundnut, soya bean, groundnut cake and soya bean cake has been on the increase from year to year leading to increase in the price of finished feeds and animal products. This has also limited expansion in commercial rabbit production. The competition between man and livestock for some of these feed ingredients, coupledwith their high cost had limited expansion in commercial rabbit production. This therefore, calls for search for alternative, non-conventional feed ingredients that could beused to replace the conventional ones in rabbit diets (Adejinmi *et al.,* 2007). The main aim of using these non-conventional feed ingredients is to reduce the cost of production, thus making it possible for people to be able to afford animal protein in their menu (Ojebiyi *et al.,* 2006).

Not much is known on the potentials of *Karaya* gum tree seed as feed ingredient in the diet of rabbits. The seeds are usually produced in abundance and wasted after production, thereby contributing to environmental pollution. Therefore, there is need to determine the nutritional value and the potential usage of this seed as rabbit feed component.

1.3 Justification for the Study

The increasing cost and uncertain availability of conventional feed ingredients, due to stiff competition between man and livestock, have made research interest to be focused on alternative protein and energy ingredients in rabbit feed. There are leguminous plant

seeds that are available which are rarely utilized for feeding animals. *Karaya* gum tree seed is one of such seeds. There isdearth of information on the use of this seed for rabbit feeding. The seeds are available and not competed for by man. Therefore, research on *Karaya* gum tree seed as an ingredient for rabbit feed could help to reveal the potentials of this seed in feeding rabbit which could also reduce the cost of feed as well as reduce the competition for conventional feed ingredients.

1.4 Aim and Objectives of the Study

The aim of this research is to investigate the possibility of replacing the conventional and competitive maize with the cheaper and available *Karaya* gum tree seeds (KGTS) in the diet of rabbits.

The objectives of the study are to:

i. determine the nutrients and anti-nutritional factors present in *Karaya* gum tree (*Sterculia setigera)* seeds;
ii. evaluate the effects of different processing methods on the nutritional and anti nutritional factors present in *Karaya* gum tree seeds (KGTS);
iii. investigate the effects of processed *Karaya* gum tree seed meal (KGTSM) on the growth performance and apparent nutrient digestibility of weaned rabbits;
iv. assess the effects of processed KGTSM on the haematological and serum biochemical indices of weaned rabbits;
v. determine the effects of processed KGTSM on the carcass characteristics and sensory properties of the meat of rabbits; and
vi. evaluate the economic benefits of using KGTSM in the diets of rabbits.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 *Karaya* Gum Tree (*Sterculia setigera* Del.), Distribution and Habitat

Karaya gum tree belongs to the family, *Malvaceae* in the major group of angiosperms (flowering plants). It is a deciduous tree often found in varied soil types. The grayish, purplish peel detachesitself in large thin irregular plates, letting appear a smooth and shallow peel. The roots are small, with very solid foundations, and the young branches have a smooth texture. The leaves are simple and have 3–5 triangular lobes, densely pubescent. Flowerings appear during the second half of the dry season between February and April in the Northern zone of Nigeria, at the same time as the new leaves and the maturation of fruits in December. Fruits are follicles containing big seeds. *Karaya* gum tree is known by different indigenous cultural communities in Nigeria. It is known in different languages as; *Kukuki, Kokongiga, Bo'boli, Sugubu, Ose – owere, Ompla, Ufia* and *Kumendul* in Hausa, Nupe, Fulani, Kanuri, Yoruba, Idoma, Igala and Tiv respectively (Agishi, 2004).

Karaya gum tree is a savanna tree, wide spread in savanna areas of tropical Africa (Agishi, 2004).The natural distribution range stretches from Senegal to Cameroon in West Africa, eastwards to Eritrea, and southwards to Angola. It grows in savanna type vegetation on a variety of soil types, thriving on poor soils as well as on hilly or stony sites (El – Khalifa, 2007).

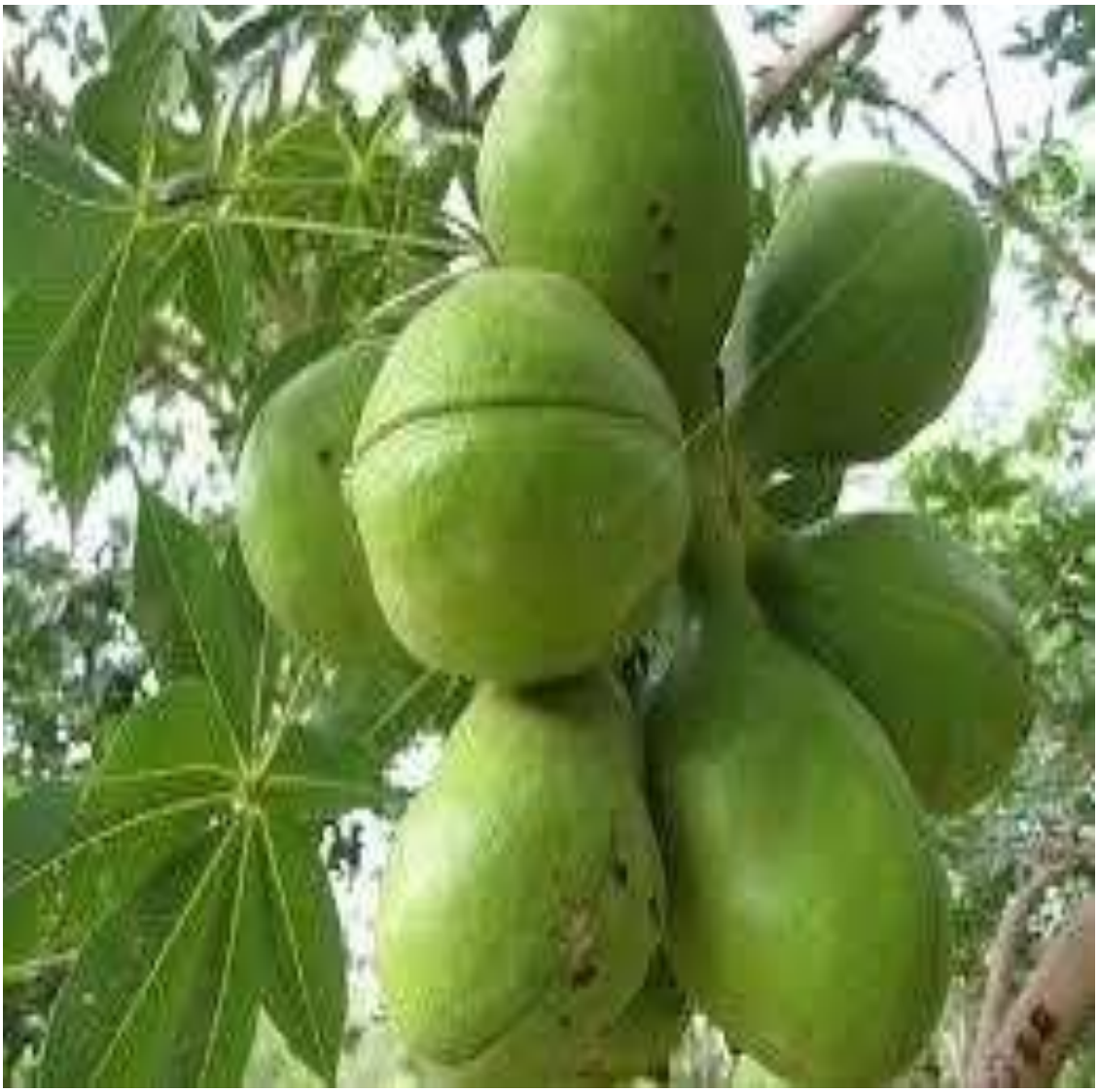

Plate I: *Karaya* gum tree unriped fruits

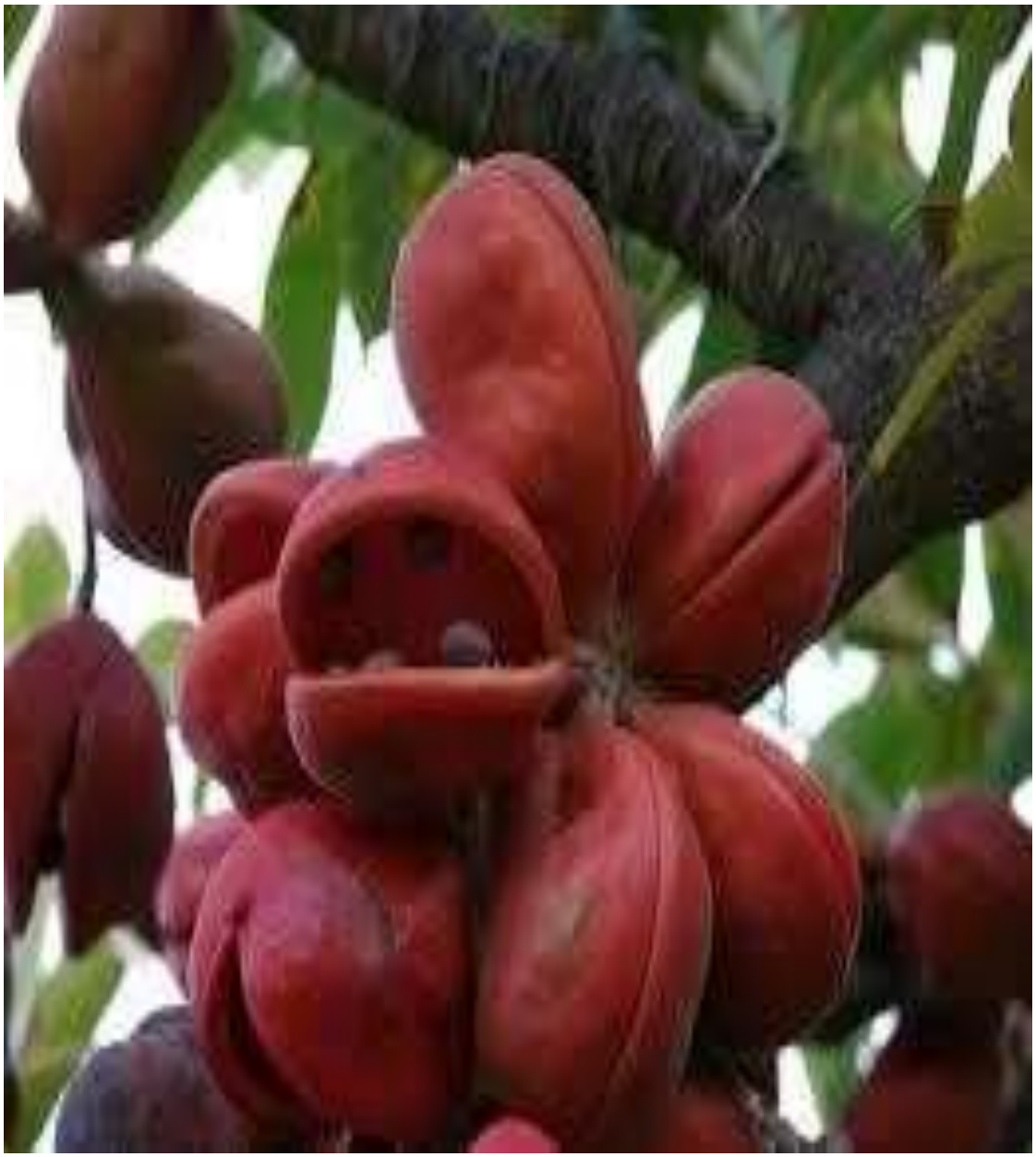

Plate II: *Karaya* gum tree riped fruits with seeds

2.2 Nutrient Composition of *Karaya* Gum Tree and Seed

Analyses of several parts of *Karaya* gum tree for nutritional composition revealed that the plant has high crude protein, fibre, amino acids, minerals, carbohydrates and fat contents. It is rich in sodium, iron, zinc and manganese and contains different types of essential vitamins (Zaruwa *et al.*, 2016). Adelakun *et al*. (2014) reported that *Karaya* gum tree seed contain; 94.80 % dry matter, 13.35 % crude protein, 6.15 % crude fibre, 26.03 % ether extract, 3.95 % ash and 45.27 % nitrogen free extract. El-Kalifa (2007) had reported the seed to contain 24.10 % crude protein, 25.25 % ether extract and 11.12 % nitrogen free extract while Idu *et al*. (2008) reported 21.40 % crude protein, 21.03 % nitrogen free extract and 11.58 % ether extract respectively.

2.3 Uses of *Karaya* Gum Tree

The wood of *Karaya* gum tree is soft, which makes it unsuitable for fuel wood and charcoal. It is therefore used for non-timber forest products. It is used for insulation and concealed items in carpentry. It provides water–soluble gum which is tapped and used as emulsifier, stabilizer and viscosifier. The gum is used as a laxative, diuretic and tranquilizer, and technically as an adhesive and for glazing pottery. The bark is used for rope making. In local medicine, the bark is also usedto treat snake bites, leprosy, syphilis, cough, bronchitis, rickets and insanity. The leaves are used as fodder for feeding animals (El–Bassir, 2015).

2.4 Non-Conventional Feed Ingredients in Rabbit Nutrition

The sharp rise in price of locally-produced feedstuff is a direct result of increasing competition between man and livestock for conventional feedstuff. Thus, the need arise to find alternative non–conventional feed ingredients for livestock and subsequently increase animal protein (Adeyemo *et al*., 2008). Effective utilization of non-

conventional feeds should be the major area of research inthe less developed countries due to shortage of conventional feedstuffs (Aro *et al*., 2008). Daudu *et al.* (2009) reported that non-conventional feedstuffs offer the best alternative for the reduction of feed cost which will ultimately lead to reduction in the price of meat and other animal products.Similarly, Fapohunda *et al*. (2008) also stated that a successful replacement of conventional feed ingredients will reduce feed cost, consequently reducing cost of production, thus making more protein available and improving animal protein intake, which is very low or deficient in the diet of the average African.

Many unconventional feed ingredients have been used in place of conventional ingredients and encouraging results were obtained. Taiwo *et al*. (2003) reported the use of cooked Mucuna seed meal-based diet up to 20 % to be relatively comparable to those fed the control diet (without Mucuna seed meal) and concluded that 20 % cooked Mucuna seed meal can be included in the diet of weaned rabbits. Raw Hibiscus seed meal (RHSM) can be used to replace groundnut cake up to 10 % level of inclusion in rabbit diet, without any adverse effect on performance and carcasscharacteristics (Abdu *et al*., 2009). Ani and Okorie (2008) also stated that 15 % processed castor bean meal and supplementary DL–methionine can be included in broiler finisher diet without any adverse effects on carcass and organ weights. Similarly, Onimisi *et al*. (2008) stated that up to 75% of groundnut cake can be replaced in the diets of growing rabbits with steamed castor seed cake,without any detrimental effects on growth performance and carcass development. However, for these non-conventional feed ingredients to meet the need of reducing cost of production, they must be available all year round and easy to procure and process if need be (Daudu *et al*., 2009). The utilization of these non-conventional ingredients as livestock feed is however not without its constraints. Utilization by monogastric animals is limited by their levels of structurally indigestiblecarbohydrate,

often designated as non-starch polysaccharides. Some of these unconventional ingredients have been found to be low in protein and high in anti-nutrients like hydrogen cyanide,polyphenols and phytin. These had led to concerted efforts by researchers to reduce or totally remove all the nutritional encumbrances militating against the utilization of these non- conventional feed sources (Aro *et al*., 2008).

2.5 The Domestic Rabbit

The domestic rabbit (*Oryctolagus cuniculus*) descended from wild rabbits found in the Mediterranean countries (Aduku and Olukosi, 1990). Rabbit belongs to the Kingdom, *Animalia*; phylum, *Chordata*; class, *Mammalia*; order, *Lagomorpha*; family, *Leporidae*; genus *Oryctolagus*and species, *Cuniculus* (Wikipedia, 2010). Rabbit is a monogastric herbivore, with a simple non –compartmentalised stomach similar to that of pig and human. Rabbit possesses a large caecum andcolon similar to that of the horse and the guinea pig. It is a coprophagous hind – gut fermenter thus, occupying a midway between ruminant and the monogastric (Oni *et al.,* 2011).

2.6 Nutrient Requirements of Rabbits

According to Anna and Lance (2005); Columbus (2009), rabbit needs a balanced diet rangingfrom grass hay to fresh green, fruits and a small amount of pelleted concentrate diet. Rabbit, like other livestock, has nutritional requirements. Adequate nutrition is highly important for growth and development of young and adult rabbits. Rabbits fed well balanced rations are efficient converters of feed to meat (Adama and Ayanwale, 2000). The amount of feed consumed and the nutrient requirements vary with the age of the rabbit and can be categorized into four age groups which are the young rabbit or fattening, lactating does, pregnant does and non-producing rabbit. Rabbit sleeps during the day and consumption of feed takes place mostly in the late afternoon and early

evening (Nakkitset, 2007).

2.6.1 Energy requirements of rabbits

The growing rabbit adjusts its feed intake according to the energy concentration of the feed given to it, where other dietary components are well balanced. Rabbits require energy level of between 2,390 and 2,500 kcal/kg of digestible energy. The provision of energy and protein in the diet accounts for some 90 % of the cost of the diet and over 60 % of the overall cost of production (Aremu *et al.*, 2010). The energy need of animals could be supplied from fats, grains and fibrous feeds. Inclusion of fat in the diets will raise the energy concentration as fats provide twice as much energy as carbohydrates from the same weight (Adama *et al.*, 2007). Okon *et al.* (2007) had reported that maize sievate of 2,185 Kcal metabolisable energy could supply the energy need of rabbit and that though energy is essential for growth, development, maintenance and reproduction,excess level in the ration of rabbit may increase the incidence of diarrhoea and enteritis.

2.6.2 Protein requirements of rabbits

Rabbit practice coprophagy and therefore the quality and quantity of protein are not critical in rabbit diet as in poultry. Ration for young growing rabbits should contain 12 to 15 % crude protein (MSUE, 2017). Different levels of protein that are required by rabbits have been determined for various body functions which include 16 % crude protein (CP) for growth, 12 % CP formaintenance, 15 % CP for pregnancy and 17 % CP for lactation. Higher levels of CP of 17 % to 20 % have been found to improve the growth rate and feed conversion efficiency but these are notrecommended for economic reasons. Most of the recommendations by foreign researchers are based on location that might not be compatible to Nigerian ecosystem (Bibi-Farouk *et al.*, 2010). The study by Ijaiya and Fasanya (2004) to examine the effect of graded levels of dietary protein at 10

%, 13 %, 16 % and 20 % CP on growth and carcass characteristics of rabbits had revealed that daily weight gain and daily feed intake increased with increase in dietary protein levels and concluded that rabbit can perform better on weight basis when provided with diets containing between 16 % and 20 % CP. Siddaramanna *et al*. (2009) reported that though rabbits have one of the highest feed to meat conversion ratio among farm animals, the conversion rate depends on the level of protein in the feed they consumed. The authors stated that factors such as litter size, weight gain and hair appearance are directly affected by the quality of protein consumed, and that proteinis made up of amino acids which form the building blocks for muscle, blood and fur. Amino acidshave various classes that include essential, non-essential, aromatic, non- aromatic and sulphur containing amino acids. Essential amino acids are those that must come from the diet because they cannot be made by the body while non-essential amino acids are produced by the body even if they cannot be obtained from food that is eaten. Aromatic amino acids have aromatic rings and are precursors for the synthesis of defence and repair compounds (JAAN'S Science class, 2012) while sulphur containing amino acids are important in cell metabolism (Brosnan and Brosnan, 2006).

2.6.3 Fibre requirements of rabbits

Rabbits are non-ruminant animals, but of herbivorous group (pseudo-ruminants), which utilise allclasses of food including fibre. Fibre is not a very useful source of energy for the rabbit yet it is avery important component (Ibrahim *et al.*, 2011). Available data had shown that fibre is necessaryin rabbit diets for normal functioning of the digestive tract. Fibre is critical for keeping rabbit's delicate gastro-intestinal tract moving (Ani *et al.*, 2011). Rabbit requirement for crude fibre (CF) isvery high, about 14 % to 25 %, when compared to other monogastric animals. Fibre and non-fibre components in the hind gut are separated with rapid excretion of the excess fibre in the hard pelletsor faeces while

the non fibre components are digested efficiently when re-injested as caecotropeswhere they are subjected to more than one passage through the digestive tract. With hind gut fermentation, a high intake of high fibre diet can be achieved with nutrient requirement met by thehigh digestibility of non fibre components (Onyekwere *et al.*, 2010).

Some researchers had recommended 12 % to 14 % crude fibre. The level of CF recommended for all purpose rabbit ration is 12 % to 14 % (Siddaramanna *et al*., 2009). Some CF content of feed concentrate with a free choice feeding of CF is said to be required for satisfaction and food digestion. Rabbits do not appear to thrive well if fed ration containing less than 13 % CF. CF requirements of rabbit vary with breed and class of rabbit. Low fibre in the diet leads to hair eatingfrom the body in an attempt to satisfy craves for fibre. CF level below 5 % has been found to resultin the disorder of the alimentary canal and increased mortality (Ibrahim *et al.*, 2011).

2.6.4 Water requirements of rabbits

Water is essential as a constituent of all parts of the body and without it, food cannot be digested. Maintenance of effective elimination of harmful products via the urine is dependent upon sufficient water, as it is also important in maintenance of almost all other physiological processes. The importance of water in maintaining the homeothermy of animals and the amount of body fluids within normal range cannot be undermined. Wiseman (2010) opined that for efficient growth andproduction performance, rabbit should be provided with adequate clean water at all times.Although rabbit can derive water from forage (especially succulent green forage), it is essential that drinking water be made available to the animal considering the fact that about 60 % to 70 % of the total body weight of an animal is comprised of water (Socha *et al.*, 2003). Lowe *et al.* (2000)

reported that a reduction in normal water intake by 20 % or more could result in a marked decrease in feed consumption, with a proportional decrease in growth. Rabbit takes in more water in the day than in the night (Malley, 2005). During the day, rabbit spends about 20 % of its time drinkingwater (Anna and Lance, 2005).

Fayez and Alnaimy (2000) reported that adequate water supply to rabbit should be a major concernin the tropics where environmental temperature and humidity prevail all round at levels detrimental to satisfactory performance of rabbit. Daily water intake increases with increase in ambient temperature and decreases with reduction in ambient temperature (Lowe *et al*., 2000). Rabbits have their normal water intake range (15 to 50 ml/kg body weight) at the temperature range of 20 ^{0}C to 25 ^{0}C, otherwise known as the comfort zone (Wikipedia, 2010). At temperature below10 ^{0}C, water intake may stop in rabbit and as the ambient temperature increases above 35 ^{0}C, rabbits can no longer regulate their internal temperature and water intake starts declining and heat prostration sets in (Lebas, 2000). At 40 ^{0}C, considerable panting and salivation occur and rabbit stops drinking water entirely (Fayez and Alnaimy, 2000).

2.7 Anti – Nutritional Factors in Rabbit Nutrition

Anti – nutritional factors (ANFs) are compounds mainly organic, which when present in the diet, may affect the health of the animal or interfere with normal feed utilization. Anti- nutritional factors may occur as natural constituents of plant and animal feeds, as artificial factors added during processing or as contaminants of the ecosystem (Njidda and Ikhimioya, 2012). These are substances that may be added deliberately, introduced unintentionally as a consequence of humanactivities or an intrinsic part of the plant or animal food material as it is formed in nature. The moredangerous from the public health standpoint are those that act in a slower, more subtle fashion and may therefore not be recognized as being dangerous. Many chemical components of natural food products

have been identified, some of which include cyanogenic glycosides, haemagglutinins, saponins, gossypol, goitrogen, trypsin inhibitor, oxalates, phytates and anti-vitamins (Onwuka, 2005).

A variety of anti-nutritional factors such as trypsin and chymotripsin, phytohaemagglutinins (pectins), urease, allergic factors, lipases and lipoxygenases can affect digestion, reduce growth and affect body metabolism of monogastric animals (Maidala *et al*., 2011). Some anti-nutritional factors such as trypsin inhibitors and chemotrypsin inhibitors affect the digestion of protein. Other anti-nutritional factors such as tannins, anthocyanins and haemagglutinins impart bitter or unacceptable taste, prevent protein digestion and decrease absorption of divalent metal ions in the intestine (Abdu *et al*., 2008). Ogbu *et al*. (2015) reported that ANF's such as tannins and saponins decrease feed intake due to their astringent properties.

Removal of these undesirable components is essential in order to improve the nutritional quality of seeds and to effectively utilize their full potentials as food (Abdu *et al*., 2008). In order to exploitthe feed potentials of the seeds for animals, processing is required. Boiling is a more conventionalmethod of detoxification, but toasting is also practiced and has advantages when drying is a problem (Tuleun *et al.,* 2008). Soaking, boiling, toasting, malting, fermentation, decortication, irradiation with microwaves, and various combinations of these are techniques which have been found to be effective for various seeds (Carew *et al*., 2008). Anti-nutritional factors (ANFs) like cyanogens, flatulence factors, tannin, trypsin inhibitor and haemaglycin in raw seeds can be inactivated by cooking or other forms of heat treatments (Ehebha *et al*., 2008).

Heat treatment such as boiling, frying and drying are frequently used to improve the utilization ofthe nutrients in legumes (Shaahu *et al*., 2015; Adelowo *et al*., 2021).

Ayanwale (2004) had also stated that different processing methods to detoxify ANFs include roasting or toasting, soaking inwater, fermentation, addition of alkaline salt, extruding and blanching. Ani and Okeke (2003) had stated that treatment by heat has been established as an effective method of destroying heat labile anti-nutritional factors.

Fermentaton involves subjecting feed ingredient to controlled microbial action or degredation to improve the nutritive value of feed ingredient. It allows the production of lactic acid that may essentially eliminate the probability of bacterial disease and parasitic nematodes (Garba and Maigandi, 2008). Natural fermentation has been reported to improve the nutritive value and availability of limiting amino acids of sorghum in the diet of weaner rabbits. It has also been reported to significantly reduce the tannin content of sorghum cultivar (Jegede *et al*., 2008). Emenalon *et al*. (2008) reported that fermenting non-sieved seeds of *Alchornea cordifolia* improved weight gain of broiler chicks at 10 % level of inclusion as replacement for maize equal to control. The authors further stated that ground sieved and fermented *Alchornea cordifolia* seed could replace maize in broiler starter diet up to 10 % level.

2.7.1 Cyanogenic glycocides

The knowledge of the cyanogenic glycosides content is vital because cyanide, being an effective cytochrome oxidase inhibitor interferes with aerobic respiratory system. Hydrocyanic acid (HCN) does not occur free but combines with sugars to form a non-toxic compound, cyanogenic glycoside. A lot of hydrocyanic acid (known to inhibit the respiratory chain at the cytochrome oxidase level) is lost during soaking and cooking so that its content in the vegetables and fruits poses no danger of toxicity. The lethal level is 50 – 60 mg/kg body weight (Onwuka, 2005).

2.7.2 Tannins

Tannin is an astringent, bitter, polyphenolic compound that binds to and precipitates protein and various other organic compounds, including amino acids and alkaloids. The astringency from tannin is what causes the dry and porker feeling in the mouth following the consumption of unripe fruits or red wine. Tannins are natural constituents of many plants, and are grouped into hydrolyzable and condensed tannins. Hydrolyzable tannins are potentially toxic and cause poisoning if large amounts of tannin–containing plant materials are consumed (Njidda andIkhimioya, 2012). Condensed tannins are far more common in non–grain starch staples and usuallyexist in the plant tissues as leuco–anthocyanins or proanthocyanidins. Tannins bind to both proteins and carbohydrates and can also act as anti–nutritional factors to provoke an astringent reaction in the mouth and make food unpalatable. They can also form complexes and thus precipitate proteins in the gut, reducing the digestibility or inhibiting digestive enzymes and micro–organisms (Onwuka, 2005). Tannins have been found to reduce feed intake as well as affectdigestibility and therefore rate of utilization of dietary nutrients in animals (Njidda and Ikhimioya,2012).

2.7.3 Saponins

Saponins are a class of chemical compounds, one of the many secondary metabolites found in natural sources in various plant species. Saponins are often bitter in taste, and so can reduce plantpalatability in animal feed. Saponins have been reported to cause depression in feed intake (Njidda and Ikhimioya, 2012). Many hypogenous photosensitization conditions in animals have been attributed to the intake of forage plants containing saponins (D'Mello, 2000). Ruminant animalscan breakdown saponins but monogastric animals cannot (Ranjhan, 2001).

2.7.4 Phytates

Phytates are found in almost all feeds of plant origin. They are present in association with protein and generally abundant in protein feeds. Phytic acid possesses high chelating ability and in plants, it is found as phytates of many minerals which are mostly not available to monogastric animals asthey lack the enzyme phytase. Phytic acid forms insoluble salts with essential minerals like phosphorus, calcium, iron, magnesium and zinc in food rendering them unavailable for absorption into the blood. Phytic acid and its hydrolysis products are associated with inhibition of calcification in rats (Onwuka, 2005).

2.7.5 Alkaloids

Alkaloids are basic natural products occurring primarily in plants. They are secondary metabolitesof amino acids. They constitute the largest and most diverse group of natural products of vegetable origin (Jigam *et al*., 2003). Alkaloids are generally found in the form of salts with organic acids. About 10 % – 20 % of all higher plants probably contain alkaloids. Gastro-intestinal upset and neurological disorders occur especially in doses in excess of 20 mg/100 g sample. Simple boilingremoves the alkaloids present in most cultivated species of yam (Onwuka, 2005).

2.7.6 Oxalates

Oxalates have long been known to occur in nearly all of living matter. Certain species of plants contain relatively large amounts of this substance, mainly as the soluble sodium or potassium salts or soluble calcium salts. The earliest interest in the toxicity of oxalates arose because of instances of human poisoning following the eating of larger quantities of the leaves known to contain relatively large amounts of oxalates. Dietary oxalate has been known to complexwith calcium, magnesium and iron leading to formation of soluble

oxalate salts and resulting in oxalate stone. This also interferes with utilization of minerals. The lethal level in man is 2 –5 g (Onwuka, 2005).

The accepted limit of anti–nutritional factors as reported by Amata (2010) for alkaloids was 640 mg/100 g, 4750 mg/100 g for tannins, 1860 mg/100 g for saponins, 341.2 mg/100 g for trypsin inhibitors, 25 mg/100 g for phytic acid while 15 mg/100 g was reported for oxalate and 1.12 % for phenol. Njidda and Ikhimioya (2012) reported 25 – 40 mg/100 g for nitrates. Similarly, Malik *et al*. (2016) reported recommended critical limit of saponins, tannins, oxalates and phytates to be 7.02 mg/100 g, 31.20 mg/100 g, 0.54 mg/100 g and 23.40 mg/100 g respectively.

2.8 Blood Indices of Rabbit

Blood is a complex fluid containing a large variety of dissolved suspended inorganic and organicsubstances or specialized circulating tissues and cells suspended in the intercellular fluid substance. Blood transports or conveys nutrients and materials to different parts of the body. Therefore, whatever affects blood will certainly affect the entire body adversely or moderately in terms of health, growth, maintenance and reproduction (Oke *et al*., 2007). The cellular elements of the blood that supply oxygen are the red blood cells, the white blood cells protect against foreign organisms and antigens while platelets initiates coagulations (Merck's Veterinary Manual, 2012).The various functions of blood are made possible by individual and collective actions of its constituents – the biochemical and haematological components. Generally, both the biochemical and haematological blood components are influenced by the quantity and quality of feed and alsothe level of anti–nutritional elements or factors present in the feed (Akinmutimi, 2004).

It is important to consider the health status of animals used in various feeding trials, and

one of the ways of assessing it is to evaluate the use of haematological studies (Jiya *et al*. 2008). A readily available and fast means of assessing clinical and nutritional health status of animals on feeding trial is the use of blood analyses the reason being that ingestion of dietary components has measurable effects on blood composition (Olabanji *et al*., 2007). Adamu *et al*. (2006) had observed that nutrition and environmental temperature have significant effects on haematological values like packed cell volume (PCV), haemoglobin (Hb) concentration and red blood cells (RBC) count.

Blood chemistry constituents reflect the physiological responsiveness of the animal to its internaland external environments which include feed and feeding (Esonu *et al*., 2001). Blood contains metabolites and other constituents, which provide a valuable medium for chemical investigation and nutritional status for human being and animals. Dietary components have been reported to have measurable effects on blood components hence, blood constituents are widely used in nutritional evaluation and survey of animals (Ewuola *et al*., 2008). Biochemical components are sensitive to elements or factors present in the feed, including elements of toxicity (Akinmutimi, 2004). They can also be used to monitor protein quality of feed. Blood chemistry studies are usually undertaken to establish the diagnostic baselines of blood characteristics for routinemanagement practices of farm animals (Tambuwal *et al*., 2002). Total serum protein had been reported as an indication of the protein retained in the body of an animal while total blood proteinand creatinine contents have been shown to depend on the quantity and quality of dietary protein (Esonu *et al*., 2001). Serum biochemical analysis is also used to determine the level of heart attack,liver damage and to evaluate protein quality and amino acid requirements in animals (Ewuola *et al*., 2008).

Mitruka and Rawnsley (1977) had reported normal haematological ranges for rabbit to be 9.9 – 19.3 g/dl, 5.50 – 12.5×10^3/mm^3, 31.0 – 50.0 %, 57.8 – 65.4 u^3, 17.1 – 23.5 ug

and 28.7 – 35.7 % for haemoglobin concentration (HbC), packed cell volume (PCV), white blood cells (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) respectively. The authors also reported 0.50 – 2.65 mg/dl,42.5 – 98.0 IU/L, 48.5 – 78.9 IU/L, 78.0 – 155 mg/dl and 30.00 – 37.00 mg/dl for serum creatinine,serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), blood glucose and blood urea concentration. Sirois (1995) had also reported normal range values to be 0 – 6 mg/dl and 0 – 3 mg/dl for total bilirubin and conjugated bilirubin respectively. Merck's Veterinary Manual (2012) reported normal physiological ranges of haematologicalcomponents for rabbit as 5 – 12.5, 1.6 – 10.6, 0.05 – 0.5, 1.2 – 7.2, 30.0 – 85.0, 1.0 – 4.0, 30.0 – 48.0, 5.0 -- 8.0, 10.0 – 17.0, 33.0 – 50.0, 58.0 – 67.0, 17.0 – 24.0 and 29.0 – 37.0 for white blood cells (10^9/l), lymphocytes (10^9/l), eosinophils (10^9/l), neutrophils (10^9/l), lymphocytes (%),eosinophils (%), neutrophils (%), red blood cells (10^9/l) haemoglobin (g/dl), packed cell volume(%), mean corpuscular volume (l), mean corpuscular haemoglobin (pg) and mean corpuscular haemoglobin concentration (pg) respectively. Medirabbit (2011) had reported the normal range albumin value for healthy rabbit to be 2.70 % - 5.00 % g/dl while normal range for platelet count is 250.00 – 600.00 × 10^9/l for healthy rabbit. Olabanji *et al*. (2007) had reported normal range of monocytes to be 0.67 % - 1.50 % respectively.

2.9 Carcass Characteristics

The proportion of dressed weight to live weight is used as a measure of most production in farm animal, because there is a relationship between weight and physical characteristics of animal which is a reflection of feed efficiency and performance (Ijaiya and Fasanya, 2004; Jiya *et al*., 2008). Anumber of factors can negatively or positively affect carcass

characteristics of animals which include nutrition, health status of the animal, stress and environmental condition. Nwagu *et al*. (2008) had stated that live weight at slaughter influences the dressing percentage and the absolute weight of the various carcass traits. In recent decades, several attempts have been made to enhancethe carcass characteristics of rabbits (Zhu *et al*., 2013).

Abdullahi *et al*. (2020) had reported that different types and different levels of rumen content hadno negative effect on carcass characteristics of growing rabbits. Amaefule *et al.* (2020) concludedin their study on effect of Bambara nut offal fed as replacement for wheat offal on growth performance and carcass yield of weaner rabbits that up to 75 % replacement of wheat offal with Bambara nut offal produce similar results on growth and carcass yield of weaner rabbits. Adeyeye*et al*. (2020) also concluded in their experiment on effects of dietary inclusion of processed wild sunflower and goat weed leaf meals on meat quality of broiler chickens that the meat quality was improved as cholesterol content and the glutathione were reduced. Similarly, Ahmed and Olorede (2003) also stated that carcass quality of broiler birds fed locust bean pulp was improved compared to the control diet due to reduction in fat content of the meat.

2.9.1 Sensory evaluation

Sensory evaluation is a subjective food analytical tool that uses the five human senses; sight, hearing, feeling, smell and taste to assess food quality in terms of acceptance or rejection. Sensory evaluation is of great importance in new product development, product improvement, quality maintenance and market research. The five human senses have the capacity to perceive the organoleptic properties of food such as colour, flavour and texture and this is the basis on which sensory evaluation is carried out. In sensory evaluation, sight is a physical sense which enables one to judge the overall appearance of a food in terms of form, texture and colour. Sense of taste is a chemical sense and

responds to the action of the chemical components of foods on the receptorsites of the taste buds, located on the tongue. Smell or olfaction, a chemical sense, responds to chemical component that reaches the olfactory tissue of the nose (Onwuka, 2005).

The palatability of food may be judged on the basis of the kind, quality and intensity of sensory impressions made among the sensory properties of food. Among the sensory properties of food, flavour, which may be broken down into taste and aroma, appearance and texture, which is the "mouth feel", may be considered. Meat palatability is dependent upon these factors (texture, aroma, flavour, juiciness, tenderness and colours). These factors are influenced by species of animal, breed, sex, age, diet fed and post-mortem handling techniques (Aremu, 2003).

A team or group of individuals called panelists is employed as judges in sensory evaluation. Theytaste the food and assess the quality based on their organoleptic properties. This group ofindividuals is usually experienced and in good health that are not suffering from conditions whichmight interfere with normal functions of taste and smell (Onwuka, 2005).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Experiment I: Determination of the Nutrients and Anti-Nutritional Factors in *Karaya* Gum Tree Seeds and the Effects of Different Processing Methods on Their Levels

The objectives of this study were to determine the:

i. proximate composition of raw, boiled, fermented and roasted *Karaya* gum tree seeds;

ii. mineral contents of raw, boiled, fermented and roasted *Karaya* gum tree seeds;

iii. vitamin contents of raw, boiled, fermented and roasted *Karaya* gum tree seeds; and the

iv. anti-nutrient contents of raw, boiled, fermented and roasted *Karaya* gum tree seeds.

3.1.3 Collection and processing of *Karaya* gum tree seeds

Twelve kilogrammes (12 kg) of *Karaya* gum tree seeds were collected in New Bussa and its environs at maturity after fruiting, which is usually between October and February. The seeds weredivided into four (4) parts of 3 kg each.1 kg of the first part was milled with hammer mill in raw form after all the seeds were cleaned and air dried to constant weight, and was labelled raw *Karaya* gum tree seeds. The second part was subdivided into three (3) parts of 1 kg each and labelled B1, B2 and B3. B1 was poured into three (3) litres of boiling water at 100^0 C in an aluminium pot of five (5) litres capacity with cover, heated by naked fire from dried wood, and boiled for ten (10) minutes.B2 was boiled in similar way for twenty (20) minutes while B3 was also boiled for thirty (30) minutes. Thereafter, the boiled seeds were removed from the boiled water, and air dried to constant weight and milled with hammer mill. The third part was also subdivided into three parts of 1 kg each and labelled F1, F2 and F3 respectively. Each of these

subsamples was soaked in three (3) litres of water in five (5) litres plastic bucket with cover and kept under anaerobic condition to ferment. F1 was fermented for three (3) days. F2 was fermented for six (6) days while F3 was fermented for nine (9) days respectively. Thereafter, each of the subsamples was washed, air dried to constant weight and milled. The fourth part was also subdivided into three (3) and labelled R1,R2 and R3 respectively. Each of these was milled coarsely, to allow heat to get to particles appropriately, and roasted in open frying pan heated by naked fire from dried wood at about 75^0 C. R1 was poured into preheated frying pan and roasted for ten (10) minutes with constant stirring. R2 was roasted in similar way for twenty (20) minutes and R3 was roasted for thirty (30) minutesrespectively. Thereafter, each sample was milled. Each of these subsamples was taken to the laboratory to determine the proximate composition, minerals, vitamins and anti-nutritional contents.

3.1.4 Proximate analysis

Samples taken from the milled seeds of *Karaya* gum tree were taken to National Cereals Research Institute (NCRI), Badeggi, Niger State, Nigeria, to determine the nutrient composition which included; Dry matter (DM), Crude fibre (CF), Crude protein (CP), Nitrogen free extract (NFE), Fat and Ash.

3.1.2.1 *Dry matter determination*

Dry matter was obtained by removing the moisture from the samples. To obtain dry matter, each sample was mixed thoroughly. Two grammes (2 g) of each sample was put into weighed dish and the weight of dish plus weight of undried sample (in triplicate) taken. The samples were dried in the oven at 80^0 C for 2 hours and at 105^0 C for 4 hours until constant weights were achieved. Thesamples were cooled in the desiccator and dry weight of samples plus dishes taken. Moisture content was calculated as;

% Moisture = $\frac{W2-w3}{W2-w1} X100$ Eq. 3.1

Where:

W1 = initial weight of empty dish,

W2 = weight of dish plus sample before drying,

W3 = final weight of dish plus sample after drying.

% Dry matter = 100 - % Moisture.

Source: AOAC (2000)

3.1.2.3 Ash determination

Ash constitutes the inorganic and mineral portions of the sample after all the moisture had been removed and the organic materials burnt away by igniting at a temperature of about 550^0 C. To obtain ash, 2 g each of the dry samples were weighed into a porcelain crucible. The samples weretransferred into a furnace at 550^0 C and allowed to remain at that temperature until a white or light gray ash was obtained. The samples were cooled in a desiccator and re–weighed.

% Ash = $\frac{W3-w1}{W2-w1} X100$ Eq. 3.2

Where;

W1 = weight of empty crucible,

W2 = weight of crucible plus sample before ashing

W3 = weight of crucible plus ash.

Source: AOAC (2000)

3.1.2.3 *Crude fibre determination*

For crude fibre determination, 2 g of samples each was defatted with petroleum ether and boiled under reflux for 30 minutes with 200 ml of a solution containing 1.25 g of

H_2SO_4 per 100 ml of solution. The solutions were filtered through linen on a fluted funnel. The residues were transferred into beakers and boiled for 30 minutes with 200 ml of a solution containing 1.25 g of NaOH per 100 mL. The residues were filtered through thin close pad of asbestos in gooch crucibles. Thereafter, the samples were dried in oven, incinerated, cooled and weighed.

% Crude fibre = Loss in weight after incineration × 100.

Source: AOAC (2000)

3.1.2.4 ***Fat (Ether extract) determination***

For ether extract determination, 2 g of the milled samples each was weighed into a known weightof filter paper and well folded. The samples were inserted into the soxhlet extraction jacket which was attached to round bottom flasks into which petroleum ether was poured. The flasks wereheated up at 60^0 C and the jacket was refluxed for 6 hours. The fat in the samples was extracted into the flasks. The samples were thereafter, removed and dried at 105^0 C for 1 hour. It was then allowed to cool in a desiccator and weighed.

$$\% \text{ Fat (Ether Extract)} = \frac{Weight\ of\ fat}{Weight\ of\ sample} X100 \qquad \text{Eq. 3..3}$$

Source: AOAC (2000)

3.1.2.5 ***Crude protein determination***

To determine crude protein, two grammes (2 g) of the milled samples each was weighed into Kjeldhalflasks and 5 g of anhydrous sodium sulphate catalyst was added. 25 mL of concentrated sulphuric acid and 5 glass beads were also added (to prevent bumping during heating). The mixtures were heated at 400^0 C in the fume cupboard to digest. The digest was allowed to cool and was diluted with distilled water. The excess acid was neutralized with sodium hydroxide solution. The solution was distilled into boric acid

indicator solution until reddish–pink colour was obtained. The proteinin the samples was obtained by multiplying the nitrogen by the factor, 6.25.

Thus, % Crude protein = Total Nitrogen × 6.25.

Source: AOAC (2000)

3.1.2.7 Nitrogen free extract determination

Nitrogen free extract (NFE) was obtained by summing all the percentages of Moisture, Crude fibre(CF), Crude protein (CP), Ash and Ether extract (EE) and subtracted from 100. Thus, to obtain NFE, all the percentages of the above mentioned were added and the total subtracted from 100.

