RODUCTION, PRESERVATION AND /ALUATION OF PLANTAIN POWDER BY USING FRYING METHOD

BY

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NOVEMBER, 2004.

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DECLARATION

I YUSUF LAWAL 98/7301EH do declare that this project work "PRODUCTION, PRESERVATION AND EVALUATION OF PLANTAIN POWDER USING FRYING METHOD" is an original work of mine and never copied.

22/01/04
Date

CERTIFICATION

I certify that this project "PRODUCTION, PRESERVATION AND EVALUATION OF PLANTAIN POWDER BY USING FRYING METHOD" was carried out by YUSUF LAWAL DAURA under the supervision of Engr. Adeniyi of department of chemical engineering, federal university of technology Minna,

FABRI — 23/11/2014

Engr. Adeniyi O. — Date

(supervisor)

_____ — _____

Dr. Agberugbah — Date

Head of department

_____ — _____

External examiner — Date

DEDICATION

This work is dedicated to the memories of my late Aunty Malama Hasiya Yahaya may the almighty Allah grant her eternal rest and permanent abode in Aljanna.

ACKNOWLEDGEMENT

All praise are due Allah, the lord of the world, the merciful.

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ABSTRACT

In this study the plantain powder was produced by using frying method and characterized. This was done by analyzing some of the essential compositions like protein, moisture content, sugar, starch and lipid content etc which where found to be 0.89, 64.2, 5.66, 22.5 and 0.217 respectively. The result obtained were compared with the standard values, and frying method was found to be suitable method in producing plantain powder and that the plantain powder was found be substitute food for fresh plantain during off-season.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

plantain (*Musa Paradisiaca*) are the major starch staple crop grown through out the humid tropics of the world. The fruits are slender, angular, pointed and contain an orange yellow pulp which remains starchy at maturity. Plantain presumably originated in southern India (Simmond 1986) through natural interspecific hybridization. Plantains are high yielding plants which form an integral component of the farming system in tropical Africa (Wilson 1983, Swennen 1990). Although plantain produces fruits through out the year, the major harvest occur in the dry season (December-March). At this period most of the starchy staples are in short supply or are difficult to harvest, this gives plantain an edge over other staple crops. It is reported that plantain and banana constitutes the fourth most important global food commodity after rice, wheat and maize in terms of gross value of production.

Plantains are highly nutritious containing large amount of carbohydrate and minerals such as phosphorus, calcium, potassium as well as vitamin A and C. in east Africa, plantain constitute the main staple foods for about 50% of the population. The world production of plantain is approximately 24 million tons of which 17 million tons representing 70.8% are produced in Africa (FAO 1987). In this part of the world the annual consumption is over 400kg per person. Fresh fruit of plantain is cooked green, made into paste, fried, baked, dried and ground into flour (powder) (stover and Simmonds 1987). When processed, the resulting product can be packaged and stored for very long period of time. Processing for storage could be through canning, drying, freezing or fermentation in the case if alcoholic beverages and vinegar (Stover and Simmonds 1987). Processing of plantain is a means of using surplus fruits during harvest and fruit that are considered unsuitable for export.

In most developing countries were green palntian are consumed as a major part of meal the predominant method of preparation include boiling or steaming and serve as a cooked vegetable with other dishes.

Plantain tree helps to maintain the quality of soil,. It reduces or prevent soil erosion by deflecting rainfall with its broad leaves and as well served as shed for some crops. The overriding constraints to plantain production are decreasing soil fertility, the widespread leaves spot disease called black sigatoka (IITA 1992), stover and Simmonds 1987). Mycosphyaerella musicola leach and Mycosphyaerella Fijiensis

are respectively the casual agents of yellow sigatoka and black sigatoka (Fullerton 1994).

Balck sigatoka is a virulent airborne fungal leaf spot disease which can reduces plantain yield by up to 30-50% (stover 1983). Black sigatoka disease can be controlled but the cost of chemical fungicide is quite prohibitive. The massive application of chemicals in plantain plantation is also drawing the attention of the environmentalist and concern public, therefore the best alternative approach for the control of black sigatoka is by breeding resistant varieties.

1.2 OBJECTIVE OF THE STUDY

This project involves the use of frying method to produce plantain powder. It also involves the preservation of plantain powder.

1.3 SCOPE OF THE STUDY

i. Production of plantain powder by using frying method

ii. Characterize the plantain powder produce

iii. Compare its nutritional composition with known standards.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 EVOLUTION AND DISTRIBUTION

Plantain *(Musa paradisiacal)* is a member of Eusaceae family ad genus Musa, and all wild Musa Spp are native to south and south east Asia and the south west pacitice (simmonds, 1972, 1976). Plantains is derived from two wild diploid species, *Musa accuminata colla* which are the donors of the "A" and "B" genomes respectively (simmonds, 1966). Edibility first evolved in wild M. acuminate and edible diploids are still widely spread through south east Asia. There is no evidence of edibility within M. balbisiana, its, therefore believed that hybrid evolved by the out word migration of edible diploid M. accuminata into the area of M. balbisiana followed by hybridization and polyploidy (simmonds 1976). Therefore plantain is a triploid with genomic constitutions AAB (swennen and Vuylsteke, 1989).

