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EFFECTS OF PRE-TREATMENTS ON THE QUALITY OF ACHA FLOUR AND ACHA FLOUR BASED BISCUIT

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ABSTRACT

Acha (*Digitaria exilis*) flour was produced from soaked and malted acha grains. Composite flours were formulated by substituting acha flour with soaked/ malted acha flour, respectively, at 10, 20, 30, 40, 50 and 100%. Biscuits were prepared from the composite flours. The functional properties of the composite flours and the physical, chemical and sensory properties of the composite achaflour biscuits were determined. The bulk density decreased from 2.20 - 0.73 and 2.20 – 1.50g/cm3, respectively, for soaked and malted acha flour respectively. However, the water absorption capacity decreased from2.20 – 1.13 and 2.2 – 1.50cm3/g. The spread ratio of the biscuit increased from 5.75 - 7.64. and 5.75 – 6.41, for soaked and malted flour respectively with increase in the level of the added soaked and malted acha flours. The break strength decreased from 2.8g – 1.5g and 2.8g - 0.2g respectively, with increase in the level of soaked and malted acha flours in the acha biscuit. The protein, ash, fiber and carbohydrate contents decreased from 6.92 – 6.70, 6.92 – 5.85, 2.33 – 2.10 and 77 – 67 %, respectively. However, the moisture and fat contents increased from 7.45 – 7.96 and 13.22 – 13.41 %, respectively, with increase in the level of soaked acha flour. The protein, ash, fat, fiber and carbohydrates contents decreased from 6.92 – 5.85, 2.60 – 2.10, 13.22 – 13.03, 2.34 – 2.27, 77 -66 % , respectively, while the moisture content increased with the level of malted acha flour. The average means scores for crispiness, odour, taste, texture, mouth feel increased from 6.45 – 7.45, 6.35 – 6.95, 6.45 – 6.90, 6.50 – 6.70, 6.6 – 7.0, respectively with increase with soaked acha flour. The average means scores of the crispiness, odor : 6.45 – 7.0, 6.35 – 7.00, 16.75 – 7.4, 6.5 – 7.15, 6.6 – 7.25, respectively, with increase in the level of malted acha flavor..

Keywords: Effect, Soaking, Malting, Acha, and Quality

1.0. INTRODUCTION

Acha (*Digitaria exillis*) is a cereal grain in the family of gramineae and commonly referred to as folio or hungry rice (Alemu, 2009; Ayo and Nkama, 2004). The grain is grown in areas with at least 800mm of rainfall such as the mountain Fouta Dyallon region of Guinea and dry Savanna zone of Mali and upper Volra (Lasekan, 1994, Ayo and Nkama, 2004). The major traditional foods from the grain are: thick (*tuwo*) and thin (*kuku*), porridge, steamed product (*burabusko* or couscous), *gwete* and alcoholic beverages (Jideani and Akingbala, 1993, Ayo and Nkama, 2006; Ayo and Nkama , 2004; Jidenai 1997). Acha grains may be boiled like rice; flour from acha may be fortified with other cereals flour especially for the production of porridge or pudding (Nzlibe, 1995). Nigerian people of Plateau, Bauchi and Kaduna states burns straw and ash extracted with water through perforated basket. The filtrates are used as potash for cooking indigenous delicacies. Acha grain can also be ground into flour to produce biscuit (Jideani, 2011; Ayo *et al*., 2007). Acha is nutritious and its seed is rich in methionine and cystine, which are vital to human health and deficient to today's major cereals like wheat, rice, maize, sorghum, barley and rye (Jideani and Akingbala, 1993, Ayo *et al.,* 2008, Iriving and Jiseani, 1997). Enrichment of cereal food with other protein sources such as legumes (soybean, bambaranut, tigernut, etc) has received considerable attention because it's high lysine content (an essential amino acid) which is limiting in most cereals (Enche, 1999; Ayo *et al.,* 2010). In a recent study, acha grain was shown to have high water absorption capcity, a property that could be linked to appreciable amount of pentosan. Acha contains about 33g pentosan/kg (Jideani, 1997). The high water absorption capacity of acha could be utilized in baked food. Pentosan present in baker's patent flour at a 2-3% level, consist primarily of polymeric pentosan sugars, rather than hexose sugar of starch (Ayo *et al*., 2008). Pentosans have been found to be very important regulator of water absorption and distribution in dough. (Lasekan, 1994; Ganhi and Bourue, 1991, 1990; Ayo *et al.,* 2010). Characteristics of acha protein could also potentially produce bread with desirable properties (Jideani and Ibrahim, 2005).