% NFE = 100 – (% Moisture + % CF + % CP +% EE + % Ash). Eq. 3.4

3.1.3 Determination of mineral elements

The mineral composition that included iron, sodium, calcium, potassium, magnesium, copper, zinc, and lead was determined at the Central Laboratory of National Cereals Research Institute (NCRI), Badeggi, Niger State, Nigeria. Iron, Calcium, Copper, Zinc and Magnesium were determined using Atomic Absorption Spectrophotometer (Spectronic 21 model). Sodium and Potassium were determined by flame photometry using procedure of Association of Official Analytical Chemists (AOAC, 2000) while phosphorus was determined by Molybdate method (Onwuka, 2005).

3.1.4 Determination of vitamins

3.1.4.1 *Determination* of vitamin C

To determine vitamin C, 2 g each of the seed sample was weighed and ground into a paste. 100 mLof distilled water was added to the paste in a volumetric flask which was then filtered to obtain a clear solution. 50 mL of unconcentrated solution was pipetted

into 100 mL volumetric flask in triplicates. 25 mL of 20 % metaphosphoric acid was added as a stabilizing agent and diluted to 100mL volume. 10 mL was pipetted in the small flask in which 2.5 mL acetone was added. This was titrated with indophenol solution to a faint pink colour that persisted for 15 seconds. The milligramme (mg) ascorbic acid was calculated from the formula;

$$\text{Vitamin C} = 20\ (\text{V})(\text{C})$$

Where;

V = mL indophenol solution in titration

C = mg vitamin C/ mL indophenol.

The concentration of ascorbic acid was expressed as mg ascorbic acid equivalent to 1 mL of the dye solution. That is; 10 mL ascorbic acid solution = 0.002 g ascorbic acid. If 0.002 g ascorbic acidrequire V mL dye solution to neutralize it, then

1 mL dye solution = 0.002 g ascorbic acid ÷ V.

Source: Onwuka (2005)

3.1.4.2 ***Determination of riboflavin***

Two (2) g of the seed sample was weighed in a conical flask and 50 mL of 0.2 N HCl was added and boiled on a water bath for 1 hour. The sample was cooled and the pH was adjusted to 6.0 usingNaOH. 1 N HCl was added to lower the pH to 4.5 and filtered in a 100 mL measuring flask. To remove interference, two tubes marked 1 and 2 were taken, 1 mL of acetic acid added to each tube,mixed and 0.5 mL of 3 % H_2O_2 added and properly mixed. The fluorimeter was adusted to excitation wavelength of 470 nm and emission wavelength of 525 nm. Fluorimeter was adjusted to zero deflection against 0.1 N H_2S0_4 and 100 against tube 2. Fluoriscent of tube 1 was measured. 20 mg of sodium hydrogen sulphate was added to both tubes and fluorescence was measuredwithin 10

seconds and recorded as blank reading. Riboflavin was calculated as;

Riboflavin ($\frac{mg}{g} sample$) = $\frac{x}{y-x}$ x $\frac{1}{w}$ Eq. 3.5

Where;

w = weight of sample,

x = (reading of sample 1) – (reading of sample blank),

y = (reading of sample + standard tube 2) – (reading of sample + standard blank).

Source: Onwuka (2005)

3.1.4.3 Determination of thiamin

Two (2) g of the seed sample containing thiamin was weighed into a conical flask, 75 mL of 0.2 NHCl was added and heated to boiling and boiled for 30 minutes on a water bath. The solution was cooled and 5 mL of enzyme solution was added. It was incubated at 37^0 C overnight. The materialwas placed in 100 mL flask and filled with diluted water. It was filtered and the filtrate was purified by passing through silicate column. 5 mL of acidic KCl eluate solution was taken in a conical flaskand 3 mL of alkaline ferricyanide solution was added. 15 mL of isobutanol was also added and shaken for 2 minutes. It was allowed to separate and the alcohol layer was taken. 3 g of anhydrous Na_2SO_4 was added to isobutanol extract. 5 mL of thiamin solution was taken in another 50 mL stoppered flask. Oxidation and extraction of thiochrome was carried out. The sample and the standard blank were prepared taking 5 mL each. 3 mL of 15 % NaOH was added. The fluorimeter was set to excitation wavelength of 360 nm and emissive wavelength of 435 nm. The instrument was adjusted to zero deflection with 0.1 N H_2SO_4 and 100 against the standard. Fluorimeter with the sample and the blank were read. Thiamin was thus calculated as;

Thiamine = $\frac{x}{y}$ X 0.2 X $\frac{25}{v} X \frac{100}{w}$ Eq. 3.6

Where;

x = (reading of the standard) – (reading of blank),

y = (reading of the standard) – (reading of standard blank),

v = volume of solution used for test on the column

w = weight of sample.

Source: Onwuka (2005).

3.1.4.4 *Determination of retinol*

Aliquot of 200 µl of distilled water was placed in appropriate test tube duplicates for blanks, standard solution, a control serum and unknown sample. The frozen aliquot of sample was thaw gently in an ice water bath at 15^0 C. 200 µl of alcoholic KOH was added to all the test tubes and well mixed on the vortex for 20 seconds. All the test tubes were stoppered. They were placed in awater bath at 55^0 C for 20 minutes. A 1:1 mixture of xylene-kerosene mixture was added. Retinol was extracted by vigorous mixing of each test tube on the vortex for 30 seconds. The solution wascentrifuged for 5 minutes. The xylene-kerosene supernatant was withdrawn by means of a constriction micropipette connected to a rubber tube for mouth sucking. The sample extract was placed in the spectrophotometer cuvettes. Optical absorbance was read at 328 nm for retinol and 460 nm for total carotinoids. The sample extract was transferred to glass tubes for irradiation. Theywere irradiated for 35 minutes using an ultraviolet irradiation source (black light unit). The irradiated samples were transferred to the cuvettes and their optical absorbances were read again at 328 nm. The factor 637 was used to calculate the retinol concentration and 480 was used for carotenes. The respective calculations are as

follows:

Retinol (µg/dl) = A^0 (328) – A' × (637)

Carotenes (µg/dl) = A^0 (460) (480)

Where

A^0 = Initial optical absorbance reading,

A' = Optical absorbance after ultraviolet irradiation.

Source: Onwuka (2005).

3.1.5 Determination of gross energy using Bomb calorimeter

The gross energy contents of raw, boiled, fermented and roasted *Karaya* gum tree seeds were determined by bomb calorimetry. One gramme (1 g) sample each was burnt in a suitable container and the heat released was measured. 1 g sample each was made into a pellet. The bomb calorimetercups were washed in acetone and allowed to dry in the oven. The cups were weighed empty and weighed with each sample. The bomb calorimeter was switched on for 1 hour to warm. The pelleted samples were bombed at a pressure of 30 atmosphere. The readings of the galvanometer were taken for each pellet. After series of bombings, 1 g of benzoic acid was weighed and bombed.The deflection of the samples and the benzoic acid were recorded. Benzoic acid was used as a standard to determine the energy of the samples (1 g of benzoic acid has an energy of 6.32 kcal) thus, energy of the samples was calculated as;

$$\frac{Deflection\ due\ to\ 1g\ sample}{Deflection\ due\ to\ 1g\ Benzoic\ acid} = \frac{Energy\ of\ sample}{Energy\ of\ Benzoic\ acid} \qquad \text{Eq. 3.7}$$

Therefore, Energy of 1g sample (kcal) = $\frac{Deflection\ due\ to\ 1g\ sample}{Deflection\ due\ to\ 1g\ Benzoic\ acid}$ x 6.32

Source: Nworgu (2007)

3.1.6 Determination of the anti – nutritional factors

The anti–nutritional factors in raw, boiled, fermented and roasted *Karaya* gum tree seed meals were determined in the Central laboratory of National Cereals Research Institute (NCRI), Badeggi,Niger State.

3.1.6.2 Hydrocyanic acid determination

The hydrocyanide content of raw, boiled, fermented and roasted *Karaya* gum tree seed meals were determined using the method described by AOAC (2000). Ten (10) g of dried sample each was soaked in a mixture of 200 cm^3 distilled water and 10 mL of orthophosphoric acid. The mixture was left for 12 hours to release all bonded hydrogen cyanide (HCN). A drop of anti – foaming agent (tannic acid) and anti – pumping agent were added and the solution was distilled to collect up to 150 mL of the distillate in a conical flask. This was diluted with 40 mL of distilled water. 8 mL of 6 mole/dm^3 ammonium hydroxide and 2 cm^3 of 5 % potassium iodide solution were added. The solution was titrated with 0.02 mole / dm^3 silver solution using a micro burette until a faint and permanent turbidity was obtained.

1 mL 0.02 mole/dm^3 of $AgNO_4$ = 1.08 mg HCN

$$\% \text{ cyanide} = \frac{Absorbance\ of\ test}{Absorbance\ of\ standard} \text{ x Concentration of standard} \qquad \text{Eq. 3.8}$$

3.1.6.2 *Phytate (Phytic acid) determination*

Phytic acid was determined using the method of Onwuka (2005). Ten (10) grams of the samples each were weighed into conical flasks and extracted with 0.2N hydrochloric acid (HCl) to form phytate solution. 0.5 mL of the extracts was pipetted into test tubes fitted with ground glass stoppers. 1 mL of solution (2) was added and the tubes were covered with the stoppers and fixed with clips. The tubes were heated at 100^0 C in a boiling water bath for 30 minutes. Thereafter, theywere cooled in ice water for 15 minutes and allowed

to adjust to room temperature. The contents of the tubes were mixed and centrifuged for 30 minutes at 300 g. 1 mL each of the supernatant was transferred to another test tube and 1.5 mL of solution (3) was added. The absorbance was measured at 519 nm against distilled water.

3.1.6.4 Tannin determination

Tannin was determined by Folin – Denis spectrophotometric method. One gram (1g) each of the samples was weighed and dispersed in 10 mL distilled water and agitated. They were left to stand for 30 minutes at room temperature and shaken at every 5 minutes. After 30 minutes, they were centrifuged to obtain the extract. 2.5 mL of the extract was dispersed into 50 mL volumetric flasks.Similarly, 2.5 mL each of standard tannic acid solution was dispersed into separate 50 mL flasks. 1.0 mL Folin – Denis reagent was measured into each flask and 2.5 mL of saturated Na_2CO_3 solution was added. The mixture was diluted to 50 mL and incubated for 90 minutes at room temperature. The absorbance was measured at 250 nm in a Genway model 6000 electronic spectrophotometer.Reading was taken with the reagents blank at zero.

The tannin content was calculated as,

$$\%\text{Tannin} = \frac{An}{As} \times C \times \frac{100}{W} \times \frac{vf}{va} \qquad \text{Eq. 3.10}$$

Where;

An = absorbance of test samples,

As = absorbance of standard solution,

C = concentration of standard solution,

W = weight of sample used,

Vf = total volume of extract,

Va = volume of extract analyzed.

3.1.6.4 *Alkaloid determination*

Alkaloid was determined by the gravimetric method of Harbon as adopted by Onwuka (2005). Five (5) g of each sample was dispersed with 50 mL of 10 % acetic acid solution in ethanol. The mixture was shaken and allowed to stand for 4 hours before filtering. The filtrate was thereafter evaporated to one quarter (1/4) of its original volume. Concentrated ammonium hydroxide (NH_4OH) solution was added drop wise to precipitate the alkaloid. The precipitate was filtered off with a weighed filter paper and was washed with 1 % NH_4OH solution. The precipitate was thereafter dried in the filter paper in the oven at 60^0 C for 30 minutes and weighed. Dry weight difference, the weight of alkaloid was determined and expressed as a percentage of the sample weight analyzed using the formula:

$$\% \text{ Alkaloid} = \frac{W2-W1}{W} \times 100 \qquad \text{Eq. 3.11}$$

Where;

W = weight of sample,

W1 = weight of empty filter paper,

W2 = weight of filter paper plus precipitate.

3.1.6.7 Oxalate determination

Oxalate contents of the raw, boiled, fermented and roasted samples were determined by titration method described by Onwuka (2005). Two (2) g each of sample flour was suspended in 190 mL of distilled water in a 250 mL volumetric flask. 10 mL of 6 molarhydrochloric acid was added and the suspension was digested at 100^0 C for 1 hour. It was cooled and made up to 250 mL before titration.Duplicate portions of 125 mL of the filtrate were measured into beakers and four (4) drops of methylred indicator was added. This was followed by the addition of concentrated ammonium hydroxide solution (drop

wise) until the test solution changed from pink colour to a faint yellow colour. Each portion was then heated to 90^0 C, cooled and filtered to remove precipitate. The filtrate was heated again to 90^0 C and 10 mL of 5 % calcium chloride ($CaCl_2$) solution was added and stirred constantly. After heating, it was cooled and left over night at 5^0 C. The solution was then centrifuged at 2500 revolution per minute for five (5) minutes. The supernatant was decanted and the precipitate was dissolved in 10 mL of 20 % sulphuric acid (H_2SO_4) solution. The total filtrate of digestion of 2 g of flour sample was made up to 300 mL. Aliquots of 125 mL of the filtrate was heated until near boiling and then titrated against 0.05 M standardized potassium permanganate ($KMnO_4$) solutionto a faint pink colour. The calcium oxalate content was calculated using the formula;

$$\text{Oxalate} = \frac{\text{T X (Vme)(Df)}}{\text{(ME)X Mf}} \text{ x } 10^5 \text{ (mg/100g)} \qquad \text{Eq. 3.12}$$

Where:

T = Titre of KMO_4 (mL),

Vme = Volume – mass equivalent

Df = Dilution factor,

ME = molar equivalent of KMO_4 in the oxalate,

Mf = mass of flour used.

3.1.6.8 *Saponin* determination

Saponin was determined using standard method of AOAC (2000). Two (2) g each of milled samplewas weighed into a thimble and transferred into the soxhlet extraction chamber fitted with a condenser and a flat bottom flask. 150 mL acetone was added to each flask. The samples were extracted of lipids and pigments for 3 hours by heating the flasks on a hot plate and the solvent was distilled. A preweighed round bottom flask was fitted into the soxhlet apparatus with the sample containing thimble and 150

mL of methanol was added. The saponin was extracted for 3 hours by heating the flask on a hot plate after which the solvent was distilled off. The flask was weighed again.The difference between the final and the initial weight of the saponin was calculated. Thus,

$$\% \text{ Saponin} = \frac{Weight\ of\ saponin}{Weight\ of\ Sample} \times 100 \qquad \text{Eq. 3.13}$$

3.2 Experiment II: Growth Performance, Haematological Indices, Carcass Characteristics and Economic Benefits of Weaned Rabbits Fed Diets Containing Processed *Karaya* Gum Tree Seed Meal

The objectives of this study were to:

i. determine the growth performance and apparent nutrient digestibility of weaned rabbits fed diets containing boiled, fermented and roasted *Karaya* gum tree seed meal;
ii. evaluate the haematological and serum biochemical indices of weaned rabbits fed diets containing boiled, fermented and roasted *Karaya* gum tree seed meal;
iii. assess the carcass characteristics and sensory properties of the meat of rabbits fed diets containing boiled, fermented and roasted *Karaya* gum tree seed meal; and
iv. investigate the economic benefits of feeding diets containing boiled, fermented and roasted *Karaya* gum tree seed meal to weaned rabbit

3.2.3 Experimental site

The experiment was conducted at the Teaching and Research Farm of the Federal College of Wildlife Management, New Bussa, Niger State, Nigeria. New Bussa is located in the Guinea Savanna vegetation zone of Nigeria with Latitude, N9^{0}49'10.34" and Longitude, E4^{0}34'49.15". It has a humid tropical climate with temperature of between 35^0 C and 40^0 C during the hot dry season and between 14^0 C and 15^0 C during the cold season. The period of rainy seasonis from April to October during which 1,000

mm to 1,250 mm rainfall is recorded annually. The soil type is vertisols, shrinking and swelling dark clay soil (heavy, cracking clayey soil with more than 35 % clay) and a high content of expanding clay mineral that shrinks and swells with exchanges in moisture contents (Onyeanusi, 2005).

3.2.4 Collection and processing of experimental materials

Karaya gum tree seeds were collected in New Bussa and its environment at maturity, after fruiting, which is usually between October and February. Ripe fruits that had opened were harvested fromthe trees and the seeds were manually removed from the pods. Dispersed seeds were also hand picked from the ground and properly cleaned. The seeds were divided into three parts (10 kg each). One part (10 kg) was poured into boiling water at 100^0 C in aluminium pot, covered, heated by fire from driedwood and boiled for 30 minutes. Thereafter the boiled seeds were strained off the boiled water and air dried to constant weight. They were milled with hammer mill and stored in a plastic bag. The second part (10 kg, divided into 5 kg each) was soaked in water at room temperature in 20 litres plastic buckets containing 10 litres of water each, covered and kept under anaerobic condition to ferment for nine days. Thereafter, the seeds were washed, air dried to constant weight, milled with hammer mill and stored in a plastic bag. The third part (10 kg) was crushed (coarsely milled) to allowed heat to get to particles appropriately, and roasted in open frying pan heated by naked fire of dried wood at 75^0 C for 30 minutes. Thereafter, the crushed seeds were allowed to cool, milled with hammer mill and stored in a plastic bag.

3.2.5 Experimental diets

Nine (9) experimental diets were formulated with processed (boiled, fermented and roasted) *Karaya* gum tree seed meals incorporated in the diets and labeled; T1, T2, T3,

T4, T5, T6, T7, T8and T9 respectively. Diet T1 contained no (0 %) boiled *Karaya* gum tree seed meal. Diet T2 contained 5 % boiled *Karaya* gum tree seed meal. Diet T3 contained 10 % boiled *Karaya* gum treeseed meal. Diet T4 contained 0 % fermented *Karaya* gum tree seed meal. Diet T5 contained 5 % fermented *Karaya* gum tree seed meal while Diet T6 contained 10 % fermented *Karaya* gum treeseed meal. Similarly, Diet T7 contained 0 % roasted *Karaya* gum tree seed meal. Diet T8 contained 5 % roasted *Karaya* gum tree seed meal while Diet T9 contained 10 % roasted *Karaya* gum tree seed meal respectively as presented in Table 3.1.

Table 3.1: Gross composition of the experimental diets (Experiment II)

Ingredients (%)	Treatment								
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Maize	42.00	37.00	32.00	42.00	37.00	32.00	42.00	37.00	32.00
Boiled KGTSM	-	5.00	10.00	-	-	-	-	-	-
Fermented KGTSM	-	-	-	-	5.00	10.00	-	-	-
Roasted KGTSM	-	-	-	-	-	-	-	5.00	10.00
Soya cake	14.50	13.50	12.50	14.50	13.5	12.50	14.50	13.50	12.50
Full fat soya	15.00	14.00	14.00	15.00	14.00	14.00	15.00	14.00	14.00
Rice offal	24.00	26.00	27.00	24.00	26.00	27.00	24.00	26.00	27.00
Bone meal	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
*Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
CALCULATED	**VALUES**								
Crude protein (%)	17.19	17.18	17.28	17.19	17.21	17.32	17.19	17.16	17.12
Crude fibre (%)	12.34	12.43	12.57	12.34	12.40	12.51	12.34	12.4	12.52
Ether extract (%)	6.50	7.14	7.81	6.50	7.17	7.88	6.50	7.13	7.69
Metabolisable energy (Kcal/kg)	• 2607	2602	2620	2607	2613	2642	2607	2608	2605
Methionine (%)	0.71	0.72	0.74	0.71	0.75	0.81	0.71	0.72	0.75
Lysine (%)	1.10	1.08	1.09	1.10	1.11	1.14	1.10	1.07	1.07
Calcium (%)	1.02	1.04	1.05	1.02	1.04	1.05	1.02	1.04	1.06
Phosphorus (%)	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58

Key: KGTSM = *Karaya* gum tree seed meal, T1 = Diet with 0 % boiled KGTSM, T2 = Diet with 5 % boiled KGTSM, T3 = Diet with 10 % boiled KGTSM, T4 = Diet with 0 % KGTSM, T5 = Diet with 5 % fermented KGTSM, T6 = Diet with 10 % fermented KGTSM, T7 = Diet with 0 % roasted KGTSM, T8 = Diet with 5 % roasted KGTSM, T9 = Diet with 10 % KGTSM.

*To provide the following per kg of feed: Vitamin A, 10,000 iu; vitamin D3, 2,000 iu; vitamin E, 5 iu; vitamin K, 2 mg; riboflavin, 4.2 mg; vitamin B12, 0.01 mg; panthothenicacid, 5 mg; nicotinic acid, 20 mg; folic acid, 0.5 mg; choline, 3 mg; Mg, 56 mg; Fe, 20 *mg; Cu, 1.0 mg; Zn, 5.0 mg; Co, 1.25 mg.*.

3.2.6 Experimental design and management of the experimental animals

A total of one hundred and eight (108) rabbits, cross breeds of New Zealand White and Chinchilla,of mixed sexes, aged between 6 and 8 weeks with average initial weights of 525 (± 0.24) g were purchased from the Rabbit Unit of Federal College of Wildlife Management, New Bussa, Niger State, Nigeria and from New Bussa town. They were randomLy divided into nine (9) dietary treatment groups of twelve (12) animals per treatment with each treatment triplicated with four (4)animals per replicate in 3×3 factorial arrangement in a completely randomized design experiment.The rabbits were housed in a well ventilated block pen (7m × 7m) in wood and wire hutches of 60cm × 60 cm × 50 cm (length × breadth × height) raised 50 cm above ground level. The rabbits were served with aluminium feeders and stainless steel drinkers and were fed with control diet fortwo weeks (adjustment period) before the commencement of the experiment. They were given treatment against parasites with Ivermectin® at the rate of 0.1 mL diluted to 1 mL with aqua water and injected subcutaneously. They were also given coccidiostat (Embazin-forte, a broad spectrum anticoccidal with vitamin k) in drinking water (30 g in 50 litres of water) during the adjustment period. Feed and clean drinking water were served *ad libitum*. They were fed twice per day, at about 8.00 am and 4.30 pm. The experiment lasted for twelve (12) weeks after the adjustment period of two weeks.

3.2.7 Data collection

3.2.5.1 *Growth performance study*

The rabbits were weighed individually before commencement of the experiment. Thereafter they were weighed on weekly basis during the experimental period. Weighing was done with Camry scale, made in China, 20 kg/0.05 kg model, before the feeding. The

parameters determined were:initial weight (g), final weight (g), average daily weight gain (g) (calculated by dividing weekly gain by 7 days), average daily feed intake (g), average total feed intake and feed conversion ratio.Weight gain for each rabbit was calculated by subtracting the initial weight (g) from the final weight (g), while the average daily feed intake was calculated by subtracting the left over from thefeed given divided by the number of rabbits in a hutch. Feed conversion ratio was calculated by dividing the average feed intake (g) by the average weight gain (g) according to procedure described by Akinmutimi *et al*. (2008).

3.2.5.2 *Digestibility trial*

At the end of the twelve weeks feeding trial, six (6) rabbits were randomly selected from each treatment group (two from each replicate) and housed in metabolism cages to measure their apparent nutrient digestibility. The rabbits were weighed to obtain their initial weights, and were allowed two (2) days adjustment period in the metabolism cages and fed with the experimental diets, on the basis of their mean daily feed intakes. Daily feed intake during the digestibility trial, which lasted for five (days), was measured. Faecal samples were collected daily from each cage and labelled. The samples were oven dried to constant weight at 60^0 C for 12 hours. The samples were weighed and stored in plastic bags. They were bulked together; ground and subsamples were taken from each treatment for proximate analysis according to AOAC (2000) procedures. The percentages of the nutrients (dry matter, crude protein, crude fibre, ether extract and ash) were determined according to the procedures described by Adeyemi *et al*. (2014) as;

$$\text{Digestibility coefficient (\%)} = \frac{(\text{Fi x NF}) - (\text{F x Ne})}{Fi\ x\ NF} \text{ x } 100 \qquad \text{Eq. 3.14}$$

Where;

Fi = feed intake

F = Faecal droppings

Nf = Nutrient in feed

Ne = Nutrient in excreta.

Nitrogen free extract (NFE) was calculated by subtracting other nutrients from 100 %.

Thus;

% NFE = 100 – (% ether extract + % crude protein + % crude fibre + % ash).

Source: Adeyemi *et al*. (2014)

3.2.5.3 *Blood sample collection and analysis*

At the end of the feeding and digestibility trials, six rabbits were randomLy selected (two from eachreplicate) from each treatment. Two miligrams (2 mL) of blood sample was collected with 5 mL syringe and needle from the ears of the rabbits and transfered into Ethylene Diamine Tetra Aceticacid (EDTA) treated bottles for haematological parameters analysis. The EDTA was the anti- coagulant. Another 5 mL sample from each animal was collected into sample bottles without EDTAand allowed to coagulate to produce sera for blood chemistry analysis. Sera were obtained by centrifugation of the blood samples used for analysis. The haemoglobin (Hb) concentration, packed cell volume (PCV), red blood cells (RBC) and white blood cells (WBC) were analyzed according to standard procedures described by Device and Lewis (1991) and their differentials were calculated. The harvested sera were used for evaluation of total serum protein and serum albumin which were determined by Goldberg refractometer method to obtain concentrations (g/dl)

for each biochemical values as described by Kohn and Allen (1995), while albumin, cholesterol and urea concentration were determined by the method described by Tuffrey (1995). The haematological analysis was carried out at the laboratory of the General Hospital, Kutigi, NigerState, Nigeria, while the biochemical analysis was carried out at the laboratory of the Biochemistry Department, Federal University of Technology, Minna, Niger State, Nigeria.

3.2.5.4 *Carcass characteristics*

Two (2) rabbits were randomLy selected from each replicate and slaughtered. The randomLy selected and slaughtered rabbits (54 rabbits) were weighed, skinned, eviscerated and cut into different parts. The slaughtered animals were weighed (after bleeding with sharp knife by cutting the jugular veins and the throat, and blood was allowed to drain) to give the slaughtered weights. They were skinned, the viscerals were removed and the heads were cut to give the carcass. Thereafter, each of the carcasses was weighed to obtain the carcass weight. Dressing percentage was calculated by dividing the carcass weight by the live weight and multiplied by 100. The organs were separated and weighed individually and the weights were calculated as percentages of the body (live) weightsaccording to the procedure of Henry *et al*. (2008). Thus, dressing percentages were calculated as;

$$\text{Dressing } \% = \frac{\text{carcass weight}}{\text{live weight}} \text{ X } 100 \qquad \text{Eq. 3.15}$$

3.2.5.5 *Sensory evaluation*

A panel of 32 members, consisting of 16 members of staff with 8 males and 8 females, and 16 students with 8 males and 8 females, assessed the various meat products. The meat samples were evaluated using the 9 - point Hedonic scale to score for tenderness, flavour, juiciness, colour, palatability and general acceptability. The Hedonic scale used ranged from 1 to 9 as shown below:

9 - Like extremely

8 – Like very much

7 – Like moderately

6 – Like slightly

5 – Neither like nor dislike

4 – Dislike slightly

3 – Dislike moderately

2 – Dislike very much

1 – Dislike extremely

Source**:** Egbo *et al*. (2008)

3.2.5.6 *Economic benefits of using boiled, fermented and roasted Karaya gum tree seed meals in the diets of weaned rabbits*

The prevailing market prices of the feed ingredients during the period of study were used to determine the economics of production. Cost of feed per kg was calculated based on the cost of each ingredient and the quantity used in each diet. This was used to calculate the total cost of feed consumed for each treatment. Prevailing market price of rabbit was used to determine the cost of body weight per kg live weight. Cost of feed per kg and cost of live weight per kg were used to determine the value of live weight gain per each rabbit. Reduction in feed cost was calculated by subtracting the cost of producing each treatment feed from the control treatment. This was used to determine profit/financial gain of each treatment diet according to Ekwe *et al*. (2008).

3.2.6 Data analysis

All data collected were subjected to statistical analysis using statistical analysis system (SAS, 2002) package. The analysis was carried out based on a completely randomized design model using a 3 by 3 factorial arrangement. Where means were significant, they were separated using the Duncan's Multiple Range Test as contained in the package.

3.3 Experiment III: Growth Performance, Haematological Indices, Carcass Characteristics and Economic Benefits of Weaned Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal as Replacement for Maize

The objectives of this study were to:

i. determine the growth performance and apparent nutrient digestibility of weaned rabbitsfed diets containing boiled *Karaya* gum tree seed meal as replacement for

maize in the diet of rabbits,

ii. evaluate the haematological and serum biochemical indices of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize,

iii. assess the carcass characteristics and sensory properties of the meat of rabbits fed dietscontaining boiled *Karaya* gum tree seed meal as replacement for maize, and

iv. investigate the economic benefits of replacing maize with boiled *Karaya* gum tree seed meal in rabbit diets.

3.3.1 Experimental site

The experiment was conducted at the same site as described in experiment II (3.2.1).

3.3.3 Collection and processing of experimental materials

Karaya gum tree seeds were collected in New Bussa and its environment at maturity, after fruiting, which is usually between October and February. Ripe fruits that had opened were harvested from the trees and the seeds were manually removed from the pods. Dispersed seeds were also hand picked from the ground and properly cleaned. The seeds were poured into boiling water at 100^0 C in aluminium pot, covered, heated by fire from dried wood and boiled for 30 minutes. Thereafter, the seeds were strained off the boiled water and were air dried to constant weight, milled with hammer mill and stored in plastic bags for inclusion in the diets.

3.3.3 Experimental diets

Five experimental diets were formulated with processed (boiled) *Karaya* gum tree seed meal incorporated into the diets as replacement for maize and labeled; D1, D2, D3, D4 and

D5 respectively. Diet D1 was the control diet with no (0 %) boiled *Karaya* gum tree seed meal. Diet D2 contained boiled *Karaya* gum tree seed meal replacing 25 % maize. Diet D3 contained boiled *Karaya* gum tree seed meal replacing 50 % maize. Similarly, Diet D4 contained boiled *Karaya* gum tree seed meal replacing 75 % maize while diet D5 contained boiled *Karaya* gum tree seed meal replacing 100 % maize as presented in Table 3.2.

Table 3.2: Gross composition of the experimental diets (Experiment III)

	Treatment				
Ingredients (%)	**D1**	**D2**	**D3**	**D4**	**D5**
Maize	42.00	31.50	21.00	10.50	0.00
Boiled KGTSM	-	10.50	21.00	31.50	42.00
Soya cake	15.50	12.50	10.50	10.50	15.50
Full fat soya	14.00	14.00	14.00	12.00	14.00
Rice offal	24.00	27.00	29.00	31.00	24.00
Bone meal	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30
*Premix	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
CALCULATED VALUES					
Crude protein (%)	17.35	17.33	17.37	17.38	17.42
Crude fibre (%)	12.30	12.70	13.75	13.85	13.88
Ether extract (%)	6.67	7.93	8.40	9.85	11.89
Metabolisable energy(Kcal/kg)	2601	2614	2625	2637	2642
Methionine (%)	0.71	0.74	0.78	0.84	0.86
Lysine (%)	1.11	1.09	1.11	1.13	1.10
Calcium (%)	1.02	1.06	1.10	1.14	1.17
Phosphorus (%)	0.58	0.58	0.58	0.57	0.57

Key: KGTSM = *Karaya gum tree* seed meal, D1 = Diet with 0 % KGTSM, D2 = Diet with 25 % KGTSM replacing maize, D3 = Diet with 50 % KGTSM replacingmaize, D4 = Diet with 75 % KGTSM replacing maize, D5 = Diet with 100 % KGTSM replacing maize.

*To provide the following per kg of feed: Vitamin A, 10,000 iu; vitamin D3, 2,000 iu; vitamin E, 5 iu; vitamin K, 2 mg; riboflavin, 4.2 mg; vitamin B12, 0.01 mg;panthothenic acid, 5 mg; nicotinic acid, 20 mg; folic acid, 0.5 mg; choline, 3 mg; Mg, 56 mg; Fe, 20 *mg; Cu, 1.0 mg; Zn, 5.0 mg; Co, 1.25 mg; Iodine, 0.8 mg*.

3.3.5 Experimental design and management of experimental animals

A total of sixty (60) rabbits, cross breeds of New Zealand White and Chinchilla, of mixed sexes, aged between 6 and 8 weeks with average initial weights of 515 (± 1.0) g were purchased from the Rabbit Unit of Federal College of Wildlife Management, New Bussa, Niger State, Nigeria and from New Bussa town. The rabbits were weighed and grouped to give about the same average initial weights. They were randomLy divided into five (5) dietary treatment groups of twelve (12) animals per treatment with each treatment triplicated with four (4) animals per replicate in a completely randomized design. The rabbits were housed in well ventilated block pen (7m × 7m) in wood and wire hutches of 60 cm × 60 cm × 50 cm (length × breadth × height), raised 50 cm above ground level. The rabbits were served with aluminium feeders and stainless steel drinkers and were fed with control diet for two weeks adjustment period. They were given treatment against parasites with Ivermectin® at the rate of 0.1 mL diluted to 1 mL with aqua water and injected subcutaneously. They were also given coccidiostat in drinking water during the adjustment period. Feed and clean drinking water were served *ad libitum*. They were fed twice perday, at about 8.00 am and 4.30 pm. The experiment lasted for twelve (12) weeks, after two weeks a djustment period.

3.3.6 Data collection

3.3.6.1 *Growth performance study*

The rabbits were weighed individually before the commencement of the experiment. Thereafter, they were weighed on weekly basis during the experimental period. Weighing was done with Camry scale, made in China, 20 kg/0.05 kg model, before the feeding. The parameters determined were; initial weight (g), final weight (g), average weight gain (g), average daily feed intake (g), average total feed intake and feed

conversion ratio. Weight gain for each rabbit was calculated bysubtracting the initial weight (g) from the final weight (g) while the average daily feed intake was calculated by subtracting the left over from the feed given divided by the number of rabbits in a hutch. Feed conversion ratio was calculated by dividing the average feed intake (g) by the average weight gain (g) according to the procedure of Akinmutimi *et al*. (2008).

3.3.6.2 *Digestibility trial*

At the end of the twelve weeks feeding trial, six (6) rabbits were randomLy selected from each treatment group (two from each replicate) and housed in metabolism cages to measure their apparent nutrient digestibility (for five days). The rabbits were weighed to obtain their initial weights, and were allowed two (2) days adjustment period in the metabolism cages and fed with the experimental diets, on the basis of their previous mean daily feed intakes. Daily feed intake during the digestibility trial was measured. Faecal samples were collected daily from each cage and labelled.The samples were oven dried to constant weight at 60^0 C for 12 hours. The samples were weighedand stored in plastic bags. They were bulked together; ground and subsamples were taken from each treatment for proximate analysis according to AOAC (2000) procedures. The percentages ofthe nutrients (dry matter, crude protein, crude fibre, ether extract and ash) were determined according to the procedures described by Adeyemi *et al*. (2014) as;

Digestibility coefficient (%) = $\frac{(\text{Fi x NF}) - (\text{F x Ne})}{Fi\ x\ NF}$ x 100 Eq. 3.16

Where;

Fi = feed intake,

F = Faecal droppings

Nf = Nutrient in feed

Ne = Nutrient in faeces.

Nitrogen free extract (NFE) was calculated by subtracting other nutrients from 100 %. Thus,

% NFE = 100 – (% ether extract + % crude protein + % crude fibre + % ash).

Source: Adeyemi *et al*. (2014).

3.3.6.3 *Blood samples collection and analyses*

At the end of the feeding and digestibility trials, six rabbits were randomLy selected (two from eachreplicate) from each treatment and slaughtered. 2 mL of blood sample from each rabbit was collected with 5 mL syringe and dropped into Ethylene Diamine Tetra Acetic acid (EDTA) treated bottles for haematological parameters evaluation. The EDTA was the anti-coagulant. Another 10 mL sample from each animal was collected into sample bottle without EDTA and allowed to coagulate to produce sera for blood chemistry analyses. Sera were obtained by centrifugation of the blood samples used for analysis. The haemoglobin (Hb), packed cell volume (PCV), red bloodcells (RBC) and white blood cells (WBC) were analyzed according to standard procedures described by Device and Lewis (1991) and their differentials were calculated. The harvested serawere used for evaluation of total serum protein and serum albumin which were determined by Goldberg refractometer method to obtain concentrations (g/dl) for each blood sample as describedby Kohn and Allen (1995), while albumin, cholesterol and urea concentration were determined bythe method described by Tuffrey (1995). The haematological analyses were carried out at the laboratory of the General Hospital, Kutigi, Niger State, Nigeria, while the biochemical analyses were carried out at the laboratory of the Biochemistry Department, Federal University of Technology, Minna, Niger State, Nigeria.

3.3.5.4 *Carcass characteristics*

The randomLy selected and slaughtered rabbits were weighed, skinned, eviscerated and cut into different parts. The slaughtered animals were weighed (after bleeding with sharp knife by cuttingthe jugular veins and the throat, and blood was allowed to drain out) to give the slaughtered weight. The slaughtered animals were skinned, the viscerals removed and the heads were cut to give the carcass. Thereafter, each of the carcasses was weighed to obtain the carcass weight. Dressing percentage was calculated by dividing the carcass weight by live weight and multiplied by 100. The organs were separated and weighed individually and the weights were expressed as percentages of the body (live) weights according to Henry *et al*. (2008) thus:

Dressing % = $\frac{carcass\ weight}{live\ weight}$ x 100 Eq. 3.17

3.3.5.5 *Sensory evaluation*

A panel of 20 members, consisting of 10 members of staff with 5 males and 5 females, and 10 students of 5 males and 5 females, assessed the various meat products. The meat samples were evaluated using the 9-point Hedonic scale to score for tenderness, flavour, colour, juiciness, palatability and general acceptability. The Hedonic scale used ranged from 1 to 9 as follows:

9 – Like extremely

8 – Like very much

7 – Like moderatetly

6 – Like slightly

5 – Neither like nor dislike

4 – Dislike slightly

3 – Dislike moderately

2 – Dislike very much

1 – Dislike extremely.

Source: Egbo *et al*. (2008).

3.3.5.6 *Economic benefits of using boiled Karaya gum tree seed meal as replacement for maize in the diets of weaned rabbits*

The prevailing market prices of the feed ingredients during the period of study were used to determine the economics of production. Cost of feed per kg was calculated based on the cost of each ingredient and the quantity used in each diet. This was used to calculate the total cost of feed consumed for each treatment. Prevailing market price of rabbit was used to determine the cost of body weight per kg live weight. Cost of feed per kg and cost of live weight per kg were used to determine the value of live weight gain per each rabbit. Reduction in feed cost was calculated by subtracting the cost of producing each treatment feed from the control treatment. This was used todetermine profit or financial gain of each treatment according to Ekwe *et al*. (2008).

3.3.7 Data analysis

All data collected were subjected to analysis of variance (ANOVA) using Statistical analysis system package (SAS, 2002) while significant differences were separated using Duncan's MultipleRange Test as contained in the package.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Proximate Composition of Raw, Boiled, Fermented and Roasted *Karaya* Gum Tree Seeds

The proximate compositions of raw, boiled, fermented and roasted seeds are presented in Table 4.1. The dry matter (DM) ranged from 91.18 % in boiled seeds for 30 minutes (B3) to 94.48 % in roasted seeds for 30 minutes (R3) (with mean value of 91.43 ± 0.22 % in boiled seeds and 94.56 ± 0.29 % in roasted seeds). Although the mean values of the DM were within close ranges, they were statistically different ($P<0.05$) between the treatments. The mean values were in the order of roasted seeds (R) > raw seeds (Ro) > fermented seeds (F) > boiled seeds (B). The ether extract (EE) of the seeds had mean values that ranged from 17.04 ± 0.64 % in boiled seeds to 18.90 ± 0.00 % in raw seeds (Ro). The values were statistically different ($P<0.05$) across the treatment groups.

The mean values of ash were in the range of 2.56 ± 0.00 % in the raw seeds to 6.42 ± 0.18 % in roasted seeds. Similarly, ash content was in the order of roasted seeds (R) > fermented seeds (F) > boiled seeds (B) > raw seeds (Ro). Higher ash content was in the processed seeds than the raw seeds. The mean values were also statistically different ($P<0.05$). The mean values of crude fibre (CF) were in the range of 5.64 ± 0.22 % in the boiled seeds to 7.55 ± 0.13 % in the fermented seeds. CF content was in the order of F > Ro > R > B. There were no significant ($P > 0.05$) differences between the mean values of CF for R and Ro but there were significant ($P < 0.05$) differences between R and Ro, and F and B seeds.

The mean values of crude protein (CP) were within the range of 18.26 ± 036 % in the boiled seeds and 19.00 ± 0.39% in the fermented seeds. The mean values were in the order of F >Ro>R > B. Except for the boiled seeds CP that was statistically different ($P<0.05$) from other seeds, there were no significant ($P > 0.05$) differences between the mean values of CP of other seeds. The mean values of nitrogen free extract (NFE) were within the range of 41.96 ± 0.39 % in the fermented seeds and 46.23 ± 0.03 % in the raw seeds. The mean values of NFE were in the order of Ro > R >B > F. With the exception of the fermented seeds, the value of NFE in other seed samples were statistically similar ($P>0.05$) between the treatment groups.

The mean gross energy (GE) of the seeds followed similar trend with the nutrients and was within the range of 402.58 ± 1.87 kcal/100 g in the roasted seeds to 429.90 ± 0.00 kcal/100 g in the raw seeds. The mean GE values of the seeds were in the order of Ro > F > B > R. The mean values were significantly ($P <0.05$) different between the treatment groups. Similarly, the mean metabolisable energy (ME) of the seeds followed the same trend with the gross energy and was within the range of 390.50 ± 1.81 kcal/100 g in the roasted seeds to 417.00 ± 0.00 kcal/100 g in the raw seeds. The mean ME values of the seeds were significantly ($P <0.05$) different between the treatment groups.

Table 4.1: Effects of different processing methods on nutrient composition (%) of *Karaya* gum tree seeds

Processing form	Seeds	Dry Matter	Ether Extract	Ash	Crude Fibre	Crude protein	NFE	GE(kcal/ 100g)	ME(kcal/100g)
Raw	Ro1	93.17	18 .90	2.56	6.76	18.72	46.23	429.90	417.00
	Ro2	93.17	18.90	2.56	6.76	18.72	46.23	429.90	417.00
	Ro3	93.17	18.90	2.56	6.76	18.72	46.23	429.90	417.00
Mean		93.17^{b}	18.90^{a}	2.56^{c}	6.76^{b}	18.72^{ab}	46.23^{a}	429.90^{a}	417.00^{a}
Stand. Dev.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Boiled	B1	91.60	17.62	4.03	5.64	18.68	45.63	418.62	406.06
	B2	91.52	17.14	4.74	5.42	18.09	46.13	406.87	394.66
	B3	91.18	16.35	5.68	5.86	18.02	45.27	401.10	389.07
Mean		91.43^{d}	17.04^{b}	4.82^{b}	5.64^{c}	18.26^{b}	45.68^{a}	408.86^{b}	396.60^{b}
Stand. Dev.		0.22	0.64	0.83	0.22	0.36	0.43	8.93	8.66
Fermented	F1	92.35	18.46	5.23	7.42	18.89	42.31	432.31	419.34
	F2	92.20	18.39	5.49	7.56	18.67	42.03	426.17	413.38
	F3	92.06	18.08	5.33	7.68	19.43	41.54	415.89	404.41
Mean		92.20^{c}	18.31^{a}	5.35^{b}	7.55^{a}	19.00^{a}	41.96^{b}	424.79^{a}	412.38^{a}
Stand. Dev.		0.15	0.20	0.13	0.13	0.39	0.39	8.30	7.52
Roasted	R1	94.27	17.74	6.23	5.87	18.63	45.75	404.57	392.43
	R2	94.58	17.63	6.45	6.24	18.59	45.67	402.31	390.24
	R3	94.84	16.83	6.58	6.35	18.53	46.55	400.87	388.84
Mean		94.56^{a}	17.40^{b}	6.42^{a}	6.15^{b}	18.58^{ab}	45.99^{a}	402.58^{b}	390.50^{b}
Stand. Dev.		0.29	0.50	0.18	0.25	0.05	0.49	1.87	1.81
SEM		0.36	0.24	0.44	0.22	0.10	0.53	3.90	3.59

Key: NFE=Nitrogen free extract, GE= Gross energy, ME= Metabolisable energy, Ro=Raw seeds, B= Boiled seeds for 10, 20 and 30 minutes (B1, B2 and B3), F = Fermented seeds for 3, 6 and 9 days (F1,F2 and F3), R = Roasted seeds for 10,20 and 30 minutes (R1, R2 and R3), Stand. Dev. = Standard deviation, SEM = Standard error of mean

4.2 Effects of Processing Methods on Mineral Composition of *Karaya* Gum Tree Seeds

The mineral composition of raw (Ro), boiled (B), fermented (F) and roasted (R) *Karaya* gum tree seeds (KGTS) is presented in Tables 4.2a and 4.2b. The macro minerals of Ro, B, F and R KGTS is presented in Table 4.2a. Of all the macro minerals, sodium (Na), was the most abundant ranging from 582.00 g/kg in the B seeds for 30 minutes with mean value of rothe B seeds of 631.67 ± 50.00 g/kg to 857.00 g/kg in the R seeds followed by potassium (K) with mean value of 420.00 ± 0.00 g/kg in the Ro seeds to 553.83 ± 19.65 g/kg in the R seeds. Calcium (Ca) had mean value of 366.70 ± 13.90 g/kg in the F seeds to 435.57 ± 5.10 g/kg in the B seeds. Among the macro minerals, magnesium (Mg) was the least abundant with mean values ranging from 39.42 ± 0.52 g/kg in the R seeds to 45.23 ± 0.00 in the Ro seeds followed by P with mean value of 50.28 ± 7.53 g/ kg in the F seeds to 62.21 ± 0.00 in the Ro seeds. The mean values of all the macro minerals were statistically significant ($P < 0.05$) between the treatments.