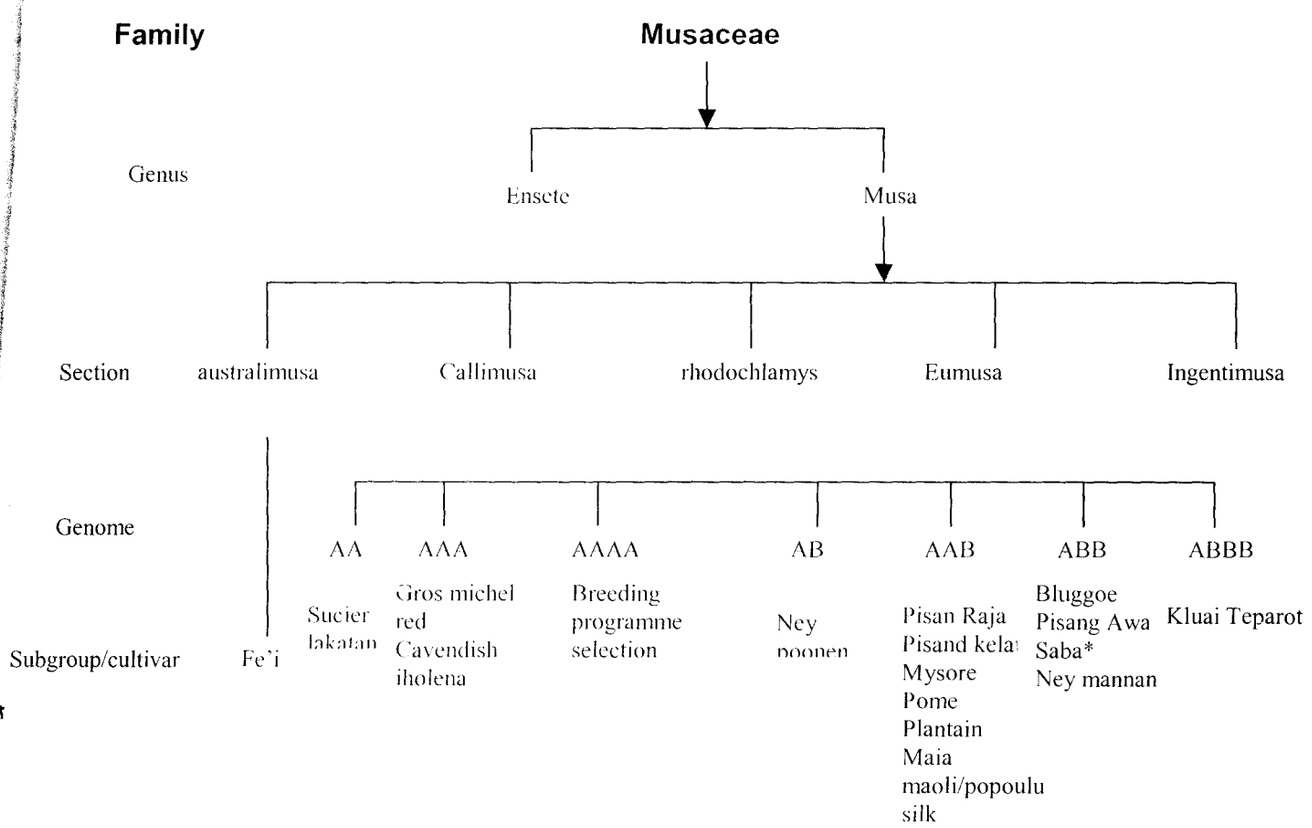
The distribution of plantain is believed to have started from Indonesia rather than from India where it is taken to the east coast of Africa in 1500_{BP}. Plantain was found in west Africa by the Portuguese in the fifteenth century which was taken by them to the canary Island where it is first known to be introduced to the new world to Haiti in 1516 (Norman, 1984). And now plantains and Bananas are grown by peasant farmers or small holders and their families almost exclusively in the developing countries of the tropics.

2.2. CLASSIFICATION/VERIETIES OF PLANTAIN AND BANANA

With the exception of Fe'i banana of pecific region which belongs to AUSTRALIMUSA, all edible plantain and bananas belong to the EUMUSA section of the genus MUSA (R. Macrea 1993). Plantains and bananas are believed to contains genomes from the too wild species Musa accuminata (A) and Musa balbisiana 'B'. The plantain (AAB) which is as a result of crosses or hydridisation between the two species are classified according characteristics estimating the contribution of the two parent species.

Based on their degree of inflorescence degeneration (morphology), swennen and vuylsteke (1987) classified plantains into four different types viz: French, French Horns, false Horn and True Horn. (Simmonds 1966) further characterized plantain by

the organge – yellow colour of the compound peptal in the flowers and the orange yellow starchy pulp when ripe. The false horn plantain type are the commonest in the west and central Africa sub-region.



* considered as BBB in the Philippine

Figure 2.1 Systematic position of banana varieties. (Modified from stover and Simmonds 1987).

2.3 MORPHOLOGY AND ANATOMY OF PLANTAIN

The plantain plant is a large, treelike determinate perremal herb with a basal rhizome, a pseudostem composed of leaf sheaths, and on terminal crown of large leaves. The terminal inflorescences is initiated near ground level and is then thrust up to the center of the pseudostem by elongation of the true stem. The based flower cluster is female and form the fruit bunch. Distal flower chisters are male, do not produce fruit and are commonly deciduous. The plantain has the largest inflorescence of any plant grown crop.

Plantain bunches have from one to twenty hands and take 2 – 6 months to reach maturity. Bunches are pendant or sub horizontal and usually weight between 10 and

60kg. Fruit fingers of different varieties can be anywhere from 6 to 60cm in length and from 50 to 100g in weight, but are more usually 15-30cm long and weigh 50-200g. The curve often seen in the fruit is caused by a negative geotropic growth response. Fruit develop from the inferior ovary of the female flower. It is a parthenocarpic berry i.e. it develop within the stimulus of pollination. Most varieties are or have very low fertility. When the mature fruit ripens, the pulp, peel ratio increases, in fact as a result of water movement from peel to the pulp associated with an increase in osmotic pressure in the pulp caused by the hydrolysis of starch (R.macrea 1997).

2.4 NUTRITIONAL COMPOSITION

Ripe plantain is very nutritious, it has long been regarded as cheap source of carbohydrate hence when taking with protein like milk it is considered to be complete food and make a major contribution to the diet and income of rural in developing countries (Wainwnht 1992). Although the protein content of plantain is low, but it is not as low as that of cassava, its concentration increases as the ripening progressed. Plantain has high concentration of ascorbic when fully matured even though the concentration of ascorbic is reduced through periods of storage and varieties of cooking methods. Potassium concentration of is about 500mg per 100g of pulp with trace amount of sodium 4mg. Plantain is also good source of vitamin C and B_6 (Encyclopedia of food science, food technology and nutrition Vol. 1).

Table 2.1 composition data per 100g edible portion of unripe plantain

Component	Proximate analysis
Water	67.5
Sugar	5.70
Starch	23.7
Dietary fibre 2.3	
Total nitrogen	0.18
Protein	1.1
Fats	0.3

Table 2.2 Composition data per 100g edible portion of unripe plantain

MINERALS	**MINERAL CONTENT (mg)**
Sodium	4
Potassium	500
Calcium	9
Magnesium	37
Phosphrous	36
Iron	0.5
Copper	0.08
Zinc	0.1
Sulphur	15
Chlorine	80

TABLE 2.3 Composition data per 100g edible portion of unripe plantain.