The consumption of cereal based foods like biscuit has triggered required development of an adequate substitute for wheat (Ayo and Nkama, 2008). Although the protein content of acha is similar or slightly lower than that of other grains. Acha is known to be easy to digest, it is traditionally recommended for children, old people and for people suffering from diabetes or stomach diseases (Jideani, 1991). Acha does not contain any gluten in or gliadine proteins which are the constituents of gluten, making this cereal suitable for people with gluten

intolerance (Ayo and Nkama, 2004). Acha has been identified as a major food for diabetic patients in Nigeria, by medical practioners (Jideani, 1991, NRC, 1996, Ayo *et al.,* 2010).
. It is of great interest to develop acha biscuit that will be of great benefit to teaming number of diabetic patients in Nigeria. The research work was aimed at assessing the effect of pretreatment on the quality of acha flour and acha-based biscuit.

2.0 MATERIALS AND METHOD

2.1 Materials

The creamy colored type of acha grains (*Digitaria exilis*), was purchased from Jos Central Market, Plateau State. The baking powder, baking fats, salt and date palm used in the production of the biscuit were purchased from Gboko Main Market, Benue State, Nigeria.

2.1.1 Preparation of Acha soaked and malted Acha flour

The *acha* grains were manually cleaned by handpicking of the chaffs and the dusts and stones were removed by washing in clean water (sedimentation). The washed and de-stoned grains were sun dried, milled (attrition milling machine model R175A), sieved (0.3mn aperture), packaged (polyethylene) and stored at ambient (32°C) temperature. Soaked acha flour was prepared by cleaning, washing and soaking of acha grain(in water) for 12hours, drained, oven dried (45°C), milled, sieved(0.3mn aperture) and packed. Malted acha flour was prepared by cleaning, washing, soaking (12hr), germinating (spread under jute cover bag constant wetting for 3days), oven dry 45°C), cum removed, milled, sieved and packed

2.1.2 Composite flour

The soaked and malted acha flours, respectively, was substituted with acha flour at 10, 20, 30, 40, 50, 100% to produce soaked acha-acha flour and malted acha-acha flour composite flour, respectively. The blends were thoroughly mixed and kept in plastics containers until needed. Other ingredients are expressed in the percentage of the acha malted/soaked flours.

Table 1: Composite flour formulation

Acha: malted acha soaked	Date palm (%)	Fat (%)	Baking powder (%)	Salt (%)	Water (%)
100 : 0	50	50	1.5	1.0	30
90 : 10	50	50	1.5	1.0	30
80 : 20	50	50	1.5	1.0	30
70 : 30	50	50	1.5	1.0	30
60 : 40	50	50	1.5	1.0	30
50 : 50	50	50	1.5	1.0	30
0 : 100	50	50	1.5	1.0	30

Source: Ayo and Nkama (2003)

2.1.3 Production of acha composite flour biscuits

Biscuits were prepared from the composites flours as shown in Table 1. The Ayo and Nkama (2003) method of biscuit production was adopted. The date palm was beaten into the fat until fluffy , and then mixed with acha flour containing the salt and baking powder. This was then thoroughly mixed into consistent dough, cut into sizes (biscuit cutter), baked at 180°C for 20min, allowed to cool down to ambient temperature, packed in polyethylene and stored at 4°C.

2.2 Evaluation of Physical Properties of Biscuits

2.2.1 Spread ratio

The spread ratio was determined by measuring the length of rows of five pieces of the biscuits and column height of the same. The spread ratio was calculated as diameter divided by height (Gomez *et al.*, 1997).

2.2.2 Break strength:

The break strength was determined by adapting Okaka and Isieh (1997) method. Biscuits of known thickness (0.4cm) were placed centrally between two parallel wooden bars (3cm apart) and weights were added on the biscuit until the biscuit snapped. The least weight that caused the breaking of the biscuit was regarded as the break strength of the biscuit.