Similarly, micro minerals (Table 4.2b) content varied from mineral to mineral. Zinc (Zn) was the most abundant in the raw seeds with mean value of 458.03 ± 18.42 g/kg. Lead (Pb) was the least abundant among the micro minerals with mean of 54.09 ± 2.58g/kg in the roasted seeds while iron (Fe) had mean values that ranged from 187.83 ±4.86 g/kg in the roasted seeds to 261.67 ± 4.73 g/kg in the boiled seeds. Fe was most abundant in the B seeds (261.67 ± 4.73 g/kg) and least in the R seeds (187.83 ± 4.86). Pb was most abundant in the Ro seeds (105.60± 0.00) and least in the R seeds (54.09± 2.58 g/kg) while Zn was most abundant in the R seeds and least 159.97± 24.89 g/kg) in the F seeds. The mean values of micro minerals were significantly ($P < 0.05$) different between the treatments.

Table 4.2a: Effects of processing methods on macro mineral composition (g/kg) of *Karaya* gum tree seeds

Processing form	Seeds	P	PR1(%)	K	PR2(%)	Na	PR3(%)	Ca	PR4(%)	Mg	PR5(%)
Raw	Ro1	62.21	0.00	420.00	0.00	750.00	0.00	410.00	0.00	45.23	0.00
	Ro2	62.21	0.00	420.00	0.00	750.00	0.00	410.00	0.00	45.23	0.00
	Ro3	62.21	0.00	420.00	0.00	750.00	0.00	410.00	0.00	45.23	0.00
Mean		62.21^{a}	0.00^{c}	420.00^{c}	0.00^{a}	750.00^{b}	0.00^{c}	410.00^{b}	0.00^{c}	45.23^{a}	0.00^{d}
Stand. Dev.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Boiled	B1	61.19	-1.64	432.10	-2.88	682.00	9.07	430.10	-4.90	44.10	21.30
	B2	61.82	-2.59	463.00	-10.24	631.00	15.87	436.40	-6.44	43.60	25.64
	B3	57.40	7.73	485.70	-15.64	582.00	22.40	440.20	-7.37	42.54	35.60
Mean		60.14^{a}	1.17^{c}	460.27^{b}	-9.59^{b}	631.67^{c}	15.78^{a}	435.57^{a}	-6.24^{d}	43.41^{b}	27.51^{a}
Stand. Dev.		2.39	5.70	27.90	6.41	50.00	6.67	5.10	1.25	0.80	7.33
Fermented	F1	54.33	12.67	450.10	-7.17	732.00	2.40	380.40	7.22	42.87	5.22
	F2	54.92	11.72	472.20	-12.43	724.00	3.47	367.10	10.46	41.46	8.34
	F3	41.60	33.13	490.30	-16.74	716.00	4.53	352.60	14.00	40.56	10.33
Mean		50.28^{b}	19.17^{a}	470.87^{b}	-12.11^{b}	724.00^{b}	3.47^{b}	366.70^{c}	10.56^{a}	41.63^{c}	7.96^{c}
Stand. Dev.		7.53	12.10	20.13	4.79	8.00	1.07	13.90	3.39	1.16	2.59
Roasted	R1	42.00	32.47	531.40	-26.52	820.00	-9.33	394.10	3.88	39.54	12.58
	R2	67.63	-8.71	562.00	33.81	834.00	-10.07	386.20	5.80	39.87	11.85
	R3	66.01	-6.11	568.10	-35.26	857.00	-14.27	366.10	10.71	38.85	14.11
Mean		58.55^{a}	5.88_{b}	553.83^{a}	-31.86^{c}	837.00^{a}	-11.22^{d}	382.13^{c}	6.80^{a}	39.42^{d}	12.84^{b}
Stand. Dev.		14.35	23.06	19.65	4.68	18.68	2.67	14.44	3.52	0.52	1.15
SEM		2.46	4.00	15.43	3.67	23.05	3.04	7.97	2.04	0.67	1.49

Key: P=Phosphorus, K=Potassium, Na=Sodium, Ca=Calcium, Mg=Magnessium,, PR=Percentage Reduction,
Ro=Raw seeds, B= Boiled seeds for 10, 20 and 30 minutes (B1, B2 and B3), F = Fermented seeds for 3, 6 and 9 days (F1, F2 and F3),
Ro=Raw seeds, B= Boiled seeds for 10, 20 and 30 minutes (B1, B2 and B3), F = Fermented seeds for 3, 6 and 9 days (F1,F2 and F3),
R = Roasted seeds for 10,20 and 30 minutes (R1, R2 and R3),

Stand. Dev. = Standard deviation, SEM = Standard error of mean

Table 4.2b: Effects of processing methods on micro mineral composition (mg/kg) of *Karaya* gum tree seeds

Processing form	Seeds	Iron	PR6 (%)	Lead	PR7 (%)	Zinc	PR8 (%)
Raw	Ro1	250.00	0.00	105.60	0.00	359.60	0.00
	Ro2	250.00	0.00	105.60	0.00	359.60	0.00
	Ro3	250.00	0.00	105.60	0.00	359.60	0.00
Mean		250.00[a]	0.00[c]	105.60[a]	0.00c	359.60[b]	0.00[c]
Stand. Dev.		0.00	0.00	0.00	0.00	0.00	0.00
Boiled	B1	267.00	-6.80	86.32	18.26	283.0	21.30
	B2	258.00	-3.20	83.40	21.02	267.40	25.64
	B3	260.77	-4.00	81.43	22.89	231.60	35.60
Mean		261.67[a]	-4.67[d]	83.72[b]	20.72[b]	260.67[c]	27.51[b]
Stand. Dev.		4.73	1.89	2.46	2.33	26.35	7.33
Fermented	F1	246.00	1.60	63.20	40.02	188.70	47.53
	F2	238.50	4.60	61.84	41.44	146.2	59.34
	F3	234.10	6.36	53.27	49.55	145.00	59.68
Mean		239.53[b]	4.19[b]	59.44[c]	43.67a	159.97[d]	55.52[a]
Stand.Dev.		6.02	2.41	5.38	5.14	24.89	6.92
Roasted	R1	184.00	26.40	56.99	46.03	438.20	-21.86
	R2	186.20	25.52	53.21	49.61	461.30	-28.28
	R3	193.30	22.68	52.06	35.55	474.60	-31.98
Mean		187.83[c]	24.87[a]	54.09[c]	43.73a	458.03[a]	-27.37[d]
Stand. Dev.		4.86	1.94	2.58	7.31	18.42	5.12
SEM		9.39	3.43	6.25	5.61	40.74	9.41

Key: PR = Percentage Reduction,

Ro=Raw seeds, B= Boiled seeds for 10, 20 and 30 minutes (B1, B2 and B3),

F = Fermented seeds for 3, 6 and 9 days (F1, F2 and F3),

Ro = Raw seeds, B = Boiled seeds for 10, 20 and 30 minutes (B1, B2 and B3), F = Fermented seeds for 3, 6 and 9 days (F1,F2 and F3), R = Roasted seeds for 10,20 and 30 minutes (R1, R2 and R3),

Stand. dev. = Standard deviation, SEM = Standard error of mean

4.3 Effects of Processing Methods on Vitamin Composition of *Karaya* Gum Tree Seeds

The vitamins composition of raw, boiled, fermented and roasted *Karaya* gum tree seeds and theirpercentage reductions under different processing methods is presented in Table 4.3. The vitaminsanalysed include; retinol (vitamin A), cholecalciferol (vitamin D), tocopherol (vitamin E),phridoxin (vitamin B6), cyanocobalamin (vitamin B12) and ascorbic acid (vitamin C). Among the vitamins analyzed, vitamin E was the most abundant in the boiled seeds (in comparison with raw and processed seeds) with mean values ranging from 21.11 ± 5.49 mg/100 g in the roasted (R) seeds to 26.85 ± 6.39 mg/100 g while B12 was the least with mean value ranging from 0.00 ± 0.00 in the boiled (B) and roasted (R) seeds to 0.01 ± 0.00 mg/100 g in the raw (Ro) and fermented seeds.

Vitamin A had the least mean value of 0.93 ± 0.00 mg/100 g in the B seeds and highest value of 1.22 ± 0.00 in the Ro seeds. Vitamin B6 had the least mean value of 0.05 ± 0.05 mg/100g in the R seeds and the highest mean value of 0.11 ± 0.02in the F seeds. Vitamin C had the least mean value of 1.33 ± 0.10mg/100g in the B seedsand highest mean value of 1.43 ± 0.11 in the F seed. Vitamin E had the least value (21.11 ± 5.49 mg/100 g) in the R seeds and highest value (26.85 ± 6.39 mg/100g) in the B seeds while vitamin D had the least value (19.26 ±0.00 mg/100 g) in the Ro seeds and the highest (21.73 ± 1.90) in the F seeds. Vitamins A, B6 and B12 were significantly ($P < 0.05$) influenced by processing methods while vitamins C, D and E were not significantly ($P < 0.05$) influenced.

Table 4.3: Effects of processing methods on vitamin composition (mg/100g) of *Karaya* gum tree seeds

Processing form	Seeds	Vit. A	PR1	Vit.B6	PR2	Vit.B12	PR3	Vit.C	PR4	Vit.D	PR5	Vit.E	PR6
Raw	Ro1	1.22	0.00	0.09	0.00	0.01	0.00	1.35	0.00	19.26	0.00	24.28	0.00
	Ro2	1.22	0.00	0.09	0.00	0.01	0.00	1.35	0.00	19.26	0.00	24.28	0.00
	Ro3	1.22	0.00	0.09	0.00	0.01	0.00	1.35	0.00	19.26	0.00	24.28	0.00
Mean		1.22^{a}	0.00^{b}	0.09^{ab}	0.00^{b}	0.01^{a}	0.00^{b}	1.35	0.00^{b}	19.26	0.00^{a}	24.28	0.00
Stand. Dev.		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Boiled	B1	0.93	23.77	0.08	0.11	0.00	100.00	1.39	-2.96	23.39	-21.14	19.54	19.52
	B2	0.93	23.77	0.09	0.00	0.00	100.00	1.21	10.37	20.39	-5.87	31.36	-29.16
	B3	0.93	23.77	0.11	22.22	0.00	100.00	1.38	-2.22	21.19	-10.02	29.64	-22.08
Mean		0.93^{b}	23.77^{a}	0.09ab	7.44^{ab}	0.00^{b}	100.00^{a}	1.33	1.73^{a}	21.66	-12.46^{b}	26.85	-10.58
Stand. Dev.		0.00	0.00	0.02	12.80	0.00	0.00	0.10	1.21	0.02	12.78	6.39	26.30
Fermented	F1	0.92	24.56	0.08	0.11	0.01	0.00^{c}	1.31	2.96	23.16	-20.25	26.38	-8.65
	F2	0.97	20.49	0.12	-33..33	0.01	0.00	1.53	-13.33	22.45	-16.56	18.34	24.46
	F3	1.26	-3.28	0.12	-33.33	0.02	-100.00	1.44	-6.67	19.57	-1.61	21.88	9.88
Mean		1.05^{ab}	13.93^{ab}	0.11^{a}	-22.18^{c}	0.01^{a}	-33.33^{c}	1.43	-5.93^{c}	21.73	-12.82^{b}	22.20	8.56
Stand. Dev.		0.18	15.05	0.02	19.31	0.01	57.75	0.11	8.19	1.90	9.87	4.03	16.59
Roasted	R1	0.94	22.95	0.10	-0.11	0.00	100.00	1.34	0.74	22.68	-17.76	18.25	24.84
	R2	0.95	22.13	0.01	88.89	0.00	100.00	1.57	-16.30	20.56	-6.75	17.65	27.31
	R3	0.98	19.67	0.03	66.67	0.00	100.00	1.28	5.19	21.78	-13.08	27.44	-13.01
Mean		0.96^{b}	21.58^{a}	0.05b	51.82^{a}	0.00^{b}	100.00a	1.40	-3.70^{c}	21.67	-12.51^{b}	21.11	13.05
Stand. Dev.		0.02	1.71	0.05	46.32	0.00	0.00	0.15	11.34	1.06	5.53	5.49	22.60
SEM		0.04	3.37	0.00	10.31	0.00	8.33	0.29	6.63	0.46	2.17	1.32	5.46

Key: Vit = Vitamin, PR = Percentage reduction,
Ro = Raw seeds, B = Boiled Seeds for 10, 20 and 30 minutes (B1, B2 and B3), F = Fermented seeds for 3, 6 and 9 days (F1, F2 and F3),
R = Roasted seeds for 10, 20 and 30 minutes (R1, R2 and R3),
Stand. dev.= Standard deviation, SEM = Standard error of mean

4.4 Effects of Processing Methods on the Anti-Nutritional Composition of *Karaya* Gum Tree Seeds

The anti-nutritional factors (ANFs) of raw, boiled, fermented and roasted *Karaya* gum tree seeds and their percentage reductions are presented in Table 4.4. The results of the analysis had shown that the raw seed contained 0.22 % phytate, 0.19 mg/100 g oxalate, 0.34 % tannin, 0.14 % saponin, 22.18 ppm cyanide, 0.49 % alkaloid and 3.90 % flavonoid respectively. The boiled seeds for 10 (B1), 20 (B2) and 30 minutes (B3) contained 0.21 %, 0.19 % and 0.04 % phytate, 0.16 mg/100g, 0.13 mg/100 g, and 0.09 mg/100 g oxalate, 0.33 %, 0.16 % and 0.02 % tannin, 0.11 %, 0.10 % and 0.06 % saponin, 20.06 ppm, 18.23 ppm, and 14.57 ppm cyanide, 0.10 %, 0.06 % and 0.00 % alkaloid and 2.68 %, 1.92 % and 0.73 % flavonoid.

The fermented seeds for 3 (F1), 6 (F2), and 9 days (F3) contained 0.16 %, 0.05 % and 0.01 % phytate, 0.11 ppm, 0.07 ppm and 0.04 ppm oxalate, 0.31 %, 0.20 % and 0.13 % tannin, 0.10 %, 0.08 % and 0.05 % saponin, 17.26 ppm, 13.14 ppm and 10.06 ppm cyanide, 0.24 %, 0.18 % and 0.09 % alkaloid and 3.16 %, 2.05 % and 0.82 % flavonoid while roasted seeds at 75^0 C for 10 (R1), 20 (R2) and 30 minutes(R3) contained 0.09 %, 0.00 % and 0.00 % phytate, 0.03 ppm, 0.010 ppm, and 0.00 ppm oxalate, 0.24 %, 0.16 % and 0.03 % tannin, 0.09 %, 0.05 % and 0.00 % saponin, 15.22 ppm, 10.03 ppm and 0.00 ppm cyanide, 0.24 %, 0.00 % and 0.00 % alkaloid and 1.74 %, 0.84 % and 0.86 % flavonoid respectively.

Among the ANFs detected in the seed, the ANFs were higher in the raw seeds than the processed seeds. Cyanide was the most abundant (22.18 ± 0.00) while saponin was the least abundant (0.14 ± 0.00). Phytate had a mean range of 0.03 ±0.05 in the R seeds and 0.22 ±

0.00 in the Ro seeds. Similarly, oxalate mean values ranged from 0.01 ± 0.02 in the R seeds to 0.19 ± 0.00 in the Ro seeds while tannin had mean values of 0.14 ± 0.11 in the R seeds to 0.34 ± 0.00 in the Ro seeds. Saponin ranged from 0.05 ± 0.05 in the R seeds to 0.14 ± 0.00 in the Ro seeds while cyanide had a mean range values of between 8.42 ± 7.74 and 22.18 ± 0.00 respectively. Alkaloid varied between 0.05 ± 0.05 in the B seeds and 0.49 ± 0.00 in the Ro seeds while flavonoid ranged from 1.15 ± 0.51 in the R seeds to 3.90 ± 0.00 in the Ro seeds. With the exception of Tannin which was not influenced by the processing methods, all other ANFs were significantly P < 0.00)by the processing methods.

Least value (highest reduction) of phytate was obtained (among the boiled seeds) in the boiled seeds for 30 minutes while the highest value (least reduction) was in 10 minutesboiled seeds. There were significant (P<0.05) differences in phytate content between the boiled seeds at different times. Phytate decreased with increase in the period of boiling. Similarly, least value (highest reduction) of phytate was obtained (among the fermented seeds) in the fermented seeds for 9 days while the highest value (least reduction) was in 3 days fermented seeds. The values were significant (P<0.05) between the fermented seeds for different days of fermentation. Fermentation took similar trend with boiling of the seeds and decreased with increase in the number of days of processing. There were differences (P<0.05) betwee the roasted seeds at different times. Total elimination of phytate was obtained in roasted seeds at 75^0 C for 20 and 30 minutes. Other anti-nutritional factors followed the same trend with phytate and decreased with increased boiling and fermentation period with exception of flavonoid that had no regular pattern in roasting.

Table 4.4: Effects of processing methods on anti-nutrient composition of *Karaya* gum tree seeds

Processing form	Seeds	Phytate	PR1	Oxalate	PR2	Tannin	PR3	Saponin	PR4	Cyanide	PR5	Alkalo.	PR6	Flavo.	PR7
Raw	Ro1	0.22	0.00	0.19	0.00	0.34	0.00	0.14	0.00	22.18	0.00	0.49	0.00	3.90	0.00
	Ro2	0.22	0.00	0.19	0.00	0.34	0.00	0.14	0.00	22.18	0.00	0.49	0.00	3.90	0.00
	Ro3	0.22	0.00	0.19	0.00	0.34	0.00	0.14	0.00	22.18	0.00	0.49	0.00	3.90	0.00
Mean		0.22^{a}	0.00^{b}	0.19^{a}	0.00^{d}	0.34	0.00^{c}	0.14^{a}	0.00^{b}	22.18^{a}	0.00^{b}	0.49^{a}	0.00^{b}	3.90^{a}	0.00^{b}
Stand. Dev.		0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Boiled	B1	0.21	4.55	0.16	15.79	0.33	2.94	0.11	21.43	20.06	9.56	0.01	79.59	2.68	31.28
	B2	0.19	13.64	0.13	31.58	0.16	52.94	0.10	28.57	18.23	17.81	0.06	87.76	1.92	50.77
	B3	0.04	81.82	0.09	52.63	0.02	94.12	0.06	57.14	14.57	34.31	0.00	100.00	0.73	81.28
Mean		0.15^{ab}	31.82^{ab}	0.13^{b}	31.58^{c}	0.17	50.00^{a}	0.09^{ab}	35.71^{a}	17.62^{a}	20.56^{b}	0.05^{b}	89.80^{a}	1.78^{b}	54.36^{a}
Stand. Dev.		0.09	42.23	0.04	18.42	0.16	45.66	0.03	18.90	2.80	12.60	0.05	10.27	0.98	25.20
Fermented	F1	0.16	27.27	0.11	42.11	0.31	8.82	0.10	28.57	17.26	22.18	0.24	51.02	3.16	18.97
	F2	0.05	77.27	0.07	63.16	0.20	41.18	0.08	42.86	13.14	40.76	0.18	63.27	2.05	47.44
	F3	0.01	95.45	0.04	78.95	0.13	61.78	0.05	64.29	10.06	54.64	0.09	81.63	0.82	78.97
Mean		0.07^{b}	68.18^{a}	0.07^{c}	63.16^{b}	0.21	38.24^{b}	0.08^{b}	42.86^{a}	13.49^{ab}	39.18^{ab}	0.17	65.31^{a}	2.01^{b}	48.46^{a}
Stand. Dev.		0.08	35.31	0.04	18.48	0.09	26.69	0.03	17.98	3.61	16.29	0.08^{b}	15.41	1.17	30.01
Roasted	R1	0.09	59.09	0.03	84.21	0.24	29.41	0.09	35.71	15.22	31.38	0.24	51.05	1.74	55.38
	R2	0.00	100.00	0.01	94.74	0.16	52.94	0.05	64.29	10.03	54.78	0.00	100.00	0.84	78.46
	R3	0.00	100.00	0.00	100.00	0.03	91.18	0.00	100.00	0.00	100.00	0.00	100.00	0.86	77.95
Mean		0.03^{b}	86.36^{a}	0.01^{d}	94.74^{a}	0.14	57.84^{a}	0.05^{b}	64.29^{a}	8.42^{b}	62.04^{a}	0.08^{b}	83.67^{a}	1.15^{b}	70.51^{a}
Stand. Dev.		0.05	23.62	0.02	8.04	0.11	31.18	0.05	21.21	7.74	34.88	0.14	28.28	0.51	13.18
SEM		0.03	12.36	0.02	10.89	0.03	10.09	0.01	7.42	1.89	8.52	0.06	11.48	0.37	9.43

Key: Ro=Raw seeds, B= Boiled seeds for 10, 20 and 30 minutes (B1, B2 and B3),
F = Fermented seeds for 3, 6 and 9 days (F1, F2 and F3),
R = Roasted seeds for 10,20 and 30 minutes (R1, R2 and R3),

Stand. Dev. = Standard deviation, SEM = Standard error of mean,

4.5 Proximate Composition of the Experimental Diets (Experiment II)

The proximate composition of the experimental diets are presented in Table 4.5. The control diets(T1, T4 and T7, diets containing 0 % processed *Karaya* gum tree seed meal) had 93.89 % dry matter (DM), 16.75 % crude protein (CP), 11.96 % crude fibre (CF), 6.56 % ether extract (EE), 11.77 % ash and 46.85 % nitrogen free extract (NFE). Diet containing 5 % boiled *Karaya* gum tree seed meal (KGTSM) (T2) had 93.14 % DM, 11.32 % Ash, 12.06 % CF, 16.72 % CP, 7.19 %EE, and 45.85 % NFE. Diet containing 10 % boiled KGTSM (T3) had 93.18 % DM, 11.47 % Ash, 12.39 % CF, 16.79 % CP, 7.40 % EE and 45.13 % NFE respectively. Similarly, diet containing 5 % fermented KGTSM (T5) had 93.07 % DM, 10.85 % Ash, 12.15 % CF, 17.00 % CP, 7.32 % EE and 45.75 % NFE. Diet containing 10 % fermented KGTSM (T6) had 94.11 % DM, 11.89 % Ash, 12.28 % CF, 16.70 % CP, 7.43 % EE and 45.81 % NFE. Diet containing 5 % roasted KGTSM (T8) had 93.30 % DM, 11.64 % Ash, 12.12 % CF, 16.94 % CP, 7.16 % EE and 45.44 % NFE while diet containing 10 % roasted KGTSM (T9) had 94.36 % DM, 12.83 % Ash, 12.68 % CF, 16.66 % CP, 7.30 % EE and 44.89 % NFE respectively.

There were slight differences between the nutrients of the experimental diets which resulted from the differences in the nutrient contentof the differently processed seeds. The CP of the diets was within the recommended level (16-17 %) for weaned rabbit. With the exception of the control diet which had slightly less than 12 % CF, other diets had CF slightlty above 12 %. The main effects of processing methods had shown that there were no significant ($P>0.05$) differences between the nutrients of the diets while the interaction effects had shown that with the exception of the NFE, there were significant ($P<0.005$) differences between the treatments in other nutrients.

Table 4.5: Main and interaction effects of processing methods on proximate composition (%) of *Karaya* gum tree seeds

Processing		DM (%)	Ash (%)	CF (%)	CP (%)	EE (%)	NFE (%)
Boiled		93.40	11.52	12.14	18.93	7.05	45.94
Fermented		93.69	11.50	12.13	18.97	7.10	45.93
Roasted		93.85	12.08	12.25	18.45	7.01	45.73
LSD		6.32	0.46	2.85	0.34	0.96	5.39
LOS		NS	NS	NS	NS	NS	NS
Levels (L)	(%)						
	0	93.89	11.77^{b}	11.96^{c}	16.75^{b}	6.56^{b}	46.85^{a}
	5	93.17	11.27^{c}	12.11^{b}	16.89^{a}	7.22^{a}	45.68^{b}
	10	93.88	12.06^{a}	12.45^{a}	16.72^{b}	7.38^{a}	40.07^{c}
LSD (0.05)		6.32	0.46	2.85	0.27	1.72	5.39
LOS		NS	*	*	*	*	*
Interaction							
Boiled	0	93.89^{a}	11.77^{b}	11.96^{e}	16.75^{b}	6.56^{c}	46.85^{a}
	5	93.14^{c}	11.32^{c}	12.06^{d}	16.72^{b}	7.19^{b}	45.85^{b}
	10	93.18^{c}	11.47^{c}	12.39^{b}	16.79^{b}	7.40^{a}	45.13^{d}
Fermented	0	93.89^{a}	11.77^{b}	11.96^{e}	16.75^{b}	6.56^{c}	46.85^{a}
	5	93.07^{c}	10.85^{d}	12.15^{c}	17.00^{a}	7.32^{a}	45.75^{b}
	10	94.11^{a}	11.89^{b}	12.28^{b}	16.70^{b}	7.43^{a}	45.18^{d}
Roasted	0	93.89^{a}	11.77^{b}	11.96^{e}	16.75^{b}	6.56^{c}	46.85^{a}
	5	93.30^{b}	11.64^{b}	12.12^{d}	16.94^{a}	7.16^{b}	45.44^{c}
	10	94.36^{b}	12.83^{a}	12.68^{a}	16.66^{b}	7.30^{a}	44.89^{e}
LSD (0.05)		6.33	0.34	2.42	0.81	1.67	4.58
LOS		*	*	*	*	*	NS
P-Value		0.04	0.03	0.01	0.03	0.02	0.34

Key: DM = Dry matter, CF = Crude fiber, CP = Crude protein, EE = Ether extract, NFE = Nitrogen free extract
NS = Not significant, LSD = Least significant difference, LOS = Level of significance,
P-Value = Probability value

4.8 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya Gum* Tree Seed Meals on the Growth Performance of Weaned Rabbits

The main and the interaction effects of different processing methods and levels of inclusion of *Karaya* gum tree seed meal on the growth performance of weaned rabbits are presented in Table. The main and the interaction effects have shown that there were no significant (P>0.05) differences between the treatment groups in the average initial body weights (IBW) of the rabbits.This is because the initial weight of the rabbits was within close range. However, there were significant (P<0.05) differences in the final body weight (FBW) of the animals. The FBW of the animals fed diets containing boiled *Karaya* gum tree seed meal was similar (P>0.05) to those fed diet containing fermented seed meal but different (P<0.05) from those fed diet containing roastedseed meal. Total weight gain (TWG), average daily gain (ADG) and feed conversion ratio (FCR)followed the same trend with FBW in which animals on diet containing boiled seed meal had similar (P>0.05) values with those on diet containing fermented seed meal which were significantly (P<0.05) different from those on roasted seed meal.

There were no significant (P>0.05) differences between the treatments in the daily feed intake (DFI). Similarly, there were no significant (P>0.05) differences between the groups in the total feed intake (TFI). Although thevalues were numerically different, they were statistically similar (P<0.05). Similarly, levels of inclusion of processed seed meal had shown that there were no significant(P<0.05) differences between the treatment groups in the IBW of the animals. There were significant (P>0.05) differences between the groups in the FBW, TWG, ADG, DFI and FCR but there were no differences (P<0.05) between the groups in the TFI. Levels of inclusion of processed seeds had shown that 0 % and 10 % levels were similar (P<0.05) in the FBW, TWG andADG which were different (P>0.05) from 5 % inclusion level. DFI were similar (P<0.05) in 5 % and

10 % levels which were different (P>0.05) from 0 %. FCR was similar (P<0.05) between 0 %and 5 % levels but was different (P>0.05) from 10 % level. Interaction effect had shown that there were no significant (P>0.05) differences in the initial bodyweight across the groups. Differences (P>0.05) existed between the groups in the final body weight, total weight gain, average daily gain, daily feed intake and feed conversion ratio while there were no significant (P>0.05) differences between the groups in the total feed intake.

4.9 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya* Gum Tree Seed Meals on the Apparent Nutrient Digestibility of Weaned Rabbits

The main and interaction effects of different processing methods and levels of inclusion of *Karaya* gum tree seed meals on the apparent nutrient digestibility of weaned rabbits are presented in Table 4.6. There were significant (P<0.05) differences between the treatment groups in the dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE) digestibilities. Higher digestibilities of DM, CP, CF, EE, ash and NFE were recorded in treatments fed diet containing boiled *Karaya* gum tree seed meal followed by those fed diet containing fermented seed meal. Animals fed diet containing roasted seed meal had lower digestibility values.

Levels of inclusion of processed seed meals had also shown that there were significant (P<0.05) differences across the treatment groups. DM digestibility was significantly (P<0.05) higher in 5 % level of inclusion followed by 0 % level. 10 % level of inclusion had lower nutrient digestibility of DM. Digestibility of CP, CF, EE, ash and NFE was significantly (P<0.05) higher in 0 % level of inclusion followed by 5 % and least digestibility was recorded in 10 % level of inclusion. Digestibility of nutrients significantly (P<0.05) decreased with increase in the level of processed seed meal in the diets.

Interaction effects of processing methods and levels of inclusion had also shown that there were significant ($P<0.05$) differences between the treatments in crude fibre, crude protein, ether extract ash and nitrogen free extract digestibility. Highest (80.63 % - 80.65 %) nutrient digestibilities were obtained in the treatment fed diet containing 5 % fermented seed meal while lowest (60.17 % - 60.19 %) digestibilities were obtained in the treatment fed diet containing 10 % roasted seed meal.The lower digestibilities recorded in animals fed diet containing roasted seed meal could be due to residual effects of anti-nutritional factors of the seeds.

Table 4.6: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the growth performance of weaned rabbits

Processing		IBW(g)	FBW(g)	TWG(g)	ADG(g)	DFI(g)	TFI(g)	FCR
Boiled		525.17	2115.00^{a}	1589.94^{a}	18.93^{a}	64.03	5379.10	3.39^{a}
Fermented		524.93	2118.33^{a}	1593.40^{a}	18.97^{a}	64.07	5381.90	3.38^{a}
Roasted		525.17	2075.00^{b}	1549.83^{b}	18.45^{b}	64.50	4830.30	3.50^{b}
LSD (0.05)		0.53	22.99	22.85	0.27	1.72	970.26	0.11
LOS		NS	**	**	**	NS	NS	*
Levels (L)	(%)							
	0	525.00	2065.00^{b}	1540.00^{b}	18.33^{b}	62.11^{b}	5217.40	3.39^{a}
	5	525.10	2171.67^{a}	1646.68^{a}	19.60^{a}	64.53^{a}	5420.80	3.29^{a}
	10	525.17	2071.67^{b}	1546.50^{b}	18.41^{b}	65.97^{a}	4953.20	3.59^{b}
LSD (0.05)		0.53	22.99	22.85	0.27	1.72	970.26	0.11
LOS		NS	**	**	**	**	NS	*
Interaction								
Boiled	0	525	2065^{bc}	1540^{cd}	18.33^{d}	62.11^{c}	5217.10	3.39^{b}
	5	525	2180^{a}	1655^{a}	19.70^{a}	65.70^{ab}	5518.80	3.34^{a}
	10	525	2100^{ab}	1575^{bc}	18.75^{c}	64.30^{bc}	5401.20	3.43^{b}
Fermented	0	525	2065^{bc}	1540^{cd}	18.33^{d}	62.11^{c}	5217.10	3.39^{b}
	5	525	2205^{a}	1680^{a}	20.00^{a}	64.50^{bc}	5418.00	3.22^{a}
	10	525	2085^{bc}	1560^{c}	18.57^{cd}	65.60^{ab}	5510.40	3.53^{bc}
Roasted	0	525	2065^{bc}	1540^{cd}	18.33^{d}	62.11^{c}	5217.10	3.39^{b}
	5	525	2130^{ab}	1605^{b}	19.11^{b}	63.40^{bc}	5325.60	3.32^{a}
	10	525	2030^{c}	1505^{d}	17.91^{e}	68.00^{a}	5712.00	3.80^{c}
LSD (0.05)		0.35	30.38	20.30	0.46	1.40	663.55	0.15
LOS		NS	**	**	**	**	NS	*
P-Value		0.71	0.02	0.04	0.02	0.02	0.61	0.01

Key: IBW = Initial body weight, DFI = Daily feed intake, FBW = Final body weight TFI = Total, feed intake TWG = Total weight gain FCR = Feed conversion ratioADG = Average daily weight gain, LSD = Least significant difference, NS = Not significant, ** = Highly significant, LOS = Level of significance, P-Value = Probability value

Table 4.7: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the apparent nutrient digestibility (%) of weaned rabbits

Processing		DM	CP	CF	EE	ASH	NFE
Boiled		78.36[a]	78.52[a]	78.51[a]	78.52[a]	78.52[a]	78.52[a]
Fermented		76.90[b]	77.05[b]	77.04[b]	77.05[b]	77.04[b]	77.04[b]
Roasted		76.14[c]	76.29[c]	76.29[c]	76.29[c]	76.28[c]	76.28[c]
LSD (0.05)		0.04	0.02	0.03	0.02	0.02	0.02
LOS		**	**	**	**	**	**
Levels (L)	(%)						
	0	79.49[b]	79.93[a]	79.93[a]	79.94[a]	79.93[a]	79.93[a]
	5	79.82[a]	79.83[b]	79.82[b]	79.83[b]	79.83[b]	79.82[b]
	10	72.09[c]	72.09[c]	72.07[c]	72.08[c]	72.08[c]	72.07[c]
LSD (0.05)		0.04	0.02	0.03	0.02	0.02	0.02
LOS		**	**	**	**	**	**
Interaction							
Boiled	0	79.50[c]	79.93[b]	79.93[b]	79.94[b]	79.93[b]	79.93[b]
	5	79.10[d]	79.10[d]	79.10[d]	79.11[d]	79.11[d]	79.11[d]
	10	76.52[e]	76.52[e]	76.51[e]	76.51[e]	76.52[e]	76.51[e]
Fermented	0	79.50[c]	79.93[b]	79.93[b]	79.94[b]	79.93[b]	79.93[b]
	5	80.63[a]	80.64[a]	80.63[a]	80.65[a]	80.63[a]	80.63[a]
	10	70.57[f]	70.57[f]	70.56[f]	70.55[f]	70.56[f]	70.57[f]
Roasted	0	79.50[c]	79.93[b]	79.93[b]	79.94[b]	79.93[b]	79.93[b]
	5	79.74[b]	79.76[c]	79.74[c]	79.75[c]	79.75[c]	79.74[c]
	10	69.18[g]	69.18[g]	69.19[g]	69.18[g]	69.17[g]	69.18[g]
LSD (0.05)		0.06	0.03	0.05	0.02	0.02	0.02
LOS		**	**	**	**	**	**
P- value		0.03	0.03	0.03	0.03	0.03	0.03

Key: DM = Dry matter, EE = Ether extract, CP = Crude protein, NFE = Nitrogen free extract, CF = Crude fibre, LSD = Least significant difference, ** = Highly significant, LOS = Level of significance, P-Value = Probability value

4.8 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya* Gum Tree Seed Meals on the Haematological Indices of Weaned Rabbits

The main and the interaction effects of different processing methods and levels of inclusion of *Karaya* gum tree seed meals on the haematological indices of weaned rabbits are presented in Table 4.8. The main effects of processing methods had shown that there were significant ($P<0.05$) differences between the treatments in the haemoglobin (Hb) with the highest (15.23 g/dl) in animals fed diet containing boiled seed meal while the lowest (12.18 g/dl) was in roasted seed meal. Similarly, there were significant ($P<0.05$) differences between the treatments in the packedcell volume (PCV) with the highest (41.60 %) in treatment fed diet with boiled seed meal while the lowest (39.91 %) was in treatment fed diet containing roasted seed meal.

Red blood cell (RBC) took the similar trend with Hb and PCV. The values were statistically different ($P<0.05$) between thetreatments. Although the values of Hb, PCV and RBC differed significantly ($P<0.05$), they were within the normal range for healthy rabbits. Significant ($P<0.05$) differences were also observed between the treatment groups in white blood cells (WBC). However, the highest (7.89×10^3/mm) white blood cell value was obtained in treatment fed diet containing roasted seed meal while the lowest (4.44×10^3/mm) value was obtained in treatment fed diet containing boiled seed meal. The values were within the normal range for normal rabbits. High Hb, PCV and RBC, and low WBC denote wellness while low Hb, PCV and high WBC denote response to health challenge or foreignmaterial. Therefore, lower Hb, PCV and RBC, and higher WBC obtained in treatment fed diet containing roasted seed meal compared with those fed diets containing boiled and fermented seed meals could be due to residual effects of anti-nutritional factors in the roasted seeds. Significant ($P<0.05$) differences were also observed in monocytes and neutrophils among the white blood differentials while

basophils, eosinophils and lymphocytes were not significantly (P>0.05) different between the treatments. However, all the values for white blood differentials were within the normal range for healthy rabbits.

Values of mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were also significantly (P<0.05) different between the treatments while mean corpuscular haemoglobin (MCH) values were not significantly (P>0.05) different between the treatments. The levels of inclusion of processed seeds had shown that there were significant (P<0.05) differences between the groups for all the parameters determined with the exception of hymphocyte, basophil and mean corpuscular haemoglobin which were not significant (P>0.05). The interaction effects of processing methods and levels of inclusion of processed seeds had also shown that there were significant (P<0.05) differences between the treatment groups for all parameters with the exception of basophil and mean corpuscular haemoglobin. The values for Hb,PCV and RBC decreased significantly (P<0.05) with increasing levels of processed seed while values of WBC increased significantly (P<0.05) with increased level of processed seed in the diets.Values for white blood differentials, MCV, MCH and MCHC had no set pattern.

Table 4.8: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the haematological indices of weaned rabbits

			PCV	RBC	WBC	LYM	MON	BAS	EOS	NEU	MCV	MCH	MCHC
		Haemoglobin	35.0 –	3.80 –	4.00 –	30.00-	0.67-	0.50-	1.00-	30.00-	50.00-	18.00-	27.00-
Processing		15.11 -18.28	50.00	7.90	10.00	85.00	1.50	1.00	4.00	48.00	75.00	24.00	34.00
Boiled		15.23^{a}	41.60^{a}	6.90^{a}	4.44^{c}	31.60	5.54^{b}	0.60	3.48	53.86^{b}	60.31^{c}	22.08	36.62^{a}
Fermented		13.35^{b}	40.86^{b}	6.10^{b}	6.29^{b}	30.60	6.33^{a}	0.62	3.94	56.98^{a}	67.66^{b}	21.88	32.58^{b}
Roasted		12.18^{c}	39.91^{c}	5.72^{c}	7.89^{a}	30.54	6.38^{a}	0.58	3.92	58.18^{a}	70.92^{a}	21.16	30.31^{c}
LSD (0.05)		0.37	0.59	0.02	0.07	0.63	0.02	0.01	0.01	0.74	0.81	1.21	0.65
LOS		**	**	**	**	NS	**	NS	NS	**	**	NS	**
Levels (L)	(%)												
	0	15.63^{a}	42.60^{a}	7.04^{a}	4.10^{c}	32.32	5.96^{b}	0.40	3.23^{b}	50.11^{c}	60.51^{b}	22.20	36.69^{a}
	5	12.75^{b}	40.50^{b}	5.98^{b}	6.98^{b}	30.98	5.57^{b}	0.60	3.63^{b}	60.82^{a}	68.51^{a}	21.27	31.41^{b}
	10	12.38^{c}	39.28^{c}	5.70^{c}	7.54^{a}	31.37	6.88^{a}	0.60	4.48^{a}	58.01^{b}	69.88^{a}	21.66	31.41^{b}
LSD (0.05)		0.37	0.59	0.02	0.07	0.63	0.02	0.01	0.01	0.74	0.81	1.21	0.65
LOS		**	**	**	**	NS	**	NS	**	**	**	NS	**
Interaction													
Boiled	0	15.63^{a}	42.60^{a}	7.04^{a}	4.10^{g}	32.32^{a}	5.96^{c}	0.40	3.23^{bc}	50.11^{b}	60.50^{de}	22.20	36.69^{a}
	5	15.21^{ab}	41.86^{a}	6.85^{b}	4.36^{f}	29.44^{bc}	4.53^{d}	0.80	3.00^{c}	60.23^{a}	61.07^{d}	22.20	36.34^{a}
	10	14.86^{b}	40.35^{b}	6.80^{c}	4.87^{e}	33.08^{a}	6.13^{bc}	0.50	4.22^{abc}	51.23^{b}	59.34^{e}	21.85	36.83^{a}
Fermented	0	15.63^{a}	42.60^{a}	7.04^{a}	4.10^{g}	32.32^{a}	5.96^{c}	0.40	3.23^{bc}	50.11^{b}	60.51^{de}	22.20	36.69^{a}
	5	12.37^{c}	39.77^{b}	5.92^{d}	6.92^{d}	30.66^{ab}	6.23^{bc}	0.50	3.46^{bc}	61.33^{a}	67.18^{c}	20.90	31.10^{b}
	10	12.04^{c}	40.21^{b}	5.33^{e}	7.84c	28.82^{bc}	6.80^{b}	0.80	5.13^{a}	59.51^{a}	75.30^{b}	22.55	29.94^{c}
Roasted	0	15.63^{a}	42.60^{a}	7.04^{a}	4.10^{g}	27.11^{c}	5.46^{c}	0.40	3.23^{bc}	50.11^{b}	60.51^{de}	22.20	36.69^{a}
	5	10.68^{d}	39.87^{b}	5.16^{f}	9.67^{b}	32.32^{a}	5.96^{c}	0.60	4.44^{ab}	61.11^{a}	77.27^{a}	20.70	26.79^{d}
	10	10.23^{d}	37.27^{c}	4.97^{g}	9.89^{a}	32.21^{a}	7.71^{a}	0.50	4.10^{abc}	63.33^{a}	74.99^{b}	20.58	27.45^{d}
LSD (0.05)		0.49	0.78	0.03	0.09	0.84	0.04	0.02	0.04	1.02	1.07	0.67	0.86
LOS		**	**	**	**	**	**	NS	**	**	**	NS	**
P –Value		0.02	0.03	0.01	0.01	0.02	0.01	0.06	0.01	0.02	0.03	0.13	0.02

Key: PCV = Packed cell volume (%), RBC = Red blood cell ($\times 10^{9}$/l), WBC = White blood cell ($\times 10^{3}$/mm),, MCV = Mean, corpuscular volume μ^{3},MCH=Mean corpuscular haemoglobin (µg), MCHC = Mean corpuscular haemoglobin concentration (%), LYM = Lymphocytes (%) , MON = Monocytes (%), BAS = Basophils (%), EOS = Eosinophils (%), NEU = Neutrophils (%), LSD = Least Significant Difference, ** = Hihgly significant, LOS = Level of significance, P-Value = Probability value

4.9 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya* Gum Tree Seed Meals on the Serum Biochemical Indices of Weaned Rabbits

The main and the interaction effects of different processing methods and levels of inclusion of *Karaya* gum tree seed meals on the serum biochemical indices of weaned rabbits are presented inTable 4.9. Main effect of processing methods had indicated that there were significant (P<0.05) differences between the treatments in the total protein. The values were within close range and within the normal range (5.40-7.30 g/dl) for healthy rabbits. Significant (P<0.05) differences were also observed in albumin and globulin while urea did not differed significantly (P>0.05) betweenthe treatments. The values for albumin, globulin and urea were also within the normal range for all the treatments. Significant (P<0.05) differences were observed across the treatments in bilirubin, cholesterol and creatinine. The values were within the normal range for all the treatment groups. Significant (P>0.05) differences between the treatments were not observed in aspartate aminotransferase (AST) but significant (P<0.05) differences were observed in the alkaline phosphatase (ALP) and alanine aminotransferase (ALT). However, all the values were within the normal range for healthy rabbits.