VITAMINS	**VITAMIN CONTENT**
Retinol (mg)	0
Carotine (mg)	360
Vitamin D (mg)	0
Thiamine (mg)	0.1
Riboflavin (mg)	0.05
Nicotinic Acid (mg)	0.7
Ascorbic Acid (mg)	15.0

Vitamin E (mg)	0.20
Vitamin B 6 (mg)	0.30
Vitamin B12 (mg)	0
Folate (mg)	22
Pantothenate (mg)	0.26

(R. Macrea 1993).

2.5 CLIMATIC AND SOIL REQUIREMENT

Plantains are grown in the wet, wet and dry and cool tropics. The main determinants of their distribution are rainfall in excess of 1250mm per year (simmonds 1966), and mean minimum temperature above 15.5°c. They are mostly grown in the low land met tropics, as seen from the distribution of plantain within 7^0 of the equator in central and West Africa (Flinn & Itoyoux, 1976). Plantains are planted as rhizome pieces or aeriel shoots at densities usually below 2000 ha^{-1}, and growth of the primary crop is thus limited by radiation interception. Yields responds linearly to increasing population to above 2500 plant he^{-1} (Simmond 1966).

Wind caused ripping and segmentation of leaf laminae, which is universal, does not have much effect in photosynthetic rate unless the leaves are killed (Taylor & Sexton, 1972). Shmuel (1953) found that 85% of the total water taken up as from the top 30cm f soil and only 5% from deeper than 60cm.

Drought accelerates maturation and reduces fruit filling, thereby reducing fruit quality (East wood & jeater, 1949). Fruit growth increases with temperature, being positively related to day – degree above 14.5°c or to mean daily temperature from 13 – 22^0c (Turner & Barkus 1982). The optimum temperature for plantain fruit yield is about 27^0c (purseglore, 1972). Simmonds (1966) concluded that the only factor common to the wide range of soil on which plantains are grown is good drainage, good drainage is of course dependent in a favourable soil structure and pore size distribution, and is essential to soil aeration. Texturally the soils vary greatly from vary course to fine volcanic materials, through sands and loams within orders to clays within orders that include inceptisols, oxisols and vertisols. (Norman), Pearson & searches, the ecology of tropical food crops).

2.6 PROBLEM ASSOCIATION TO PLAINTAIN PRODUCTION PESTS AND DISEASES

Plantain weevil and parasitic nematodes are the major pests affecting plantain production. When plantains are inflected with weevil and nematodes, yield losses may reach 85%.

Black sigatoka disease is the most critical disease affecting plantain if a plantain is infected with this disease it produces lower yield other diseases affecting plantain include fungal leaf spot, fusarium wilt (panama disease), plantain streak virus, plantain die back virus and cucumber mosaic virus which causes lower bunch weight fewer hands and less fruits.

2.62 PREVENTION AND CONTROL

The international institute of tropical Agriculture (IITA) has acknowledges that black sigatoka disease is the most critical research issues for plantain and banana in Africa. The plantain and Banana improvement programme was established following the identification of black sigatoka diseases of plantain in 1986. Plans to combat black sigatoka through both short term and long-term strategy was initiated (IITA 1988). The short-term agenda consist of the identification, multiplication and distribution of the black sigatoka resistant variety and the control. Involves the uses of chemical fungicide.

2.7 FOOD PRESERVATION

2.7.1 DEFINITION

Preservation could be defined as an act of safe-keeping of something in its original state.

Food preservation is an umbrella term conveying any measures that makes food keep well over a reasonable period of time. The objective is to minimize damage or ideally to avoid damage altogether as to provide the consumer with enjoyable food (encyclopedia of food science food technology & nutrition vol.6).

2.72 NEED FOR FOOD PRESERVATION

Cereals, fruits and other foods of plants origin are only available fresh only during a brief harvest period and scarce during off season as a result people of that area need to ensure that the harvested food has a long life. Food came to be preserved later not only because of natural necessity but also because the pattern of civilization so required. People are increasing living in town and cites where self sufficiency in food on a large scale is out of question and fever and fewer are led with the responsibility of providing food for more and more in the city, a development of this is possible only if food stuffs can be persevered for a sufficiently long time.

Food preservation has made it possible in either the developed or under developed countries to supply the population with food in any mythological manner. The trend in public opinion is increasing towards fresh product that is that are given short-term stability by the latest method of preservation (encyclopedia of food science, food technology and nutrition).

2.8 FOOD SPOILAGE

2.81 DEFINITION

In its broadest sense, food spoilage is referred to as any change in a food stuff that reduces its value nutritive value its sensory quality and usability. Some times the term spoilage depends on the extent of the change and the course of the reaction.

2.82 TYPES OF FOOD SPOILAGE

Essentially food spoilage includes chemical, enzymatic, physical and microbiological change.

2.821 CHEMICAL CHANGE

These are undesired oxidation, non-enzymatic browning reaction and chemically of governed degradation reaction of food ingredients. Some begin during processing of the food and continue during storage. The main ingredients destroy or affected by such reaction are proteins and lipids, vitamins, aroma compounds and colorants. They are wither gradually destroyed, e.g. oxidation or changed by chemical reaction to such an extent they cease to be of any nutritional value.

2.8.2 .2 ENZYMATIC CHANGE

These occur primarily after the communition of foods because the communition enables the enzyme and substrate to come into contact directly e.g. the brown coloration of vegetable raw material caused by the activity of polyphone oxidizes.

2.8.2.3 PHYSICAL CHANGE

This is the change in physical properties e.g. sings of deposits, destabilization of emulsions and foams, undesired water absorption and undesired loss of water.

2.8.2.4. MICROBIOLOGICAL CHANGE

This is caused by bacteria yeasts and moulds for spoilage to occurs, microorganism need to be present on the food. Even if they have been in activated by thermal treatment, their enzymes, which have migrated into the food, may still cause spoilage. The micro organism need to have nutrients available in a suitable form and a adequate quantity as well as favourable living conditions such as temperature, water activity, presence or absence of oxygen, redox potential and P^H value. (R Macrea. 1993)

2.9 METHODS OF PREVENTING CHEMICAL, ENZYMATIC & PHYSICAL FOOD SPOILAGE

2.91 CHEMICAL SPOILAGE:

Oxidation phenomena can be restricted by with holding or in activating the oxygen that is in contact with the food. This is achieved by using oxygen – impermeable packaging materials another method is to use antioxidants chemical change in foods can be delayed by cold storage.

2.92 ENZYMATIC SPOILAGE:

Lowering water content limits enzyme activity, certain additives, such as citric acid or sulphur dioxide. Also blanching by heat is the most preferred, method for keeping spoilage under control. Once inactivated, the enzyme can no longer causes spoilage.