2.2.3 Chemical analysis

The protein, fat, ash, crude fibre and moisture content of the samples were determined using AOAC, (2010) methods. The carbohydrate content was determined by simple difference as Carbohydrate = 100 – (% Moisture + % Protein + % Fat + % Ash + Crude fibre).

2.2.4 Evaluation of functional Properties

The bulk density, water absorption, oil absorption, foam capacity and stability, gelation and swelling capacity were determined using AOAC (2010) method.

2.2.5 Sensory evaluation of biscuits

The sensory evaluation of the biscuit samples was carried out using randomly selected 20 judges (students and staff of the Department of Food Science and Technology, University of Mkar, Benue State, Nigeria) on a nine point Hedonic scale (1= extremely dislike" and

9 =extremely like) as described by (Iwe, 2002). Qualities assessed included: colour, crispiness, aroma, mout feel, flavour, taste, texture and general acceptability. Coded samples of the same size and temperature were served to the judges.

2.3 Statistical Analysis

The data were subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version. 16. Means were separated with Duncan Multiple Range Test (DMRT). Significance was accepted at $p>0.05$.

3.0 RESULTS AND DISCUSSION

3.1 Effect of Pretreatment on the Functional Properties

The oil absorption capacity, gelling capacity, swelling capacity and bulk density of the soaked acha flour increased from 0.73-2.2, 0.26-0.3, 1.86-3.53 and 1.4-2.86g/cm3, respectively. The water absorption capacity and the foaming capacity also decreased from 2.2-1.13 and 2.2-1.33g/cm3 with increase in the added soaked acha flour (Fig. 1). The water absorption capacity, foaming capacity, gelling capacity, swelling capacity and bulk density of the malted acha flour decreased from 2.2-1.5, 2.2-1.65, 3.96-2.46 and 3.4-2.2g/cm3, respectively (Fig. 2).

The decrease in the swelling capacity with added malted acha flour could be due to its dextrinzed starches, hence could not retain water absorbed (Adeyemo *et al*., 1992). Swelling capacity can be an index of stickiness of the resultant product. The decrease in the bulk density with increase in the percentage of malted acha flour could be due to the low weight mass of the malted grain as a result of hydrolytic break down of the component and usage during germination. The relative decrease in the bulk density could be an advantage in transportation; packaging and other post handling as low density attract less transportation fee (Ayo, 2003, Ayo *et al*., 2007).

