

## Research paper

### **EFFECT OF ADDED BAMBARANUT FLOUR ON THE QUALITY OF ACHA BASED FURA**

#### **ABSTRACT.**

The raw materials (Acha and Bambaranut) was prepared and made into flour for the production of acha-based composite flour used in the production of fura. Analysis (proximate, sensory, physical and functional) was carried out on the product. The chemical composition of the fura for protein, fat, crude fibre, Ash and moisture showed increase (6.14 – 9.3, 3.0 – 4.8, 1.2 – 4.4, 0.5 – 1.1, 0.99 -1.2 respectively), while carbohydrate decreased from 88.2 – 79% with increase added bambaranut flour(0-25%). Sensory evaluation result showed a decrease in the acceptability with increase percentage concentration of bambaranut flour. The result of functional property, for bulk density and foam capacity increased (0.57 – 0.76g/ml, 6.67 – 12.2%, respectively) while water absorption capacity decreased (57 – 42%) with increase in the added bambara nut flour. The product was most acceptable at 10% added bambaranut flour which did improve the protein, fat and fibre content by 27.5, 37.8 and 31.5%, respectively.

#### **INTRODUCTION**

Acha (*Digitaara exillis*) also known as hungry rice is one of the indigenous African cereal which belong to the poaceae (grasses) (Jideani and Akingbala 1993). The plant is about 4.5cm high with tiny bug ear, will grow on poor sandy soil which will not support the growth of some more popular cereal and thrive in area where few cereal would to form (Irvine 1979, NRC 1996).

The kernels of this cereal is tiny and weighs about 0.5mg. it is classified as millet but on like other millet it is low in protein (Oyenuga, 1968). However acha protein is unique in that it has greater methionine content than other cereal protein (Kent 1987).

The major traditional food from the grain are thick (Tuwo) and thin (kunu) steamed product (Burabusko or Couscous) and alcoholic beverages (Jideani and Akingbala,1993)

Acha is one of the most nutritious of all grain, its seeds is rich in methionine and cystine amino acid, they are vital to human health and deficient in todays major is

35 cereals, like wheat, rice, maize, sorghum, barley and rye (Jideani and Akingbala,  
36 1993).

37

38 Enrichment of cereal based food with other protein source such as legumes has  
39 received considerable attention. This is because legumes protein are rich in lysine, an  
40 essential limiting amino acid in most cereal (Alobo, 2000, GRAD 2004). Acha  
41 contain high water absorption capacity that gives it the capacity to be utilized in baked  
42 foods. It also contain pentosan (Lasekan and lasekan 1998, Ayo 1998) which gives it  
43 the ability to form gel in the presence of oxidizing agent at room temperature with  
44 high residual protein coupled with high level of sulphur and hydrophobic amino acid  
45 residue which makes it useful in baking (Obizoba et al 1994, Okaka 2005). The recent  
46 finding of the unique property of acha is relatively lowering the blood glucose level  
47 (Ayo et al 2007) and the subsequent reducing of diabetic populace has made the same  
48 an attractive research focus in recent time.

49

50 The use of composite flour in making baked product has been studied in great details  
51 since 1904 when food and agricultural organizations (FAO) of United State sponsored  
52 composite flour programme, most effort of researchers were centered on composite  
53 flour made from sorghum, maize, cassava, cha yam, potatoes etc. the study of  
54 composite flour was further triggered by food and agricultural organization FAO  
55 (1993). An investigation of the use of cassava in biscuit making.

56 Bambara nut (*voandzeia subterranean* (L) thouars) is a seed of Africa origin used  
57 locally as a vegetable. It was first found in West Africa.  
58 (<http://wapedia.mobi/en/bambara>). The plant is leguminous and has numerous  
59 nitrogen fixing nodules on the root. Evidence has shown that based on the root

60 nodules, the plant supports land care provision in Africa (National Research council,  
61 2006). The quest for plant with nutritional properties continue to receive attention.  
62 Bambara groundnut(*Vigna subterranean*) which constitutes complete food stuff is  
63 reported to contain protein, carbohydrate and lipids and can be consumed at different  
64 stages of maturation ( NRC, 2006, Baryh 2001). The plant has a potential to improve  
65 malnutrition and boost food availability.