2.93 PHYSICAL SPOILAGE

Typified by precipitation reaction and destabilization are prevented by additives such as emulsifier and thickeners.

2.10 METHOD OF PREVENTION MICROBIOLOGICAL FOOD SPPILAGE

This type of spoilage can be combated in two ways: Physical and chemical, the Physical method involve the use of heat, cold, drying and irradiation. The chemical methods involve adding some kind of preservatives to the food R. Macrea 1993.

2.10.1 HEAT TREATMENT METHOD

Heat treatment for improving or keeping the properties of food was not known in early pre-history except for the use of smoking which combine heat with a chemical method of food preservation.

Preservation by heat involves killing all or certain microorganism that is making it sterile. The extent to which micro organism are killed depends primarily on the temperature and duration of its action but also on the P^H value, water content, presence or absence of certain food ingredient or additives and other factors.

The heat treatment may have not only an antimicrobial action on food stuffs but also other effects, desired or undesired. The treatment actually cooks the food to a greater or lesser extent. Furthermore, sensitive ingredients such as vitamins and aroma may be damage. The duration of the heat treatment plays a more important role than the treatment temperature in reducing the extent of this reaction.

2.10.2 REFRIGERATION AND FREEZING

It has been known for thousands of years that certain food can be kept longer if stored at low temperature. This is why food used to be stored in cool cellars and cave.

Unlike heat treatment, refrigeration does not kill microorganism but merely inhibits their growth, the lower the ambient temperature the greater is the inhibitory effect. The ingredient of food are nearly always damage less by refrigeration than by heat treatment, however refrigeration and freezing may influence the physical structure of food according to its type.

Deep freezing is storage at temperature below -18^0c.

2.10.3 DEHYDRATION:

This method is use to preserve cereals, vegetable, fruits, fish, and liquids such as milk, and this is probably the oldest method of food preservation.

In the dehydration and drying process, the microorganism are not killed but merely inhibited in their growth because they lack the free water necessary. (R. Macrea 1993)

2.11.0 USES OF PLANTIAN

Plantains form a basis of a very wide variety of food; it can be cooked wither green or ripe. Some of these bases include:

2.11.1 PLANTAIN CHIPS:

These are prepared by frying round slices of unripe Ned or slightly ripened plantain pulp in vegetable oil. Best quality plantain chips have been obtained in Cameroon by frying round slices of pulp (2mm thick) in refined palm oil between 160 and 170^0c for 2 to 3 minutes these generally absorb less frying oil than chips from cooking banana dessert banana. They contain less than 35% of fats and between 1 to 3 percentage residual humidity.

2.11.2 BOILED PLANTAIN:

Plantain can be boiled when green, ripening or fully ripe. They can be peeled before or after cooking but in order to retain many of its nutrients it's advisable to be cooked in its skin. They can be left whole or cut into pieces. When sprinkled with dried, ground red pepper it could be served as a dish (Mathew and Penny, 1988).

2.11.3 ROASTED PLANTAIN

Ripe or medium ripe plantain can be cooked over charcoal or under a grill until tender. Small plantains can be left whole, while larger ones should be cut in half, length ways. These are good on their own or as snacks with groundnuts.

2.11.4 Fried Plantain: Ripe plantain are peeled and cut in to round or slice (¼ - ½cm thick), palm oil or vegetable oil about 1cm depth and at 160^0 - 180^0 is used to dry the slice. One layer at a time until its golden brown. When dried its served as a hot snacks. (Mathew & Penny 1988).

2.11.5 PLANTAIN FLOUR:

Ripe plantains are peeled and slice very thinly then dried under sun. When grind or pound into a fine flour it could be use for biscuits, bread or cakes (Mathew and Penny 1988).

2.11.6 PLANTAIN FRITTERS

The pulp of over ripe plantain are pounded and mixed with small quantity of maize flour (about ¼ pulp weight) and salt to form a homogenous pastry.

2.12.0 THEORY OF FRYING

Catering outlets provide a fast food service, and frying is extensively used.

TYPES OF FRYING

2.12.1 SHALLOW FRYING

In shallow or pan-frying, the cooking oil contributes to the development of flavour and colour in the food from sticking to the hot cooking surface. Shallow frying is more of an art than deep fat frying since chef must judge the temperature so that the food cooks completely without burning on the surfaces. In this way the full colour and flavour are developed from the reaction between protein, carbohydrate and fat, and their oxidation product. Since in pan-frying the oil is used only once, there is little concern with respect to resistance to oxidation, the oil mentioned above can therefore be used interchangeably.

Certain slurry types products have been developed by brush hydrogenation to give improve stability to oxidation. These are used in deep-frying but because they are pourable they are also convenient to use in shallow frying.

2.12.2 DEEP-FAT-FRYING

Deep fat frying is widely practiced and is one of the most important methods of food preparation. Deep fat frying is used in both institutional and industrial situations. The principles applied to the frying operation and equipment cleanliness are the same in both situations but differ in detail. Similarly, t\with respect to the vegetable oil used, the rate of turnover of oil or fat in the fryer influences the medium selected for the frying operation.

In contrast to shallow or pan-frying, the food is completely submerged in the hot oil and can be held at high temperature for long periods. In addition fatty matter and other substances from the food being cooked can be transferred to the frying oil.

As mentioned above, the nature of the deep-fat-frying operation dictates the type of oil or fat selected. In many situations, where there is a high turnover, highly unsaturated vegetable oil such as soya bean oil, rapeseed oil can be used successfully. Where turnover is lower and improved stability to oxidation is required e.g. where oil is kept hot for a long period, then hydrogenated vegetable oil are used so that the unsaturation is significantly reduced, thereby increasing stability. The vegetable oil can be hydrogenated to varying degrees to improve stability to oxidation and maintain a satisfactory palate sensation, free of greasiness. The alternative give the operator a wide choice so that he/she can select the quality most for the operation and product.

As an example of high turnover situation the frying of potato crisps is now mostly a continuous frying operation, in which the absorption of oil is usually between 32%and 40%. The turnover in oil is very high, so that unsaturated liquid vegetable oils can be used successfully, usually as part of a blend with oils such as palm oil or its liquid fraction.