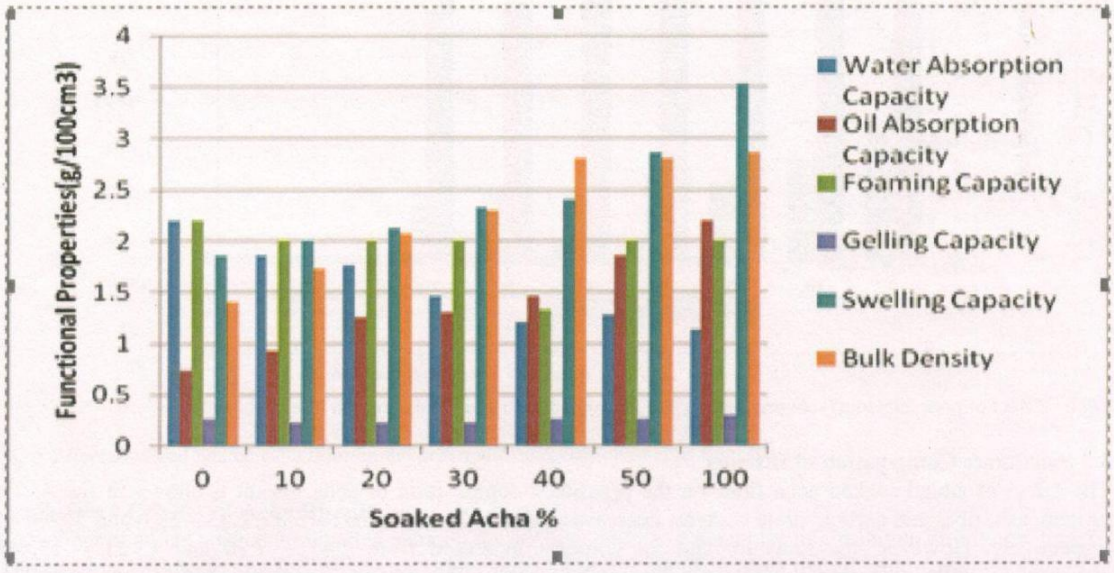

Fig 1. Effect of soaking acha on the functional properties of acha flour

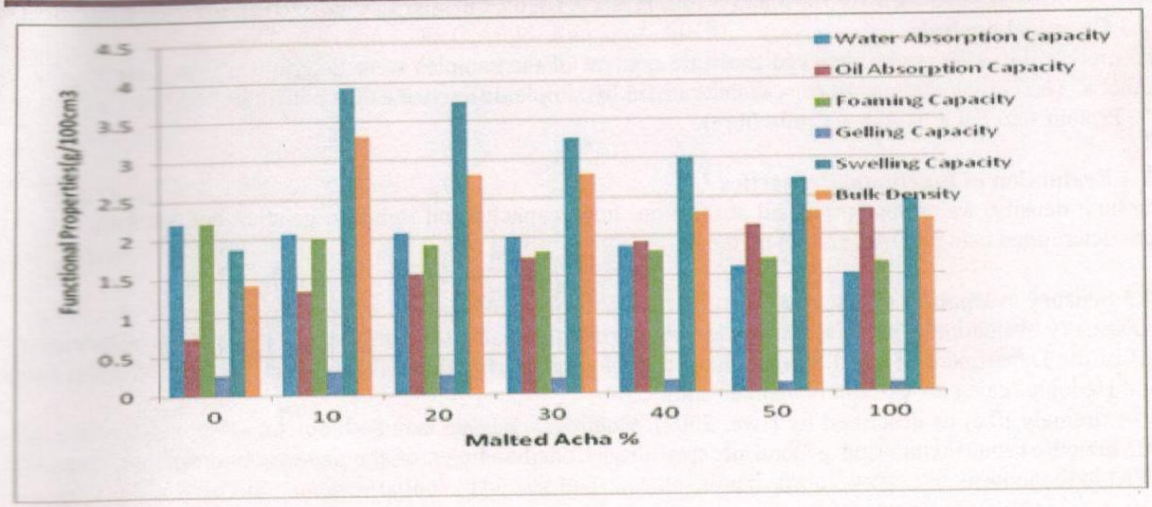

Fig 2. Effect of malting acha on the functional properties of acha flour

3.2 Effect of Pretreatment on the Physical Property of Acha Biscuit

The effect of pretreatment (soaking and malting) on the quality of acha based biscuit is presented in Fig. 3. The spread ratio increased from 5.75 - 7.64. and 5.75 – 6.41, for the soaked and malted flour based biscuits, respectively with increase in the added soaked and malted acha . The increase in the spread ratio which also relate to viscosity could be due to the absorbed water during soaking and the biochemical break down of the carbohydrate by the enzymes during malting (growth of the shoot) (Ayo *et al*., 2007)

The break strength decreased from 2.8g – 1.5g and 2.8g - 0.2g respectively, with increase in the added soaked and malted acha biscuit. The decrease could be due to the increase in the water content of soaked acha flour and biochemical break down that occurred in malted acha flour. This results in diluting the protein and carbohydrates levels which are responsible for hardness of biscuit (Okaka and Isieh, 1990; Ayo and Nkama , 2003; Ayo *et al*,. 2003) and in weakening of the bonding of the components of the resultant biscuits.