Levels of inclusion of the test ingredients had shown that with the exception of urea which was not significantly (P>0.05) different, there were significant (P<0.05) differences between the treatment groups for all other parameters determined. Values of the parameters increased with increased levels of the test ingredients with the exception of albumin, urea and creatinine. Valuesof creatinine decreased with increased levels of the test ingredients but albumin and urea had no regular pattern. However, all the values were within normal range for rabbits. Interaction effects of processing methods followed

similar trend with levels of inclusion of the seed meals. There were significant (P<0.05) differences between the treatments for all the parameters with the exception of urea.

4.10 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya* Gum Tree Seed Meals on Carcass Characteristics of Weaned Rabbits

The main and the interaction effects of different processing methods and levels of inclusion of *Karaya* gum tree seed meals on the carcass characteristics of weaned rabbits are presented in Table 4.10. The live weight (LW) of the randomLy selected rabbits for slaughter was significantly (P<0.05) different between the treatments. The differences between the treatments were due to the fact that animals did not have the same weight after feeding trial and were selected at random to slaughter for carcass characteristics. Similarly, there were significant (P<0.05) differences between the treatment groups in the slaughtered weight (SW), dressed weight (DW) and dressing percentage (D %). The head, hind legs, ribs, skin and the intestine also differ significantly (P<0.05) between the treatments while the fore legs were not significantly (P>0.05) different. The heart, liver, kidneys and lungs (vital organs) were not significantly (P>0.05) different between the treatments. This had shown that the test ingredients did not have any negative effects on the vital organs since there was no any damage, enlargement or inflammation of any of the vital organs.

4.11 The levels of inclusion of processed *Karaya* gum tree seed meal had shown that there were significant (P<0.05) differences between the treatments for all the parameters measured. Levels ofinclusion of processed seed had shown that although the vital organs were numerically within closeranges, they were statistically different (P<0.05) between the treatments. Similarly, the interactioneffects and levels of inclusion of the processed seeds had shown that there were significant (P<0.05) differences between the treatments for all the parameters with the exception of the ribs. Although the values of the

parameters were within close ranges, they were statistically different (P<0.05). However, the differences (increase/decrease) between the parameters had no defined pattern.

4.12 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya* Gum Tree Seed Meals on the Sensory Properties of the Meat of Weaned Rabbits

The main and the interaction effects of different processing methods and levels of inclusion of *Karaya* gum tree seed meals on sensory properties of meat from rabbits is presented in Table 4.11.The main effects of processing methods had shown that there were significant (P<0.05) differences between the treatment groups for flavour and tenderness of the meat while there were no significant(P>0.05) differences between the treatments for palatabilty, colour, Juiciness and acceptability.Although the values for tenderness were within close ranges, they were statistically different(P<0.05) between the treatments fed diet containing boiled seed meal and treatments fed diets containing fermented and roasted seed meals.

The levels of inclusion of processed *Karaya* gum tree seed meals had shown that there were significant (P<0.05) differences between the treatments for flavour, juiciness and tenderness while significant (P>0.05) differences were not observed between the treatments for palatability, colourand acceptability. The differences observed had no set pattern between the treatments. Similarly, interaction effects of processing methods had shown that significant (P<0.05) differences existedbetween the treatments for flavour, juiciness and tenderness while there were no significant (P>0.05) differences between the treatments for palatability, colour and acceptablity. However, the differences had no regular pattern.

Table 4.9: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the serumbiochemical indices of weaned rabbits

Processing		Total. Protein 5.40-7.30 (g/dl)	Albumin 2.40-4.50 (g/dl)	Globulin 2.90-4.90 (g/dl)	Urea 20.50-25.00 (g/dl)	Bili. 0.00-1.00 (mg/dl)	Cholesterol 10.00-80.00 (mg/dl)	Creatinine 0.50-2.20 (mg/dl)	AST 4.00-20.00 (µ/l)	ALT 10.00-45.00 (µ/l)	ALP 10.00-120.00 (µ/l)
Boiled		6.54^{b}	3.90^{b}	2.64^{ab}	24.14	0.54^{c}	23.93^{c}	1.06^{c}	15.92	20.16^{c}	39.61^{b}
Fermented		6.83^{a}	4.08^{a}	2.75^{a}	24.47	0.83^{a}	56.59^{a}	1.19^{b}	15.95	30.68^{b}	43.04^{a}
Roasted		6.53^{b}	3.96^{b}	2.57^{b}	24.29	0.78^{b}	44.69^{b}	1.80^{a}	16.60	32.10^{a}	42.74^{a}
LSD (0.05)		0.09	0.68	0.13	0.48	0.03	1.22	0.07	0.71	0.88	0.98
LOS		**	**	**	NS	**	**	**	NS	**	**
Levels (L)	(%)										
	0	6.37^{c}	3.82^{c}	2.55^{b}	24.22	0.53^{c}	21.23^{c}	1.73^{a}	15.63^{b}	17.63^{c}	40.61^{c}
	5	6.68^{b}	4.12^{a}	2.56^{b}	24.16	0.78^{b}	50.48^{b}	1.29^{b}	16.36^{a}	31.19^{b}	41.60^{b}
	10	6.85^{a}	4.00^{b}	2.84^{a}	24.52	0.83^{a}	53.49^{a}	1.02^{c}	16.47^{a}	34.12^{a}	43.19^{a}
LSD (0.05)		0.09	0.68	0.13	0.48	0.03	1.22	0.07	0.71	0.88	0.98
LOS		**	**	**	NS	**	**	**	**	**	**
Interaction											
Boiled	0	6.37^{e}	3.82^{d}	2.55^{bc}	24.22^{ab}	0.53^{e}	21.23^{f}	1.73^{b}	15.63^{b}	17.63^{f}	40.61^{cd}
	5	6.53^{de}	3.93^{cd}	2.61^{bc}	23.64^{b}	0.42^{f}	24.68^{e}	0.77^{ef}	15.89^{b}	20.17^{e}	38.82^{d}
	10	6.72^{c}	3.96^{bc}	2.76^{b}	24.55^{ab}	0.68^{d}	25.87^{e}	0.67^{f}	16.64^{ab}	22.67^{d}	39.39^{cd}
Fermented	0	6.37^{e}	3.82^{d}	2.55^{bc}	24.22^{ab}	0.53^{e}	21.23^{f}	1.73^{b}	15.63^{b}	17.63^{f}	40.61^{cd}
	5	6.92^{b}	4.43^{a}	2.49^{c}	24.57^{ab}	1.00^{a}	72.34^{b}	0.99^{d}	16.23^{b}	36.05^{c}	43.67^{b}
	10	7.20^{a}	3.99^{bc}	3.21^{a}	24.21^{ab}	0.94^{b}	76.19^{a}	0.84^{e}	17.62^{a}	38.37^{b}	44.85^{a}
Roasted	0	6.37^{e}	3.82^{d}	2.55^{bc}	24.22^{ab}	0.53^{e}	21.23^{f}	1.73^{b}	15.63^{b}	17.63^{f}	40.61^{cd}
	5	6.60^{cd}	4.01^{bc}	2.59^{bc}	24.64^{a}	0.93^{b}	54.43^{d}	2.11^{a}	15.58^{b}	37.34^{bc}	42.30^{bc}
	10	6.62^{cd}	4.06^{b}	2.56^{bc}	24.45^{ab}	0.87^{c}	58.42^{c}	1.55^{c}	16.55^{ab}	41.32^{a}	45.32^{a}
LSD (0.05)		0.12	0.09	0.17	1.01	0.03	1.61	0.09	0.89	1.16	1.30
LOS		**	**	**	**	**	**	**	**	**	**
P- value		0.01	0.01	0.01	0.02	0.00	0.02	0.01	0.03	0.02	0.02

Key: AST = Aspatate aminotransferase (µ/l), ALP = Alkaline phosphatase (µ/l), ALT = Alanine aminotransferase (µ/l), Bili = Bilirubin, LSD= Least significant difference, NS = Not significant, ** = Highly significant, LOS = Level of significance, P-Value = Probability value

Table 4.10: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the carcasscharacteristics of weaned rabbits

Processing		LW	SW	DW	D%	Head	F.Leg	H. Leg	Skin	Ribs	Intest	Heart	Liver	Kidney	Lungs
Boiled		2146.11^{a}	2080.97^{a}	1488.00^{a}	69.33^{a}	942^{a}	6.80	2.88^{a}	10.92^{a}	21.55^{b}	21.61^{a}	0.29	2.36	0.53	0.66
Fermented		2110.00^{b}	2025.82^{b}	1424.00^{b}	67.49^{b}	8.94^{b}	6.79	2.94^{a}	10.80^{b}	21.72^{ab}	20.15^{b}	0.28	2.35	0.55	0.65
Roasted		2065.00^{c}	1992.12^{b}	1402.67^{c}	67.93^{b}	8.98^{b}	6.80	2.80^{b}	10.61^{c}	21.91^{a}	20.28^{b}	0.29	2.38	0.54	0.65
LSD (0.05)		29.91	40.16	14.74	0.41	0.21	0.14	0.08	0.07	0.24	0.39	0.01	0.08	0.02	0.02
LOS		**	**	**	**	**	NS	**	**	**	**	NS	NS	NS	NS
Levels (L)	(%)														
	0	2065.00^{b}	1995.89^{b}	1414.33^{b}	68.44^{a}	8.73^{c}	6.88^{a}	2.94^{a}	10.84^{a}	21.75^{ab}	19.54^{c}	0.29^{b}	2.20^{c}	0.55^{a}	0.63^{c}
	5	2173.33^{a}	2085.97^{a}	1492.89^{a}	68.79^{a}	9.67^{a}	6.78^{ab}	2.83^{b}	10.78^{a}	21.55^{b}	21.89^{a}	0.27^{b}	2.38^{b}	0.52^{b}	0.65^{b}
	10	2082.78^{b}	2017.05^{b}	1408.44^{b}	67.59^{b}	8.95^{b}	6.73^{b}	2.86^{b}	10.71^{b}	21.88^{a}	20.60^{b}	0.30^{a}	2.51^{a}	0.54^{ab}	0.67^{a}
LSD (0.05)		29.91	40.16	14.74	0.41	0.21	0.14	0.08	0.07	0.24	0.39	0.01	0.08	0.02	0.02
LOS		**	**	**	**	**	**	**	**	**	**	**	**	**	**
Boiled	0	2065de	1996^{c}	1413^{e}	68.44^{c}	8.73^{c}	6.88^{ab}	2.94^{a}	10.84^{b}	21.75	19.54^{c}	0.29^{ab}	2.20^{d}	0.55^{abc}	0.63^{c}
	5	2240^{a}	2176^{a}	1547^{a}	69.05^{b}	9.89^{a}	6.73^{ab}	2.80^{b}	11.02^{a}	12.38	22.58^{a}	0.27^{b}	2.47^{b}	0.52^{bc}	0.67^{ab}
	10	2133^{c}	2071^{b}	1504^{b}	70.50^{a}	9.64^{ab}	6.78^{ab}	2.91^{a}	10.90^{b}	21.51	22.69^{a}	0.31^{a}	2.42^{bc}	0.51^{c}	0.67^{ab}
Fermented	0	2065de	1996^{c}	1413^{e}	68.44^{c}	8.73^{c}	6.88^{ab}	2.94^{a}	10.84^{b}	21.75	19.54^{c}	0.29^{ab}	2.20^{d}	0.55^{abc}	0.63^{c}
	5	2180^{b}	2075^{b}	1481^{c}	68.22^{c}	9.49^{b}	6.70^{ab}	2.90^{ab}	10.84^{b}	21.45	21.55^{b}	0.27^{b}	2.33^{c}	0.53^{abc}	0.65^{abc}
	10	2085^{d}	2006^{c}	1378^{f}	69.09^{b}	8.60^{c}	6.79^{ab}	2.98^{a}	10.71^{c}	21.96	19.36^{c}	0.30^{ab}	2.51^{ab}	0.57^{a}	0.67^{ab}
Roasted	0	2065de	1996^{c}	1413^{e}	68.44^{c}	8.73^{c}	6.88^{ab}	2.94^{a}	10.84^{b}	21.75	19.54^{c}	0.29^{ab}	2.20^{d}	0.55^{abc}	0.63^{c}
	5	2100^{cd}	2007^{c}	1451^{d}	69.11^{b}	9.61^{ab}	6.93^{a}	2.78^{bc}	10.49^{d}	21.81	21.54^{b}	0.28^{ab}	2.33^{c}	0.52^{bc}	0.64^{bc}
	10	2030^{e}	1973^{c}	1343^{g}	66.17^{d}	8.61^{c}	6.61^{b}	2.69^{c}	10.51^{d}	22.16	19.74^{c}	0.31^{a}	2.60^{a}	0.55^{abc}	0.68^{a}
LSD (0.05)		39.53	53.07	19.47	0.55	0.28	0.32	0.10	0.10	0.48	0.51	0.02	0.10	0.03	0.03
LOS		**	**	**	**	**	**	**	**	NS	**	**	**	**	**
P – value		0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.02	0.16	0.02	0.01	0.01	0.00	0.01

Key: LW = Live weight (g), SW = Slaughtered weight (g), DW = Dressed weight (g), D% = Dressing percentage (%), F.leg = Fore leg (%), H.leg = Hind leg (%), Intest = Intestine (%), LSD = Least significant difference, NS = Not significant, ** = Highly significant, LOS = Level of significance, P-Value = Probability value

Table 4.11: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the sensory properties of the meat of weaned rabbits

Processing		Palatability	Flavour	Colour	Juiciness	Acceptability	Tenderness
Boiled		86.11	74.77^{b}	86.11	76.39	77.43	58.10^{a}
Fermented		86.11	75.23^{a}	86.11	76.39	77.43	57.99^{b}
Roasted		86.11	72.34^{c}	86.11	76.39	77.43	57.99^{b}
LSD (0.05)		0.00	0.01	0.00	0.00	0.00	0.01
LOS		NS	*	NS	NS	NS	*
Levels (L)	(%)						
	0	86.11	75.35^{a}	86.11	76.39^{b}	77.43	57.99^{b}
	5	86.11	75.23^{a}	86.11	79.83^{a}	77.43	58.10^{a}
	10	86.11	71.75^{b}	86.11	76.39^{b}	77.43	57.99^{b}
LSD (0.05)		0.00	0.01	0.00	0.00	0.00	0.01
LOS		NS	*	NS	*	NS	*
Interaction							
Boiled	0	86.11	75.35^{a}	86.11	76.38^{ab}	77.43	57.99^{b}
	5	86.11	75.00^{a}	86.11	76.40^{a}	77.43	57.99^{b}
	10	86.11	75.35^{a}	86.11	76.39^{ab}	77.43	57.99^{b}
Fermented	0	86.11	75.35^{a}	86.11	76.39^{ab}	77.43	57.99^{b}
	5	86.11	75.35^{a}	86.11	76.39^{ab}	77.43	58.33^{a}
	10	86.11	73.61^{b}	86.11	76.39^{ab}	77.43	57.99^{b}
Roasted	0	86.11	75.35^{a}	86.11	76.39^{ab}	77.43	57.99^{b}
	5	86.11	75.35^{a}	86.11	76.39^{ab}	77.43	57.99^{b}
	10	86.11	66.32^{d}	86.11	76.39^{ab}	77.43	57.99^{b}
LSD (0.05)		0.00	0.02	0.00	0.00	0.00	0.00
LOS		NS	*	NS	*	NS	*
P-value		0.08	0.04	0.08	0.04	0.06	0.02

Key: LSD = Least significant difference, * = Significant, NS = Not significant, LOS = Level of significance, P-Value = Probability value

4.13 Main and Interaction Effects of Processing Methods and Levels of Inclusion of *Karaya* Gum Tree Seed Meals on the Economic Benefits of Weaned Rabbits

Main and interaction effects of different processing methods on the economic benefits of rabbits fed diets containing boiled, fermented and roasted *Karaya* gum tree seed meals is presented in Table 4.12. The main effect of processing methods had shown that there were no significant (P>0.05) differces between the treatments in the cost of feed per kilogramme (CF/kg). However, significant (P<0.05) differences were observed among the treatments in the reduction in cost of feed (RCF/kg) which also led to significant (P<0.05) differnces in the percentage reduction in the cost of feed (% RCF). There were significant (P<0.05) differences between the treatments in the total feed intake (TFI). TFI was significantly (P<0.05) higher (5,418.23 g) in treatment fed diet with roasted seed meal compared to those fed diets with boiled (5,379.03 g) and fermented (5,381.83 g) which were not different (P>0.05) from each other. However, no significant (P>0.05) differences were observed in the cost of feed consumed (CFC) but significant (P<0.05) differences were observed between the treatment fed diet containing roasted seed meal and treattments fed diets with boiled and fermented seed meals in the reduction in cost of feed consumed (RCFC) as well as percentage reduction in cost of feed consumed (% RCFC).

Total weight gains (TWG) were significantly (P<0.05) different between the treatments. Higher (1,593.40 g and 1,589.83 g) TWG were obtained in the treatments fed diets with fermented and boiled seed meals, which were not statistically different (P>0.05), while lower (1,549.83 g) TWGwas obtained in the treatment fed diet with roasted seed meal. Cost of feed per Kg body weight gain (CF/BG), cost differential (CDif) and cost of producing rabbit (CPR) followed the same trendwith CF/BG. There were no significant (P>0.05) differences between the treatments in the cost of weaner rabbits (CWR) as well

as selling price of the rabbits after the experiment. This is due to local pricing of animals. Similarly, profits were not significantly (P>0.05) different between the treatments although they were numerically different. Higher (₦765.04) profit was obtained in treatment fed diet containing fermented seed meal while lower (₦678.60) profit was obtained in treatment fed diet containing roasted seed meal.

Levels of inclusion of processed seed meals had shown that there were no significant (P>0.05) differences between the treatments in the CF/kg, CWR, SPri and Profit but there were significant (P<0.05) diffrences between the treatments in the RCF/kg, % RCF, TFI, RCFC, % RCFC, TWG,CF/BG, CDif and CPR respectively. Interaction effects of processing methods followed the sametrend with levels of inclusion of the seed meals. There were no significant (P>0.05) differences between the treatments and the levels of inclusion of the processed seed meals in the cost of feed per kilogramme but there were numerical reductions in the cost of feed per kilogramme with increased levels of processed seed meals. There were significant (P<0.05) reductions in the cost of feed per kg with increased levels of processed seed meals. Total feed intakes were also significantly (P<0.05) influenced with increased levels of processed seed meals. This could be dueto palatability of the feeds, aroma of the processed seeds and possibly the need to balance amino acid that might have been affected by processing leading to amino acid imbalance. Cost of feed consumed (CFC) also differed significantly between the treatments. This had led to significant (P<0.05) reduction in the cost of feed consumed. Total weight gain (TWG) also differed significantly (P<0.05) between the treatments. At 5 % levels of inclusion of processed seed meals,animals on diet containing 5 % fermented seed meal had highest (1,680.20 g) weight while animalson diet with roasted seed meal had lowest (1,605.00 g) weight. However, at 10 % levels of inclusion of processed seed meals, animals on diet with boiled seed meal had higher

(1,577.00 g)while animals on diet with roasted seed meal had lower (1,505.00 g) weight. Higher feed intake was not translated into higher gain. This could be due to interference of anti-nutritional factors which would have affected nutrient utilization of the feed. Cost of feed per body weight gain, cost differential and cost of producing each rabbit also differed significantly ($P<0.05$) between the treatments. Costof weaner rabbits, selling price and profits were not statistically different ($P>0.05$) between the treatments. However, the profits were not numerically the same. At 5 % levels of inclusion of processed seed meals, animals on diet without processed seed meal had highest (₦770.55) profit followed by those on roasted seed meal (₦769.26) while at 10 % levels of inclusion, those on boiled seed meal had higher (₦768.82) profit than those on fermented and roasted seed meals (₦760.08 and ₦744.98 respectively).

Table 4.12: Main and interaction effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the economicbenefits of weaned rabbits

Processing		CF/kg	RCF/kg	%RCF	TFI	CFC	RCFC	TWG	CF/BG	CDif	CWR	CPR	SPri	Prof
Boiled		81.01	1.31^{b}	1.59^{c}	5379.03^{b}	435.66	-6.21^{b}	1589.83	274.14^{a}	4.72^{b}	800.00	1235.66^{b}	2000.00	764.34
Fermented		80.84	1.48^{a}	1.79^{a}	5381.83^{b}	434.96	-5.51^{a}	1593.40	273.35^{a}	5.51^{b}	800.00	1234.96^{b}	2000.00	765.04
Roasted		80.95	1.37^{b}	1.66^{b}	5418.23^{a}	438.40	-8.95^{c}	1549.83	247.07^{b}	18.32a	800.00	1321.40^{a}	2000.00	678.60
SEM		0.36	0.36	0.44	43.90	2.69	0.69	16.93	1.31	1.31	0.00	2.99	0.00	1.86
LOS		NS	*	*	*	NS	*	NS	*	*	NS	*	NS	NS
Levels (L)	(%)													
	0	82.32	0.00^{c}	0.00^{c}	5217.10^{c}	429.45	0.00^{a}	1540.00^{b}	278.86^{a}	0.00^{c}	800.00	1229.45^{b}	2000.00	770.55
	5	80.71	1.61^{b}	1.95^{b}	5420.80^{b}	437.53	-8.08^{b}	1646.57^{a}	265.79^{b}	13.07^{a}	800.00	1237.53^{a}	2000.00	762.47
	10	79.77	2.55^{a}	3.09^{a}	5544.20^{a}	442.04	-12.59^{c}	1546.67^{b}	286.04^{a}	8.48^{b}	800.00	1242.04^{a}	2000.00	757.96
LOS		NS	*	*	*	NS	*	*	*	*	NS	*	NS	NS
Interaction														
Boiled	0	82.32	0.00^{d}	0.00^{e}	5217.10^{e}	429.45	0.00^{b}	1540.00^{b}	278.86^{b}	0.00^{d}	800.00	1229.45	2000.00	770.55
	5	80.88	1.44^{c}	1.75^{d}	5518.80^{b}	446.36	16.91^{a}	1654.50^{a}	269.79^{b}	9.07^{b}	800.00	1246.36	2000.00	753.64
	10	79.83	2.49^{a}	3.02^{b}	5401.20^{c}	431.18	-1.73^{b}	1575.00^{b}	273.77^{b}	5.09^{c}	800.00	1231.18	2000.00	768.82
Fermented	0	82.32	0.00^{d}	0.00^{e}	5217.10^{e}	429.45	0.00^{b}	1540.00	278.86^{b}	0.00^{d}	800.00	1229.45	2000.00	770.55
	5	80.38	1.94^{b}	2.36^{c}	5418.00^{c}	435.50	-6.05^{c}	1680.20^{a}	259.20^{b}	19.66^{a}	800.00	1235.50	2000.00	764.50
	10	79.83	2.49^{a}	3.02^{b}	5510.40^{b}	439.92	-10.47^{d}	1560.00^{b}	282.00^{b}	-3.14^{d}	800.00	1239.92	2000.00	760.08
Roasted	0	82.32	0.00^{d}	0.00^{e}	5217.10^{e}	429.45	0.00^{b}	1540.00^{b}	278.86^{b}	0.00^{d}	800.00	1229.45	2000.00	770.55
	5	80.88	1.44^{c}	1.75^{d}	5325.60^{d}	430.74	-1.29^{b}	1605.00^{b}	268.37^{b}	10.49^{b}	800.00	1230.74	2000.00	769.26
	10	79.66	2.66^{a}	3.23^{a}	5712.00^{a}	455.02	-25.57^{e}	1505.00^{b}	302.34^{a}	-23.48^{e}	800.00	1255.02	2000.00	744.98
SEM		2.92	0.21	0.22	84.66	17.19	1.56	48.44	11.29	29.59	0.00	28.35	0.00	26.97
LOS		NS	*	*	*	NS	*	*	*	*	NS	NS	NS	NS
P-value		0.06	0.01	0.01	0.04	0.12	0.00	0.04	0.03	0.02	0.07	0.15	0.24	0.13

Key: CF/kg = Cost of feed per kilogramme (₦), RCF/kg = Reduction in cost of feed per kilogramme (₦), % RCF = Percentage reduction in cost of feed, TFI = Total feed intake (g), CFC= Cost of feed consumed (₦), RCFC = Reduction in cost of feed consumed (₦), TWG = Total weight gain (g), CF/BG = Cost of feed per body weight gain (₦), CDif = Cost differential (₦), CWR = Cost of weaner rabbit (₦), CPR = Cost of producing each rabbit (₦), SPri = Selling price, Prof = Profit (₦), SEM = Standard error of mean, P-value = Probability value, LOS = Level of significance, L = Levels of inclusion, NS = Not significant, * = Significant ,

4.14 Proximate Composition of the Experimental Diets Containing Boiled *Karaya* GumTree Seed Meal as Replacement for Maize (Experiment III)

The proximate composition of the experimental diets containing boiled *Karaya* gum tree seed meal (BKGTSM) as replacement for maize is presented in Table 4.13. The results had shown that raw *Karaya* gum tree seed (R_0KGTS) contained 93.17 % dry matter (DM), 18.72 % crude protein (CP), 6.76 % crude fibre (CF), 18.90 % ether extract (EE), 2.56 % ash and 46.23 % nitrogen free extract(NFE) while BKGTS contained 91.18 % DM, 18.02 % CP, 5.86 % CF, 16.35 % EE, 5.68 % ash and 45.27 % NFE respectively. Diet containing 0 % BKGTSM (control diet), (D1), had 93.72 % DM, 17.23 % CP, 12.09 % CF, 6.33 % EE, 6.16 % ash and 51.91 % NFE. Diets containing 25 %BKGTSM, (D2), 50 % BKGTSM, (D3), 75 % BKGTSM, (D4) and 100 % BKGTSM, (D5), had 91.44 %, 91.38 %, 91.33 % and 91.10 % DM, 18.35 %, 19.48 %, 20.67 % and 21.64 %, CP and 12.68 %, 12.21 %, 13.01 % and 12.37 % CF. Similarly, D2, D3, D4 and D5 had 6.63 %, 6.52 %, 6.34 % and 5.08 % ash, 7.97 %, 9.23 %, 10.98 % and 11.79 % EE and 45.81 %, 43.94 %, 40.33 % and 40.22 % NFE respectively. D1 had the highest (93.72 %) DM while diet with 100 % maize replacement (D5) had the least DM (91.10 %). DM decreased with increased level of boiled seeds in the diets. This could be due to absorption and storage of moisture when the seeds were boiled.

Ash was highest (6.63 %) in diet with 25 % boiled seeds but decreased with increased levels of the test ingredient. Crude fibre was higher in diets D2, D3, D4 and D5 than D1 but had no set pattern with increased level of the boiled seeds. Crude protein (CP) and ether extract (EE) were higher in D2 than in D1 and increased with increased level of boiled seeds in the diets. This is because the seed had higher CP and EE than the maize replaced. Nitrogen free extract (NFE) was highest in D1 and lowest in D5.

Table 4.13: Proximate composition of the experiment III diets containing boiled *Karaya* gum tree seed meal as replacement for maize

Parameters (%)	D1	D2	D3	D4	D5	Boiled KGTS	Raw KGTS
Dry matter	93.72	91.44	91.38	91.33	91.10	91.18	93.17
Ash	6.16	6.63	6.52	6.34	5.08	5.68	2.56
Crude fiber	12.09	12.68	12.21	13.01	12.37	5.86	6.76
Crude protein	17.23	18.35	19.48	20.67	21.64	18.02	18.72
Ether extract	6.33	7.97	9.23	10.98	11.79	16.35	18.90
Nitrogen free extract	51.91	45.81	43.94	40.33	40.22	45.27	46.23

Key: D1 = Control (0 % Maize replacement) diet, D2 = 25 % Maize replacement diet D3 = 50 % Maize replacement diet , D4 = 75 % Maize replacement diet, D5 = 100 % Maize replacement (total replacement) diet,
NFE = Nitrogen free extract, KGTS = *Karaya* gum tree seed

4.14 Growth Performance of Weaned Rabbits Fed Diets Containing Boiled *Karaya* Gum TreeSeed Meal as Replacement for Maize

The growth performance of weaned rabbits fed diets containing boiled *Karaya* gum tree seed mealas replacement for maize is presented in Table 4.14. The average initial weights of the animals were between 514 g and 516 g which were within close range. There were no significant ($P>0.05$) differences between the animals fed diet without boiled *Karaya* gum tree seed meal (D1) and thosefed diets containing 25 % and 50 % boiled *Karaya* gum tree seed meal (D2 and D3) as replacementfor maize but there were significant ($P<0.05$) differences between D1, D2 and D3, and D4 and D5 (animals fed diets containing 75 % and 100 % *Karaya* gum tree seed meal) in final weight. Highest(1,943.00 g) final weight was recorded in animals fed diet with 25 % (D2) test ingredient as replacement for maize while the lowest (1,699.40 g) value was recorded in animals fed diet with 100 % (D5) maize replacement. Final body weight decreased with increased test ingredient. Although D1 was numerically different from D5, there was no statistical difference ($P>0.05$) between them.

Average daily weight gain followed the same trend with final body weight. Average daily feed intake and total feed intake were significantly ($P<0.05$) different between the treatments. Average daily and total feed intakes increased with increase in the test ingredient. Feed conversion ratio (FCR) also increased significantly ($P<0.05$) with increase in the test ingredient. FCR was numerically lowest (2.86) in control (D1) and highest (4.30) in D5. However, D1, D2, and D3 were not statistically different ($P>0.05$) from each other but were different ($P<0.05$) from D4 and D5. Mortality was highest (16.67 %) in D1 and no mortality was recorded in D4 and D5. Therefore,it could be said that the test ingredient was not responsible for the mortality.

Table 4.14: Growth performance of rabbits fed diets containing boiled *Karaya* gum tree seed meal

Parameters	D1	D2	D3	D4	D5	SEM	P-Value	LOS
Initial weight(g)	515.00	515.00	514.00	516.00	515.00	0.123	0.71	NS
Final weight (g)	1928.87^{ab}	1943.00^{a}	1908.40^{b}	1776.00^{c}	1699.40^{d}	13.65	0.03	*
Average total weight gain(g)	1411.20^{ab}	1428.00^{a}	1394.40^{b}	1260.00^{c}	1184.40^{d}	13.63	0.04	*
Average daily weight gain(g)	16.80^{a}	17.00^{a}	16.60^{a}	15.00^{b}	14.10^{c}	0.161	0.02	*
Average daily feed intake (g)	48.00^{c}	48.10^{c}	50.50^{bc}	57.00^{ab}	60.60^{a}	0.49	0.02	*
Total feed intake (g)	4032.00^{c}	4112.64^{c}	4242.00^{bc}	4788.00^{ab}	5090.40^{a}	228.56	0.04	*
Feed conversion ratio	2.90^{a}	2.90^{a}	3.04^{a}	3.80^{b}	4.30^{c}	3.80^{b}	0.01	*
Mortality (%)	16.67^{a}	8.33^{b}	8.33^{b}	0.00^{c}	0.00^{c}	0.04	0.02	*

Key: ^{a,b,c} Means on the same row with different superscripts were significantly ($P<0.05$)different D1 = Control (0 % Maize replacement) diet, D2 = 25 % Maize replacement dietD3 = 50 % Maize replacement dietD4 = 75 % Maize replacement diet
D5 = 100 % Maize replacement (total replacement) diet
LOS = Level of significant, * = Significant, P-Value=Probability value,
SEM=Standard error of mean, NS=Not significant

4.15 Apparent Nutrient Digestibility of Weaned Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal (BKGTSM) as Replacement for Maize

The apparent nutrient digestibility of weaned rabbits fed diets containing boiled *Karaya* gum treeseed meal (BKGTSM) as replacement for maize is presented in Table 4.15. There were significant($P<0.05$) differences between the treatments in the dry matter (DM) digestibility with the highest(69.37 %) obtained in diet (D1) (without the test ingredient) while the lowest (64.22 %) was in diet (D5) (with 100 % maize replacement). DM digestibility decreased with increased test ingredient. Although D2 (25 % maize replacement) and D3 (50 % maize replacement) were numerically different from the control (D1), they were statistically similar ($P>0.05$). However, D4 (75 % maize replacement) and D5 (100 % maize replacement) were statistically different from the control (D1). Ash digestibility also varied ($P<0.05$) between the treatments. Highest (79.43 %) digestibility was obtained in D2 while the lowest (65.01 %) was in D5. D2, D3 and D4 were numerically different from D1 but were statistically similar ($P>0.05$) to D1 while D5 was statistically different ($P<0.05$)from D1. Crude fibre (CF) digestibility took similar trend with ash digestibility. There were no significant ($P>0.05$) differences between D2, D3 and D4, and D1 but there was difference ($P<0.05$) between D1 and D5.

Crude protein (CP) digestibility followed similar pattern with CF. There were no significant ($P>0.05$) differences between D2, D3 and D4, and D1 but there was significance ($P<0.05$) difference between D5 and D1. There were no significant ($P>0.05$) differences betweenthe treatments in the ether extract (EE) digestibility. There were significant ($P<0.05$) differences across the groups in Nitrogen free extract (NFE). Highest nutrient digestibility was in EE while lowest digestibility was in NFE.

Table 4.15: Apparent nutrient digestibility of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

Parameters (%)	D1 (0 %)	D2 (25 %)	D3 (50 %)	D4 (75 %)	D5 (100 %)	SEM	P-Value	LOS
Dry matter	69.37^{a}	68.73^{a}	66.10^{ab}	65.01^{b}	64.22^{b}	0.96	0.02	*
Ash	77.30^{a}	79.43^{a}	78.20^{a}	77.19^{a}	65.01^{b}	0.98	0.03	*
Crude fiber	78.50^{a}	77.74^{a}	77.48^{a}	76.69^{a}	74.15^{b}	0.99	0.03	*
Crude protein	77.53^{a}	76.10^{ab}	75.01^{ab}	75.00^{ab}	74.90^{b}	0.99	0.03	*
Ether extract	83.90	84.00	81.61	83.52	81.65	0.94	0.16	NS
Nitrogen free extract	61.84^{a}	59.21^{a}	53.99^{b}	49.10^{c}	50.30^{bc}	1.02	0.01	*

Key: ^{a,b,c} Means on the same row with different superscripts were significantly ($P<0.05$) different

D1= control (0 % maize replacement) diet, D2=25 % maize replacement diet,

D3=50 % maize replacement diet, D4 = 75 % maize replacement diet,

D5 = 100 % maize replacement (total replacement) diet
LOS = Level of significant, * = Significant, NS=Not significant,
P-Value = Probability value, SEM = Standard error of mean

4.16 Haematological Indices of Weaned Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal as Replacement for Maize

The haematological indices of weaned rabbits fed diets with boiled *Karaya* gum tree seed meal (BKGTSM) as replacement for maize is presented in Table 4.16. There were no significant (P>0.05) differences in the values of haemoglobin between the animals fed diet without boiled *Karaya* gum tree seed meal (0 % BKGTSM) as replacement for maize (D1) and animals fed diets with 25 % BKGTSM, 50 % BKGTSM, 75 % BKGTSM and 100 % BKGTSM (D2, D3, D4 and D5) respectively. There were no significant (P>0.05) differences between the treatment groups inthe haemoglobin (Hb) values. Although the values were numerically different, they were statistically similar. There were significant (P<0.05) differences across the treatments in the packed cell volume (PCV) values. The PCV of animals fed diets containing 50 % (D3) and 100 % (D5) maize replacement were similar (P>0.05) with control (D1) while the PCV of the treatmentsfed diets with 25 % (D2) and 75 % (D4) maize replacement were different from D1.

There were no significant (P>0.05) differences between D2, D4 and D5, and D1 in the red blood cells (RBC) but there was significant (P<0.05) difference between D3 and D1. All the values for Hb, PCV and RBC were within the normal range for healthy rabbits. Similarities between the treatments in the Hb, PCV and RBC means the test ingredient had no negative effects on these parameters. Significant (P<0.05) differences were observed between the treatments in the white blood cells. The values increased (from D2 to D5) with increased test ingredient in the diets. This could be due to the residual effects of anti-nutritional factors from the seeds. However, the values were within the normal range for rabbit. Similarly, there were significant (P<0.05) differences between the groups in the white blood differentials (Lymphocytes, monocytes, basophils, eosinophils

and neutrophils). Significant (P<0.05) differences were also observed across the treatment groups in the mean corpuscular volume (MCV) mean corpuscular haemoglobin (MCH) and mean corpuscularhaemoglobin concentration (MCHC). There were no set patterns in the values of MCV, MCH andMCHC respectively.

4.17 Serum Biochemical Indices of Weaned Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal as Replacement for Maize

The serum biochemical indices of weaned rabbits fed diets with boiled *Karaya* gum tree (BKGT)seed meal as replacement for maize is presented in Table 4.17. There were significant (P<0.05) differences in total protein of the experimental rabbits fed diets containing BKGT seed meal as replacement for maize. Total protein of the treatment fed diet with 25 % maize replacement (D2) had lower (5.19 g/dl) total protein than control (5.52 g/dl) while treatments fed diets with 50 % maize replacement (D3), 75 % maize replacement (D4) and 100 % maize replacement (D5) had higher (6.37 g/dl, 6.80 gdl and 6.18 g/dl for D3, D4 and D5) total protein than D1. However, all the values were within normalrange for rabbit. There were differences (P<0.05) between the treatments in albumin values. The values for D3, D4 and D5 were lower than control while D2 was higher than D1. Similarly, globulin and urea values were significantly (P<0.05) different across the treatments. All the values were within the normal range values for rabbits. Significant (P<0.05) differences were also observed between the treatments in bilirubin, cholesterol and creatinine values. There were significant (P<0.05) differences between the treatments in the aspartateaminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP). However, all the values were within the normal ranges for rabbit. This had shown that the test ingredient had no negative effect on the serum indices of the rabbits.

Table 4.16: Haematological parameters of weaned rabbits fed diets containing boiled *Karaya* gum tree seed meal

Parameters	Normal range	D1	D2	D3	D4	D5	SEM	P-value	LOS
HB (g/dl)	9.40-17.40	14.12	13.17	14.44	13.55	13.33	0.43	0.06	NS
PCV (%)	35.00-50.00	43.01^{a}	39.10^{b}	40.10^{ab}	39.46^{b}	41.23^{a}	0.34	0.02	*
RBC ($\times10^{6}$/ mm^{3})	3.80-7.90	6.75^{a}	6.62^{a}	5.33^{b}	6.05^{ab}	5.82^{ab}	0.48	0.01	*
WBC($\times10^{9}$ /l)	4.00-10.00	6.88^{bc}	4.93^{d}	6.33^{c}	7.22^{b}	8.11^{a}	0.21	0.01	*
Lymphocytes (%)	30.00-85.00	29.13^{b}	27.28^{c}	28.44^{bc}	29.53^{b}	33.35^{a}	0.37	0.02	*
Monocytes (%)	0.67-1.50	4.43^{d}	6.53^{a}	6.00^{b}	4.87^{c}	6.84^{a}	0.49	0.02	*
Basophils (%)	0.50-1.00	0.60^{b}	0.49^{c}	0.51^{c}	0.60^{b}	0.70^{a}	0.06	0.01	*
Eosinophils (%)	1.00-4.00	4.44^{a}	3.98^{b}	3.17^{c}	4.03^{ab}	4.15^{a}	0.51	0.01	*
Neutrophils (%)	30.00-48-00	53.23^{c}	50.27^{d}	61.33^{a}	57.43^{b}	49.24^{d}	0.29	0.02	*
MCV(mm^{3})	50.00-75.00	6.45^{b}	6.06^{c}	7.53^{a}	6.52^{b}	7.41^{a}	0.16	0.01	*
MCH (µg)	18.00-24.00	21.17^{c}	20.05^{c}	27.09^{a}	22.40^{b}	23.70^{b}	0.21	0.02	*
MCHC (%)	27.00-34.00	32.82^{c}	32.92^{c}	36.07^{a}	34.34^{b}	32.30^{c}	0.93	0.02	*

Key: ^{abc}Means on the same row with different superscripts were significantly (P<0.050) different
Hb = Haemoglobin, PCV = Packed cell volume, RBC = Red blood cell, WBC = White blood cell, MCV = Mean cell volume,
MCH = Mean corpuscularhaemoglobin, MCHC = Mean corpuscular haemoglobin concentration
D1 = control (0 % maize replacement) diet, D2 = 25 % maize replacement diet, D3 = 50 % maize replacement diet,
D4 = 75 % maize replacement diet,D5 = 100 % maize replacement (total replacement) diet
LOS = Level of significance, NS = Not significant, * = Significant, P-Value = Probability value, SEM = Standard error of mean

Table 4.17: Serum biochemical indices of rabbits fed diets containing boiled *Karaya* gum tree seed meal

Parameters	Normal range	D1	D2	D3	D4	D5	SEM	P-values	LOS
Total protein (g/dl)	5.40-7.30	5.52^{c}	5.19^{d}	6.37^{b}	6.80^{a}	6.15^{b}	0.05	0.01	*
Albumin (g/dl)	2.40-4.50	3.93^{a}	4.18^{a}	3.13^{c}	3.67^{ab}	3.31^{ab}	0.42	0.01	*
Globulin (g/dl)	2.90-4.90	1.59^{c}	1.01^{d}	3.24^{b}	3.14^{b}	3.51^{a}	0.31	0.01	*
Urea (mg/dl)	20.50-25.00	18.53^{c}	15.25^{d}	18.98^{c}	19.61^{b}	20.25^{a}	0.46	0.02	*
Bilirubin (mg/dl)	0.00-1.00	0.50^{b}	0.57^{b}	0.48^{c}	0.75^{a}	0.76^{a}	0.08	0.01	*
Cholesterol (mg/dl)	10.00-80.00	28.43^{ab}	26.20^{c}	23.65^{d}	27.44^{b}	29.23^{a}	0.23	0.02	*
Creatinine (mg/dl)	0.50-2.20	1.65^{b}	0.91^{d}	1.31^{c}	1.84^{b}	2.15^{a}	0.13	0.01	*
A S T (µ/l)	4.00-20.00	10.10^{d}	12.36^{b}	13.75^{a}	10.46^{c}	8.54^{e}	0.39	0.02	*
A L T (µ/l)	10.00-45.00	23.53^{a}	18.45^{e}	19.34^{d}	21.34^{c}	22.53^{b}	1.42	0.01	*
A L P (µ/l)	10.00-120.00	30.44^{a}	26.32^{d}	27.25^{c}	28.53^{b}	29.54^{a}	0.09	0.02	*

Key:

$^{a, b, c, d, e}$Means on the same row with different superscripts were significantly

($P < 0.05$) different AST = Aspartate aminotransferase, ALP = Alkaline

phosphatase, ALT = Alanine aminotransferase

D1 = Control (0 % Maize replacement) diet, D2 = 25 % Maize replacement diet, D3 = 50 % Maize replacement diet,D4 = 75 % Maize replacement diet, D5 = 100 % Maize replacement (total replacement) diet

LOS = Level of significant, * = Significant, P-Value = Probability value, SEM = Standard error of mean

4.18 Carcass Characteristics of Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal as Replacement for Maize

Carcass characteristics of rabbits fed diets with boiled *Karaya* gum tree seed meal (BKGTSM) as replacement for maize is presented in Table 4.18. The results had shown that there were significant($P<0.05$) differences in the live weights of the slaughtered animals. This is because the slaughteredanimals were randomLy selected from the group after the feeding trials. Slaughterd weight and dressed weight followed similar trend with one another and were significantly ($P<0.05$) different between the treatments. Similarly, dressing percentages were significantly ($P<0.05$) differentbetween the groups. Treatments fed diets with 75 % maize replacement (D4) and 100 % maize replacement (D5) had higher (67.13 % and 66.61 % for D4 and D5) dressing percentages than the control (D1, 66.43 %) while treatments fed diets with 25 % maize replacement (D2) and 50 % maize replacement (D3) had lower (66.24 %) dressing percentage than D1. Although the dressing percentages were within close range, they were statistically different ($P<0.05$).