In fact, food operation where fryers are kept continually hot, oils with reduced levels of unsaturation, achieved by hydrogenation, are favoured, e.g. Soya bean oil where the unsaturation has been reduced by hydrogenation, as measured by the iodine value test, form a starting value of 130-135 to 70-75 or in the case of palm the iodine value reduced from 55 to 40-45. In some fast food outlets, a pressure frying system is used to prepare fried chicken. This is an enclosed fryer in which vaporized moisture raises the pressure in the vessels, speeding up the cooking of the chicken. However, chicken fat is leached out into the frying oil, causing a high fat turnover. In some restaurants frying and sautéing extra stability to oxidation, avoiding formation of strong flavours and, in the deep-frying, giving an improved frying life for an intermittent operation. Oils such as palm oil have became popular with fish and chipped potato fryers, where there is a relatively heavy-duty but good turnover, and the lower unsaturation in palm oil, compared with liquid vegetable oils makes it the preferred alternatives (R. Macrae 1993).

2.12.3 VEGETABLE OILS

Vegetable oils are used extensively in catering outlets, mainly in the form of salad oils and cooking oils. The oils used must have good stability to oxidation and they should be fully liquid at room temperature oils such as soya bean oil, rapeseed oil, corn/oil cotton seed il and sun flower oil are popular in this sector. The oils are processed to be completely bland, and to ensure clarity at room temperature they may require winterization to remove natural waxes, as in the case of sunflower oil. A high quality oil is derived from groundnut oil, Soya bean oil by brush hydrogenation to reduce the indolence acid content, followed by winterization to remove ant high melting triglyecrudes. This process results in a fully liquid oil of enhanced stability (R. macrea 1997).

2.12.4 DEGRADATION PROCESS DURING FRYING

Vegetable oils and fats deteriorate mainly as a result of hydrolysis and oxidation, ring formation and polymerization. Since the frying process is carried out at high temperature and in the presence of oxygen, both thermal and oxidation processes are taking place simultaneously, producing both volatile and non-volatile decomposition products. The nature and quantity of these products are affected by the frying conditions and the type of food being fried. However, as these degradation products accumulate they not only cause off flavors in the food, but lead to smoking foaming and discoloration of the frying medium.

Hydrolysis leads to increase acidity in frying fats wing to the initial generation of fatty acid, mono and diglycerides from the triglycerides. Certain types of fatty acid soaps can also be created which in turn accelerates breakdown of the frying medium. Oxidation takes place via the same pathway as that of low-temperature oxidation, i.e. formation and decomposition of hydroperoxide intermediates (R macrea 1997).

2.13.0 PACKAGING AND STORAGE

Dried foods are susceptible to insects contamination and moisture reaborption and must be properly packaged and stored immediately. The food is first of all cooled completely, because packaging of warm food causes sweating which could provide enough moisture for mould to grow. Pack food into clean, dry, insect-proof containers as tightly as possible without crushing (IITA 1992).

Glass jars, metal or boxes with tightly fitted lids or moisture and vapour resistant freezer cartons make good container for storing dried foods. Heavy-duty plastic bags are acceptable but are not insect and rodent proof. Pack food in an amount that will be used in a recipe. Every time a package is reopened, the food is exposed to air and moisture that lowers the quality of the food.

Dried foods should be stored in a cool, dry and dark areas. Recommended storage time for dried food ranges from 4 months to 1 year. Because food quality is affected by it, the storage temperature helps determine the length of storage, the higher the temperature, the shorter the storage time (IITA 1992).

CHAPTER THREE

3.0 MATERIAL AND METHOD

3.10 Material: Three bunches of matured green plantain were purchased from Minna central market and also two litres of refined vegetable oil were purchased.

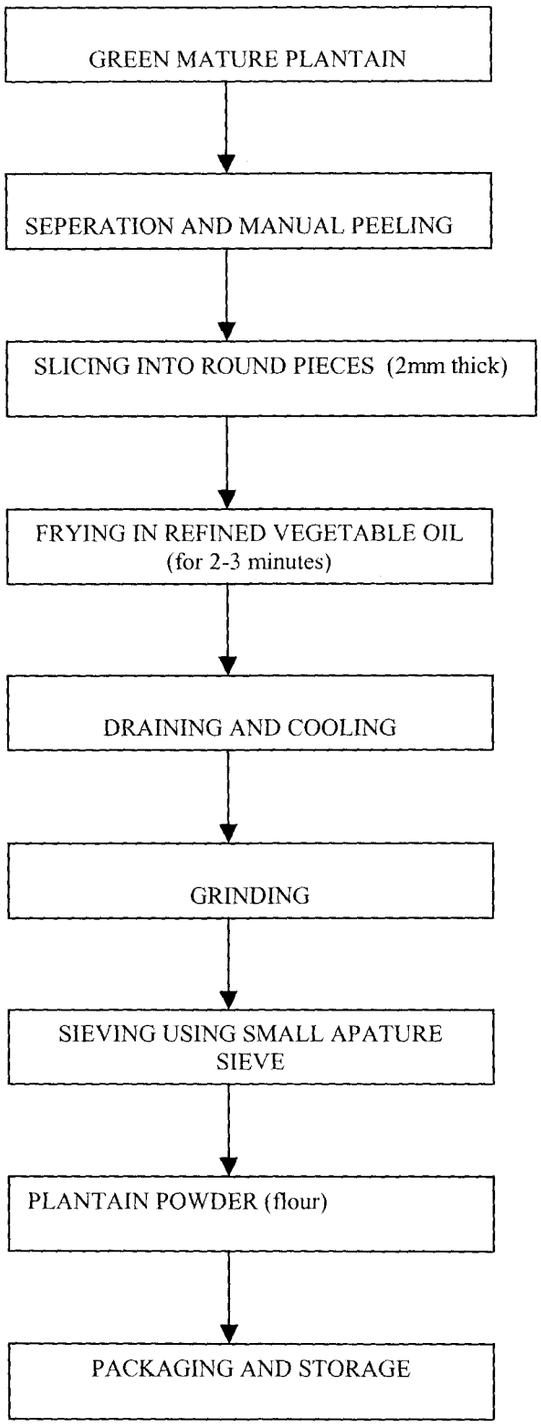
3.11 LIST OF EQUIPMENTS USED:

- Electric stove
- Thermometer
- Frying pan
- Stainless steel knife
- Sieve
- Stop watch

3.2 METHOD

The bunches of matured green plantain were separated into individual fingers washed and peeled manually. The pulp was sliced into round pieces of about 2mm thick using stainless steel knife.

The stove was used to heat up the one-centimeter depth of the refined vegetable oil in the frying pan to an average temperature of 167^0C (measured with the thermometer). One layer at a time, the slices were fried for two to three minutes were then removed and placed on the sieve for some hours for effective draining and cooling. The fried slices were then ground and sieved into more finer particles or flour (powder). The procedure is represented in a flow chart below.