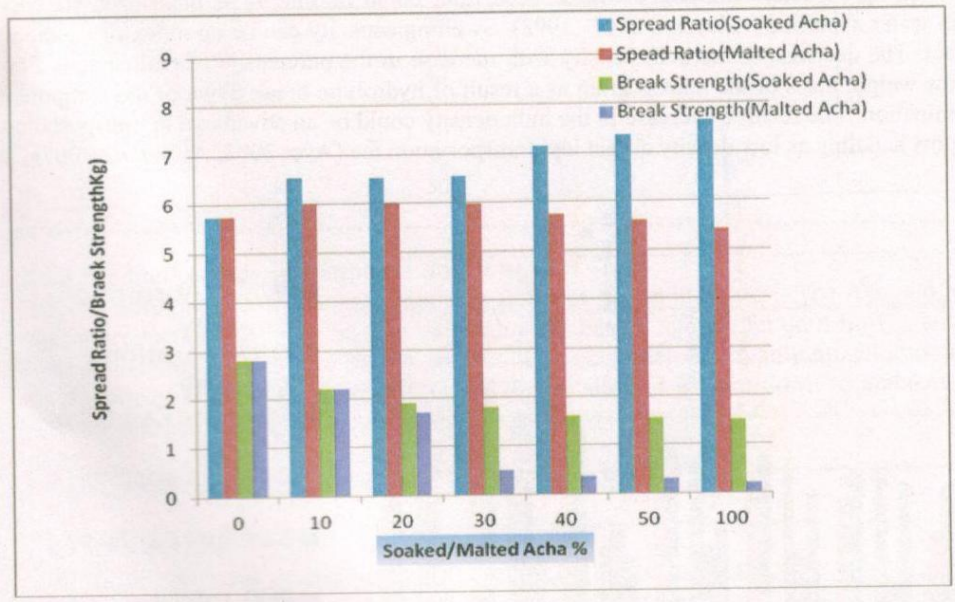

Fig 3. Effect of pretreatments (soaking/malting) on the spread ratio and break strength of acha biscuits

3.3 Proximate Composition of Biscuits

The effect of added soaked acha flour on the proximate composition of acha biscuit is shown in fig. 4. The protein, ash, fiber and carbohydrate contents decreased from 6.92 – 6.70, 6.92 – 5.85, 2.33 – 2.10 and 77 – 67 % respectively. However, the moisture and fat contents increased from 7.45 – 7.96 and 13.22 – 13.41% respectively, with increase in added soaked acha flour level, .The decrease is not significant, ($p < 0.05$). The decrease in protein, ash and carbohydrate content could be due to their solubility in water and were probably

Modu *et al.* (2005). The considerable loss of protein on soaking might be due to leaching out of the low molecular weight nitrogen compounds into water (Falmata *et al.*, 2013). The protein, ash, fat, fiber and carbohydrates contents decreased from 6.92 – 5.85, 2.60 – 2.10, 13.22 – 13.03, 2.34 – 2.27, 77 -67%, respectively, with increase in the added malted acha flour (Fig.5). The decrease in protein, ash, fiber, and carbohydrate contents were significant ($p<0.05$) at 30% and above level of additional malted acha. The general decrease in the protein, ash, fibre and carbohydrate contents which agreed with ealier findings of Okral (2008), Gernah *et al.*(2011), Alemu (2009) and Mubarak (2005) could be as a result of action of hydrolytic enzymes existing in the grain coupled with the mobilization of soluble materials into the shoots and roots for germination. The decrease in protein in particular could be due to break down and utilization of the nutrients during the malting process for the growth of the shoot. This could be as a result of the mobilization of storage nitrogen of the acha grain to produce the nutritionally high quality proteins needed by the young plant for its development. Cereal grains are reported to be rich in essential fatty acids (Adeyemo *et al.*, 1992) which play a very important role in the proper development of brain cells in infants and children. Thus if germination adversely affects the quality of essential fatty acids of grains, the need for supplementation becomes most crucial. The significant ($p<0.05$) increase in the moisture content could be attributed to the high relative humidity maintained during the malting process(by adding water) and also increase in the water absorption during soaking (Modu *et al.*, 2005). The relative high moisture content could affect the shelf stability if not properly packed.