The parts that include the head, skin, fore leg, hind leg, ribs and intestine were also significantly ($P<0.05$) different between the treatments. The values were numerically within close range. There were significant ($P<0.05$) differences across the treatment groups in the vital organs that include the heart, liver, kidney and lungs. The values numerically increased slightly with increase in the test ingredient in the diets. This could be due to residual effects of anti-nutritional factors. However, this increase in the vital organs might not pose any danger as the increase is slight.

Table 4.18: Carcass characteristics of weaned rabbits fed diets containing boiled *Karaya* gum tree seed meal

Parameters	D1	D2	D3	D4	D5	SEM	P-values	LOS
Live weight (g)	1999.63^{ab}	2028.27^{a}	1996.10^{ab}	1926.53^{c}	1949.57^{b}	18.23	0.04	*
Slaughtered weight (g	1932.43^{b}	1961.70^{a}	1933.00^{b}	1873.33^{c}	1889.13^{c}	18.47	0.03	*
Dressed weight (g)	1328.30^{ab}	1343.57^{a}	1322.20^{b}	1293.30^{c}	1298.73^{c}	16.83	0.03	*
Dressing percentage	66.43^{b}	66.24^{b}	66.24^{b}	67.13^{a}	66.61^{ab}	0.35	0.02	*
Head (%) LW	8.26^{ab}	9.09^{a}	8.95^{a}	7.92^{c}	8.43^{ab}	0.15	0.01	*
Skin (%) LW	10.76^{b}	10.93^{a}	10.97^{a}	10.83^{ab}	10.56^{c}	0.44	0.01	*
Fore leg (%) LW	6.69^{ab}	6.60^{ab}	6.82^{a}	6.48^{b}	6.44^{b}	0.36	0.01	*
Hind leg (%) LW	12.24^{a}	12.46^{a}	12.28^{a}	11.46^{b}	10.21^{c}	0.41	0.01	*
Ribs (%) LW	22.13^{a}	21.54^{ab}	21.60^{ab}	20.15^{b}	20.01^{b}	0.38	0.02	*
Intestine (%) LW	19.38^{c}	21.54^{a}	21.00^{a}	20.34^{b}	19.43^{c}	0.32	0.02	*
Heart (%) LW	0.28^{b}	0.29^{b}	0.30^{b}	0.32^{a}	0.33^{a}	0.01	0.01	*
Liver (%) LW	2.23^{d}	2.34^{c}	2.37^{c}	2.68^{b}	2.83^{a}	0.03	0.01	*
Kidney (%) LW	0.54^{c}	0.56^{ab}	0.56^{ab}	0.57^{ab}	0.59^{a}	0.01	0.01	*
Lung (%) LW	0.62^{c}	0.63^{c}	0.66^{b}	0.68^{a}	0.69^{a}	0.01	0.01	*

Key: ^{abc}Means on the same row with different superscripts differ significantly ($P < 0.05$), D1 = Diet with 0 % maize replacement, D2 = Diet with 25 % maize replacement, D3 = Diet with 50 % maize replacement, D4 = Diet with 75 % maize replacement, D5 = Diet with 100 % maize replacement, LW = Live weight, LOS = Level of significance, * = Significant, P-Value = Probability value, SEM = Standard error of mean

4.19 Sensory Properties of the Meat of Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal as Replacement for Maize

Sensory properties of the meat of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize is presented in Table 4.19. There were no significant (P>0.05) differences between the treatment groups for palatability of the rabbit meat. The values for palatability rated were numerically and statistically the same between the treatment groups. Similarly, there were no significant (P>0.05) differences between the treatment groups for other parameters (tenderness,flavour, colour, juiciness and acceptability) assessed. All the values for the parameters assessed were numerically and statistically the same between the treatment groups.

Colour of the meat was rated highest (87.78 %) among the parameters assessed across the treatments. An indication that the colour was attractive to the panelists.This result had shown that replacement of maize with boiled *Karaya* gum tree seed meal had no detrimental effects on the palatability, tenderness, flavour, colour, juiciness and acceptability of the meat from rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize.

Table 4.19: Sensory properties of the meat of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

Parameters (%)	D1	D2	D3	D4	D5	SEM	P-value	LOS
Palatability	82.78	82.78	82.78	82.78	82.78	0.76	0.07	NS
Tenderness	82.22	82.22	82.22	82.22	82.22	0.73	0.07	NS
Flavour	83.89	83.89	83.89	83.89	83.89	0.76	0.08	NS
Colour	87.78	87.78	87.78	87.78	87.78	0.79	0.08	NS
Juiciness	78.89	78.89	78.89	78.89	78.89	0.68	0.06	NS
Acceptability	80.56	80.56	80.56	80.56	80.56	0.74	0.07	NS

Key:
D1 = Diet with 0 % Maize replacement, D2 = Diet with 25 % Maize replacement,
D3 = Diet with 50 % Maize replacement, D4 = Diet with 75 % Maize replacement,
D5 = Diet with 100 % Maize replacement,
LOS = Level of significance, NS = Not significant,
P-Value = Probability value, SEM = Standard error of mean

4.20 Economic Benefits of Rabbits Fed Diets Containing Boiled *Karaya* Gum Tree Seed Meal as Replacement for Maize

The economic benefits of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize is presented in Table 4.20. There were significant (P<0.05) differences in the cost of feed per kilogramme (kg) between the treatment groups. Highest cost of feed per kg was in control diet (D1) while the least cost was obtained in treatment with 50 % (D3) boiled *Karaya* gum tree (BKGT) seed meal (as replacement for maize). The cost of feed per kg decreased with increasing BKGT seed in the diet up to 50 % level of inclusion. At 75 % (D4) and 100 % (D5) levels ofinclusion of seed meal as replacement for maize, cost of feed per kg increased significantly (P<0.05) above that of 50 % maize replacement (D3). D3 had the least (₦75.02) costof feed per kg which also gave the highest (₦19.58) reduction in the cost of feed while D1 had highest (₦94.60) cost of feed per kg.

Total feed intake increased significantly (P<0.05) with increased levels of test ingredient in the diet. Highest (5,090.40 g) total feed intake was recorded in D5 while lowest (4,032.00 g) was in D1. Cost of feed consumed differed significantly (P<0.05) between the treatments with the least (₦318.24) in D3 while the highest (₦411.29) was in D5. Similarly, total weight gain differed significantly (P<0.05) across the treatments with the highest (1,428.00 g) recorded in D2 while the lowest (1,184.40 g) was in D5. Total cost of production differed significantly (P<0.05) between the treatments. The highest (₦1,411.29)was in D5 and the lowest (₦1,318.24) was in D3. The profit and the percentage followed the same trend with highest (₦ 681.76, 34.09 %) in D3 and the lowest (₦ 588.71, 29.44 %) in D5.

Table 4.20: Economic benefits of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

Parameters	D1	D2	D3	D4	D5	SEM	P-values	LOS
Cost of feed/kg (₦)	94.60[a]	91.16[b]	75.02[e]	82.25[c]	80.80[d]	2.35	0.03	*
Reduction in cost of feed (₦)	0.00[e]	3.44[d]	19.58[a]	12.35[c]	13.86[b]	0.20	0.01	*
% Reduction in cost of feed (%)	0.00[e]	3.64[d]	20.70[a]	13.05[c]	14.59[b]	2.06	0.03	*
Total feed intake (g)	4,032.00[e]	4,112.64[d]	4,242.00[c]	4,788.00[b]	5,090.40[a]	164.32	0.04	*
Cost of feed consumed (₦)	381.42[c]	374.89[d]	318.24[e]	403.37[b]	411.29[a]	18.42	0.02	*
Reduction in feed cost (₦)	0.00[c]	6.53[b]	63.18[a]	-21.95[d]	-29.87[e]	1.68	0.01	*
% Reduction in feed cost (%)	0.00[c]	1.71[b]	16.56[a]	-5.75[d]	-7.83[e]	53.42	0.02	*
Total weight gain (g)	1,411.20[b]	1,428.00[a]	1,329.40[c]	1,260.00[d]	1,184.40[e]	56.87	0.04	*
Cost of feed/ kg body weight(₦)	270.28[c]	262.53[d]	228.23[e]	320.13[b]	347.26[a]	10.52	0.03	*
Cost differential/kg body weight gain (₦)	0.00[c]	7.75[b]	42.05[a]	-49.85[d]	-79.96[e]	14.93	0.02	*
Cost of weaned rabbits (₦)	1,000	1,000	1,000	1,000	1,000	0.00	0.14	NS
Total cost of production (₦)	1,381.42[c]	1,374.89[c]	1,318.24[d]	1,403.37[b]	1,411.29[a]	26.43	0.04	*
Selling price per animal (₦)	2,000	2,000	2,000	2,000	2,000	0.00	0.23	NS
Profit (₦)	618.58[c]	625.11[b]	681.76[a]	596.63[d]	588.71[e]	28.46	0.04	*
% Profit (%)	30.93[c]	31.26[b]	34.09[a]	29.83[d]	29.44[e]	0.10	0.02	*

Key:[i] [abc]Means on the same row with different superscripts differ significantly (P<0.05)
D1 = Diet with 0 % maize replacement, D2 = Diet with 25 % maize replacement,
D3 = Diet with 50 % maize replacement, D4 = Diet with 75 % maize replacement,
D5 = Diet with 100 % maize replacement, LOS = Level of significant,
NS = Not significant, * = Significant, P-value = Probability value,
SEM = Standard error of mean

4.21 Discussion

4.21.1 Proximate composition of raw, boiled, fermented and roasted *Karaya* gum tree seeds

There were significant (P<0.05) differences between the treatment groups in the nutrientcomposition. Dry matter (DM) content was significantly (P<0.05) higher (94.27 %, 94.58 % and 94.84 %) in the roasted seeds (R1, R2 and R3 respectively) than the raw seeds (93.17 %). This could be as a result of exposure of the crushed (seed) particles to heat which would have decreased the moisture contents by evaporation thereby increasing the DM. The raw seeds also had significantly (P<0.05) higher DM than fermented (92.35 %, 92.20 % and 92.06 % for F1, F2 and F3) and boiled seeds (91.60 %, 91.52 % and 91.18 % for B1, B2 and B3). This could be due to thefact that the seeds would have absorbed and stored moisture as inter-cellular liquid thereby increased the moisture content. This is contrary to Aro *et al.* (2008) who stated that the moisturecontent of samples decreased with fermentation and attributed to the fact that the micro-organisms utilized moisture for growth thereby reducing the samples moisture content while at the same timeincreasing DM content. The DM of the raw seeds was similar to that reported by Adelakun *et al*. (2014) who reported raw seeds to contain 94.80 % DM.

The crude protein (CP) content of the raw and the processed seeds were numerically within closeranges. However, the CP obtained in this study was higher (18.72 %) than the CP reported by Adelakun *et al.* (2014) who reported raw seeds to contained 13.35 % CP but lower than CP (24.1 %) obtained by El-Khalifa (2007) and Idu *et al*. (2008) (21.40 % CP). The CP content decreasedsignificantly (P<0.05) with increase in boiling time which could be ascribed to the leaching of nutrients into the boiling water. This is in line with Akinmutimi (2004) who ascribed decrease in crude protein level of cooked Bambara groundnut to the leaching of nutrients into cooking medium(water). It also

agreed with Taiwo *et al*. (2003) who stated that the lower values for CP, CF and EE in the cooked mucuna seed meal could be due to cooking effect as solubilization of nutrients into the cooking water could have taken place. Similarly, the CP of the roasted seeds decreased with increase in the time of roasting which could also be ascribed to the effect of heat that would have affected the seeds. This reduction in CP could be attributed to possible denaturing of proteinby heat. This agreed with Diarra *et al.* (2008) who stated that reduction in CP in boiled mango seed kernel meal was attributed to denaturing of protein by heat and leaching of soluble protein in boiling water. However, the CP of the fermented seeds increased significantly ($P<0.05$) in the microbially fermented samples. This would have resulted from the activities of the micro-organisms. This is in line with Aro *et al*. (2008) who stated that the CP was significantly ($P<0.05$) improved in all the microbially fermented samples which would have resulted from the possible secretion of some enzymes (proteins) such as amylase, linamarase and cellulase.

The high CP content obtained in fermented seeds could also possibly be due to the modification effect of the fermentation process that leads to CP improvement. This agrees with Wafer *et al*. (2021). The ether extract (EE) of the raw and processed seeds varied significantly ($P<0.05$) between the treatment groups. Raw seeds had higher (18.90 %) ether extract than processed seeds.The EE obtained in this study was lower (18.90 %) than that reported by Adelakun *et al*. (2014) (26.03 %)and El-Khalifa (2007) (25.25 %) but higher than that reported by Idu *et al*. (2008) (11.58 %). EE decreased (17.62 %, 17.14 % and 16.35 % for B1, B2 and B3) with increase in boiling time. Thiscould be due to the fact that some part of the oil in the seeds would have dissolved into the boiled water thereby decreasing the oil content of the seeds. This means that the longer the boiling time, the more the reduction in the EE content. This agrees with Omoikhoje *et al*. (2008) who stated thatthe longer the cooking time, the more the loss of nutrients. Similar

observation was made by Akinmutimi *et al.* (2003) that the reduced EE observed could be due to lipid–containing compounds that would have been burnt off during the toasting process. Similarly, EE also decreased (18.46 %, 18.39 % and 18.08 % for F1, F2 and F3) with increase in the number of daysof fermentation. This could also be due to the reason already advanced for boiling. EE for roastedseeds (17.74 %, 17.63 % and 16.83 % for R1, R2 and R3) followed the same trend with boiled andfermented seeds. Ani and Okorie (2008) had stated that dry heat treatment had been reported to destroy some amino acids, particularly lysine, threonine, tyrosine, cysteine and methionine, and consequently reduces the protein quality and also tends to limit the suitability.

The energy contents of raw and processed seeds also followed the same trend with EE. High energy content of the seeds suggests the portentiality of the seeds as energy source and it is worthy of note as protein utilization and energy intake are closely interrelated as stated by Omoikhoje *et al.* (2008). The authors had also stated that generally, prolonged heating has been known to be harmful to the nutritive value of legume seeds and that an optimum cooking time of 20 minutes at 120^{o} C for pigeon pea is sufficient. Similarly, Akinmutimi (2004) asserted that for appreciable values of CP and mineralsand higher percentage reduction in the anti-nutrient substances of *Mucuna utilis* seeds, an optimum cooking time of 90 minutes at 100^{o} C is adequate.

The crude fibre (CF) (6.76 %) and nitrogen free extract (NFE) (46.23 %) obtained in this study were similar to those reported by Adelakun *et al.* (2014) (6.15 % CF and 45.27 % NFE) but higherthan NFE reported by El-Khalifa (2007) (11.12 % NFE) and Idu *et al.* (2008) (21.03 % NFE). Ash content (2.56 %) was lower than that of Adelakun *et al.* (2014) (3.95 %). Variation in nutrient composition of the seeds could be due to geographical location, soil constituent, growth conditionand state of harvest or maturity of seeds at harvest. This is in line with Ani and Okeke (2003) whostated that a wide

variability exists in the chemical composition of seeds due to geographical location, growth condition and probably processing and storage.

4.21.2 Mineral composition

There were significant ($P<0.05$) differences across the treatment groups in the mineral content of raw and processed seeds. However, the increase/decrease in the mineral constituents of the processed seeds did not show a clear-cut trend. This is similar to observation of Aro *et al.* (2008) who also observed irregular trend in fermented cassava starch residues. Phosphorus increased onlyin boiled seeds for 20 minutes (B2) and roasted seeds for 20 minutes (T2) and 30 minutes (T3) while it decreased in other processed seeds. Potassium decreased in 10 minutes boiled seeds (B1) and increased in all other samples. This could be due to precipitation in the processing. Sodium decreased in boiled and fermented samples while it increased in roasted samples. The decrease could be ascribed to dissolution of sodium in water while increase in roasted seeds could be ascribed to the effect of heat which had led to decrease in moisture content of the samples. Calcium content also increased in 10 and 30 minutes boiled seeds (B1 and B3) while it decreased in all other samples. Magnesium and lead decreased significantly ($P<0.05$) between the treatment groups. The values decreased with increase in period of boiling, fermentation and roasting. Iron followed similar trend with calcium, increased in B2 and B3 while it also decreased in all other processed samples. Zinc constituents of the processed seeds also followed similar trend with sodium, increased significantly ($P<0.05$) with increase in roasting period while it decreased significantly ($P<0.05$) in other processed seeds. The poorly defined and divergent trend in mineral elements of processed seeds was similar to observation of Aro *et al.* (2008).

4.21.3 Vitamins composition

The vitamin constituents of the raw and processed seeds were significantly ($P<0.05$)

different between the treatment groups. The increase/decrease had no regular or clear-cut trend similar to what was observed in the mineral costituents. Vitamin A decreased significantly ($P<0.05$) between the treatment groups except in 9 days fermented seeds (F3). Vitamin D increased significantly ($P<0.05$) across the treatments but the increase had no regular pattern. Vitamin E increased in 20 and 30 minutes boiled seeds (B2 and B3), 10 minutes fermented seeds (F1) and 30 minutes roasted seeds (R3) while it decreased in other treatment groups. Similar trends were observed in other vitamins across the treatments. This irregular trend could not be satisfactorily explained. However, decrease in vitamin B-complex could be ascribed to the effect of heat as they are heat labile and are destroyed by heat. Boiling and roasting could therefore have affected vitamins that are susceptible to loss due to heat. Decrease in vitamin C could also be due to dissolution in water asit is soluble in water. Boiling and fermentation could also have affected vitamins A and D since they are susceptible to loss due to cooking and fermentation.

4.21.4 Anti-nutritional factors

There were significant ($P<0.05$) differences between the processed seeds in anti-nutritional composition of the seeds. Phytate content of the seeds significantly ($P<0.05$) decreased with increase in the period of processing. The decrease cut across the processing methods. There were significant ($P<0.05$) increase in the percentage reduction of phytate constituent of the processed seeds. Phytate content of the seeds decreased considerably with period of boiling giving reduction of 4.17 %, 12.50 % and 80.56 % for boiled seeds at 10, 20 and 30 minutes (B1, B2 and B3) respectively. Similarly, phytate reduced by 24.54 %, 79.17 % and 96.30 % for 3, 6 and 9 days fermented seeds while it reduced by 60.19 %, 100 % and 100 % in roasted seeds for 10, 20 and 30minutes (R1, R2 and R3) respectively. The reduction in phytate content is an

indication that the three processing methods are effective in reducing/eliminating the phytate. Similar trends were observed in other anti-nutritinal factors (ANFs) in which the percentage reductions significantly ($P<0.05$) increased with increase in period of processing. The results of this study had shown thatboiling, fermentation and roasting had significantly ($P<0.05$) reduced ANFs of *Karaya* gum tree seeds.

The processing methods used had proved effective remedies for detoxification of toxic elements in *Karaya* gum tree seeds but roasting proved to be the best among the three methods of processing in reducing the ANFs. These results corroborate Tuleun *et al.* (2008) who stated that boiling and roasting both proved effective remedies for the toxic ANFs and that roasting appearedto be the better method of processing *Mucuna* beans, giving results that were comparable to that of soybeans (ANFs). This agreed with Carew *et al.* (2008) who stated that soaking, boiling, roasting, malting, fermentation, decortication, irradiation and various combinations of these are techniques which have been found to be effective for various seeds. It also agreed with Ayanwale(2004) who listed roasting, soaking in water, fermentation, extruding and blanching among the different processing methods to detoxify ANFs.

Generally, the results had shown that roasting reduced the ANFs more than boiling and fermentation in *Karaya* gum tree seeds. This could be due to the facts that the seeds were coarselycrushed before roasting which would have exposed the seed particles more to the heat thereby having heat effect on the ANFs. Moreso, the seed is not a very hard seed which could make it easyfor heat to get to the inner particles of the seed to act on the ANFs.

4.21.5 Proximate composition of the experimental diets (Experiment II)

The results of the analysis had shown that control diets (T1, T4 and T7) had 93.89 % dry matter (DM), 16.75 % crude protein (CP), 11.96 % crude fibre (CF) and 11.77 % ash. The

diet containing5 % boiled *Karaya* gum tree seed meal (KGTSM) (T2), diet containing 5 % fermented KGTSM (T5) and diet containing 5 % roasted KGTSM (T8) had 93.14 %, 93.07 %, and 93.30 % DM, 16.72 %, 17.00 % and 16.94 % CP, 12.06 %, 12.15 % and 12.12 % CF and 11.32 %, 10.85 % and 11.64 % ash (for T2, T5 and T8) respectively. The lower DM obtained in diet containing 5 % boiled seeds and diet containing 5 % fermented seeds compared to diet containing 5 % roasted seeds could be due to the fact that the inter-cellular moisture would have increased when the seeds were boiled/fermented thereby increased the moisture content of the seeds which consequently decreased the DM while in the roasted seeds, the inter-cellular moisture would have been decreased by dry heat thereby increasing the DM content of the seeds.

The ether extract (EE) of diets T2 and T8 were lower than EE of T5 which could be due to the effect of heat that would have liberated more oil from the seeds. Similarly, T5 had more CP content than T2 and T8 which could be due to the activities of microbes responsible for fermentation. The diet containing 10 % boiled KGTSM (T3), diet containing 10 % fermented KGTSM (T6) and dietcontaining 10 % roasted KGTSM (T9) had 93.18 %, 94.11 % and 94.36 % DM, 16.79 %, 16.90 % and 16.66 % CP, 12.39 %, 12.28 % and 12.68 % CF and ash of 11.47 %, 11.89 % and 12.83 % for T3,T6, and T9. The DM was higher in T9 than in T3 and T6 which could be due to the reason advanced at 5 % levels of inclusion. The EE was also as in 5 % levels of inclusion. The CP contents of the diets were within the recommended CP for growing rabbits. Bibi-Farouk *et al.* (2010) recommended 16 % CP for growth. Similarly, Ijaiya and Fasanya (2004) concluded that rabbit can perform better on weight basis when provided with diets containing between 16 % and 20 % CP. The CF of the diets also was within the recommended level of 12 % CF.

4.21.6 Effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals ongrowth performance of weaned rabbits

The average initial body weights of the animals were similar. There were no significant (P>0.05) differences between the treatments in the initial body weights (IBW). There were significant (P<0.05) differences in the final body weights (FBW) across the treatment groups. Significant (P<0.05) differences existed in the total weight gain (TWG), average daily gain (ADG) and feed conversion ratio (FCR) between animals fed diet containing boiled *Karaya* gum tree seed meals (KGTSM), animals fed diet containing fermented KGTSM and animals fed diet containing roasted KGTSM. However, no significant (P>0.05) differences existed between animals fed diet with boiled KGTSM and animals fed diet with fermented KGTSM for the parameters measured. FBW,TWG and ADG were significantly (P<0.05) higher in T5 (treatment fed diet with 5 % fermented KGTSM) followed by treatment fed diet with 5 % boiled KGTSM and then treatment fed diet with 5 % roasted KGTSM. T1, T4 and T7 (control, treatment fed diet with 0 % KGTSM) had significantly (P<0.05) lower FBW, TWG and ADG than treatments with 5 % processed seeds (T2,T5 and T8). Daily and total feed intakes were significantly (P<0.05) higher in T9 followed by T2 and then T5. T1 had lower feed intake than treatments with 5 % processed seeds. Higher intake obtained in treatments with processed seeds could be due to the aroma and palatability of the processed seeds which would have attracted the animals to consume more feed. Better FCR was obtained in T5 followed by T8 and T2. This had shown that treatments with 5 % processed seeds were superior to the control.

At 10 % levels of inclusion of processed seeds, FBW, TWG and ADG were higher in T3 (treatment fed diet with 10 % boiled KGTSM) followed by T6 (treatment fed diet with 10 % fermented KGTSM) and then T9 (treatment fed diet with 10 % roasted KGTSM).

The values were numerically different between T3 and T6 but were not statistically different (P>0.05). However, T3 and T6 were significantly (P<0.05) different from T9. T3 and T6 were also similar to T1. Similarly, feed intake and feed conversion ratio (FCR) took the same trend with weight gains. This had indicated that 10 % levels of inclusion of boiled and fermented KGTSM were comparable to the diet without KGTSM. In overall performance, although feed intake was higher in treatment containing roasted KGTSM, weight gain was least in that treatment compared with the treatmentscontaining boiled and fermented KGTSM. The higher feed intake without the corresponding higher weight gain could be due to the effect of heat on the protein content which possibly might have affected some of the amino acids leading to amino acid imbalance. This observation is in line with Karsin *et al.* (2008) who stated that animals tend to increase their feed intake to compensatefor amino acid imbalance when feed offered is deficient in amino acids. The high feed intake on diet T2 could also be due to the cooking which made the nutrients more palatable, thus enhancing feed intake (Taiwo *et al*. 2003).

4.21.7 Effects of processing methods and levels of inclusion of *Karaya gum tree* seed meal on nutrient digestibility of weaned rabbits

There were significant (P<0.05) differences across the treatments in dry matter (DM), crudeprotein (CP), crude fibre (CF), ether extract (EE), nitrogen free extract (NFE) and ash digestibilities. Higher digestibilities were obtained in treatment fed diet with 5 % fermented *Karaya* gum tree seed meal (KGTSM). The values obtained for digestibilities of T1, T4 and T7 (control) were numerically within close ranges with 5 % processed seeds (T2, T5 and T8), but were statistically different (P<0.05). At 10 % levelsof inclusion of processed seeds (T3, T6 and T9), treatment fed diet with boiled seeds (T3) had significantly (P<0.05) higher digestibilities than those fed diets with fermented and roasted seed meals (T6 and T9). Nutrient digestibilities decreased with increasing levels

of processed seed meals in the diets. Least values were however, obtained in the treatment fed with 10 % raosted KGTSM. These results had shown that 5 % level of inclusion of boiled KGTSM was better digested. The results followed similar trends with performance characteristics. The least digestibilities of T9 may probably be due to high lignin and cellulose fraction of the fibre of *Karaya* gum tree seeds which would have decreased the digestibilities of the feed. This agreed with Agbo(2003) who stated that the lignin and cellulose fraction of the dietary fibre of cooked cowpea madethe total cell wall, hemi-cellulose and DM highly digestible compared to uncooked cowpea.

4.21.8 Effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on haematological indices of weaned rabbits

Significant ($P<0.05$) differences existed between the treaments for all the parameters determined (haemoglobin (Hb), packed cell volume (PCV), red blood cells (RBC), white blood cells (WBC),mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC)), except mean corpuscular haemoglobin (MCH). Similarly, significant ($P<0.05$) differences were observed in white blood differentials (lymphocyte, monocyte, eosinophil and neutrophil) with the exception of basophil. Higher values of Hb, PCV and RBC were in treatment fed diet without *Karaya* gum tree seed meal (T1) while least value was obtained in treatment fed diet with 10 % roasted *Karaya* gum tree seed meal (T9). Although, the values were significantly ($P<0.05$) different across the treatments, they were within the normal ranges (9.40 – 17.40 g/dl for Hb, 35.00 – 50.00 % for PCV and 3.80 – 7.90 × 10^6/mm^3 for RBC) for healthy rabbits (Mitruka and Rawnsley, 1977). Normal range values for Hb indicate that the vital physiological relationship of haemoglobin with oxygen in the transport of gases (oxygen and carbon dioxide) to and fro the tissues of the body, have been maintained and is normal (Njidda *et al*., 2006).

The differences observed could be explained with the findings of Ignasi *et al.* (2003) as

reported by Jiya *et al*. (2008) that such differences are common in domestic animal species and rabbits, and that gradual increase in Hb, RBC and PCV concentration take place after birth and continues until adult stage is attained in about one year of age. The white blood cells (WBC) were least in T1 (4.10×10^9/l) and significantly ($P<0.05$) increased with increasing periods of boiling, fermentation and roasting across the treatments. Highest value(9.89×19^9/l) was obtained in T9 although all the values were within the normal range ($4.00 - 10.00\times10^9$/l) for healthy rabbit. The calculated MCV, MCH and MCHC were also statistically different ($P<0.05$). However, all the values were within the normal ranges for rabbits. Low valuesof haematological parameters such as 10.30 g/dl Hb, 30 % PCV and 7.10×10^6/mL RBC could be due to the harmful effects of residual anti-nutritional factors (Bawala *et al.*, 2007).WBC count lower than normal range suggests a greater challenge to the immune system of rabbits (NseAbasi *et al.*, 2014). A decrease in WBC count, however, reflects on a fall in the production of defensive mechanism to combat infection (Ehebha *et al.,* 2008). Increased RBC values are associated with high quality dietary protein and with disease free animals (NseAbasi *et al.*, 2014). The PCV values obtained in this study indicated lack of anaenia which suggested that the diets didnot cause nutrient restriction which would have led to decrease in PCV, Hb, MCH and MCV values below the normal ranges. Thus, the haematological parameters measured in this study are index of adequate nutritional status. This agreed with Owosibo *et al.* (2008) who stated that the similar PCVobtained in their study indicates lack of anaemia and that the values suggested the diets did not cause nutritional restriction which would have led to reduction in haematological parameters. Thus, the authors ascribed the similarities to adequate nutritional status of the animals.

4.21.9 Effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals onserum biochemical indices of weaned rabbits

Significant (P<0.05) values of serum indices were obtained across the treatment groups for all theparameters measured in this study with the exception of urea. The values for total protein, albuminand globulin were numerically similar but were statistically different (P<0.05) between thetreatments. However, the values were all within the normal ranges (5.40 – 7.30 g/dl for total protein, 2.40 – 4.50 g/dl for albumin and 2.90 – 4.90 g/dl for globulin) for rabbits (Annon, 1980). This result had shown that the experimental animals fed diets with *Karaya* gum tree seed meals (KGTSM) did not suffer from the synthesis and concentration of serum total protein, albumin and globulin which would have led to hypoproteinaemia, hypoalbuminaemia and hypoglobulinaemia respectively. This is in line with Ewuola *et al*. (2008).

Aspartate amino transferase (AST), alanine amino transferase (ALT) and alkaline phosphatase (ALP) were significantly (P<0.05) influenced across the treatment groups. ALT and ALP values increased with increasing levels of processed seeds in the diets while AST increased withincreasing levels of boiled and fermented KGTSM in the diets but decreased with increasing levels of roasted KGTSM in the diets. Although AST, ALP and ALT values were statistically different,they were within the normal ranges for rabbit. This is an indication that the experimental animalsdid not suffer heart, kidney and/or liver damages due to cellular destruction that would have been caused by the *Karaya* gum tree seeds. Ewuola *et al*. (2003) and Ewuola *et al*. (2008) had ascribed elevated AST, ALP and ALT to damage due to cellular destruction caused by toxins which were responsible for heart, kidney and liver damages.

Urea concentrations were statistically similar across the treatment groups. The values

were withinthe normal range for rabbit. This showed that the protein contents of the diets were appropriately utilized by the experimental animals. Bilirubin, creatinine and cholesterol values were significantly($P<0.05$) different between the treatments. Bilirubin values were significantly ($P<0.05$) higher (1.00 mg/dl) in treatment with 5 % fermented KGTSM followed by 10 % fermented KGTSM. However, all the values were within the normal range (0.00-1.00 mg/dl). This indicated that the processed seeds had no negative effects on the bilirubin. Similarly, creatinine values were within the normal range (0.5-2.20 mg/dl) although treatment with 5 % roasted seeds had significantly ($P<0.05$) higher value than other treatments. Since the values were within the normal range, it is therefore an indication that the processed seeds had no negative effects on the creatinine of the animals. High values of creatinine than normal range value indicate kidney disease. This is in linewith Olayinka *et al*. (2021) who stated that high values of creatinine and urea suggest kidney disease and renal failure due to damage to the glomerulus and hence poor glomerular filtration andexcretion. Cholesterol content was higher in control diet (T1) than diets with processed KGTSM(T2 – T9). The reason could be ascribed to the high oil content of the *Karaya* gum tree seeds. However, since the values of cholesterol were within the normal range, it could be stated that the fat (EE) content of the feed was appropriately utilized.

4.21.10 Effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on carcass characteristics of weaned rabbits

The live weight (LW), slaughtered weight (SW), dressed weight (DW) and dressing percentages were significantly ($P<0.05$) different among the treatments. At 5 % levels of inclusion of processed seeds, treatment fed diet with 5 % boiled *Karaya* gum tree seed meal (KGTSM) (T2) had the highest live weight (2,240 g) and slaughtered weight (2,175.53 g) followed by treatment fed diet with 5 % fermented KGTSM (T5) and then

treatment fed diet with 5 % roasted KGTSM (T8). Control diets (T1, T4 and T7) had lower live weight (2,065 g) and slaughtered weight (1,996 g) thanthe 5 % processed seeds containing diets (T2, T5 and T8). At 10 % levels of inclusion, treatment fed diet containing 10 % boiled KGTSM (T3) had the highest live weight (2,133.3 g) and slaughtered weight (2,071.38 g) followed by T8 and T9. In all, with the exception of T9 that had lower values (2,030 g LW and 1,973.43 g SW) than T1, all other treatments had higher values than T1. Contrary to LW and SW, dressed weight (DW) was highest (1,546.67 g) in T2 followed by T3(1,504 g) and lowest (1,343.33 g) was in T9 while dressing percentage (D %) was highest (70.50 %) in T3 and lowest (66.09 %) was in T6. The live weights and the dressing percentages obtained in this study were higher than those obtained by Abu and Bakare (2008) on effects of replacement of Maize with unprocessed sorghum on the performance, digestibility and carcass characteristics of rabbits.

The lowest DW and dressing percentage observed in T6 and T9 could be due to depressed feed conversion efficiency which might have led to low availability of nutrients needed for body development. This is in line with Ani and Okorie (2008). The values for head, fore leg, hind leg, skin and viscera were numerically within close ranges but statistically different ($P<0.05$) between the treatments with the exception of fore leg. Similarly, the values for heart, liver, kidney and lungs were also within close ranges. The main effect of processing methods had shown that the values were not significant ($P>0.05$) while the interactioneffect had indicated that significant ($P<0.05$) differences existed among the treatments. From the results of this study, no hypertrophy was observed in the liver or any of other vital organs (kidney,lungs or heart) to show the negative effects of feeding diets with processed KGTSM. Further more,similarities obtained in the organs weights showed that they were not involved in any much detoxification of harmful substances. It is thus

evident that the processed seeds did not negatively affect liver, kidney, lungs or heart.

4.21.11 Effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the sensory properties of rabbit meat

There were no significant (P>0.05) differences between the treatment groups for all the parameters(tenderness, juiciness, acceptability, colour and palatability) measured with the exception of flavour. Although the values for tenderness were numerically different between the treatments feddiets with 5 % boiled *Karaya* gum tree seed meal and other treatments, they were statistically not significant (P>0.05). Values for flavour were within close range (73.61 % to 75.35 %) with the exception of treatment fed diet containing 10 % roasted *Karaya* gum tree seed meal (T9) (66.32 %). The values were statistically different (P<0.05). The similarities obtained in all the treatments were indications that the processed seeds did not have any negative effect on the carcasses of the rabbits. The results had shown that the meat of the rabbits had acceptable tenderness, flavour, juiciness, acceptability, colour and palatability among the people that constituted the panel to evaluate the meat. Thus, inclusion of *Karaya* gum tree seed meals in the diets of rabbits did not significantly (P>0.05) affect the organoleptic properties of rabbit meat. These results are similar to that of Henry *et al*. (2008) who stated that there were no significant (P>0.05) differences in the organoleptic properties of grass cutters between the treatments fed diets with different energy levels that contained cassava and wheat offals.

4.21.12 Effects of processing methods and levels of inclusion of *Karaya* gum tree seed meals on the economic benefits of weaned rabbits

The ingredients used and the prevailing market prices at the time of the experiment were used to determine the economic benefits of weaned rabbits fed diets containing boiled, fermented and roasted *Karaya* gum tree seed meals. From the results obtained, cost of

feed per kilogramme (kg) was not statistically (P>0.05) different between the treatments but reduced with inclusion levels of processed *Karaya* gum tree seed meals. At 5 % and 10 % levels of inclusion of boiled *Karaya* gum tree seed meal, there were reductions of ₦ 1.44 (1.75 %) and ₦2.49 (3.02 %). There were reductions of ₦1.49 (2.36 %) and ₦2.49 (3.02 %) at 5 % and 10 % levels of inclusion of fermented *Karaya* gum tree seed meal while roasted seed meal had ₦1.44 (1.75 %) and ₦2.66 (3.23 %) reductions at 5 % and 10 % levels. The results had shown that increase in the levels of processed seeds in the diets had led to corresponding decrease in the cost of feeds.

The reduction in cost of feed per kg of the diets containing processed seeds could be attributed to the difference in price between maize and cost of obtaining and processing *Karaya* gum tree seeds. Although the seeds were not purchased, little finance was involved in obtaining and processing the seeds which was less than the amount used to purchased maize. This is similar to the report of Diarra *et al*. (2008) who stated that the reduction in cost of feed per kg of Mango kernel-based diets was attributed todifference in price between Maize and Mango kernel at the time of the experiment. They reported that the Mango kernels were not purchased but little financial motivation was given to children tocollect the kernels. The least cost of feed (₦79.66) per kg was in the diet with 10 % roasted seedsfollowed by diets with 10 % boiled (₦79.83) and 10 % fermented (₦79.83) seed meals. Cost of feed consumed was least (₦430.74) in treatment with roasted seeds at 5 % levels of inclusion among the diets with processed seeds while treatments with 5 % boiled and fermented seeds had ₦446.36 and ₦435.50 respectively. However, at 10 % levels of inclusion of processed seeds, treatment with boiled seed meal had least (₦431.18) cost of feed consumed while diets withfermented and roasted seed meals had ₦439.92 and ₦455.02. All the values were not statistically(P>0.05) different among the treatments. Profit/gain was higher (₦770.55) in the control diets followed

by treatment with roasted seed meal (₦769.26) at 5 % levels of inclusion but at 10 % levels of inclusion, treatment with boiled seed meal had higher (₦768.82) profit than those with fermented (₦760.08) and roasted (₦744.98) seed meals. The values were not statistically (P>0.05)different between the treatments.

4.21.13 Proximate composition of the experimental diets (Experiment III)

The dry matter (DM) of the experimental diets were high (>90 %) but decreased gradually with increased level of boiled *Karaya* gum tree seed meal (BKGTSM) in the diets.This could be due to the fact that the seeds would have absorbed and stored moisture as intercellular moisture during boiling which would have increased moisture content of the seeds and consequently decreased the DM of the seeds and hence DM of the feed as well. The crude protein (CP) content of the diets were between 17.23 % (0 % BKGTSM) (D1) and 21.64 % (100 % BKGTSM) (D5) which was adequate for growing rabbit. 16 % to18 % CP is recommended for growing rabbit (Bibi-Farouk *etal.,* 2010). The CP content increased with increase in the BKGTSM in the diets. This is because the seed has higher CP than the maize being replaced in the diets. Similarly, the crude fibre (CF) was also sufficient for growth (12 % - 16 %). Ether extract (EE) of the diets increased with increasein BKGTSM in the diets which also led to the increase in energy content of the diets. The reason is because the seed is oil-rich seed which was higher in oil than the maize being replaced, hence, led to increase in EE and thus, energy contents. Conversely, nitrogen free extract (NFE) decreasedwith increase in BKGTSM in the diets while ash content increased at 25 % replacement (D2) and decreased at other replacement levels.

4.21.14 Growth performance of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

The average initial weights of the rabbits were similar (514 g to 516 g). Average final weights differed significantly (P<0.05) between the treatment groups. The highest final

weight (1,943.00 g) was obtained in treatment fed diet with 25 % boiled *Karaya* gum tree seed meal (BKGTSM) as maize replacement (D1) while the least final weight (1,699.40 g) was obtained in treatment feddiet with 100 % BKGTSM as replacement for maize (D5). Average total weight gains and averagedaily weight gains followed the same trend with average final weight. Although average final weight, average total weight gains and average daily weight gains were numerically different between treatment fed diet with 0 % BKGTSM (D1) (Control) and treatment fed diet with 25 % BKGTSM (D2), and treatment fed diet with 50 % BKGTSM (D3), they were not statistically ($P>0.05$) different but were different ($P<0.05$) with treatments fed diets with 75 % (D4) and 100 % BKGTSM (D5) respectively.

Average daily feed intake and average total feed intake also took the same trend with weight gains.Daily and total feed intake increased with increased BKGTSM in the diets while weight gain did not follow the same trend. The increase in feed intake might be due to palatability of the feed containing BKGTSM and aroma emanating from the BKGTSM which might have attracted the animals to consume more feed. This is in line with Egbewande and Olorede (2003). It could also be due to the imbalance of amino acids. Imbalance in amino acids in the diets containing BKGTSM could have affected the performance of the animals negatively. This agreed with Etuk *et al.* (2003). More so, the observed depression in weight gains especially at higher levels (75 % and 100 %) of inclusion of BKGTSM could also be due to the residual effects of anti-nutritional factors (ANFs)since the ANFs were not totally removed or eliminated from the boiled seeds but were reduced tolow levels. Ukachukwu and Szabo (2003) and Ezeagu *et al.* (2003) had reported the presence of residual ANFs in processed mucuna seed meal and had attributed decreased feed intake and subsequent growth depression to the ANFs. Similarly, Ani *et al.* (2011) had stated that phytate is known to reduce bio-availability of minerals and

causes growth inhibition. The author further stated that tannin binds to proteins including enzymes of the digestive tract thereby affecting the utilization of protein. Abu and Bakare (2008) had also stated that the tannin in sorghum combined with proteins thereby inhibiting the digestibility of rabbits.

The feed conversion ratio (FCR) increased with increase in BKGTSM in the diets with the highestFCR (4.30) in D5 while the lowest (2.86) was in D1. Although the values of FCR for D1, D2 andD3 were numerically different, they were statistically not significant ($P>0.05$) but were significant($P<0.05$) with D4 and D5. Lowest FCR obtained in D1 showed that D1 was superior to others but non-significant difference between D1, D2 and D3 was an indication that up to 50 % level of inclusion of BKGTSM did not affect growth performance of the animals. It was difficult to conclude that the mortality observed was due to dietary treatment effect.

4.21.15 Apparent nutrient digestibility of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

The apparent nutrient digestibility as affected by the replacement of maize with boiled *Karaya* gum tree seed meal (BKGTSM) showed that ether extract (EE) was better digested than other nutrients. Dry matter (DM) digestibility decreased with increase in BKGTSM in the diets. Highest DM digestibility (69.37 %) was observed in control (D1) while least DM digestibility (64.22 %) was in treatment fed diet with 100 % BKGTSM replacement for maize (D5). The crude protein (CP), crude fibre (CF), EE and DM digestibility decreased with increase in BKGTSM. Although the values were numerically different, they were not statistically different ($P>0.05$) between D1, D2 and D3. The slight decrease in digestibility among the treatments might have resulted from the amino acid imbalance and or possibly due to activities of anti-nutritional factors (ANFs).

The lower nutrient digestibility might have been caused by the interference of ANFs with digestive enzymes, affecting the biological utilization of the protein, fat and carbohydrate. However, the similarities among the treatments showed that replacement of maize with BKGTSM had no effect on nutrient digestibility of rabbits.