GREEN MATURE PLANTAIN
SEPERATION AND MANUAL PEELING
SLICING INTO ROUND PIECES (2mm thick)
FRYING IN REFINED VEGETABLE OIL
(for 2-3 minutes)
DRAINING AND COOLING
GRINDING
SIEVING USING SMALL APATURE
SIEVE
PLANTAIN POWDER (flour)
PACKAGING AND STORAGE

3.3 **ANALYSIS:** after production of the plantain powder certain chemical compositions were determined as follows using the following equipments and reagents.

3.3.1 LIST OF EQUIPMENT USED:

EQUIPMENT	MANUFACTURERS
Flat bottom flask	simax
Round bottom flask	Simax (czecholosvakia)
Soxhlet (extractor)	Electrothermal
Kjeldahl flask	Kjeldatherm
Evaporating dish	Simax
Bunsen burner	griffin
Muffle furnace	Digital thermol
Pipette	Din (W/Germany)
Cornical Flask	Simax
Burette	Din (W/Germany)
Dessicator	

3.32 LIST OF REAGENTS USED

Reagent	Formular
Sodium Hydroxide	NaoH
Boric acid	$H_3 B0_3$
Mixed indicator	$(CH_3)_2 N.C_6 H_4N. NC_6 H_4. C00H$
Acetone ethanol	$(CH_3)_2. Co/C_2 H_50H$
Hydrochloric acid	HCL
Glacial acetic acid	$CH_3 C00H$

3.33 VITAMIN C:

2ml of glacial acetic acid and 1ml of chloroform were added to 5ml of the sample the solution titrated with the solution of 2,6 – chloro-phenol in dophenol in the burette until permanent faint pink colour is obtain. The titre "T" was then recorded.

The titration was repeated with 5ml distilled water for blank B, and 5ml of standard ascorbic acid solution (st). The vitamin C content of the sample was then calculated (mg/100mg).

$$\frac{(T - B_1)}{St - B1} \text{ Xn dilutions}$$

Where:

T: = value of the sample

B: = blank

St = standard solution of ascorbic acid.

3.4 ASH CONTENT:

Clean, flat – bottomed silicadish was held in a hot Bunsen burner flame for one minute, which was then transferred to a desiccator cooled, weighed and recorded as W_1. 5g of the sample (Plantain power) was taken into the dish and weighed, and recorded as W_2 hence the weight of the sample was obtained as $(W_2 - W_1)$. The silica dish containing the sample was heated gently on a Bunsen burner in a fume cup board until smoking ceased then transferred to muffie furnace and heated to about 500^0c until all the carbon has been burnt away for about 24 – 48 hrs. the furnace switched off, the dish was immediately removed, covered and placed inside a dessicator cooled, weight and recorded as W_3.

The ash content is calculated as $\text{Ash\%} = \frac{(W_3 - W_1) \times 100\%}{W_2 - W_1}$

3.5 MOISTURE CONTENT:

Metallic dish was dried in an oven at 80^0c for minutes, cooled in a desiccators weighed and recorded as W_1. 5g of the sample (Plantain power) was taken into the dish weighed and recorded as W_2. The dish with the sample was dried in an oven at 80^0c for 24 hours and was quickly transferred to a desiccator and cooled, which was then quickly weighed with minimum exposure to atmosphere as W_3. The loss in weight of the sample during the drying is the moisture content.

The moisture content is calculated as moisture content %

$$= \frac{(W_2 - W_3) \times 100}{W_2 - W_1}$$

3.6 LIPID

Lipid content was estimated by directly extracting the dry material exhaustively using a suitable lipid solvent e.g. petroleum (40^0c – 60^0c)., diethylether.

About 2g of the sample (plantain power) was taken into the thimble of known weight (W_1), sample the thimble were weight together as W_2, which were then placed inside a soxhlet extractor. 300ml of acetone-ethanol mixture (1.1) was poured into a 500ml

round bottom flask, which was sitted in an electrically connected heating mantle. The mantle was switched on and then increased carefully and slowly until the solvent boils. Condensed solvent vapour collected in the thimble and dissolves the lipid was continuously run-back into flask. The heating and so the extraction process was continued for about removed, dried in an oven at 50^0c for 24hrs, cooled in a dessicator, weighted an 2 recorded as W_3.

The lipid is calculated as lipid % = $\frac{(W_2 - W_3)}{W_2 - W_1} \times 100$

3.7 NITROGEN AND CRWDE PROTEIN

Kjedahl method for estimation of nitrogen was used, about 250mg of the sample was weighed into a clean, dry 100ml kjeldal flask, about lg of mixed catalyst, 4ml concentrated H_2SO4 and few chips of pumice stone were added.

Over an electric heater it was digested carefully with low flame and then at higher temperature until contents were clean greenish digestion was continued for further 60 minutes the heat was put off 15ml of water was added. The content was transferred to 50ml volumetric flask. 10lm of the digest was transferred using pipette into the nitrogen still, 10ml of 26% No oH solution was added to the digest. Steam distill ammonia was librated into the 5ml boric acid solution containing 4 drops of mixed indicator taken in the conical flask distillate titrate were removed with the standard hydrochloric acid, the indicator changed from green through gray to pink the amount of acid consumed was noted. Blank was run through the whole procedure and the burette reading was subtracted from that above nitrogen percentage is calculated as:

Nitrogen % = $\frac{\text{Corrected titre ml}}{\text{10 X sample weight (g)}}$

and crude protein % = 6.25 X Nitrogen %

3.7 STRACH

100mg of dry sample (plantain power) was weighed and transferred into 100ml volumetric 10ml of distilled water was added to it and stirred with long glass rod so that the sample was dispersed thoroughly. 13ml of 52% perchloric acid reagent was added to the dispersed sample in the flask. The content was stirred frequently and agitated by hour for 30 minutes to ensure full hydrolysis. The glass rod was washed

down into flask with distilled water and the solution was made up to 100ml with distilled water, the solution was filtered into a 250ml graduated flask and later diluted to mark with distilled water and thoroughly mixed.

0.2ml of the diluted filtrate was pipette into 10ml test tube and 0.8ml of distilled water was added and duplicate determination was made. Duplicate blanks and standards containing 1ml of distille water and 1ml 5% (v/v) phenol was added and mixed, followed by 5ml 96% (v/v) $H_2 S0_4$ the golden yellow coloured solution was allowed to cool in a cool water bath before the absorbance was taken at 49onm the percentage starch content was calculated using 112.5 X A X 100

Where A = absorbance

3.9 SUGAR

100mg of the defatted sample was weight into a boiling tube and 25ml of hot 80% (v/v) ethanol was added and the mixture was shaken. The content was allowed to stand for about 15 minutes and then was filtered into a beaker through a what man No 41 filter paper. The extraction was repeated so that soluble sugar was completely removed.