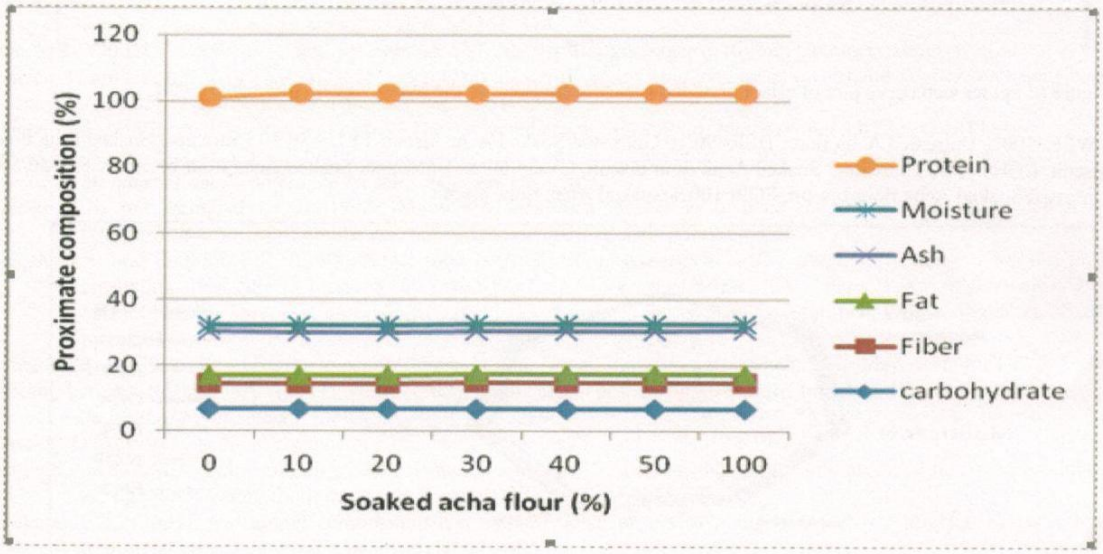

Fig.4 Effect of added soaked acha flour on the proximate composition of acha flour biscuit

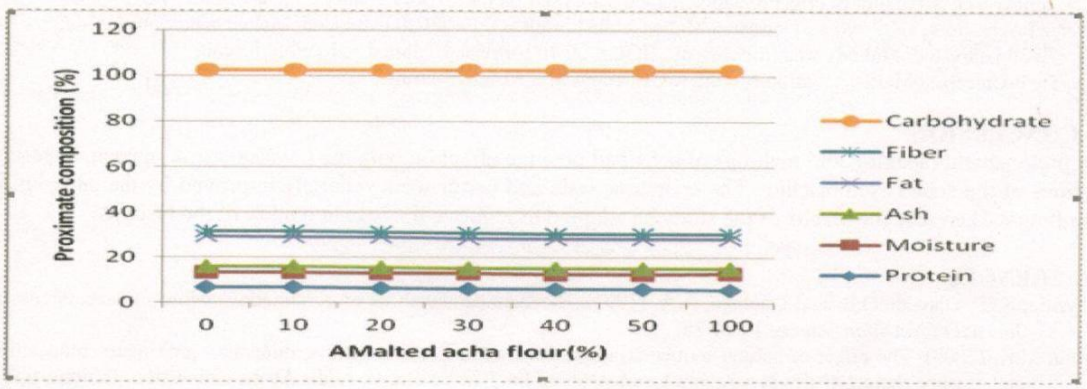

Fig.5 Effect of added malted acha flour on the proximate composition of acha flour biscuit

3.4 Sensory Quality of Acha Biscuit

The effect of added soaked and malted acha on the sensory quality of acha biscuit are shown on Figures 6 and 7. The average means scores for crispiness, odour, taste, texture, mouth feel increased from 6.45 – 7.45, 6.35 – 6.95, 6.45 – 6.90, 6.50 – 6.70, 6.6 – 7.0, respectively with increase in the added level of soaked acha flour. The

increases were generally not significant ($p < 0.05$). The increase in the average means scores of the assessed parameters could be due to the enhanced functional properties in the absorption of moisture during soaking. The samples were generally accepted as indicated by the averaged means scores of the acceptability (6.75 – 6.5). The average means scores of the crispiness, odour, colour , taste and texture increased 6.45 – 7.0, 6.35 – 7.00, 16.75 – 7.4, 6.5 – 7.15, 6.6 – 7.25, respectively, with increase in the added malted acha flour (0 – 10%). The increases were generally not significant ($p > 0,05$). The increased scores of the assessed quality of biscuits containing malted acha could be probably due to inherent flavored compounds produced during malting.