4.21.16 Haematological indices of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

The values for haemoglobin (Hb) were higher (14.44 g/dl) in treatments fed diet with 50 % maize replacement (D3) and control diet (D1) (14.12 g/dl) than other treatments. Although the values forHb were numerically different among treatments, they were not statistically different ($P>0.05$). This indicated their similarities with the control. The values were within the normal range value of 9.4 to 17.40 g/dl (Mitruka and Rawnsley, 1977). The packed cell volume (PCV) was higher (43.10 %) in control (D1) and D5 (41.23 %) than other treatments. There was statistical difference ($P<0.05$) between D1 and D2, D3 and D4 but there was no difference ($P>0.05$) between D1 and D5. However, all the values were within normal range of 31.00 % to 50.00 % (Mitruka and Rawnsley, 1977). The similarities observed for haemoglobin and PCV could be attributed to the direct relationship between Hb and PCV. It could also be an indication of adequate nutritional status of the animals. This is in line with Egbewande and Olorede (2003) who reported that PCV and Hb concentration indicate nutritional status. The red blood cells (RBC) were numerically different between the treatments but statistically not significant ($P>0.05$). All the values for RBC were within the normal range values for healthy rabbits reported by Mitruka and Rawnsley (1977).

White blood cells (WBC) differed ($P<0.05$) between the treatments with D2 ($4.93\times10^3/mm^3$) andD3 ($6.33\times10^3/mm^3$) having lower values than D1 ($6.88\times10^3/mm^3$)

while D4 ($7.22\times10^3/mm^3$) andD5 ($8.11\times10^3/mm^3$) had higher values than D1. Up to 50 % level of inclusion of BKGTSM as replacement for maize did not show any negative reaction as WBC were lower than obtained in control (D1). However, at 75 % (D4) and 100 % (D5) replacement of maize with BKGTSM, there was increased leucopoiesis resulting in higher WBC values than other treatments. Higher WBC count of animals on BKGTSM diet than other diets could be due to higher concentration of the residual ANFs of the BKGTSM. The animals might have produced more WBC in response to the relatively higher ANFs content of the diets. However, the values obtained for WBC were within the normal range for healthy rabbits. This is in line with Olafadehan *et al.,* (2010). Generally, toxic sub stances in feed tend to suppress haemopoietic tissues with consequent production of lower WBC. Since none of the rabbits suffered from leukopenia, it appears that feeding of boiled *Karaya*gum tree seed meal diet did not affect the immune status of the animals because the WBC functions primarily as a defense system as it contains lymphocytes that have a central role in the immunological defense mechanism of the body (Eruschenko, 2000; Olafadehan *et al.,* 2010).

4.21.17 Serum biochemical indices of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

The value of total protein was lower in treatment fed with diet containing 25 % boiled *Karaya* gum tree seed meal (BKGTSM) (D2) than control (D1) while treatments fed with diet containing 50 % (D3), 75 % (D4) and 100 % (D5) had higher total protein than control. The values increased(from D3 to D5) with increased BKGTSM in the diets. D3 to D5 were similar but were different($P<0.05$) from D2. Although the values were dissimilar, they were within the normal range for healthy rabbits (Annon, 1980). Low total protein is an indication that there is an alteration in protein metabolism of the animals since protein synthesis is related to the amount of available protein in the diet

(Ewuola *et al.*, 2008). Values for albumin took similar trend with total protein.Values for D3 to D5 were similar (P>0.05) and lower than control while D2 was higher than control but were all within the normal range.This indicated absence of hypo and hyper albuminaemia condition in the animals. Similarly, globulin which is directly related to total protein and albumin followed the same trend. The values were numerically different but statistically (P>0.05) similar between D3, D4 and D5 which were higher than D1 and D2. D3 to D5 were within normal range but D1 and D2 were below normal range.

Serum creatinine differed significantly (P<0.05) among the treatments but the values were withinthe normal range of 0.5 to 2.65 mg/dl. This suggested that there was no wasting or catabolism of muscle tissues, and the animals were not surviving at the expense of the body reserves (Olafadehan *et al*., 2010). This was a good indication that dietary proteins were well utilized by the animals and residual ANFs in the BKGTSM did not interfere with the nutrient utilization of the feeds. The blood urea levels were significant (P<0.05) among the treatments and all the values including the control were below the normal range (30.00 to 37.00 mg/dl) reported by Mitruka and Rawnsley (1977). Since all the treatments had lower urea concentration than the normal range, it might not be in connection with amino acid imbalance in the diets containing BKGTSM because an amino acid imbalance in diet results in an increased blood urea concentration. Urea is known to be a function of protein quality. A high urea level in the blood is an indication of low quality protein diet. Diet that is deficient in amino acid will have the available amino acid deaminated and hence result in an increase in the excretion of urea. This is in line with Ranjhan (2001) and Olafadehan *et al*. (2O10) who affirmed that in a diet that is deficient in amino acid, the available amino acid will be deaminated, and hence result in an increase in the excretion of urea. Serum urea and protein concentration depend on both quality and quantity of dietary protein (Anyaehie and Okorie, 2008).

Aspartate amino transferase (AST) values were higher in D2, D3 and D4 than control (D1) while it was lower in D5 than D1. There was no set pattern in the increase/decrease in AST. The valueswere statistically ($P<0.05$) different between the groups. Alanine amino transferase (ALT), AST and ALP increased with decreased BKGTSM in the diets. Significant ($P<0.05$) differences were observed between the treatments. However, the values were within normal range (Mitruka and Rawnsley, 1977) which indicated that there was no negative effect on heart, kidney and / or liver damage caused by *Karaya* gum tree seeds. Elevated AST, ALP and ALT above normal rangesare caused by toxins leading to heart, liver and kidney damages (Ewoula, *et al*., 2008). Bilirubin and cholesterol values differed significantly ($P<0.05$) between the groups but there was no set pattern. The values were within the normal ranges indicating appropriate utilization of the oil content of the feed/seed.

4.21.18 Carcass characteristics of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

Slaughtered weights and dressed weights differed significantly ($P<0.05$) between the treatments in accordance with initial live weights of the animals. Dressing percentages also differed significantly ($P<0.05$) between groups. Treatments fed diets containing boiled Karaya gum tree seed meal (BKGTSM) as replacement for maize (D2, D3 and D5) had similar ($P>0.05$) dressing percentages with control (D1) while D4 was different ($P<0.05$) from the control. Head, skin, fore leg, hind leg, ribs and intestine also differed significantly ($P<0.05$) though the values were within close range. Values for heart, liver, kidney and lungs were similar in D2 and D3 with control(D1) while D4 and D5 differed with D1. Although vital organs (heart, liver, kidney and lungs) increased with increasing levels of BKGTSM in the diets, they were within close ranges. This signified that the *Karaya* gum tree seeds in the diet were not detrimental. No hypertrophy was observed in

the liver and other vital organs to show negative effect or toxicity of the test seed. The slight increase in the vital organs might be due to residual effects of anti–nutritional factors (ANFs) since they were not completely removed after boiling or could be the effect of those ANFs not detected and remained in the processed seeds.

4.21.19 Sensory properties of the meat of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

The sensory evaluation of the meat of rabbits fed diets containing different levels of boiled *Karaya*gum tree seed meal (BKGTSM) as replacement for maize had indicated that the panelists had rated the meat high in the parameters measured. This showed acceptability of the meat. There were no significant (P>0.05) differences between the meat from different treatments. The similarities obtained between the treatments indicated that replacement of maize with BKGTSM did not affectthe meat negatively. The meat from different treatments was not characterized by significant changes in colour, tenderness, juiciness, flavour, palatability and acceptability. The general acceptability of the meat could be due to the fact that most people were already used to other meattypes such as beef, chicken and chevon. Having different meat with different flavour / aroma, taste and colour might be attractive. This is in line with Apata *et al*. (2008) who stated that most peopleare already used to beef, chicken and chevon and their flavour might not make difference to them.

4.21.20 Economic benefits of rabbits fed diets containing boiled *Karaya* gum tree seed meal as replacement for maize

The ingredients used and the prevailing market prices at the time of the experiment are as follows:Maize = 100/kg (50 kg bag at ₦ 5,000)

Karaya gum tree seeds = ₦ 57.14 (35 kg collected at ₦ 2,000)

Cost of processing = ₦ 10/kg (50 kg bag at ₦ 500)

Soya cake = ₦ 130/kg (50 kg bag at ₦ 6,000 + ₦ 500 processing fee)

Soya bean meal = ₦ 140/kg (50 kg bag at ₦ 7,000)

Rice offal = ₦ 10/kg Bone meal = ₦ 40/kg

Salt = ₦ 150/kg

Vitamin premix = ₦ 1,000/kg

Lysine = ₦ 950/kg

Methionine = ₦ 1,850/kg

Diet 1 / Treatment D1;

Average total feed consumed = 4,032.00 g

Percentage (%) of maize in the diet = 42 %

Quantity of maize in the diet = 42 ÷ 100 × 4,032 = 1,693.44 g

Cost of maize in the diet = 1,693.44 ÷ 1,000 × 100 = ₦ 169.34 k

Quantity of soya cake in the diet = 15.5 ÷ 100 × 4,032 = 624.96 g

Cost of soya cake = 624.96 ÷ 1,000 × 130 = ₦ 81.24

Quantity of soya bean meal in the diet = 14 ÷ 100 × 4,032 = 564.48 g

Cost of soya meal = 564.48 ÷ 1,000 × 140 = ₦ 79.03 k

Quantity of rice offal = 24 ÷ 100 × 4,032 = 967.68 g

Cost of rice offal = 967.68 ÷ 1,000 × 10 = ₦ 9.68 k

Quantity of bone meal = 3.5 ÷ 100 × 4,032 = 141.12 g

Cost of bone meal = 141.12 ÷ 1,000 × 40 = ₦ 5.64 k

Quantity of salt = 0.3 ÷ 100 × 4,032 = 12.10 g

Cost of salt = 12.10 ÷ 1,000 × 150 = ₦ 1.82 k

Quantity of premix = 0.3 ÷ 100 × 4,032 = 12.10 g

Cost of premix = 12.10 ÷ 1,000 × 1,000 = ₦ 12.10 k

Quantity of lysine = 0.2 ÷ 100 × 4,032 = 8.06 g

Cost of lysine = 8.06 ÷ 1,000 × 950 = ₦ 7.66 k

Quantity of methionine = 0.2 ÷ 100 × 4,032 = 8.06 g

Cost of methionine = 8.06 ÷ 1,000 × 1,850 = ₦ 14.91 k

Total cost of feed (D1) consumed = sum total of all the cost of ingredients = ₦ 381.42 k

Cost of feed (D1) per kg = 381.42 ÷ 4,032 × 1,000 = ₦ 94.60 k/kg

Reduction in cost of feed consumed was calculated by subtracting the individual cost of feed consumed of other treatments (D2 to D5) from the control (D1) while percentage reduction was calculated by dividing the reduction by D1 and multiplied by 100.

In the same way;

Average total feed intake (D2) = 4,112.64 g

Total cost of feed (D2) = ₦ 374.89 k = ₦ 91.16 k/kg

Average total feed intake (D3) = 4,242.00 g

Total cost of feed (D3) = ₦ 318.24k = ₦ 75.02 k/kg

Average total feed intake (D4) = 4,788.00 g

Total cost of feed (D4) = ₦ 403.37k = ₦ 82.25 k/kg

Average total feed intake (D5) = 5,090.40 g

Total cost of feed (Ð5) = ₦ 11.29k = ₦ 80.80 k/kg

Reduction in cost of feed per kg for each treatment (D2 to D5) was calculated by subtracting the cost of feed per kg of individual treatments from control (D1) while percentage reduction in cost of feed was calculated by dividing the reduction in cost of feed by cost feed in D1 and multiplied by 100. Cost of feed per kg body weight gain (CF

/kg BWG) was calculated by equating the total cost of feed of each treatment with its total feed intake.

Thus; CF /kg BWG (D1) was calculated as;

1,411.20 g cost ₦ 381.42. Hence, 1,000 g cost 381.42 ÷ 1,411.20 × 1,000 = ₦ 270.28 k.

Cost differential per kg body weight gain was calculated by subtracting other individual treatmentsfrom the control (D1). Cost of producing each animal was calculated by adding cost of weaned rabbit to average total cost of feed consumed. Profit was calculated by subtracting cost of production from selling price per animal while percentage profit was calculated by dividing the profit of each treatment by selling price and multiplied by 100. Although 100 % replacement of maize with BKGTSM (D5) had highest feed intake, there was depressed weight gain. Highest reduction in cost of feed per kg, least cost of feed consumed, least cost per kg weight gain, least cost of production and highest return/profit were obtained in 50 % maize replacement with BKGTSM. The cost benefit accruing from feeding of the dietary treatment differed significantly ($P<0.05$) from each other. Beyond 50 % replacement, reduction in cost of feed per kg, total weightgain and financial gain decreased with increasing BKGTSM in the diet. This result is similar to the result of Okon *et al*. (2008) on cost effectiveness of feeding boiled sun-dried taro cocoyam diets to growing Japanese quails who stated that although 100 % replacement gave highest returns to naira, highest cost saving per kg of meat and least cost, there was depressive effect on intake and gain beyond 50 % inclusion level in the diet.

CHAPTER FIVE

6.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The findings of this study had revealed that:

Karaya gum tree seed is rich in energy, protein, minerals and vitamins and also contain anti- nutritional factors that include cyanogenic glycocides, tannin, saponin, phytate, alkaloid and oxalate. Boiling, fermentation and roasting can eliminate or reduce the anti-nutritional factors present inthe *Karaya* gum tree seed. Roasting the seeds at 75^0 C for 30 minutes gave the highest reduction of most of the anti-nutritional factors present in the seed. However, boiled seeds at 100^0 C for 30minutes gave similar percentage reduction and also gave better results at 10 % level of inclusion.

The inclusion of processed *Karaya* gum tree seed meals (boiled, fermented and roasted) in the diet of rabbits had no detrimental effects on growth performance and apparent nutrient digestibility. Feeding diets containing processed *Karaya* gum tree seed meals had no negative effects on haematological and serum biochemical indices of rabbits.

Inclusion of processed *Karaya* gum tree seed in the diet of rabbits had no negative effect on the carcass characteristics and sensory properties of the meat of rabbits. Feeding diets containing processed *Karaya* gum tree seeds gave comparable financial benefit to the control diet. And finally, boiled *Karaya* gum tree seed can replace costly and competitive maize in the diet of rabbits up to 50 % inclusion level without detrimental effects on growth performance, apparent nutrient digestibility, feed conversion ratio, health status of the animals and financial benefits. However, inclusion beyond 50 % level had adverse effect on performance, nutrient digestibility, carcass traits, blood constituents and financial benefit.

5.2 Recommendations

Based on the results of this study, it is thus recommended that:

1. Karaya gum tree (*Sterculia setigera*) seeds should be boiled at 100^0 C for 30 minutes, fermented for 9 days or roasted at 75^0 C for 30 minutes to detoxify anti-nutritional factors present in the seeds
2. Boiled Karaya gum tree seed meal should be included in the diet of weaned rabbits up to 50 % level to replace costly and competitive maize.
3. Further research should be carried out to investigate the effects of boiled Karaya gumtree seed meal on the reproductive performance of rabbits.
4. Also, similar research should be carried out on other livestock species to reduce the dependency on the costly and competitive maize grain, to make animal protein more available and affordable to the Nigerian populace.

5.3 Contribution to Knowledge

1. It had established the proximate composition, mineral and vitamin contents as well as anti-nutritional component of Karaya gum tree seeds in the raw, boiled, fermented and roasted forms.
2. The processing techniques (boiling, fermentation and roasting) in this work can eliminate or reduce the anti-nutritional factors thereby prevent toxification from the seeds when fed to rabbits.
3. It had revealed that processed *Karaya* gum tree seeds can be used as ingredient in rabbit diet.
4. It has also revealed that up to 10 % dietary inclusion of boiled, fermented and roasted *Karaya* gum tree seed meal in the rabbit diet had no detrimental effects on growth performance, nutrient digestibility, carcass quality and blood

constituents.

5. Boiled *Karaya* gum tree seed meal can replace up to 50 % part of maize in rabbit diet to reduce cost of production.
6. The processed *Karaya* gum tree seed meal has financial benefit in rabbit diet.

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APPENDIX I

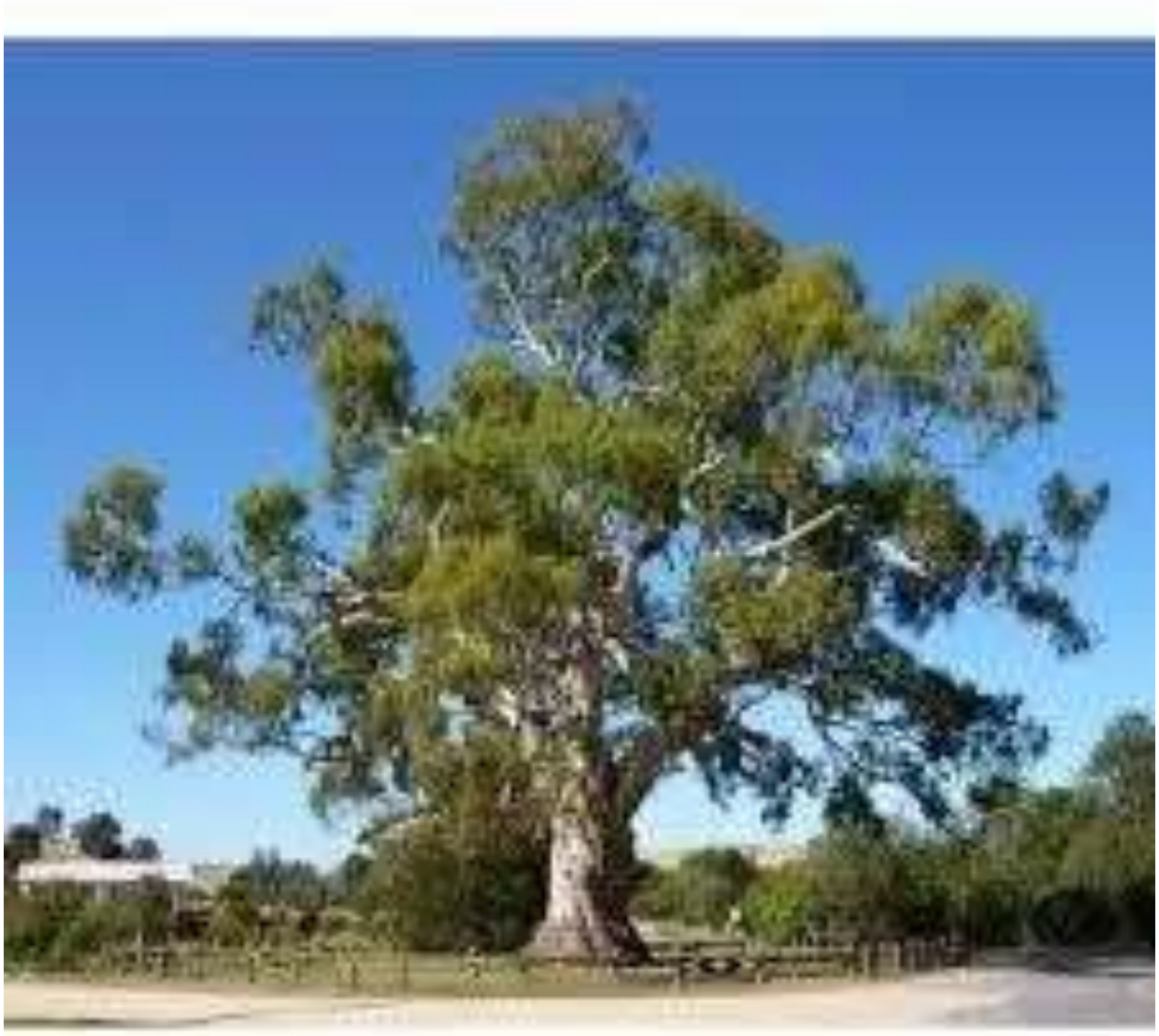

Plate I: *Karaya* Gum Tree

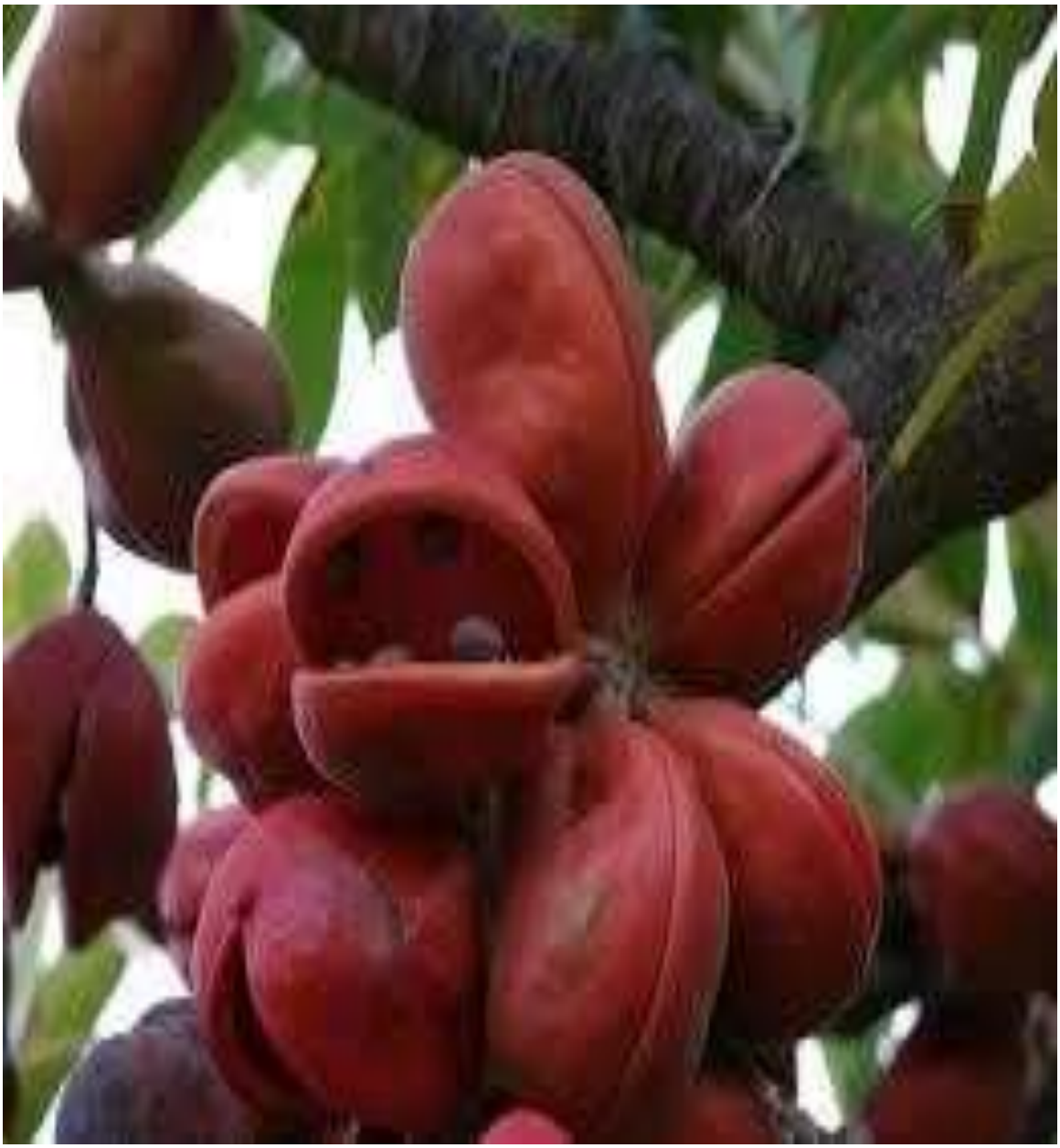

Plate II: *Karaya* Gum Tree Riped Fruits with seeds

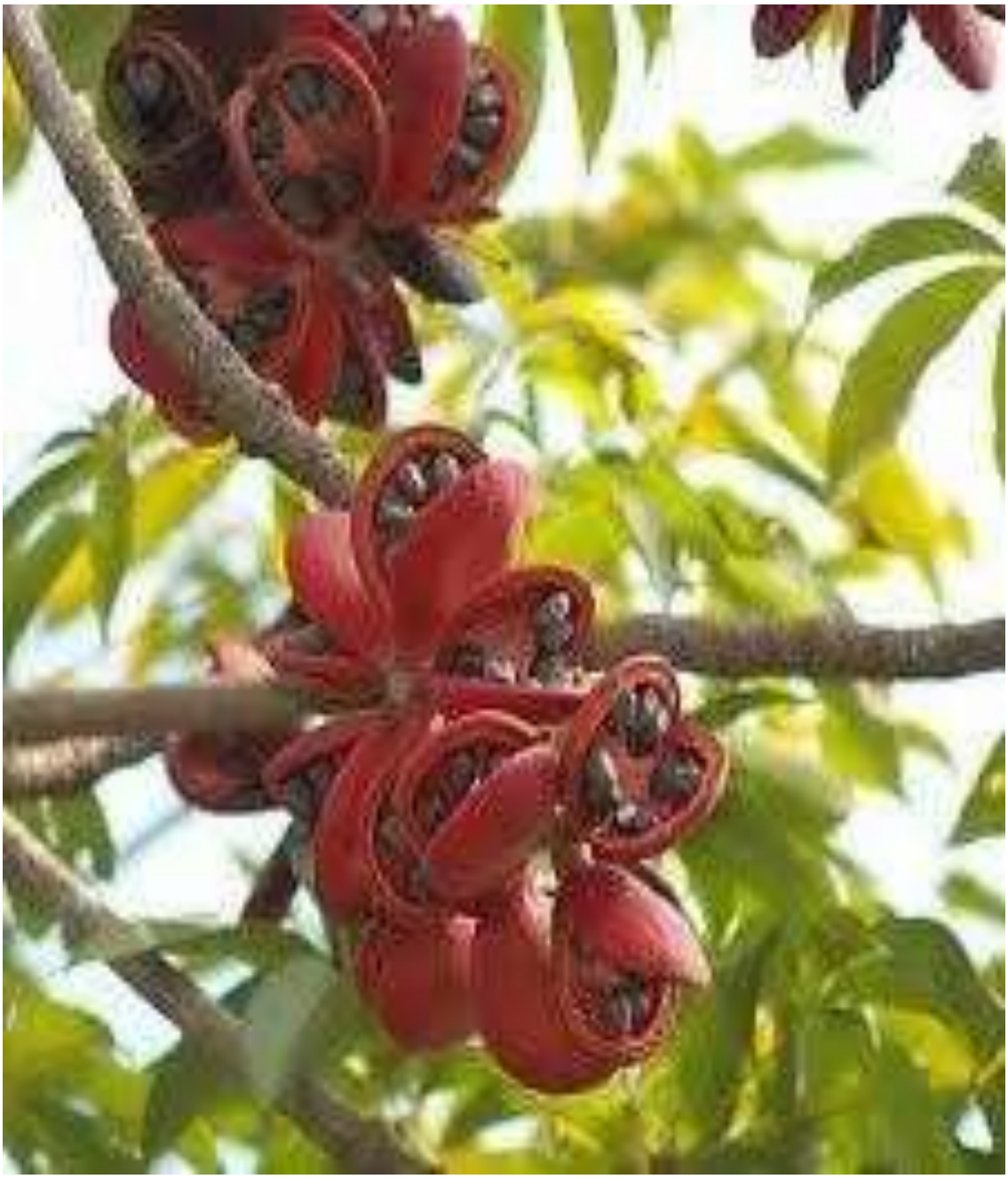

Plate III: *Karaya* Gum Tree Ripe Fruit with Seeds

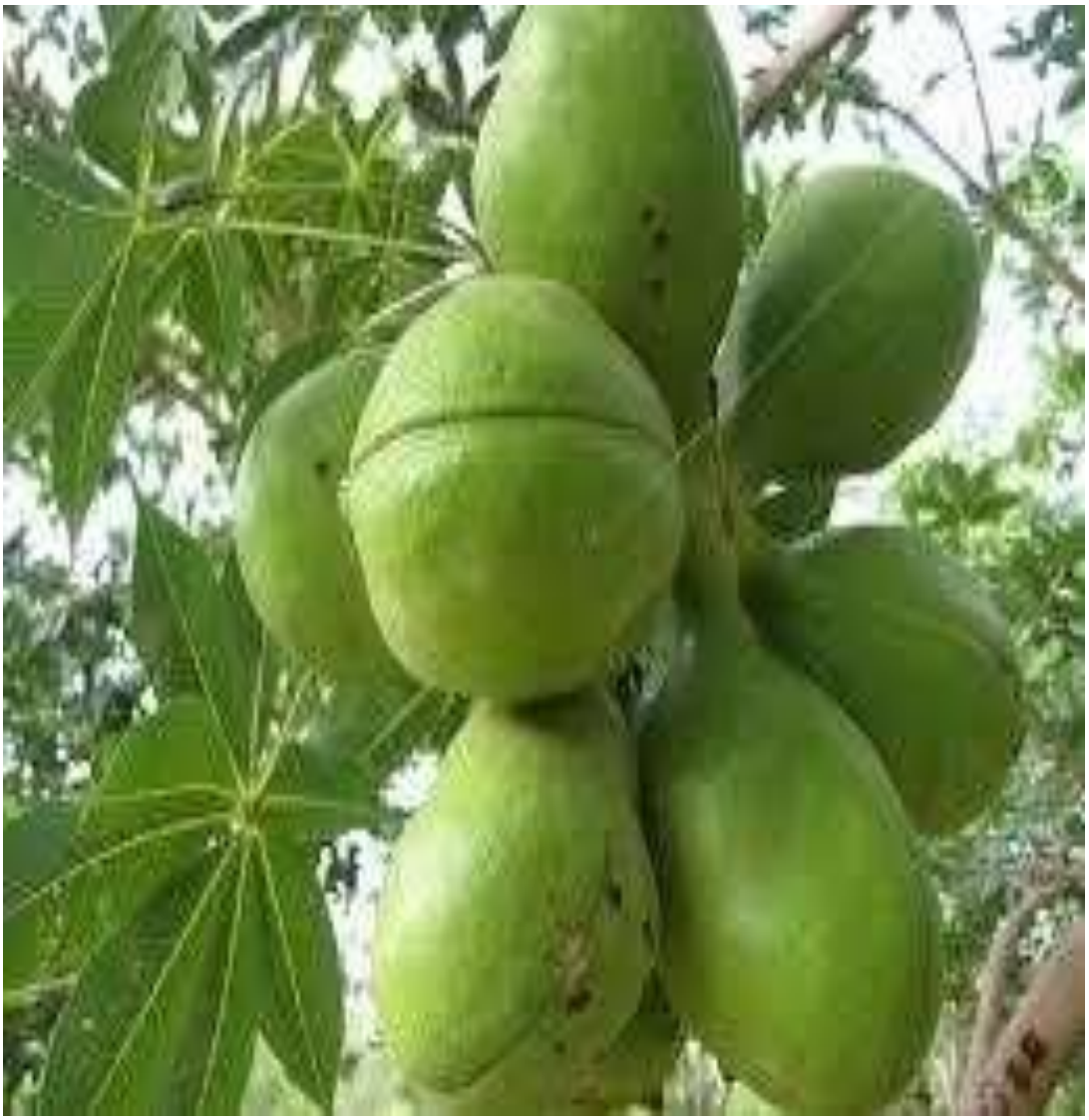

Plate IV: *Karaya* Gum Tree Unripe Fruit

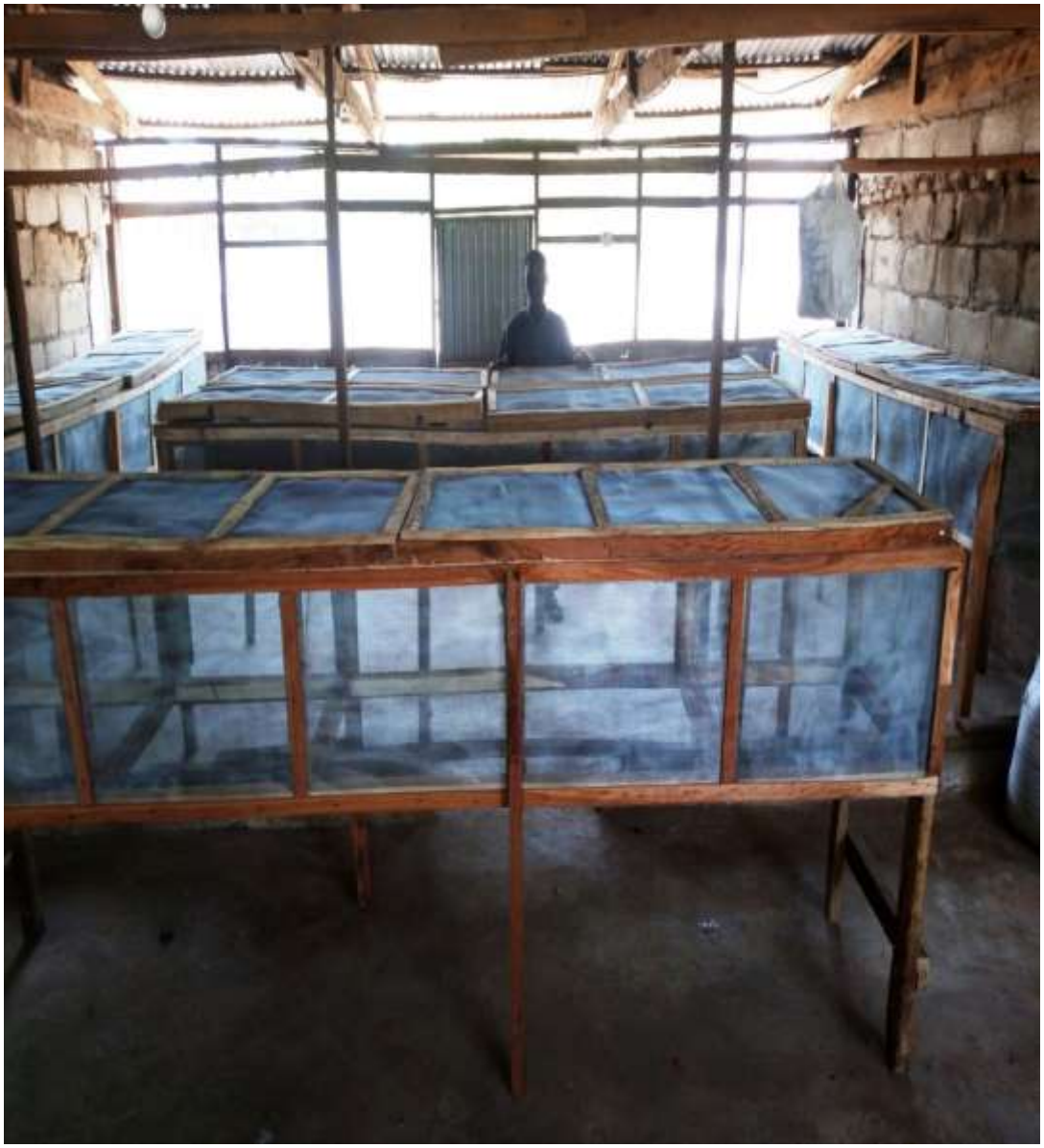

Plate V: Experimental unit without rabbits.

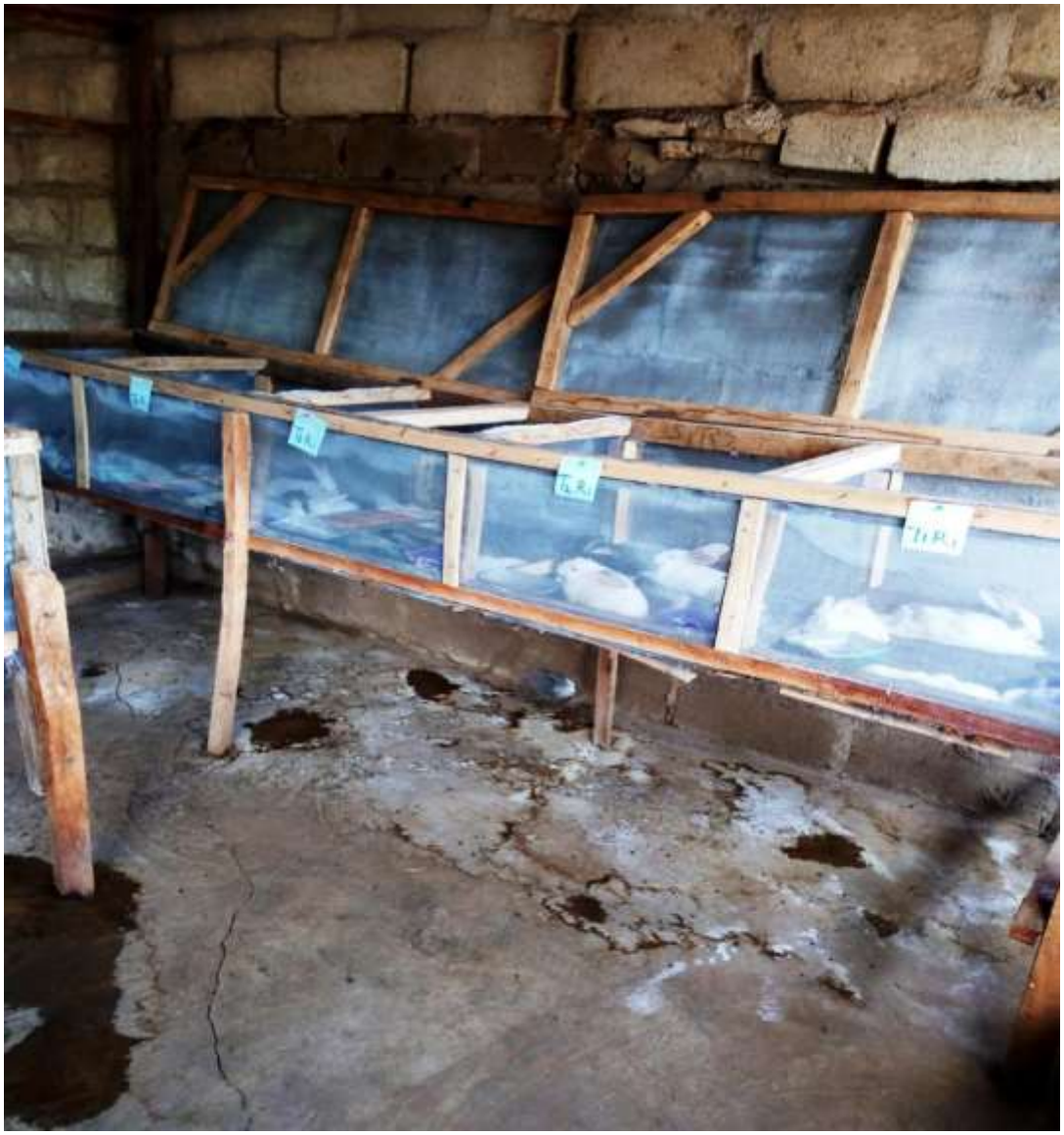

Plate VI: Experimental Unit with Rabbit

Plate VII: Supervisor at supervision

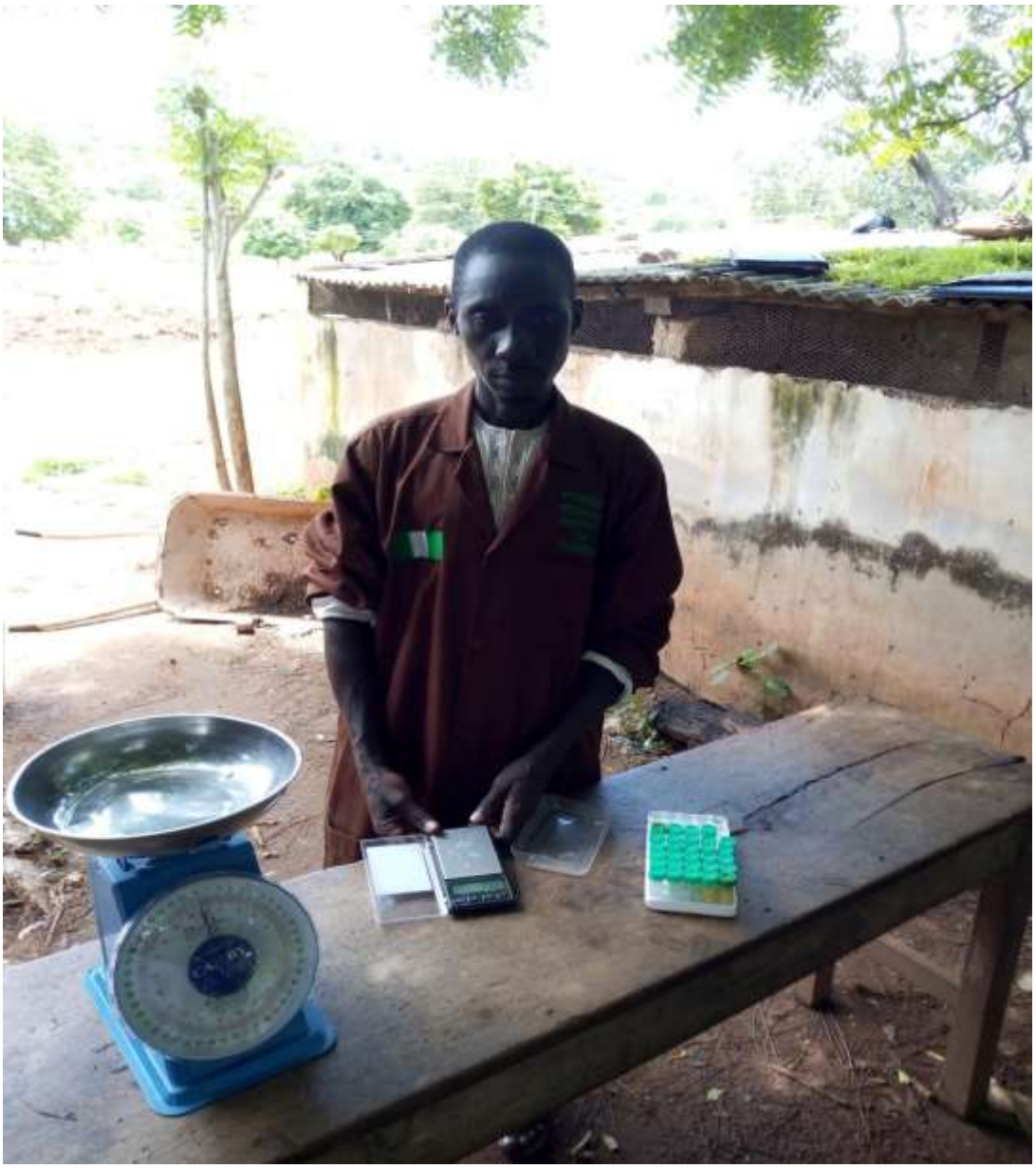

Plate VIII: Blood Sample Collection

APPENDIX II

Calculation of the economic benefits of weaned rabbits

(Experiment II) fed diets containing different levels of inclusion of

***Sterculia setigera* seed meals**

The ingredients used and the prevailing market prices at the time of the

experiment are as follows:Maize = ₦ 80/kg (50 kg bag at ₦4000)

Sterculia seeds = ₦57.14 (35 kg at ₦2000)

Soya cake = ₦120/kg

Full fat soya = ₦130/kg (50 kg bag at ₦6000 + ₦500 processing fee)

Rice offal = ₦10/kg (cost involved to obtain 100 kg bag)

Bone meal = ₦ 40/kg Salt = ₦ 140/kg

Vitamin premix = ₦ 900/kg Lysine = ₦ 800/kg

Methionine = ₦ 1700/kg

Diets 1, 4 and 7 / Treatment T1, T4 and T7 (Control)

Average total

feed consumed

= 5217.10 g

Percentage (%)

of maize in the

diet = 42 %

Quality of maize in the diet = 42 ÷ 100 × 5217.10 = 2191.18 gCost of maize in the diet = 2191.18 ÷ 1000 × 80 = 175.29

Quantity of soya cake in the diet = 15.5 ÷ 100 × 5217.10 = 808.65 gCost of soya cake in the diet = 808.65 ÷ 1000 × 120 = ₦97.04 Quantity of full fat soya = 14 ÷ 100 × 5217.10 = 730.39 g

Cost of full fat soya = 730.39 ÷ 1000 × 130 = ₦94.95

Rice husk Quantity = 24 ÷ 100 × 5217.10 = 1252.10 g

Cost of rice husk = 1252.10 ÷1000 × 10 = ₦12.52

Quantity of bone meal = 3.5 ÷ 100 ×5217.10 = 182.60 g

Cost of bone meal = 182.60 ÷ 1000 × 40 = ₦7.30 Quantity of salt = 0.3 ÷ 100 × 5217.10 = 15.65 g

Cost of salt = 15.65 ÷ 1000 × 140 = ₦2.19

Quantity of premix = 0.3 ÷ 100 × 5217.10 = 15.65 gCost of premix = 15.65 ÷ 1000 × 900 = ₦14.09

Quantity of lysine = 0.2

÷ 100 × 5217.10 =

10.43 gCost of lysine =

10.43 ÷ 1000 × 800 =

₦8.34

Quantity of methionine = 0.2

÷ 100 × 5217.10 = 10.43 g

Cost of methionine = 10.43 ÷

1000 × 1700 = ₦ 17.73

Total cost of feed (T1) consumed = sum total of all the cost of

ingredients involved = ₦429.45Cost of feed (T1) per kg = 429.45 ÷

5217.10 × 1000 = ₦82.32/kg.