66

67 Food fortification has been defined as the addition of one or more essential nutrient to  
68 a food whether or not its normally contained in the food for the purpose of preventing  
69 or correcting a demonstrated deficiency of one or more nutrient in a population or  
70 specific group (FAO/WHO 1994). Diet that lack variety can be deficient in certain  
71 nutrient due to the soil of a region, or because of the inherent inadequacy of diet.  
72 Addition of micronutrients to staples and condiment can prevent large scale  
73 deficiency disease in these cases.

74

75 Fura is a semi-solid dumpling cereal meal produced mainly from moist pearl millet  
76 (*pennisetum glaucum*) flour, blended with spices compressed into balls and boiled for  
77 30 minutes while still hot the cooked dough is worked in the motar with pestle (with  
78 addition of hot water) until a smooth slightly elastic cohesive lump (fural was formed.  
79 The work is aimed at adding bambara groundnut flour to improve the quality of  
80 acha based flour food fura.

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82

83 **Materials and Method**

84 Acha grains (*Digitaria exilis*), Bambara nut (*Vigna subterranean*), cloves, salt ginger,  
85 red chilly pepper, black pepper were purchased from Muda-Lawal market Bauchi.

86 The Acha grain was sorted and washed with water to remove stones, dust and foreign  
87 materials, the grain was sundried, milled using hammer mill and sieved with a sieve  
88 of aperture size of 0.300m. The flour was packed in Polythene and stored in a cool dry  
89 environment acha flour.

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91 The Bambara nut seed was sorted, cleaned, toasted, and allowed to cool. The seed was  
92 milled with the use of hammer mill into fine flour and sieved through a sieve with  
93 aperture 0.300m, packed in a polythene bag and stored in a cool dry environment as  
94 Bambara nut flour

95

## 96 **Production of Fura:**

97 The bambaranut flour was substituted into the acha flour( 0, 5, 10, 15, 20 25) and  
98 mixed with weighed spices (ginger, cloves, black pepper and red chilly pepper) as  
99 shown in Table 1, mixed thoroughly(manually) and conditioned(adding 100cm<sup>3</sup>  
100 water) to improve molding. The conditioned flour is weighed (20g), molded into  
101 balls, steamed (15mins), boiled (30min covered with water) and pound (local motar)  
102 until a smooth and slightly elastic consistency was achieved. The smooth and elastic  
103 dough is remolded into balls (30g), coated with wheat flour to avoid cracking, cooled  
104 and stored in dry atmosphere.

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107

108 **Table 8: Project Recipe for Formulation**

|                   | Sample/Ingredient per gram |      |      |      |      |      |
|-------------------|----------------------------|------|------|------|------|------|
| Acha flour        | 100                        | 95   | 90   | 85   | 80   | 75   |
| Bambara nut flour | 0                          | 5    | 10   | 15   | 20   | 25   |
| Ginger            | 1.34                       | 1.34 | 1.34 | 1.34 | 1.34 | 1.34 |
| Black pepper      | 0.24                       | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| Chilly pepper     | 0.50                       | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Cloves            | 0.67                       | 0.67 | 0.67 | 0.67 | 0.67 | 0.67 |

109

## 110 **Methods**

### 111 **Sensory qualities evaluation**

112 The sensory evaluation of the samples were carried out for consumer acceptance, and  
 113 preference using twenty (20) untrained judges randomly selected(student and staff of  
 114 the Dept. of Food Science and Technology, Federal Polytechnic, Bauchi) using a  
 115 nine(9) point Hedonic Scale (1 and 9, representing extremely dislike and extremely  
 116 like, respectively.). The quality assessed include:- colour, taste, odour, texture and  
 117 overall acceptance. Coded samples of the same size at the same temperature (35°C)  
 118 were served in a coloured(white) plate of the same size to judges in each panel  
 119 cupboard under the florescent light. Only one sensory attribute was tested in one  
 120 sitting(Ihekoronye and Ngoddy 1985). Data collected were subjected to Analysis of  
 121 Variance and difference between the mean were separated using Duncan multiple test  
 122 (Larmond, 1997). . Unless otherwise mentioned, all the measurements were made in  
 123 triplicate and the values represent the average of the three measurement.