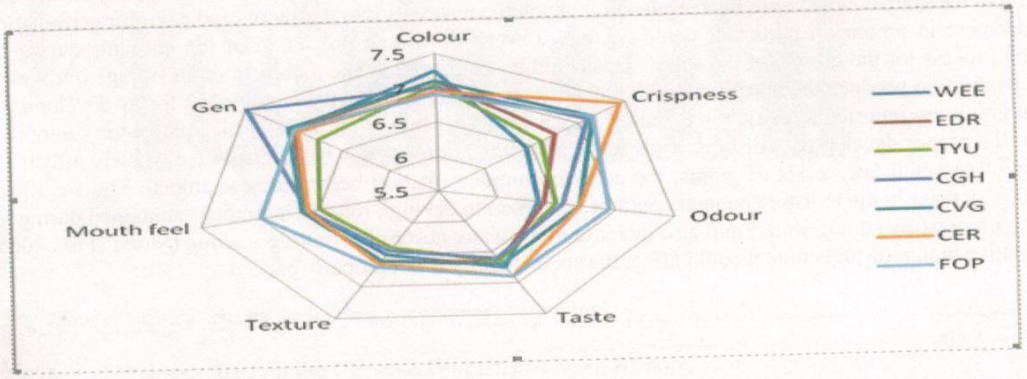

Figure 6: Spider web curve plot of effect of added soaked acha flour on the sensory quality of acha biscuit

t-WEE=100% Untreated Acha flour, DER=90/10 Untreated/Soaked Acha biscuit,TYU= 80/20 Untreated/ Soaked acha flour biscuit, CGH=70/30 Untreated/ Soaked Acha flour biscuit, CVG= 60/40 Untreated/ Soaked Acha flour biscuit, CER=50/50 Unteated/Soaked Acha flour biscuit, FOP=100% Soaked Acha flour biscuit

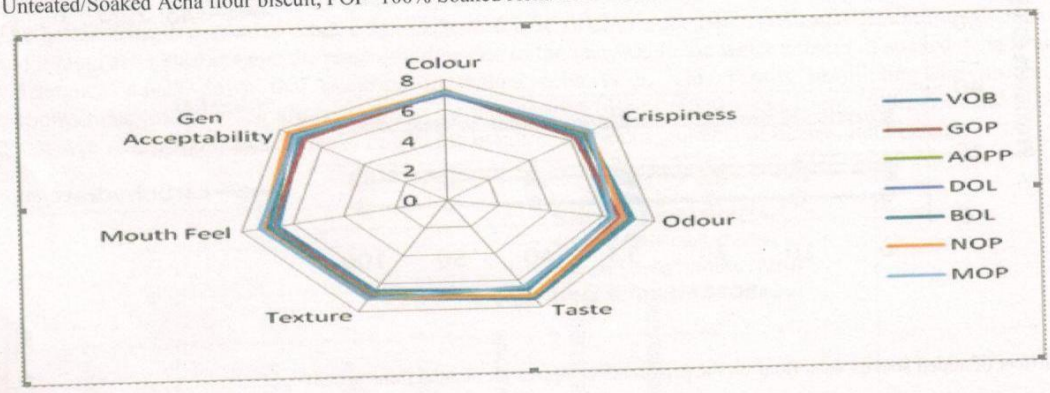

Fig. 7: Spider web curve plot of effect of added malted acha flour on the sensory quality of acha biscuit -VOB=100% Untreated Acha flour, GOP=90/10 Untreated/Malted Acha biscuitAOPP= 80/20 Untreated/ Malted acha flour biscuit, DOL=70/30 Untreated/ Malted Acha flour biscuit, BOL = 60/40 Untreated/ Malted Acha flour biscuit, BOL=50/50Untreated/MaltedAchaflourbiscuit, MOP=100% MaltedAchaflourbis.

4.0 CONCLUSION

The pretreatment (soaking and malting) of acha had positive effect on both the physical, proximate and sensory qualities of the acha based biscuits. The crispness, taste and odour were generally improved by the added malt acha flours. Therefore the results of the study be adopted to improve the baking quality of the biscuits.

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