Reduction in cost of feed consumed was calculated by subtracting the

individual cost of feed consumed of other treatments (T2 to T9) from

the control (T1) while percentage reduction was calculated by dividing

the reduction by T1 and multiplied by 100.

In the same way, Average total feed intake (T2) = 5518.80 gTotal cost of feed (T2) =

₦446.36

Cost of feed (T2) per kg = ₦80.88 Average total feed intake (T3) = 5418.00Total

cost of feed (T3) = ₦435.50

Cost of feed (T3) per kg = ₦80.38 Average total feed intake (T5) = 5401.20 gTotal cost of feed (T5) = ₦430.74

Cost of feed (T5) per kg = ₦80.88 Average total feed intake (T6) = 5401.20 gTotal cost of feed (T6) = ₦431.18

Cost of feed (T6) per kg = ₦79.83 Average total feed intake (T8) = 5510.40 gTotal cost of feed (T8) = ₦439.92

Cost of feed (T8) = ₦79.83

Average total feed intake (T9) = 5712.00 gTotal cost of feed (T9) = ₦456.02

Cost of feed (T9) per kg = ₦79.84

Reduction in cost of feed per kg for each of the treatments (T2 to T9) was calculated by subtracting the cost of feed kg of individual treatments from the control (T1) while percentage reduction in cost of feed was calculated by dividing the reduction in cost of feed by cost of feed in T1 and multiplied by 100. Cost of feed per kg body weight gain (CF/kg BWG) was calculated by equatingthe total cost of feed of each treatment with its total feed intake CF/kg BWG (T1) was calculated as;

1540 g cost ₦429.45

1000 g cost 429.45 ÷ 1540 × 1000 = ₦278.86

Cost differential per kg body weight gain was calculated by subtracting other treatments (individually) from the control. Cost of producing each animal was

calculated by adding cost ofweaned rabbit to average total cost of feed consumed. Profit was calculated by subtracting cost of production from selling per animal while percentage profit was calculated by dividing the profit of each treatment by selling price and multiplied by 100.

APPENDIX III

```
ONEWAY VAR00003 VAR00005 VAR00004 VAR00006

VAR00007 VAR00008VAR00009 BY VAR00001

 /STATISTICS DESCRIPTIVES
```

/MISSING ANALYSIS

/POSTHOC=DUNCAN ALPHA(0.05).

Oneway

Notes

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Descriptives

		N	Mean	Std. Deviation	Std. Error
Initial Body Weight	Treatment 1	3	525.0000	.00000	.00000
	Treatment 2	3	525.0000	1.00000	.57735
	Treatment 3	3	525.5000	.50000	.28868
	Treatment 4	3	525.0000	.50000	.28868
	Treatment 5	3	524.8000	.20000	.11547
	Treatment 6	3	525.0000	1.00000	.57735
	Treatment 7	3	525.5000	.00000	.00000
	Total	21	525.1143	.56682	.12369
Total Weight Gain	Treatment 1	3	1540.0000	20.00000	11.54701

	Treatment 2	3	1560.0000	4.00000	2.30940
	Treatment 3	3	1504.5000	10.50000	6.06218
	Treatment 4	3	1605.0000	9.50000	5.48483
	Treatment 5	3	1680.2000	4.80000	2.77128
	Treatment 6	3	1575.0000	49.50758	28.58321
	Treatment 7	3	1654.8333	30.00139	17.32131
	Total	21	1588.5048	62.62318	13.66550
Final Body Weight	Treatment 1	3	2065.0000	20.00000	11.54701
	Treatment 2	3	2085.0000	5.00000	2.88675
	Treatment 3	3	2030.0000	10.00000	5.77350
	Treatment 4	3	2130.0000	10.00000	5.77350
	Treatment 5	3	2205.0000	5.00000	2.88675
	Treatment 6	3	2100.0000	50.00000	28.86751
	Treatment 7	3	2180.0000	30.00000	17.32051
	Total	21	2113.5714	62.55283	13.65015
Average Daily Weight Gain	Treatment 1	3	18.3333	.23502	.13569
	Treatment 2	3	18.5700	.05000	.02887
	Treatment 3	3	17.9133	.12503	.07219
	Treatment 4	3	19.1067	.11504	.06642
	Treatment 5	3	20.0033	.05508	.03180
	Treatment 6	3	18.7500	.58506	.33779
	Treatment 7	3	19.7033	.35501	.20497

Descriptives

		95% Confidence Interval for Mean		Minimum	Maximum
		Lower Bound	Upper Bound		
Initial Body Weight	Treatment 1	525.0000	525.0000	525.00	525.00
	Treatment 2	522.5159	527.4841	524.00	526.00
	Treatment 3	524.2579	526.7421	525.00	526.00
	Treatment 4	523.7579	526.2421	524.50	525.50
	Treatment 5	524.3032	525.2968	524.60	525.00
	Treatment 6	522.5159	527.4841	524.00	526.00
	Treatment 7	525.5000	525.5000	525.50	525.50
	Total	524.8563	525.3723	524.00	526.00
Total Weight Gain	Treatment 1	1490.3172	1589.6828	1520.00	1560.00
	Treatment 2	1550.0634	1569.9366	1556.00	1564.00
	Treatment 3	1478.4166	1530.5834	1494.00	1515.00
	Treatment 4	1581.4007	1628.5993	1595.50	1614.50
	Treatment 5	1668.2761	1692.1239	1675.40	1685.00
	Treatment 6	1452.0164	1697.9836	1526.00	1625.00
	Treatment 7	1580.3058	1729.3609	1625.00	1685.00
	Total	1559.9990	1617.0105	1494.00	1685.00
Final Body Weight	Treatment 1	2015.3172	2114.6828	2045.00	2085.00
	Treatment 2	2072.5793	2097.4207	2080.00	2090.00

	Treatment 3	2005.1586	2054.8414	2020.00	2040.00
	Treatment 4	2105.1586	2154.8414	2120.00	2140.00
	Treatment 5	2192.5793	2217.4207	2200.00	2210.00
	Treatment 6	1975.7931	2224.2069	2050.00	2150.00
	Treatment 7	2105.4759	2254.5241	2150.00	2210.00
	Total	2085.0977	2142.0451	2020.00	2210.00
	Treatment 1	17.7495	18.9171	18.10	18.57
	Treatment 2	18.4458	18.6942	18.52	18.62
	Treatment 3	17.6027	18.2239	17.79	18.04
Average Daily Weight Gain	Treatment 4	18.8209	19.3924	18.99	19.22
	Treatment 5	19.8665	20.1401	19.95	20.06
	Treatment 6	17.2966	20.2034	18.17	19.34
	Treatment 7	18.8214	20.5852	19.35	20.06

Descriptives

		N	Mean	Std. Deviation	Std. Error
Average Daily Weight Gain	Total	21	18.9114	.74523	.16262
	Treatment 1	3	62.1000	2.00749	1.15902
	Treatment 2	3	65.6000	2.40000	1.38564
	Treatment 3	3	68.0000	2.00000	1.15470
	Treatment 4	3	63.4000	.87178	.50332
Daily F/I	Treatment 5	3	64.5000	1.00000	.57735
	Treatment 6	3	64.3000	.70000	.40415
	Treatment 7	3	65.7000	1.70000	.98150
	Total	21	64.8000	2.25499	.49208

Total F/I	Treatment 1	3	5217.4000	170.05140	98.17922
	Treatment 2	3	5510.4000	201.60000	116.39381
	Treatment 3	3	3948.0000	2911.05754	1680.69985
	Treatment 4	3	5325.6000	73.22950	42.27907
	Treatment 5	3	5418.0000	84.00000	48.49742
	Treatment 6	3	5401.2000	58.80000	33.94820
	Treatment 7	3	5518.8000	142.80000	82.44562
	Total	21	5191.3429	1066.94192	232.82582
FCR	Treatment 1	3	3.3900	.15524	.08963
	Treatment 2	3	3.5333	.14012	.08090
	Treatment 3	3	3.7967	.08505	.04910
	Treatment 4	3	3.3400	.05568	.03215
	Treatment 5	3	3.2233	.04509	.02603
	Treatment 6	3	3.4300	.07000	.04041
	Treatment 7	3	3.3367	.02517	.01453
	Total	21	3.4357	.19252	.04201

Descriptives

		95% Confidence Interval for Mean		Minimum	Maximum
		Lower Bound	Upper Bound		
Average Daily Weight Gain	Total	18.5722	19.2507	17.79	20.06
Daily F/I	Treatment 1	57.1131	67.0869	60.00	64.00
	Treatment 2	59.6381	71.5619	63.20	68.00
	Treatment 3	63.0317	72.9683	66.00	70.00
	Treatment 4	61.2344	65.5656	62.40	64.00
	Treatment 5	62.0159	66.9841	63.50	65.50

	Treatment 6	62.5611	66.0389	63.60	65.00
	Treatment 7	61.4770	69.9230	64.00	67.40
	Total	63.7735	65.8265	60.00	70.00
Total F/I	Treatment 1	4794.9689	5639.8311	5040.00	5379.00
	Treatment 2	5009.5978	6011.2022	5308.80	5712.00
	Treatment 3	-3283.4678	11179.4678	588.00	5712.00
	Treatment 4	5143.6878	5507.5122	5241.60	5376.00
	Treatment 5	5209.3324	5626.6676	5334.00	5502.00
	Treatment 6	5255.1327	5547.2673	5342.40	5460.00
	Treatment 7	5164.0651	5873.5349	5376.00	5661.60
	Total	4705.6767	5677.0090	588.00	5712.00
FCR	Treatment 1	3.0044	3.7756	3.23	3.54
	Treatment 2	3.1853	3.8814	3.39	3.67
	Treatment 3	3.5854	4.0079	3.71	3.88
	Treatment 4	3.2017	3.4783	3.29	3.40
	Treatment 5	3.1113	3.3353	3.18	3.27
	Treatment 6	3.2561	3.6039	3.36	3.50
	Treatment 7	3.2742	3.3992	3.31	3.36
	Total	3.3481	3.5234	3.18	3.88

ANOVA

		Sum of Squares	df	Mean Square	F
Initial Body Weight	Between Groups	1.346	6	.224	.618
	Within Groups	5.080	14	.363	

	Total	6.426	20		
	Between Groups	70452.003	6	11742.000	20.597
Total Weight Gain	Within Groups	7981.247	14	570.089	
	Total	78433.250	20		
	Between Groups	70157.143	6	11692.857	20.210
Final Body Weight	Within Groups	8100.000	14	578.571	
	Total	78257.143	20		
	Between Groups	9.992	6	1.665	20.892
Average Daily Weight Gain	Within Groups	1.116	14	.080	
	Total	11.107	20		
	Between Groups	63.840	6	10.640	3.934
Daily F/I	Within Groups	37.860	14	2.704	
	Total	101.700	20		
	Between Groups	5607133.611	6	934522.269	.762
Total F/I	Within Groups	17160167.760	14	1225726.269	
	Total	22767301.371	20		
	Between Groups	.618	6	.103	11.699
FCR	Within Groups	.123	14	.009	
	Total	.741	20		

ANOVA

		Sig.
Initial Body Weight	Between Groups	.713
	Within Groups	
	Total	
Total Weight Gain	Between Groups	.000
	Within Groups	
	Total	
Final Body Weight	Between Groups	.000
	Within Groups	
	Total	
Average Daily Weight Gain	Between Groups	.000
	Within Groups	
	Total	
Daily F/I	Between Groups	.016
	Within Groups	
	Total	
Total F/I	Between Groups	.611
	Within Groups	
	Total	

FCR	Between Groups	.000
	Within Groups	
	Total	

Post Hoc Tests

Homogeneous Subsets

Initial Body Weight

Duncan

Roasted Treatment	N	Subset for alpha = 0.05
		1
Treatment 5	3	524.8000
Treatment 1	3	525.0000

Treatment 2	3	525.0000
Treatment 4	3	525.0000
Treatment 6	3	525.0000
Treatment 3	3	525.5000
Treatment 7	3	525.5000
Sig.		.224

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Total Weight Gain

Duncan

Roasted Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 3	3	1504.5000			
Treatment 1	3	1540.0000	1540.0000		
Treatment 2	3		1560.0000		
Treatment 6	3		1575.0000	1575.0000	
Treatment 4	3			1605.0000	
Treatment 7	3				1654.8333
Treatment 5	3				1680.2000
Sig.		.090	.109	.146	.214

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Final Body Weight

Duncan

Roasted Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 3	3	2030.0000			
Treatment 1	3	2065.0000	2065.0000		
Treatment 2	3		2085.0000		
Treatment 6	3		2100.0000	2100.0000	
Treatment 4	3			2130.0000	
Treatment 7	3				2180.0000
Treatment 5	3				2205.0000
Sig.		.096	.112	.149	.224

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Average Daily Weight Gain

Duncan

Roasted Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 3	3	17.9133			
Treatment 1	3	18.3333	18.3333		

Treatment 2	3		18.5700		
Treatment 6	3		18.7500	18.7500	
Treatment 4	3			19.1067	
Treatment 7	3				19.7033
Treatment 5	3				20.0033
Sig.		.090	.107	.144	.214

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Daily F/I

Duncan

Roasted Treatment	N	Subset for alpha = 0.05		
		1	2	3
Treatment 1	3	62.1000		
Treatment 4	3	63.4000	63.4000	
Treatment 6	3	64.3000	64.3000	
Treatment 5	3	64.5000	64.5000	
Treatment 2	3		65.6000	65.6000
Treatment 7	3		65.7000	65.7000
Treatment 3	3			68.0000
Sig.		.120	.142	.111

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Total F/I

Duncan

Roasted Treatment	N	Subset for alpha = 0.05
		1
Treatment 3	3	3948.0000

Treatment 1	3	5217.4000
Treatment 4	3	5325.6000
Treatment 6	3	5401.2000
Treatment 5	3	5418.0000
Treatment 2	3	5510.4000
Treatment 7	3	5518.8000
Sig.		.143

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

FCR

Duncan

Roasted Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 5	3	3.2233			
Treatment 7	3	3.3367	3.3367		
Treatment 4	3	3.3400	3.3400		
Treatment 1	3	3.3900	3.3900	3.3900	
Treatment 6	3		3.4300	3.4300	
Treatment 2	3			3.5333	
Treatment 3	3				3.7967
Sig.		.063	.280	.096	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

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VAR00007 VAR00008BY VAR00001
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
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Oneway

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	Cases Used	Statistics for each analysis are based on cases with no missing data for any variable in the analysis.

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Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean
						Lower Bound
Dry matter	Control	3	79.4667	.02887	.01667	79.3950
	Treatment 1	3	79.1000	.10000	.05774	78.8516
	Treatment 2	3	80.6300	.01000	.00577	80.6052
	Treatment 3	3	79.7400	.04000	.02309	79.6406
	Treatment 4	3	76.5200	.02000	.01155	76.4703
	Treatment 5	3	70.5700	.01000	.00577	70.5452
	Treatment 6	3	69.1800	.01000	.00577	69.1552

Crude Protein	Total	21	76.4581	4.44735	.97049	74.4337
	Control	3	79.9300	.03000	.01732	79.8555
	Treatment 1	3	79.1000	.05000	.02887	78.9758
	Treatment 2	3	80.6400	.01000	.00577	80.6152
	Treatment 3	3	79.7600	.00000	.00000	79.7600
	Treatment 4	3	76.5200	.00000	.00000	76.5200
	Treatment 5	3	70.5700	.00000	.00000	70.5700
	Treatment 6	3	69.1800	.00000	.00000	69.1800
Crude Fibre	Total	21	76.5286	4.50061	.98211	74.4799
	Control	3	79.9300	.01000	.00577	79.9052
	Treatment 1	3	79.1000	.10000	.05774	78.8516
	Treatment 2	3	80.6300	.01000	.00577	80.6052
	Treatment 3	3	79.7400	.01000	.00577	79.7152
	Treatment 4	3	76.5100	.01000	.00577	76.4852
	Treatment 5	3	70.5600	.00000	.00000	70.5600
	Treatment 6	3	69.1900	.01000	.00577	69.1652
Ether Extract	Total	21	76.5229	4.49671	.98126	74.4760
	Control	3	79.9400	.00000	.00000	79.9400
	Treatment 1	3	79.1100	.01000	.00577	79.0852
	Treatment 2	3	80.6500	.00000	.00000	80.6500
	Treatment 3	3	79.7500	.01000	.00577	79.7252
	Treatment 4	3	76.5100	.00000	.00000	76.5100
	Treatment 5	3	70.5500	.05000	.02887	70.4258
	Treatment 6	3	69.1800	.01000	.00577	69.1552

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
Dry matter	Control	79.5384	79.45	79.50
	Treatment 1	79.3484	79.00	79.20
	Treatment 2	80.6548	80.62	80.64
	Treatment 3	79.8394	79.70	79.78
	Treatment 4	76.5697	76.50	76.54
	Treatment 5	70.5948	70.56	70.58
	Treatment 6	69.2048	69.17	69.19
	Total	78.4825	69.17	80.64
Crude Protein	Control	80.0045	79.90	79.96
	Treatment 1	79.2242	79.05	79.15
	Treatment 2	80.6648	80.63	80.65
	Treatment 3	79.7600	79.76	79.76
	Treatment 4	76.5200	76.52	76.52
	Treatment 5	70.5700	70.57	70.57
	Treatment 6	69.1800	69.18	69.18
	Total	78.5772	69.18	80.65
Crude Fibre	Control	79.9548	79.92	79.94
	Treatment 1	79.3484	79.00	79.20
	Treatment 2	80.6548	80.62	80.64
	Treatment 3	79.7648	79.73	79.75
	Treatment 4	76.5348	76.50	76.52
	Treatment 5	70.5600	70.56	70.56
	Treatment 6	69.2148	69.18	69.20

	Total	78.5697	69.18	80.64
	Control	79.9400	79.94	79.94
	Treatment 1	79.1348	79.10	79.12
	Treatment 2	80.6500	80.65	80.65
Ether Extract	Treatment 3	79.7748	79.74	79.76
	Treatment 4	76.5100	76.51	76.51
	Treatment 5	70.6742	70.50	70.60
	Treatment 6	69.2048	69.17	69.19

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean
						Lower Bound
Ether Extract	Total	21	76.5271	4.50687	.98348	74.4756
	Control	3	79.9300	.00000	.00000	79.9300
	Treatment 1	3	79.1100	.00000	.00000	79.1100
	Treatment 2	3	80.6300	.03000	.01732	80.5555
	Treatment 3	3	79.7500	.00000	.00000	79.7500
NFE	Treatment 4	3	76.5200	.02000	.01155	76.4703
	Treatment 5	3	70.5600	.01000	.00577	70.5352
	Treatment 6	3	69.1700	.00000	.00000	69.1700
	Total	21	76.5243	4.50343	.98273	74.4743
	Control	3	79.9300	.03000	.01732	79.8555
	Treatment 1	3	79.1100	.01000	.00577	79.0852
Ash	Treatment 2	3	80.6300	.02000	.01155	80.5803
	Treatment 3	3	79.7400	.02000	.01155	79.6903

Treatment 4	3	76.5100	.00000	.00000	76.5100
Treatment 5	3	70.5700	.00000	.00000	70.5700
Treatment 6	3	69.1800	.00000	.00000	69.1800
Total	21	76.5243	4.49793	.98153	74.4769

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
Ether Extract	Total	78.5786	69.17	80.65
	Control	79.9300	79.93	79.93
	Treatment 1	79.1100	79.11	79.11
	Treatment 2	80.7045	80.60	80.66
	Treatment 3	79.7500	79.75	79.75
NFE	Treatment 4	76.5697	76.50	76.54
	Treatment 5	70.5848	70.55	70.57
	Treatment 6	69.1700	69.17	69.17
	Total	78.5742	69.17	80.66
	Control	80.0045	79.90	79.96
	Treatment 1	79.1348	79.10	79.12
	Treatment 2	80.6797	80.61	80.65
	Treatment 3	79.7897	79.72	79.76
Ash	Treatment 4	76.5100	76.51	76.51
	Treatment 5	70.5700	70.57	70.57
	Treatment 6	69.1800	69.18	69.18
	Total	78.5717	69.18	80.65

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Dry matter	Between Groups	395.553	6	65.926	35137.962	.000
	Within Groups	.026	14	.002		
	Total	395.579	20			
Crude Protein	Between Groups	405.102	6	67.517	135034.086	.000
	Within Groups	.007	14	.001		
	Total	405.109	20			
Crude Fibre	Between Groups	404.387	6	67.398	44931.848	.000
	Within Groups	.021	14	.002		
	Total	404.408	20			
Ether Extract	Between Groups	406.232	6	67.705	169263.179	.000
	Within Groups	.006	14	.000		
	Total	406.237	20			
NFE	Between Groups	405.616	6	67.603	338012.929	.000
	Within Groups	.003	14	.000		
	Total	405.618	20			
Ash	Between Groups	404.624	6	67.437	262256.500	.000
	Within Groups	.004	14	.000		

Total	404.628	20			

Post Hoc Tests

Homogeneous Subsets

Dry matter

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 6	3	69.1800						
Treatment 5	3		70.5700					
Treatment 4	3			76.5200				
Treatment 1	3				79.1000			
Control	3					79.4667		
Treatment 3	3						79.7400	
Treatment 2	3							80.6300
Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Crude Protein

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 6	3	69.1800						
Treatment 5	3		70.5700					
Treatment 4	3			76.5200				
Treatment 1	3				79.1000			
Treatment 3	3					79.7600		
Control	3						79.9300	
Treatment 2	3							80.6400
Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Crude Fibre

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 6	3	69.1900						
Treatment 5	3		70.5600					

Treatment 4	3			76.5100				
Treatment 1	3				79.1000			
Treatment 3	3					79.7400		
Control	3						79.9300	
Treatment 2	3							80.6300
Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Ether Extract

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 6	3	69.1800						
Treatment 5	3		70.5500					
Treatment 4	3			76.5100				
Treatment 1	3				79.1100			
Treatment 3	3					79.7500		
Control	3						79.9400	
Treatment 2	3							80.6500

Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

NFE

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 6	3	69.1700						
Treatment 5	3		70.5600					
Treatment 4	3			76.5200				
Treatment 1	3				79.1100			
Treatment 3	3					79.7500		
Control	3						79.9300	
Treatment 2	3							80.6300
Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Ash