The solvent was evaporate off the extract by heating on a hot plate, the residue was dissolved with little water and transferred into a 100ml volumetric flask and made to mark with distilled water. 1ml aliquot was pipetted into a test tube and 1ml of 5% (w/v) phenol solution was added to each tube mixture was added 5ml 96% (v/v) sulphuric acid and shaken vigorously. The resulting yellow complex was cooled in a water bath.

A sample blank using 1ml distilled water and each of the 1ml standard were treated like in sample preparation. The absorbance of the resulting golden yellow colour was read at 490nm with a colorimeter by using distilled water as a blank. The sample blank absorbance was noted.

The percentage sugar content was calculated as sugar content % =

$$\frac{0.05 \text{ X D X } 100}{\text{T}}$$

Where: D = dilution factor

T = average titre value

CHAPTER FOUR

4.0 RESULT AND DISCUSSION OF RESULT

4.10 RESULTS:

After carrying out the analysis the results obtained are shown in the tables below.

TABLE 4.11: DETERMINATION OF VITAMIN C (ASCORBIC ACID)

Sample	**1st titre value used (cm^3)**	**2nd titre value used (cm^3)**	**Weight of sample (g)**	**Dilution factor**	**Vitamin C (100mg/100g)**
Fresh Plantain (T)	7.25	7.30	1.00	100	14.15
Plantain powder	4.00	5.30	0.35	100	8.74
Standard Assorbic	49.00				
Blank	0.40				

Vitamin C = $(T - B_1)$ X n, where T sample

$St - B_1$ B_1 = Blank

N = dilution factor

St = standard

TABLE 4.12: THE TABLE SHOWING ASH CONTENT OF THE SAMPLE

Sample	**Weight of Empty crucible (W_1)g**	**Weight of crucible + Sample before burning W_2 (g)**	**Weight crucible + sample after burning W_3 (g)**	**Weigth of sample used (g)**	**% ASH**
Plantain powder					
A	10.20	15.20	10.53	5	6.60
B	8.99	13.99	9.30	5	6.20
C	10.23	15.23	10.54	5	6.20

$$\% \text{ ASH} = \frac{(W_3 - W_1) \times 100}{W_2 - W_1}$$

TABLE 4.13: SHOWS MOISTURE CONTENT OF THE SAMPLE

Sample	Weight of Empty crucible (W_1)g	Weight of crucible + Sample before frying W_2 (g)	Weight crucible + sample after frying W_3 (g)	% Moisture
Fresh Plantain				
A	10.20	15.20	11.99	64.2
B	9.00	14.00	10.80	64.0
C	10.23	15.23	12.01	64.4

$$\% \text{ Moisture} = \frac{(W_2 - W_3) \times 100}{W_2 - W_1}$$

Where:

W_1 = weight of empty crucible

W_2 = weight crucible + sample before frying

W_3 = Weight crucible + sample after frying

TABLE 4.14: SHOWS PERCENTAGE LIPID EXTRACTED

Sample	Weight of Empty thimble (W_1)g	Weight of thimble + sample before extraction) W_2	Weight thimble + sample after extraction W_3	Weight simple of used (g)	% Lipid Extracted
resh lantain					
	1.250	6.250	6.236	5	0.28
	1.900	6.900	6.8870	5	0.26
	2.000	7.000	6.9865	5	0.27

Plantain powder					
A	1.900	3.900	3.8960	2.000	0.20
B.	1.250	3.252	3.2480	2.002	0.21
C.	2.001	4.003	3.998	2.002	0.25

$$\% \text{ Lipids} = \frac{(W_2 - W_3) \times 100}{W_2 - W_1}$$

TABLE 4.15: SHOWS PERCENTAGE OF NITROGEN AND CRUDE PROTEIN

ample	**1st titre value (cm^3)**	**2nd titre value ($cm^{3)}$**	**Sample weight (g)**	**% Nitrogen**	**% crude protein**
resh lantain					
1	1.70	1.70	1.00	0.l6	1.000
lantain owder V_1	0.60	0.60	0.35	0.143	0.89
lank V_0	0.1	0.1	-	-	-

$$\% \text{ Nitrogen} = \frac{V_1 - V_o}{10 \times \text{sample weight}}$$

$$\% \text{ crude protein} = \frac{(V_1 - V_0) \times 6.25}{10 \times \text{sample weight})}$$

TABLE 4.16: SHOWS PERCENTAGE STARCH

Sample	weight of sample (mg)	Total Volume	Aliquot taken	Absorbance	% starch
Plantain	100	250	0.2	0.002	22.5
Standard	100	250	0.2	0.01	-

% Starch = 112.5 X A X 100

Where A = absorbance.

TABLE 4.17: SHOWS DETERMINATION OF PERCENTAGE SUGAR

Sample	1st titre value (cm^3)	2nd titre value ($cm^{3)}$	Sample weight (g)	Dilution Factor (d)	% Sugar
Fresh Plantain	29.00	26.00	1.00	30	5.45
Plantain powder	27.00	26.00	0.35	30	5.66

$$\% \text{ Reducing Sugar} = \frac{0.05 \times D \times 100}{T}$$

Where D = dilution factor

T = average titre value

4.2 DISCUSSION OF RESULT

The amount of crude protein obtained from the analysis in table 4.15 was found to conformed with the standard value which is 1.1% the slight difference is considered to be negligible.

The value of vitamin c (Ascorbic acid) was also found to be close to the standard value, which is 15.0. The percentage lipid extracted from the fresh plantain was found to conformed with the standard value which is 0.31 but that of plantain powder was found to slightly vary with the standard value i.e. it was found to be less than the standard value, the difference (decrease) in the vitamin C (ascorbic acid) and lipid extracted in the plantain powder may be as a result of some fatty matter and other

substances from the plantain were transferred to the frying oil during frying. The moisture content of the fresh plantain was found to be 64.2%, which conformed with the standard value 67.5%.

The sugar content for both the fresh plantain and plantain powder was found to be much closer to the standard value which was 5.7, the low sugar content was as a result of unripe plantain used since sugar content increases as ripening progress.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONLUSION

The analysis carried out on the plantain powder produced by frying method shows that the results conformed within the standard range. The difference that was found in Ascorbic acid, moisture content and crude protein is negligible.

Therefore it can be concluded that frying method could be used to produce plantain powder.

5.2 RECOMMENDATION

From various results obtained in chapter 4 and those values reported in chapter 2 it is therefore recommended that frying method can be used to produce plantain powder. And that since unripe plantain contains less sugar than the ripe one it is therefore recommended in producing the powdered plantain so that even diabetic patients can take it. However, the consumption of the food (plantain powder) is suggested since analysis has shown that all the nutritional composition are within the standard range.

Other method such as drying (oven and sun drying) could also be investigated in producing plantain powder.

APPENDIX

Determination of % vitamin C,

For fresh plantain

$$\text{Vita C, } = \frac{(T - B_1) \times n}{St - B_1}$$

$$\text{Where } T = \frac{7.25 + 7.32}{2} = 7.275$$

$B_1 = 0.4$

St = 49.0

n = 100

$$\ldots\% \text{ vitamin C} = \frac{(7.275 - 0.4) \times 100}{49.0 - 0.4} = 14.15\%$$

For plantain powder

$$T = \frac{4 + 5.3}{2} = 4.65$$

$$\ldots\% \text{ Vitamin C} = \frac{(4.65 - 0.4) \times 100}{49 - .04} = 8.74$$

Determination of ASH content.

For A,

$$\% \text{ ASH} = \frac{(W_3 - W_1) \times 100}{W_2 - W_1}$$

Where $W_1 = 10.2$, $W_2 = 15.2$, $W_3 = 10.53$

$$\% \text{ Ash} = \frac{(10.53 - 10.2) \times 100}{15.2 - 10.2} = 6.6\%$$

For B $W_1 = 8.99$, $W_2 = 13.99$, $W_3 = 9.30$,

$$\frac{(9.3 - 9.99) \times 100}{13.99 - 8.99} = 6.2\%$$

For C,

$$\% \frac{(W_3 - W_1) \times 100}{W_2 - W_1}$$

Where $W_1 = 10.23$, $W_2 = 15.25$, W_3, = 10.54

$$\ldots\% = \frac{10.54 - 10.23 \times 100}{15.23 - 10.23} = 6.2\%$$

Determination of moisture content

For A % moisture = $\frac{(W_2 - W_3) \times 100}{W_2 - W_1}$

Where $w_1 = 10.20$, $W_2 = 15.20$, $W_3 = 11.99$

% Moisture $\frac{(15.20 - 11.99) \times 100}{15.20 - 10.20} = 64.2\%$

For B % Moisture = $\frac{(W_2 - W_3) \times 100}{W_2 - W_1}$

$W_1 = 9.00$

$W_2 = 14.00$

$W_3 = 10.80$

... % Moisture = $\frac{14.00 - 10.80 \times 100}{14 - 9}$ 64%

For C % Moisture = $\frac{W_2 - W_3}{W_2 - W_1}$

Where $W_1 = 10.23$

$W_2 = 15.23$

$W_3 = 12.01$

... % Moisture = $\frac{(15.23 - 12.01) \times 100}{15.23 - 10.23} = 64.4\%$

Determination of percentage lipid extracted for fresh plantain.

For A % = $\frac{W_2 - W_3}{W_2 - W_1}$

Where $w_1 = 1.25$, $W_2 = 6.25$, $W_3 = 6.2360$

... % Lipid = $\frac{(6.25 - 6.236) \times 100}{6.25 - 1.25} = 0.28\%$

For B, $\frac{(W_2 - W_3) \times 100}{W_2 - W_1}$

Where $W_1 = 1.9$, $W_2 = 6.9$, $W_3 = 6.8870$

... % Lipid = $\frac{(6.9 - 6.8870) \times 100}{6.9 - 1.9} = 0.26\%$

For C, $\frac{W_2 - W_3 \times 100}{W_2 - W_1}$

Where W_1 2,00, $W_2 = 7.00$, $W_3 = 6.9885$

... % Lipid $= \frac{7 - 6.9865 \times 100}{} = 0.27\%$

7 - 2

For plantain powder

For A, % lipid = $\frac{w_2 - W_3}{W_2 - W_1}$

Where $w_1 = 1.900$, $w_2 = 3.900$, $W_3 = 3.8960$

% Lipid = $\frac{(3.9 - 3.8960) \times 100}{3.9 - 1.9}$ 0.20%

For B, $W_2 - W_3$ where $W_1 = 1.25$, $W_2 = 3.25$, $W_3 = 3.2455$

$\frac{}{W_2 - W_1}$

...% Lipid = $\frac{(3.25 - 3.248) \times 100}{3.25 - 1.25}$ = 0.20%

For C, $W_2 - W_3$ where $W_1 = 2.001$, $W_2 = 4.003$, $W_3 = 3.998$

$\frac{}{W_2 - W_1}$

...% Lipid = $\frac{(4.003 - 3.998) \times 100}{4.003 - 2.001}$ = 0.25%

Determination of percentage nitrogen and crude protein.

For fresh plantain

% nitrogen $\frac{V_1 - V_o}{10 \times \text{sample weight}}$

Sample weight = 1.00

...% Nitrogen = $\frac{1.700 - 0.1}{10 \times 1.00}$ = 0.1600

% protein = 0.160 X 6.25 = 1.00%

For plantain powder

% Nitrogen = $\frac{V_1 - V_o}{10 \times \text{sample weight}}$

Where $V_1 = 0.600$

$V_0 = 0.1$, sample weight = 0.35

% Nitrogen = $\frac{0.600\ 0.1}{10 \times 0.35} = 0.143\%$

% Protein = 0.143 X 6.25 = 0.89%

Determination of percentage starch

% Starch = 1125 X A X100

Where A 0.002

..% starch = 112.5 X 0.002 X 100 = 22.5%

Determination of percentage sugar. Where D = dilution factor % sugar

$$= \frac{0.05 \times D \times 100}{T}$$

T = average titre value

... % sugar for fresh plantain

$$= \frac{0.05 \times D \times 100}{T}$$

Where D = 30

$$T = \frac{29 + 26}{2} = 22.5$$

.. % sugar $$\frac{0.05 \times 30 \times 100}{27.5} = 5.45\%$$

For plantain powder

$$\% \text{ Sugar} = \frac{0.05 \times D \times 100}{T}$$

Where D = 30

$$T = \frac{27 + 26}{2} = 26.5$$

... % Sugar $$= \frac{0.05 \times 30 \times 100}{26.5} = 5.66\%$$

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