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7

Treatment 6	3	69.1800						
Treatment 5	3		70.5700					
Treatment 4	3			76.5100				
Treatment 1	3				79.1100			
Treatment 3	3					79.7400		
Control	3						79.9300	
Treatment 2	3							80.6300
Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

```
ONEWAY VAR00003 VAR00004 VAR00005 VAR00006 VAR00007
VAR00008

VAR00009 BY Treatment

  /STATISTICS DESCRIPTIVES

  /MISSING ANALYSIS

  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

Notes

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Comments		
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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each analysis are based on cases with no missing data for any variable in the analysis.
Syntax		ONEWAY VAR00003 VAR00004 VAR00005 VAR00006 VAR00007 VAR00008 VAR00009 BY Treatment /STATISTICS DESCRIPTIVES /MISSING ANALYSIS /POSTHOC=DUNCAN ALPHA(0.05).
Resources	Processor Time	00:00:00.39
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[DataSet1] C:\Users\KENNIE\Desktop\Alh. students\Full blood data input.sav

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean

						Lower Bound
Haemoglobin	Treatment 1	3	15.6300	.29000	.16743	14.9096
	Treatment 2	3	15.2100	.02646	.01528	15.1443
	Treatment 3	3	14.8600	.12000	.06928	14.5619
	Treatment 4	3	12.3700	.99000	.57158	9.9107
	Treatment 5	3	12.0400	.02000	.01155	11.9903
	Treatment 6	3	10.6800	.08000	.04619	10.4813
	Treatment 7	3	10.2300	.01000	.00577	10.2052
	Total	21	13.0029	2.13396	.46567	12.0315
PCV	Treatment 1	3	42.6000	.05000	.02887	42.4758
	Treatment 2	3	41.8600	.98000	.56580	39.4255
	Treatment 3	3	40.3500	.03000	.01732	40.2755
	Treatment 4	3	39.7700	1.09000	.62931	37.0623
	Treatment 5	3	40.2100	.21000	.12124	39.6883
	Treatment 6	3	39.8700	.99504	.57449	37.3982
	Treatment 7	3	37.2700	.00000	.00000	37.2700
	Total	21	40.2757	1.71030	.37322	39.4972
RBC	Treatment 1	3	7.0400	.02000	.01155	6.9903
	Treatment 2	3	6.8500	.05000	.02887	6.7258
	Treatment 3	3	6.8000	.00000	.00000	6.8000
	Treatment 4	3	5.9200	.01000	.00577	5.8952
	Treatment 5	3	5.3333	.00577	.00333	5.3190
	Treatment 6	3	5.1633	.00577	.00333	5.1490
	Treatment 7	3	4.9700	.02646	.01528	4.9043
	Total	21	6.0110	.83584	.18240	5.6305
WBC	Treatment 1	3	4.1000	.10000	.05774	3.8516

Treatment 2	3	4.3733	.01155	.00667	4.3446
Treatment 3	3	4.8733	.01528	.00882	4.8354
Treatment 4	3	6.9200	.00000	.00000	6.9200
Treatment 5	3	7.8433	.00577	.00333	7.8290
Treatment 6	3	9.6700	.01000	.00577	9.6452
Treatment 7	3	9.8900	.10000	.05774	9.6416

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
Haemoglobin	Treatment 1	16.3504	15.34	15.92
	Treatment 2	15.2757	15.19	15.24
	Treatment 3	15.1581	14.74	14.98
	Treatment 4	14.8293	11.38	13.36
	Treatment 5	12.0897	12.02	12.06
	Treatment 6	10.8787	10.60	10.76
	Treatment 7	10.2548	10.22	10.24
	Total	13.9742	10.22	15.92
PCV	Treatment 1	42.7242	42.55	42.65
	Treatment 2	44.2945	40.88	42.84
	Treatment 3	40.4245	40.32	40.38
	Treatment 4	42.4777	38.68	40.86
	Treatment 5	40.7317	40.00	40.42
	Treatment 6	42.3418	38.87	40.86
	Treatment 7	37.2700	37.27	37.27

RBC	Total	41.0542	37.27	42.84
	Treatment 1	7.0897	7.02	7.06
	Treatment 2	6.9742	6.80	6.90
	Treatment 3	6.8000	6.80	6.80
	Treatment 4	5.9448	5.91	5.93
	Treatment 5	5.3477	5.33	5.34
	Treatment 6	5.1777	5.16	5.17
	Treatment 7	5.0357	4.94	4.99
WBC	Total	6.3914	4.94	7.06
	Treatment 1	4.3484	4.00	4.20
	Treatment 2	4.4020	4.36	4.38
	Treatment 3	4.9113	4.86	4.89
	Treatment 4	6.9200	6.92	6.92
	Treatment 5	7.8577	7.84	7.85
	Treatment 6	9.6948	9.66	9.68
	Treatment 7	10.1384	9.79	9.99

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean
						Lower Bound
WBC	Total	21	6.8100	2.31706	.50562	5.7553
MCV	Treatment 1	3	60.5100	1.00000	.57735	58.0259
	Treatment 2	3	61.0700	.03000	.01732	60.9955
	Treatment 3	3	59.3400	.99504	.57449	56.8682
	Treatment 4	3	67.1800	.90000	.51962	64.9443

	Treatment 5	3	75.3000	.30000	.17321	74.5548
	Treatment 6	3	77.2700	1.07000	.61776	74.6120
	Treatment 7	3	74.9900	.00000	.00000	74.9900
	Total	21	67.9514	7.45537	1.62689	64.5578
MCH	Treatment 1	3	22.2000	1.73251	1.00027	17.8962
	Treatment 2	3	22.2000	1.15000	.66395	19.3432
	Treatment 3	3	21.8533	.00577	.00333	21.8390
	Treatment 4	3	20.9000	.01000	.00577	20.8752
	Treatment 5	3	22.5500	.05000	.02887	22.4258
	Treatment 6	3	20.7000	.01000	.00577	20.6752
	Treatment 7	3	20.5800	.05000	.02887	20.4558
	Total	21	21.5690	1.01784	.22211	21.1057
MCHC	Treatment 1	3	36.6933	1.00500	.58024	34.1968
	Treatment 2	3	36.3400	.10000	.05774	36.0916
	Treatment 3	3	36.8300	.09000	.05196	36.6064
	Treatment 4	3	31.1033	1.00500	.58024	28.6068
	Treatment 5	3	29.9400	.00000	.00000	29.9400
	Treatment 6	3	26.7900	.90000	.51962	24.5543
	Treatment 7	3	27.4500	.01000	.00577	27.4252
	Total	21	32.1638	4.22132	.92117	30.2423

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
WBC	Total	7.8647	4.00	9.99

MCV	Treatment 1	62.9941	59.51	61.51
	Treatment 2	61.1445	61.04	61.10
	Treatment 3	61.8118	58.34	60.33
	Treatment 4	69.4157	66.28	68.08
	Treatment 5	76.0452	75.00	75.60
	Treatment 6	79.9280	76.20	78.34
	Treatment 7	74.9900	74.99	74.99
	Total	71.3451	58.34	78.34
MCH	Treatment 1	26.5038	20.20	23.24
	Treatment 2	25.0568	21.05	23.35
	Treatment 3	21.8677	21.85	21.86
	Treatment 4	20.9248	20.89	20.91
	Treatment 5	22.6742	22.50	22.60
	Treatment 6	20.7248	20.69	20.71
	Treatment 7	20.7042	20.53	20.63
	Total	22.0324	20.20	23.35
MCHC	Treatment 1	39.1899	35.69	37.70
	Treatment 2	36.5884	36.24	36.44
	Treatment 3	37.0536	36.74	36.92
	Treatment 4	33.5999	30.10	32.11
	Treatment 5	29.9400	29.94	29.94
	Treatment 6	29.0257	25.89	27.69
	Treatment 7	27.4748	27.44	27.46
	Total	34.0853	25.89	37.70

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Haemoglobin	Between Groups	88.903	6	14.817	95.489	.000
	Within Groups	2.172	14	.155		
	Total	91.075	20			
PCV	Between Groups	52.130	6	8.688	19.089	.000
	Within Groups	6.372	14	.455		
	Total	58.503	20			
RBC	Between Groups	13.965	6	2.328	4325.457	.000
	Within Groups	.008	14	.001		
	Total	13.973	20			
WBC	Between Groups	107.334	6	17.889	6108.439	.000
	Within Groups	.041	14	.003		
	Total	107.375	20			
MCV	Between Groups	1103.578	6	183.930	319.014	.000
	Within Groups	8.072	14	.577		
	Total	1111.650	20			
MCH	Between Groups	12.061	6	2.010	3.250	.032
	Within Groups	8.659	14	.618		
	Total	20.720	20			

MCHC	Between Groups	350.695	6	58.449	143.647	.000
	Within Groups	5.697	14	.407		
	Total	356.391	20			

Post Hoc Tests

Homogeneous Subsets

Haemoglobin

Duncan

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 7	3	10.2300			

Treatment 6	3	10.6800			
Treatment 5	3		12.0400		
Treatment 4	3		12.3700		
Treatment 3	3			14.8600	
Treatment 2	3			15.2100	15.2100
Treatment 1	3				15.6300
Sig.		.184	.322	.295	.213

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

PCV

Duncan

Treatment	N	Subset for alpha = 0.05		
		1	2	3
Treatment 7	3	37.2700		
Treatment 4	3		39.7700	
Treatment 6	3		39.8700	
Treatment 5	3		40.2100	

Treatment 3	3		40.3500	
Treatment 2	3			41.8600
Treatment 1	3			42.6000
Sig.		1.000	.348	.201

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

RBC

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 7	3	4.9700						
Treatment 6	3		5.1633					
Treatment 5	3			5.3333				
Treatment 4	3				5.9200			
Treatment 3	3					6.8000		
Treatment 2	3						6.8500	
Treatment 1	3							7.0400

Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

WBC

Duncan

Treatment	N	Subset for alpha = 0.05						
		1	2	3	4	5	6	7
Treatment 1	3	4.1000						
Treatment 2	3		4.3733					
Treatment 3	3			4.8733				
Treatment 4	3				6.9200			
Treatment 5	3					7.8433		
Treatment 6	3						9.6700	
Treatment 7	3							9.8900
Sig.		1.000	1.000	1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

MCV

Duncan

Treatment	N	Subset for alpha = 0.05				
		1	2	3	4	5
Treatment 3	3	59.3400				
Treatment 1	3	60.5100	60.5100			
Treatment 2	3		61.0700			
Treatment 4	3			67.1800		
Treatment 7	3				74.9900	
Treatment 5	3				75.3000	
Treatment 6	3					77.2700
Sig.		.080	.382	1.000	.625	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

MCH

Duncan

Treatment	N	Subset for alpha = 0.05		
		1	2	3
Treatment 7	3	20.5800		
Treatment 6	3	20.7000	20.7000	
Treatment 4	3	20.9000	20.9000	
Treatment 3	3	21.8533	21.8533	21.8533
Treatment 1	3		22.2000	22.2000
Treatment 2	3		22.2000	22.2000
Treatment 5	3			22.5500
Sig.		.088	.052	.334

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

MCHC

Duncan

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 6	3	26.7900			
Treatment 7	3	27.4500			

Treatment 5	3		29.9400		
Treatment 4	3			31.1033	
Treatment 2	3				36.3400
Treatment 1	3				36.6933
Treatment 3	3				36.8300
Sig.		.226	1.000	1.000	.387

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

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VAR00007 VAR00008VAR00009 VAR00010 VAR00011 BY
Treatment
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
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Oneway

Notes

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	N of Rows in Working Data File	21
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	Cases Used	Statistics for each analysis are based on cases with no missing data for any variable in the analysis.
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[DataSet1] C:\Users\KENNIE\Desktop\Alh. students\Full blood data input.sav

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean
						Lower Bound
PROTEIN	Treatment 1	3	6.3700	.03000	.01732	6.2955
	Treatment 2	3	6.5200	.04000	.02309	6.4206
	Treatment 3	3	6.7200	.01000	.00577	6.6952
	Treatment 4	3	6.9200	.05292	.03055	6.7886
	Treatment 5	3	7.2000	.20000	.11547	6.7032
	Treatment 6	3	6.6000	.01732	.01000	6.5570
	Treatment 7	3	6.6200	.18193	.10504	6.1681
	Total	21	6.7071	.27623	.06028	6.5814
ALBUMIN	Treatment 1	3	3.8200	.10000	.05774	3.5716
	Treatment 2	3	3.9267	.03215	.01856	3.8468
	Treatment 3	3	3.9600	.10000	.05774	3.7116
	Treatment 4	3	4.4300	.19079	.11015	3.9561
	Treatment 5	3	3.9933	.01528	.00882	3.9554
	Treatment 6	3	4.0133	.01528	.00882	3.9754
	Treatment 7	3	4.0600	.02000	.01155	4.0103
	Total	21	4.0290	.19789	.04318	3.9390
AST	Treatment 1	3	15.6300	.05000	.02887	15.5058
	Treatment 2	3	15.8900	.91000	.52539	13.6294
	Treatment 3	3	16.2300	.03000	.01732	16.1555
	Treatment 4	3	15.5800	.00000	.00000	15.5800
	Treatment 5	3	16.6400	.06000	.03464	16.4910

	Treatment 6	3	17.6200	.09165	.05292	17.3923
	Treatment 7	3	16.5500	1.93124	1.11500	11.7525
	Total	21	16.3057	.95729	.20890	15.8700
	Treatment 1	3	24.2200	.02646	.01528	24.1543
	Treatment 2	3	23.6400	.04000	.02309	23.5406
	Treatment 3	3	24.5700	1.02679	.59282	22.0193
UREA	Treatment 4	3	24.6400	.31048	.17926	23.8687
	Treatment 5	3	24.5500	.02000	.01155	24.5003
	Treatment 6	3	24.2100	.03000	.01732	24.1355
	Treatment 7	3	24.4500	.97596	.56347	22.0256

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
	Treatment 1	6.4445	6.34	6.40
	Treatment 2	6.6194	6.48	6.56
	Treatment 3	6.7448	6.71	6.73
	Treatment 4	7.0514	6.86	6.96
PROTEIN	Treatment 5	7.6968	7.00	7.40
	Treatment 6	6.6430	6.58	6.61
	Treatment 7	7.0719	6.51	6.83
	Total	6.8329	6.34	7.40
	Treatment 1	4.0684	3.72	3.92
ALBUMIN	Treatment 2	4.0065	3.89	3.95
	Treatment 3	4.2084	3.86	4.06

	Treatment 4	4.9039	4.23	4.61
	Treatment 5	4.0313	3.98	4.01
	Treatment 6	4.0513	4.00	4.03
	Treatment 7	4.1097	4.04	4.08
	Total	4.1191	3.72	4.61
AST	Treatment 1	15.7542	15.58	15.68
	Treatment 2	18.1506	14.98	16.80
	Treatment 3	16.3045	16.20	16.26
	Treatment 4	15.5800	15.58	15.58
	Treatment 5	16.7890	16.58	16.70
	Treatment 6	17.8477	17.54	17.72
	Treatment 7	21.3475	14.58	18.44
	Total	16.7415	14.58	18.44
UREA	Treatment 1	24.2857	24.20	24.25
	Treatment 2	23.7394	23.60	23.68
	Treatment 3	27.1207	23.58	25.63
	Treatment 4	25.4113	24.34	24.96
	Treatment 5	24.5997	24.53	24.57
	Treatment 6	24.2845	24.18	24.24
	Treatment 7	26.8744	23.45	25.40

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean
						Lower Bound
UREA	Total	21	24.3257	.56438	.12316	24.0688

ALP	Treatment 1	3	40.6100	.99000	.57158	38.1507
	Treatment 2	3	38.8167	1.73702	1.00287	34.5017
	Treatment 3	3	39.3900	1.00504	.58026	36.8933
	Treatment 4	3	43.6700	.99504	.57449	41.1982
	Treatment 5	3	44.8500	.95394	.55076	42.4803
	Treatment 6	3	42.3000	.01000	.00577	42.2752
	Treatment 7	3	45.3200	.02000	.01155	45.2703
	Total	21	42.1367	2.60891	.56931	40.9491
ALT	Treatment 1	3	17.6300	.98000	.56580	15.1955
	Treatment 2	3	20.1700	.03000	.01732	20.0955
	Treatment 3	3	22.6700	.07000	.04041	22.4961
	Treatment 4	3	36.0500	.97596	.56347	33.6256
	Treatment 5	3	38.3700	1.00000	.57735	35.8859
	Treatment 6	3	37.3400	1.46369	.84506	33.7040
	Treatment 7	3	41.3200	.29052	.16773	40.5983
	Total	21	30.5071	9.43675	2.05927	26.2116
BILRUBIN	Treatment 1	3	.5300	.03000	.01732	.4555
	Treatment 2	3	.4200	.03464	.02000	.3339
	Treatment 3	3	.6800	.01000	.00577	.6552
	Treatment 4	3	1.0033	.00577	.00333	.9890
	Treatment 5	3	.9433	.00577	.00333	.9290
	Treatment 6	3	.9300	.04583	.02646	.8162
	Treatment 7	3	.8700	.01000	.00577	.8452
	Total	21	.7681	.21607	.04715	.6697
CHOLESTEROL	Treatment 1	3	21.2300	.88255	.50954	19.0376
	Treatment 2	3	24.6800	1.08000	.62354	21.9971
	Treatment 3	3	25.8700	.01732	.01000	25.8270

Treatment 4	3	72.3400	1.73309	1.00060	68.0348
Treatment 5	3	76.1900	1.78955	1.03320	71.7445
Treatment 6	3	54.4300	1.97000	1.13738	49.5362

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
UREA	Total	24.5826	23.45	25.63
	Treatment 1	43.0693	39.62	41.60
	Treatment 2	43.1317	36.82	39.98
	Treatment 3	41.8867	38.39	40.40
	Treatment 4	46.1418	42.67	44.66
ALP	Treatment 5	47.2197	43.95	45.85
	Treatment 6	42.3248	42.29	42.31
	Treatment 7	45.3697	45.30	45.34
	Total	43.3242	36.82	45.85
	Treatment 1	20.0645	16.65	18.61
	Treatment 2	20.2445	20.14	20.20
	Treatment 3	22.8439	22.60	22.74
	Treatment 4	38.4744	35.05	37.00
ALT	Treatment 5	40.8541	37.37	39.37
	Treatment 6	40.9760	35.66	38.34
	Treatment 7	42.0417	41.02	41.60
	Total	34.8027	16.65	41.60
BILRUBIN	Treatment 1	.6045	.50	.56

	Treatment 2	.5061	.40	.46
	Treatment 3	.7048	.67	.69
	Treatment 4	1.0177	1.00	1.01
	Treatment 5	.9577	.94	.95
	Treatment 6	1.0438	.89	.98
	Treatment 7	.8948	.86	.88
	Total	.8664	.40	1.01
CHOLESTEROL	Treatment 1	23.4224	20.23	21.90
	Treatment 2	27.3629	23.60	25.76
	Treatment 3	25.9130	25.86	25.89
	Treatment 4	76.6452	71.28	74.34
	Treatment 5	80.6355	74.74	78.19
	Treatment 6	59.3238	52.46	56.40

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean
						Lower Bound
CHOLESTEROL	Treatment 7	3	58.4200	.03464	.02000	58.3339
	Total	21	47.5943	22.22868	4.85070	37.4759
	Treatment 1	3	1.7300	.10536	.06083	1.4683
	Treatment 2	3	.7700	.06083	.03512	.6189
	Treatment 3	3	.6700	.02000	.01155	.6203
CREATININE	Treatment 4	3	.9900	.01732	.01000	.9470
	Treatment 5	3	.8400	.05292	.03055	.7086
	Treatment 6	3	2.1067	.00577	.00333	2.0923

Treatment 7	3	1.5500	.01732	.01000	1.5070
Total	21	1.2367	.52933	.11551	.9957

Descriptives

		95% Confidence Interval for Mean	Minimum	Maximum
		Upper Bound		
CHOLESTEROL	Treatment 7	58.5061	58.40	58.46
	Total	57.7127	20.23	78.19
CREATININE	Treatment 1	1.9917	1.63	1.84
	Treatment 2	.9211	.70	.81
	Treatment 3	.7197	.65	.69
	Treatment 4	1.0330	.98	1.01
	Treatment 5	.9714	.78	.88
	Treatment 6	2.1210	2.10	2.11
	Treatment 7	1.5930	1.54	1.57
	Total	1.4776	.65	2.11

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PROTEIN	Between Groups	1.368	6	.228	20.260	.000
	Within Groups	.158	14	.011		
	Total	1.526	20			
ALBUMIN	Between Groups	.667	6	.111	13.339	.000

	Within Groups	.117	14	.008		
	Total	.783	20			
	Between Groups	9.182	6	1.530	2.342	.089
AST	Within Groups	9.146	14	.653		
	Total	18.328	20			
	Between Groups	2.157	6	.359	1.194	.364
UREA	Within Groups	4.214	14	.301		
	Total	6.371	20			
	Between Groups	122.313	6	20.385	20.657	.000
ALP	Within Groups	13.816	14	.987		
	Total	136.129	20			
	Between Groups	1770.755	6	295.126	401.493	.000
ALT	Within Groups	10.291	14	.735		
	Total	1781.046	20			
	Between Groups	.925	6	.154	241.550	.000
BILRUBIN	Within Groups	.009	14	.001		
	Total	.934	20			
	Between Groups	9858.219	6	1643.036	955.746	.000
CHOLESTEROL	Within Groups	24.068	14	1.719		
	Total	9882.287	20			

CREATININE	Between Groups	5.567	6	.928	348.535	.000
	Within Groups	.037	14	.003		
	Total	5.604	20			

Post Hoc Tests

Homogeneous Subsets

PROTEIN

Duncan

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 1	3	6.3700			
Treatment 2	3	6.5200	6.5200		
Treatment 6	3		6.6000		
Treatment 7	3		6.6200		
Treatment 3	3		6.7200		
Treatment 4	3			6.9200	
Treatment 5	3				7.2000
Sig.		.105	.050	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

ALBUMIN

Duncan

Treatment	N	Subset for alpha = 0.05		
		1	2	3

Treatment 1	3	3.8200		
Treatment 2	3	3.9267	3.9267	
Treatment 3	3	3.9600	3.9600	
Treatment 5	3		3.9933	
Treatment 6	3		4.0133	
Treatment 7	3		4.0600	
Treatment 4	3			4.4300
Sig.		.095	.126	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

AST

Duncan

Treatment	N	Subset for alpha = 0.05	
		1	2
Treatment 4	3	15.5800	
Treatment 1	3	15.6300	
Treatment 2	3	15.8900	

Treatment 3	3	16.2300	16.2300
Treatment 7	3	16.5500	16.5500
Treatment 5	3	16.6400	16.6400
Treatment 6	3		17.6200
Sig.		.171	.071

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

UREA

Duncan

Treatment	N	Subset for alpha = 0.05
		1
Treatment 2	3	23.6400
Treatment 6	3	24.2100
Treatment 1	3	24.2200
Treatment 7	3	24.4500
Treatment 5	3	24.5500
Treatment 3	3	24.5700
Treatment 4	3	24.6400
Sig.		.067

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

ALP

Duncan

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
Treatment 2	3	38.8167			
Treatment 3	3	39.3900			
Treatment 1	3	40.6100	40.6100		
Treatment 6	3		42.3000	42.3000	
Treatment 4	3			43.6700	43.6700
Treatment 5	3				44.8500
Treatment 7	3				45.3200
Sig.		.053	.056	.113	.073

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

ALT

Duncan

Treatment	N	Subset for alpha = 0.05					
		1	2	3	4	5	6
Treatment 1	3	17.6300					
Treatment 2	3		20.1700				
Treatment 3	3			22.6700			
Treatment 4	3				36.0500		
Treatment 6	3				37.3400	37.3400	
Treatment 5	3					38.3700	
Treatment 7	3						41.3200
Sig.		1.000	1.000	1.000	.087	.163	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

BILRUBIN

Duncan

Treatment	N	Subset for alpha = 0.05					
		1	2	3	4	5	6
Treatment 2	3	.4200					
Treatment 1	3		.5300				
Treatment 3	3			.6800			
Treatment 7	3				.8700		
Treatment 6	3					.9300	
Treatment 5	3					.9433	
Treatment 4	3						1.0033
Sig.		1.000	1.000	1.000	1.000	.528	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

CHOLESTEROL

Duncan

Treatment	N	Subset for alpha = 0.05					
		1	2	3	4	5	6
Treatment 1	3	21.2300					
Treatment 2	3		24.6800				
Treatment 3	3		25.8700				
Treatment 6	3			54.4300			
Treatment 7	3				58.4200		
Treatment 4	3					72.3400	
Treatment 5	3						76.1900
Sig.		1.000	.285	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

CREATININE

Duncan

Treatment	N	Subset for alpha = 0.05					
		1	2	3	4	5	6

Treatment 3	3	.6700					
Treatment 2	3		.7700				
Treatment 5	3		.8400				
Treatment 4	3			.9900			
Treatment 7	3				1.5500		
Treatment 1	3					1.7300	
Treatment 6	3						2.1067
Sig.		1.000	.119	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

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  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(PERIOD*PROCESSIN)
  /PRINT=ETASQ
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA CFkg BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: CFkg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	1974.923[a]	8	246.865	1.114	.399	
Intercept	164648.861	1	164648.861	742.830	.000	
PERIOD	1540.390	6	256.732	1.158	.371	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	3989.713	18	221.651			
Total	170613.496	27				
Corrected Total	5964.636	26				

a. R Squared = .331 (Adjusted R Squared = .034)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: CFkg

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	82.320	8.596	64.261	100.379
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	80.380	8.596	62.321	98.439
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	79.830	8.596	61.771	97.889
	ROASTED	.[a]	.	.	.
	BOILED	82.320	8.596	64.261	100.379
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	80.880	8.596	62.821	98.939
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	79.830	8.596	61.771	97.889
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	82.320	8.596	64.261	100.379
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	80.880	8.596	62.821	98.939
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	54.053	8.596	35.995	72.112

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

CFkg

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	54.0533
FX9days	3	79.8300
BX30min	3	79.8300
FX6days	3	80.3800
BX20min	3	80.8800
RX20mins	3	80.8800
FX3days	3	82.3200
BX10min	3	82.3200

RX10mins	3	82.3200
Sig.		.058

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 221.651.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

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UNIANOVA RCFkg BY PERIOD PROCESSIN
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  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(PERIOD*PROCESSIN)
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  /CRITERIA=ALPHA(.05)
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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA RCFkg BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: RCFkg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squar
Corrected Model	30.384[a]	8	3.798	365.060	.000	
Intercept	51.723	1	51.723	4971.580	.000	
PERIOD	30.254	6	5.042	484.670	.000	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	.187	18	.010			
Total	82.294	27				
Corrected Total	30.571	26				

a. R Squared = .994 (Adjusted R Squared = .991)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: RCFkg

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	.000	.059	-.124	.124
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	1.940	.059	1.816	2.064
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	2.490	.059	2.366	2.614
	ROASTED	.[a]	.	.	.
	BOILED	-1.004E-013	.059	-.124	.124
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	1.440	.059	1.316	1.564
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	2.490	.059	2.366	2.614
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	-1.004E-013	.059	-.124	.124
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	1.440	.059	1.316	1.564
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	2.657	.059	2.533	2.780

a. This level combination of factors is not observed, thus the corresponding population marginal mean isnot estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

RCFkg

Duncan[a,b]

PERIOD	N	Subset			
		1	2	3	4
FX3days	3	.0000			
BX10min	3	.0000			
RX10mins	3	.0000			
BX20min	3		1.4400		
RX20mins	3		1.4400		
FX6days	3			1.9400	
FX9days	3				2.4900
BX30min	3				2.4900

RX30mins	3				2.6567
Sig.		1.000	1.000	1.000	.073

Means for groups in homogeneous subsets are displayed.Based on observed means.

The error term is Mean Square(Error) = .010.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

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  /CRITERIA=ALPHA(.05)
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA RCF BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: %RCF

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	9672552.052[a]	8	1209069.007	1.002	.468	
Intercept	1226121.994	1	1226121.994	1.016	.327	
PERIOD	7259086.850	6	1209847.808	1.002	.454	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	21728377.880	18	1207132.104			
Total	32627051.926	27				
Corrected Total	31400929.932	26				

a. R Squared = .308 (Adjusted R Squared = .000)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: %RCF

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	.000	634.332	-1332.683	1332.683
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	2.360	634.332	-1330.323	1335.043
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	3.020	634.332	-1329.663	1335.703
	ROASTED	.[a]	.	.	.
	BOILED	.000	634.332	-1332.683	1332.683
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	1.750	634.332	-1330.933	1334.433
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	3.020	634.332	-1329.663	1335.703
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	.000	634.332	-1332.683	1332.683
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	1.750	634.332	-1330.933	1334.433
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	1906.007	634.332	573.324	3238.689

a. This level combination of factors is not observed, thus the corresponding population marginal meanis not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

%RCF

Duncan[a,b]

PERIOD	N	Subset
		1
FX3days	3	.0000
BX10min	3	.0000
RX10mins	3	.0000
BX20min	3	1.7500
RX20mins	3	1.7500
FX6days	3	2.3600
FX9days	3	3.0200
BX30min	3	3.0200

RX30mins	3	1906.0067
Sig.		.080

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1207132.104.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

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  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(PERIOD*PROCESSIN)
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  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA TF1 BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	6
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: TF1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squar

Corrected Model	5174062.294[a]	7	739151.756	.642	.716	
Intercept	634211971.979	1	634211971.979	550.983	.000	
PERIOD	3642663.726	5	728532.745	.633	.678	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	18416883.840	16	1151055.240			
Total	662187660.810	24				
Corrected Total	23590946.134	23				

a. R Squared = .219 (Adjusted R Squared = -.122)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: TF1

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	5217.100	619.423	3903.982	6530.218
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	5418.000	619.423	4104.882	6731.118
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	5510.400	619.423	4197.282	6823.518
	ROASTED	.[a]	.	.	.
	BOILED	5217.100	619.423	3903.982	6530.218
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	5401.200	619.423	4088.082	6714.318
BX30min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	5217.100	619.423	3903.982	6530.218
RX20mins	BOILED	.[a]	.	.	.

	FERMENTED	.[a]	.	.	.
	ROASTED	5325.600	619.423	4012.482	6638.718
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	3960.007	619.423	2646.888	5273.125

a. This level combination of factors is not observed, thus the corresponding population marginal meanis not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

TF1

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	3960.0067
FX3days	3	5217.1000
BX10min	3	5217.1000
RX10mins	3	5217.1000
RX20mins	3	5325.6000
BX30min	3	5401.2000
FX6days	3	5418.0000
FX9days	3	5510.4000
Sig.		.138

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1151055.240.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

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UNIANOVA CFC BY PERIOD PROCESSIN
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA CFC BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: CFC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	52223.478[a]	8	6527.935	.757	.644	
Intercept	4730615.356	1	4730615.356	548.434	.000	
PERIOD	37104.337	6	6184.056	.717	.641	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	155262.072	18	8625.671			
Total	4938100.906	27				
Corrected Total	207485.550	26				

a. R Squared = .252 (Adjusted R Squared = -.081)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: CFC

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	429.450	53.621	316.796	542.104
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	435.500	53.621	322.846	548.154
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	439.920	53.621	327.266	552.574
	ROASTED	.[a]	.	.	.
	BOILED	429.450	53.621	316.796	542.104
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	446.360	53.621	333.706	559.014
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	431.180	53.621	318.526	543.834
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	429.450	53.621	316.796	542.104
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	430.740	53.621	318.086	543.394
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	295.157	53.621	182.503	407.810

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

CFC

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	295.1567
FX3days	3	429.4500
BX10min	3	429.4500
RX10mins	3	429.4500
RX20mins	3	430.7400
BX30min	3	431.1800
FX6days	3	435.5000
FX9days	3	439.9200

BX20min	3	446.3600
Sig.		.099

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 8625.671.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA RFC BY PERIOD PROCESSIN
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  /EMMEANS=TABLES(PERIOD*PROCESSIN)
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA RFC BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: RFC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	1430.022[a]	8	178.753	11.620	.000	
Intercept	1053.813	1	1053.813	68.504	.000	
PERIOD	1419.671	6	236.612	15.381	.000	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	276.896	18	15.383			
Total	2760.731	27				
Corrected Total	1706.919	26				

a. R Squared = .838 (Adjusted R Squared = .766)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: RFC

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	.000	2.264	-4.757	4.757
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	-6.050	2.264	-10.807	-1.293
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	-10.470	2.264	-15.227	-5.713
	ROASTED	.[a]	.	.	.
	BOILED	.000	2.264	-4.757	4.757
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	-16.910	2.264	-21.667	-12.153
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
BX30min	BOILED	-1.730	2.264	-6.487	3.027
	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	.000	2.264	-4.757	4.757
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	-1.290	2.264	-6.047	3.467
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	-19.777	2.264	-24.534	-15.019

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

RFC

Duncan[a,b]

PERIOD	N	Subset			
		1	2	3	4
RX30mins	3	-19.7767			
BX20min	3	-16.9100	-16.9100		
FX9days	3		-10.4700	-10.4700	
FX6days	3			-6.0500	-6.0500
BX30min	3				-1.7300
RX20mins	3				-1.2900
FX3days	3				.0000
BX10min	3				.0000

RX10mins	3				.0000
Sig.		.383	.060	.184	.109

Means for groups in homogeneous subsets are displayed.Based on observed means.

The error term is Mean Square(Error) = 15.383.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

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  /CRITERIA=ALPHA(.05)
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA RFC_A BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: %RFC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	662542.873[a]	8	82817.859	.980	.482	
Intercept	79668.971	1	79668.971	.943	.344	
PERIOD	495096.287	6	82516.048	.976	.469	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	1521456.184	18	84525.344			
Total	2263668.028	27				
Corrected Total	2183999.057	26				

a. R Squared = .303 (Adjusted R Squared = -.006)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: %RFC

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	.000	167.854	-352.649	352.649
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	-1.410	167.854	-354.059	351.239
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	-2.440	167.854	-355.089	350.209
	ROASTED	.[a]	.	.	.
	BOILED	.000	167.854	-352.649	352.649
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	-3.940	167.854	-356.589	348.709
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	-.400	167.854	-353.049	352.249
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	-1.568E-013	167.854	-352.649	352.649
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	-.300	167.854	-352.949	352.349
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	497.373	167.854	144.724	850.022

a. This level combination of factors is not observed, thus the corresponding population marginal mean isnot estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

%RFC

Duncan[a,b]

PERIOD	N	Subset
		1
BX20min	3	-3.9400
FX9days	3	-2.4400
FX6days	3	-1.4100
BX30min	3	-.4000
RX20mins	3	-.3000
FX3days	3	.0000
BX10min	3	.0000
RX10mins	3	.0000

RX30mins	3	497.3733
Sig.		.082

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 84525.344.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA TWG BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: TWG

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partia Squa
Corrected Model	684798.472[a]	8	85599.809	1.601	.193	
Intercept	63468347.201	1	63468347.201	1187.260	.000	
PERIOD	500419.116	6	83403.186	1.560	.216	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	962241.307	18	53457.850			
Total	65115386.980	27				
Corrected Total	1647039.779	26				

a. R Squared = .416 (Adjusted R Squared = .156)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: TWG

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	1540.000	133.489	1259.550	1820.450
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	1680.200	133.489	1399.750	1960.650
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	1560.000	133.489	1279.550	1840.450
	ROASTED	.[a]	.	.	.
	BOILED	1540.000	133.489	1259.550	1820.450
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	1654.500	133.489	1374.050	1934.950
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	1575.000	133.489	1294.550	1855.450
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	1540.000	133.489	1259.550	1820.450
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	1605.000	133.489	1324.550	1885.450
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	1104.033	133.489	823.584	1384.483

a. This level combination of factors is not observed, thus the corresponding population marginal meanis not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

TWG

Duncan[a,b]

PERIOD	N	Subset	
		1	2
RX30mins	3	1104.033	
FX3days	3		1540.000
BX10min	3		1540.000
RX10mins	3		1540.000
FX9days	3		1560.000
BX30min	3		1575.000
RX20mins	3		1605.000
BX20min	3		1654.500

FX6days		3	1680.200
Sig.		1.000	.520

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 53457.850.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
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  /POSTHOC=PERIOD(DUNCAN)
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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA CFB BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.05

[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: CFB

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	18158.572[a]	8	2269.822	.572	.787	
Intercept	1894003.266	1	1894003.266	477.250	.000	
PERIOD	13886.632	6	2314.439	.583	.739	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	71434.317	18	3968.573			
Total	1983596.156	27				
Corrected Total	89592.889	26				

a. R Squared = .203 (Adjusted R Squared = -.152)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: CFB

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	278.860	36.371	202.447	355.273
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	259.200	36.371	182.787	335.613
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	282.000	36.371	205.587	358.413
	ROASTED	.[a]	.	.	.
	BOILED	278.860	36.371	202.447	355.273
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	269.790	36.371	193.377	346.203
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	273.770	36.371	197.357	350.183
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	278.860	36.371	202.447	355.273
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	268.370	36.371	191.957	344.783
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	193.987	36.371	117.574	270.400

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

CFB

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	193.9867
FX6days	3	259.2000
RX20mins	3	268.3700
BX20min	3	269.7900
BX30min	3	273.7700
FX3days	3	278.8600
BX10min	3	278.8600
RX10mins	3	278.8600

FX9days	3	282.0000
Sig.		.152

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 3968.573.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA CD BY PERIOD PROCESSIN
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  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
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  /PRINT=ETASQ
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA CD BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: CD

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	161746.109[a]	8	20218.264	.804	.608	
Intercept	28358.426	1	28358.426	1.127	.302	
PERIOD	121511.859	6	20251.977	.805	.579	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	452914.385	18	25161.910			
Total	643018.920	27				
Corrected Total	614660.494	26				

a. R Squared = .263 (Adjusted R Squared = -.064)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: CD

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	.000	91.582	-192.407	192.407
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	19.660	91.582	-172.747	212.067
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	-3.140	91.582	-195.547	189.267
	ROASTED	.[a]	.	.	.
	BOILED	-1.284E-013	91.582	-192.407	192.407
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	9.070	91.582	-183.337	201.477
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	5.090	91.582	-187.317	197.497
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	-1.284E-013	91.582	-192.407	192.407
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	10.490	91.582	-181.917	202.897
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	250.507	91.582	58.100	442.914

a. This level combination of factors is not observed, thus the corresponding population marginal mean isnot estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

CD

Duncan[a,b]

PERIOD	N	Subset
		1
FX9days	3	-3.1400
FX3days	3	.0000
BX10min	3	.0000
RX10mins	3	.0000
BX30min	3	5.0900
BX20min	3	9.0700
RX20mins	3	10.4900
FX6days	3	19.6600

RX30mins	3	250.5067
Sig.		.105

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 25161.910.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA CWR BY PERIOD PROCESSIN
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  /INTERCEPT=INCLUDE
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  /EMMEANS=TABLES(PERIOD*PROCESSIN)
  /PRINT=ETASQ
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA CWR BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: CWR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partia Squa
Corrected Model	61616.071[a]	8	7702.009	1.000	.469	
Intercept	18017334.009	1	18017334.009	2339.303	.000	
PERIOD	46212.053	6	7702.009	1.000	.455	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	138636.160	18	7702.009			
Total	18217586.240	27				
Corrected Total	200252.231	26				

a. R Squared = .308 (Adjusted R Squared = .000)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: CWR

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	800.000	50.669	693.549	906.451
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	800.000	50.669	693.549	906.451
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	800.000	50.669	693.549	906.451
	ROASTED	.[a]	.	.	.
	BOILED	800.000	50.669	693.549	906.451
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	800.000	50.669	693.549	906.451
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	800.000	50.669	693.549	906.451
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	800.000	50.669	693.549	906.451
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	800.000	50.669	693.549	906.451
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	952.007	50.669	845.555	1058.458

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

CWR

Duncan[a,b]

PERIOD	N	Subset
		1
FX3days	3	800.0000
FX6days	3	800.0000
FX9days	3	800.0000
BX10min	3	800.0000
BX20min	3	800.0000
BX30min	3	800.0000
RX10mins	3	800.0000
RX20mins	3	800.0000

RX30mins	3	952.0067
Sig.		.081

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 7702.009.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
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  /POSTHOC=PERIOD(DUNCAN)
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  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA CPR BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: CPR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partia Squa
Corrected Model	195222.460[a]	8	24402.807	1.190	.358	
Intercept	43138272.321	1	43138272.321	2104.282	.000	
PERIOD	150750.136	6	25125.023	1.226	.339	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	369004.160	18	20500.231			
Total	43702498.941	27				
Corrected Total	564226.620	26				

a. R Squared = .346 (Adjusted R Squared = .055)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: CPR

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	1229.450	82.664	1055.778	1403.122
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	1235.500	82.664	1061.828	1409.172
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	1239.920	82.664	1066.248	1413.592
	ROASTED	.[a]	.	.	.
	BOILED	1229.450	82.664	1055.778	1403.122
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	1246.360	82.664	1072.688	1420.032
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	1231.180	82.664	1057.508	1404.852
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	1229.450	82.664	1055.778	1403.122
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	1230.740	82.664	1057.068	1404.412
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	1504.013	82.664	1330.342	1677.685

a. This level combination of factors is not observed, thus the corresponding population marginal meanis not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

CPR

Duncan[a,b]

PERIOD	N	Subset
		1
FX3days	3	1229.4500
BX10min	3	1229.4500
RX10mins	3	1229.4500
RX20mins	3	1230.7400
BX30min	3	1231.1800
FX6days	3	1235.5000
FX9days	3	1239.9200
BX20min	3	1246.3600

RX30mins	3	1504.0133
Sig.		.055

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 20500.231.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
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  /EMMEANS=TABLES(PERIOD*PROCESSIN)
  /PRINT=ETASQ
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA SP BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: SP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partia Squa
Corrected Model	467432.960[a]	8	58429.120	1.000	.469	
Intercept	103034349.120	1	103034349.120	1763.408	.000	
PERIOD	350574.720	6	58429.120	1.000	.455	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	1051724.160	18	58429.120			
Total	104553506.240	27				
Corrected Total	1519157.120	26				

a. R Squared = .308 (Adjusted R Squared = .000)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: SP

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	2000.000	139.558	1706.800	2293.200
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	2000.000	139.558	1706.800	2293.200
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	2000.000	139.558	1706.800	2293.200
	ROASTED	.[a]	.	.	.
	BOILED	2000.000	139.558	1706.800	2293.200
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	2000.000	139.558	1706.800	2293.200
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	2000.000	139.558	1706.800	2293.200
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	2000.000	139.558	1706.800	2293.200
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	2000.000	139.558	1706.800	2293.200
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	1581.327	139.558	1288.127	1874.527

a. This level combination of factors is not observed, thus the corresponding population marginal meanis not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

SP

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	1581.3267
FX3days	3	2000.0000
FX6days	3	2000.0000
FX9days	3	2000.0000
BX10min	3	2000.0000
BX20min	3	2000.0000
BX30min	3	2000.0000
RX10mins	3	2000.0000

RX20mins	3	2000.0000
Sig.		.081

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 58429.120.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA PROF BY PERIOD PROCESSIN
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  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(PERIOD*PROCESSIN)
  /PRINT=ETASQ
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
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Univariate Analysis of Variance

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA PROF BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.03

[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: PROF

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squar
Corrected Model	177776.018[a]	8	22222.002	1.201	.352	
Intercept	14680321.451	1	14680321.451	793.471	.000	
PERIOD	137471.307	6	22911.884	1.238	.333	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	333025.312	18	18501.406			
Total	15191122.781	27				
Corrected Total	510801.330	26				

a. R Squared = .348 (Adjusted R Squared = .058)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: PROF

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	770.550	78.531	605.562	935.538
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	764.500	78.531	599.512	929.488
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	760.080	78.531	595.092	925.068
	ROASTED	.[a]	.	.	.
	BOILED	770.550	78.531	605.562	935.538
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	753.640	78.531	588.652	918.628
BX20min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	768.820	78.531	603.832	933.808
BX30min	FERMENTED	.[a]	.	.	.

	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	770.550	78.531	605.562	935.538
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	769.260	78.531	604.272	934.248
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	508.387	78.531	343.399	673.374

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

Homogeneous Subsets

PROF

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	508.3867
BX20min	3	753.6400
FX9days	3	760.0800
FX6days	3	764.5000
BX30min	3	768.8200
RX20mins	3	769.2600
FX3days	3	770.5500
BX10min	3	770.5500

RX10mins	3	770.5500
Sig.		.054

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 18501.406.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA PROF_A BY PERIOD PROCESSIN
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(PERIOD*PROCESSIN)
  /PRINT=ETASQ
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
```

Univariate Analysis of Variance

Notes

Output Created		23-NOV-2021 21:30:55
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA PROF_A BY PERIOD PROCESSIN /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(PERIOD*PROCESSIN) /PRINT=ETASQ /CRITERIA=ALPHA(.05) /DESIGN=PERIOD PROCESSIN PERIOD*PROCESSIN.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03

[DataSet1] C:\Users\Alhaji Ali Y\Documents\ECONOMICS.sav

Warnings

Subsets cannot be computed with alpha = .050

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	2
PROCESSIN	BOILED	9
	FERMENTED	9
	ROASTED	8

Tests of Between-Subjects Effects

Dependent Variable: %PROF

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial E Square
Corrected Model	4.283[a]	8	.535	.	.	
Intercept	37282.408	1	37282.408	.	.	
PERIOD	4.255	6	.709	.	.	
PROCESSIN	.000	0	.	.	.	
PERIOD * PROCESSIN	.000	0	.	.	.	
Error	.000	17	.000			
Total	37975.090	26				
Corrected Total	4.283	25				

a. R Squared = 1.000 (Adjusted R Squared = 1.000)

Estimated Marginal Means

PERIOD * PROCESSIN

Dependent Variable: %PROF

PERIOD	PROCESSIN	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
	BOILED	.[a]	.	.	.
FX3days	FERMENTED	38.530	.000	38.530	38.530
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX6days	FERMENTED	38.230	.000	38.230	38.230
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
FX9days	FERMENTED	38.000	.000	38.000	38.000
	ROASTED	.[a]	.	.	.
	BOILED	38.530	.000	38.530	38.530
BX10min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
BX20min	BOILED	37.680	.000	37.680	37.680

	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	38.440	.000	38.440	38.440
BX30min	FERMENTED	.[a]	.	.	.
	ROASTED	.[a]	.	.	.
	BOILED	.[a]	.	.	.
RX10mins	FERMENTED	.[a]	.	.	.
	ROASTED	38.530	.000	38.530	38.530
	BOILED	.[a]	.	.	.
RX20mins	FERMENTED	.[a]	.	.	.
	ROASTED	38.460	.000	38.460	38.460
	BOILED	.[a]	.	.	.
RX30mins	FERMENTED	.[a]	.	.	.
	ROASTED	37.200	.000	37.200	37.200

a. This level combination of factors is not observed, thus the corresponding population marginalmean is not estimable.

Post Hoc Tests

PERIOD

```
UNIANOVA TENDERNESS BY PERIOD
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:16:32
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA TENDERNESS BY PERIOD /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PERIOD.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.05

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3

Tests of Between-Subjects Effects

Dependent Variable: TENDERNESS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.308[a]	8	.039	3468.000	.000
Intercept	90915.021	1	90915.021	8182351874.997	.000
PERIOD	.308	8	.039	3468.000	.000
Error	.000	18	1.111E-005		
Total	90915.329	27			
Corrected Total	.308	26			

a. R Squared = .999 (Adjusted R Squared = .999)

Estimated Marginal Means

Grand Mean

Dependent Variable: TENDERNESS

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound

58.028	.001	58.026	58.029

Post Hoc Tests

PERIOD

Homogeneous Subsets

TENDERNESS

Duncan[a,b]

PERIOD	N	Subset	
		1	2
FX3days	3	57.9900	
FX6days	3	57.9900	
FX9days	3	57.9900	
BX10min	3	57.9900	
BX30min	3	57.9900	
RX10mins	3	57.9900	
RX20mins	3	57.9900	
RX30mins	3	57.9900	
BX20min	3		58.3300
Sig.		1.000	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1.11E-005.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

UNIANOVA FLAVOUR BY PERIOD

```
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:17:00
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA FLAVOUR BY PERIOD /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PERIOD.
Resources	Processor Time	00:00:00.06
	Elapsed Time	00:00:00.08

```
[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
```

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3

Tests of Between-Subjects Effects

Dependent Variable: FLAVOUR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	212.855[a]	8	26.607	82573.009	.000
Intercept	148309.674	1	148309.674	460271400.931	.000
PERIOD	212.855	8	26.607	82573.009	.000
Error	.006	18	.000		
Total	148522.534	27			
Corrected Total	212.861	26			

a. R Squared = 1.000 (Adjusted R Squared = 1.000)

Estimated Marginal Means

Grand Mean

Dependent Variable: FLAVOUR

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
74.114	.003	74.107	74.122

Post Hoc Tests

PERIOD

Homogeneous Subsets

FLAVOUR

Duncan[a,b]

PERIOD	N	Subset			
		1	2	3	4
RX30mins	3	66.3200			
BX30min	3		73.6100		
FX6days	3			75.0000	
FX3days	3				75.3500
FX9days	3				75.3500
BX10min	3				75.3500
BX20min	3				75.3500
RX10mins	3				75.3500
RX20mins	3				75.3500
Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.Based on observed means.

The error term is Mean Square(Error) = .000.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA COLOUR BY PERIOD
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
```

```
/EMMEANS=TABLES(OVERALL)
/CRITERIA=ALPHA(.05)
```

```
  /DESIGN=PERIOD.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:17:15
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA COLOUR BY PERIOD /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PERIOD.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03

```
[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
```

Between-Subjects Factors

		N
PERIOD	FX3days	3

FX6days	3
FX9days	3
BX10min	3
BX20min	3
BX30min	3
RX10mins	3
RX20mins	3
RX30mins	3

Tests of Between-Subjects Effects

Dependent Variable: COLOUR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	8	1.481E-005	.015	1.000
Intercept	200199.722	1	200199.722	208702413.224	.000
PERIOD	.000	8	1.481E-005	.015	1.000
Error	.017	18	.001		
Total	200199.740	27			
Corrected Total	.017	26			

a. R Squared = .007 (Adjusted R Squared = -.435)

Estimated Marginal Means

Grand Mean

Dependent Variable: COLOUR

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
86.109	.006	86.097	86.122

Post Hoc Tests

PERIOD

Homogeneous Subsets

COLOUR

Duncan[a,b]

PERIOD	N	Subset
		1
RX30mins	3	86.1033
FX3days	3	86.1100
FX6days	3	86.1100
FX9days	3	86.1100
BX10min	3	86.1100
BX20min	3	86.1100
BX30min	3	86.1100
RX10mins	3	86.1100
RX20mins	3	86.1100
Sig.		.818

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .001.

a. Uses

Harmonic

Mean

Sample

Size =

3.000.

b. Alpha = .05.

```
UNIANOVA JUICINESS BY PERIOD
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
```

```
  /DESIGN=PERIOD.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:17:28
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA JUICINESS BY PERIOD /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PERIOD.
Resources	Processor Time	00:00:00.05
	Elapsed Time	00:00:00.05

```
[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
```

Between-Subjects Factors

		N
PERIOD	FX3days	3

FX6days	3
FX9days	3
BX10min	3
BX20min	3
BX30min	3
RX10mins	3
RX20mins	3
RX30mins	3

Tests of Between-Subjects Effects

Dependent Variable: JUICINESS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	8	6.204E-005	.931	.516
Intercept	157558.195	1	157558.195	2363372917.555	.000
PERIOD	.000	8	6.204E-005	.931	.516
Error	.001	18	6.667E-005		
Total	157558.196	27			
Corrected Total	.002	26			

a. R Squared = .293 (Adjusted R Squared = -.022)

Estimated Marginal Means

Grand Mean

Dependent Variable: JUICINESS

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
76.390	.002	76.387	76.394

Post Hoc Tests

PERIOD

Homogeneous Subsets

JUICINESS

Duncan[a,b]

PERIOD	N	Subset	
		1	2
FX3days	3	76.3833	
FX9days	3	76.3867	76.3867
BX10min	3	76.3900	76.3900
BX30min	3	76.3900	76.3900
RX10mins	3	76.3900	76.3900
RX20mins	3	76.3900	76.3900
RX30mins	3	76.3900	76.3900
BX20min	3	76.3933	76.3933
FX6days	3		76.4000
Sig.		.204	.096

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 6.67E-005.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA PALATABILITY BY PERIOD
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:17:41
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA PALATABILITY BY PERIOD /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PERIOD.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Warnings

Subsets cannot be computed with alpha = .050

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3

Tests of Between-Subjects Effects

Dependent Variable: PALATABILITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	8	.000	.	.
Intercept	200203.167	1	200203.167	.	.
PERIOD	.000	8	.000	.	.
Error	.000	18	.000		
Total	200203.167	27			
Corrected Total	.000	26			

a. R Squared = . (Adjusted R Squared = .)

Estimated Marginal Means

Grand Mean

Dependent Variable: PALATABILITY

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
86.110	.000	86.110	86.110

Post Hoc Tests

PERIOD

```
UNIANOVA ACCEPTABILITY BY PERIOD
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /POSTHOC=PERIOD(DUNCAN)
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PERIOD.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:18:00
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA ACCEPTABILITY BY PERIOD /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /POSTHOC=PERIOD(DUNCAN) /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PERIOD.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PERIOD	FX3days	3
	FX6days	3
	FX9days	3
	BX10min	3
	BX20min	3
	BX30min	3
	RX10mins	3
	RX20mins	3
	RX30mins	3

Tests of Between-Subjects Effects

Dependent Variable: ACCEPTABILITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	8	.000	.000	1.000
Intercept	161875.932	1	161875.932	118445804.122	.000
PERIOD	.000	8	.000	.000	1.000
Error	.025	18	.001		
Total	161875.957	27			
Corrected Total	.025	26			

a. R Squared = .000 (Adjusted R Squared = -.444)

Estimated Marginal Means

Grand Mean

Dependent Variable: ACCEPTABILITY

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
77.430	.007	77.415	77.445

Post Hoc Tests

PERIOD

Homogeneous Subsets

ACCEPTABILITY

Duncan[a,b]

PERIOD	N	Subset
		1
BX30min	3	77.4300
FX3days	3	77.4300
FX6days	3	77.4300
FX9days	3	77.4300
BX10min	3	77.4300
BX20min	3	77.4300
RX10mins	3	77.4300

RX20mins	3	77.4300
RX30mins	3	77.4300
Sig.		1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .001.

a. Uses Harmonic Mean Sample Size = 3.000.

b. Alpha = .05.

```
UNIANOVA TENDERNESS BY PROCESSING
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PROCESSING.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:18:32
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.

Syntax		UNIANOVA TENDERNESS BY PROCESSING /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PROCESSING.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PROCESSING	BOILED	9
	FERMENTE	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: TENDERNESS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.077[a]	2	.039	3.997	.032
Intercept	90915.021	1	90915.021	9429388.505	.000
PROCESSING	.077	2	.039	3.997	.032
Error	.231	24	.010		
Total	90915.329	27			
Corrected Total	.308	26			

a. R Squared = .250 (Adjusted R Squared = .187)

Estimated Marginal Means

Grand Mean

Dependent Variable: TENDERNESS

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
58.028	.019	57.989	58.067

```
UNIANOVA FLAVOUR BY PROCESSING
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PROCESSING.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:18:52
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA FLAVOUR BY PROCESSING /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PROCESSING.

Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PROCESSING	BOILED	9
	FERMENTE	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: FLAVOUR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	43.473[a]	2	21.736	3.080	.064
Intercept	148309.674	1	148309.674	21013.510	.000
PROCESSING	43.473	2	21.736	3.080	.064
Error	169.388	24	7.058		
Total	148522.534	27			
Corrected Total	212.861	26			

a. R Squared = .204 (Adjusted R Squared = .138)

Estimated Marginal Means

Grand Mean

Dependent Variable: FLAVOUR

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
74.114	.511	73.059	75.170

```
UNIANOVA COLOUR BY PROCESSING
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PROCESSING.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:19:24
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA COLOUR BY PROCESSING /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PROCESSING.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PROCESSING	BOILED	9
	FERMENTE	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: COLOUR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.963E-005[a]	2	1.481E-005	.020	.980
Intercept	200199.722	1	200199.722	276844686.428	.000
PROCESSING	2.963E-005	2	1.481E-005	.020	.980
Error	.017	24	.001		
Total	200199.740	27			
Corrected Total	.017	26			

a. R Squared = .002 (Adjusted R Squared = -.081)

Estimated Marginal Means

Grand Mean

Dependent Variable: COLOUR

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
86.109	.005	86.099	86.120

```
UNIANOVA JUICINESS BY PROCESSING
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PROCESSING.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:19:34
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA JUICINESS BY PROCESSING /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PROCESSING.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PROCESSING	BOILED	9
	FERMENTE	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: JUICINESS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.407E-006[a]	2	3.704E-006	.053	.949
Intercept	157558.195	1	157558.195	2238984869.263	.000
PROCESSING	7.407E-006	2	3.704E-006	.053	.949
Error	.002	24	7.037E-005		
Total	157558.196	27			
Corrected Total	.002	26			

a. R Squared = .004 (Adjusted R Squared = -.079)

Estimated Marginal Means

Grand Mean

Dependent Variable: JUICINESS

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
76.390	.002	76.387	76.394

```
UNIANOVA PALATABILITY BY PROCESSING
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PROCESSING.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:19:46
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA PALATABILITY BY PROCESSING /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PROCESSING.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

```
[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
```

Between-Subjects Factors

		N
PROCESSING	BOILED	9
	FERMENTE	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: PALATABILITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.

Corrected Model	.000[a]	2	.000	.	.
Intercept	200203.167	1	200203.167	.	.
PROCESSING	.000	2	.000	.	.
Error	.000	24	.000		
Total	200203.167	27			
Corrected Total	.000	26			

a. R Squared = . (Adjusted R Squared = .)

Estimated Marginal Means

Grand Mean

Dependent Variable: PALATABILITY

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
86.110	.000	86.110	86.110

```
UNIANOVA ACCEPTABILITY BY PROCESSING
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(OVERALL)
  /CRITERIA=ALPHA(.05)
  /DESIGN=PROCESSING.
```

Univariate Analysis of Variance

Notes

Output Created		08-DEC-2021 21:19:57
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		UNIANOVA ACCEPTABILITY BY PROCESSING /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /EMMEANS=TABLES(OVERALL) /CRITERIA=ALPHA(.05) /DESIGN=PROCESSING.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Between-Subjects Factors

		N
PROCESSING	BOILED	9
	FERMENTE	9
	ROASTED	9

Tests of Between-Subjects Effects

Dependent Variable: ACCEPTABILITY

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	2	.000	.000	1.000
Intercept	161875.932	1	161875.932	157927738.829	.000
PROCESSING	.000	2	.000	.000	1.000
Error	.025	24	.001		
Total	161875.957	27			
Corrected Total	.025	26			

a. R Squared = .000 (Adjusted R Squared = -.083)

Estimated Marginal Means

Grand Mean

Dependent Variable: ACCEPTABILITY

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
77.430	.006	77.417	77.443

```
MEANS TABLES=TENDERNESS FLAVOUR COLOUR JUICINESS
PALATABILITY ACCEPTABILITYBY PERIOD
  /CELLS SEMEAN.
```

Means

Notes

Output Created		08-DEC-2021 21:33:01
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.

	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.
Syntax		MEANS TABLES=TENDERNESS FLAVOUR COLOUR JUICINESS PALATABILITY ACCEPTABILITY BY PERIOD /CELLS SEMEAN.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.03

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
TENDERNESS * PERIOD	27	100.0%	0	0.0%	27	100.0%
FLAVOUR * PERIOD	27	100.0%	0	0.0%	27	100.0%
COLOUR * PERIOD	27	100.0%	0	0.0%	27	100.0%
JUICINESS * PERIOD	27	100.0%	0	0.0%	27	100.0%
PALATABILITY * PERIOD	27	100.0%	0	0.0%	27	100.0%
ACCEPTABILITY * PERIOD	27	100.0%	0	0.0%	27	100.0%

Report

Std. Error of Mean

PERIOD	TENDERNESS	FLAVOUR	COLOUR	JUICINESS	PALATABILITY	ACCEPTABILITY
FX3days	.00000	.00577	.00000	.00667	.00000	.00000
FX6days	.00000	.00000	.05196	.01000	.00000	.00577
FX9days	.00000	.00000	.00577	.00333	.00000	.00577
BX10min	.00000	.00577	.00000	.00000	.00000	.00000
BX20min	.00577	.02887	.00577	.00667	.00000	.01732
BX30min	.00000	.00577	.00000	.00000	.00000	.05774
RX10mins	.00000	.00577	.00000	.00000	.00000	.00000

RX20mins	.00000	.00000	.01000	.00000	.00000	.01732
RX30mins	.00000	.00000	.00333	.00000	.00000	.01000
Total	.02096	.55065	.00498	.00155	.00000	.00592

```
SORT CASES  BY PROCESSING.
SPLIT FILE SEPARATE BY PROCESSING.
DESCRIPTIVES VARIABLES=TENDERNESS FLAVOUR COLOUR JUICINESS
PALATABILITYACCEPTABILITY
  /STATISTICS=MEAN.
```

Descriptives

Notes

Output Created		08-DEC-2021 21:39:03
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	PROCESSING
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.
Syntax		DESCRIPTIVES VARIABLES=TENDERNESS FLAVOUR COLOUR JUICINESS PALATABILITY ACCEPTABILITY /STATISTICS=MEAN.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

PROCESSING = BOILED

Descriptive Statistics[a]

	N	Mean
TENDERNESS	9	58.1033
FLAVOUR	9	74.7700
COLOUR	9	86.1100
JUICINESS	9	76.3911
PALATABILITY	9	86.1100
ACCEPTABILITY	9	77.4300
Valid N (listwise)	9	

a. PROCESSING = BOILED

PROCESSING = FERMENTE

Descriptive Statistics[a]

	N	Mean
TENDERNESS	9	57.9900
FLAVOUR	9	75.2333
COLOUR	9	86.1100
JUICINESS	9	76.3900
PALATABILITY	9	86.1100
ACCEPTABILITY	9	77.4300
Valid N (listwise)	9	

a. PROCESSING = FERMENTE

PROCESSING = ROASTED

Descriptive Statistics[a]

	N	Mean
TENDERNESS	9	57.9900
FLAVOUR	9	72.3400
COLOUR	9	86.1078
JUICINESS	9	76.3900
PALATABILITY	9	86.1100
ACCEPTABILITY	9	77.4300
Valid N (listwise)	9	

a. PROCESSING = ROASTED

```
MEANS TABLES=TENDERNESS FLAVOUR COLOUR JUICINESS
PALATABILITY ACCEPTABILITYBY PROCESSING
  /CELLS SEMEAN.
```

Means

Notes

Output Created		08-DEC-2021 21:42:43
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	PROCESSING
	N of Rows in Working Data File	27
Syntax		MEANS TABLES=TENDERNESS FLAVOUR COLOUR JUICINESS PALATABILITY ACCEPTABILITY BY PROCESSING /CELLS SEMEAN.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.00

```
[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
```

Warnings

Split variable PROCESSING has been specified as a grouping variable following BY keyword in the variable list. If Total category is needed for this variable it should be specified as a grouping variable and not a split variable. Otherwise, it must be removed from the variable list.
Execution of this command stops.

```
SPLIT FILE OFF.
MEANS TABLES=TENDERNESS FLAVOUR COLOUR JUICINESS
PALATABILITY ACCEPTABILITYBY PROCESSING
  /CELLS SEMEAN.
```

Means

Notes

Output Created		08-DEC-2021 21:43:02
Comments		
Input	Data	C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav
	Active Dataset	DataSet2
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	27
Missing Value Handling	Definition of Missing	For each dependent variable in a table, user-defined missing values for the dependent and all grouping variables are treated as missing.
	Cases Used	Cases used for each table have no missing values in any independent variable, and not all dependent variables have missing values.

Syntax		MEANS TABLES=TENDERNESS FLAVOUR COLOUR JUICINESS PALATABILITY ACCEPTABILITY BY PROCESSING /CELLS SEMEAN.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.02

[DataSet2] C:\Users\Alhaji Ali Y\Documents\PALATABILITY.sav

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
TENDERNESS * PROCESSING	27	100.0%	0	0.0%	27	100.0%
FLAVOUR * PROCESSING	27	100.0%	0	0.0%	27	100.0%
COLOUR * PROCESSING	27	100.0%	0	0.0%	27	100.0%
JUICINESS * PROCESSING	27	100.0%	0	0.0%	27	100.0%
PALATABILITY * PROCESSING	27	100.0%	0	0.0%	27	100.0%
ACCEPTABILITY * PROCESSING	27	100.0%	0	0.0%	27	100.0%

Report

Std. Error of Mean

PROCESSING	TENDERNESS	FLAVOUR	COLOUR	JUICINESS	PALATABILITY	ACCEPTABILI
BOILED	.05669	.29013	.00167	.00200	.00000	.01
FERMENTE	.00000	.05836	.01509	.00441	.00000	.00
ROASTED	.00000	1.50500	.00324	.00000	.00000	.00
Total	57.9900	.55065	.00498	.00155	.00000	.00

-