124

### 125 **Chemical properties**

126 The moisture, fat, ash Moisture determination, carbohydrate and protein content was  
 127 determined (A.O.A.C 2006, Ayo and Agu 2012)

128

## 129 **Functional properties**

### 130 **Foaming capacity**

131 Two gram of the sample of fura was blended (using Kenwood blender) with 80ml  
132 distilled water for 5min and poured into the measuring cylinder. The height of the  
133 foam was determined by taking the reading (Clarke and Lee 1986, Gomeaz et al 1997,  
134 Narayana 1982)

135

### 136 **Water Absorption Capacity**

137 The samples (2.0g) were weighed into the tubes and 25ml of water was added, shaken  
138 allowed to stand for 1hr at room temperature with occasional shaking. The mixture  
139 was centrifuged at 16000rpm for 25min. Excess water was decanted by inverting the  
140 tubes on absorbent paper. Weight of the sample before and after recorded, The water  
141 absorbed was calculated (Lin et., 1974, Ayo and Okoliko 2003, Ooraiku, 1980)

142

### 143 **Bulk Density**

144 The procedure of Hall and Hedicy (1971) was used. Twenty gram of the sample was  
145 measured into graduated flask and tapped or dropped on a soft pad-table 30 times and  
146 the volume noted (Vml). The bulk density was calculated by dividing the  
147 volume (Vml) by the weight (twenty gram).

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## 155 RESULTS AND DISCUSSIONS

### 156 Effect of added bambaranut flour on the chemical quality of Acha based Fura

157 The effect of added bambaranut flour on the chemical composition of Acha based fura  
158 is detailed in Table 2 below;

| Acha | Bambaranut | Crude<br>protein | Fat  | Crude<br>fiber | Ash  | Moisture | Carbohydrate |
|------|------------|------------------|------|----------------|------|----------|--------------|
| 100  | 0          | 6.14             | 3.01 | 1.20           | 0.50 | 0.99     | 88.20        |
| 95   | 5          | 7.41             | 3.50 | 1.31           | 0.60 | 1.00     | 86.21        |
| 90   | 10         | 7.83             | 4.25 | 1.71           | 0.70 | 1.05     | 84.53        |
| 85   | 15         | 8.90             | 4.40 | 2.30           | 0.81 | 1.10     | 82.54        |
| 80   | 20         | 9.11             | 4.61 | 3.90           | 0.93 | 1.20     | 8.33         |
| 75   | 25         | 9.30             | 4.80 | 4.4            | 1.12 | 1.22     | 79.21        |

159 **Table 2: Chemical Composition of Acha based Fura (%)**

160

161

162 **Moisture:** The moisture content increased from 0.99 to 1.22% with increase in the  
163 added bambara nut flour (0-25%). The increase in the moisture content is relatively  
164 low which could be an advantage in the keeping quality of the product as it will not  
165 allow the growth of spoiling microorganisms and biochemical and enzymatic  
166 reactions.

167

168 **Fat:** The fat content increases from 3.0 – 4.8% with increase in the percentage (0 –  
169 25%) of bambaranut flour. The increase in fat content could be due to the added  
170 bambaranut added. The relative increase in fat content could improve the energy level  
171 of the consumer as it has been known that one gram of fat or oil will yield about  
172 368kj/gkcal of energy when oxidized in the body (Okaka, 2001). The relatively low  
173 level of moisture content of the products could prevent hydrolysis of the fat that could  
174 endanger its shelf life.

175

176 **Crude Protein:** The protein content increased from 6.14 – 9.3% with increase in the  
177 percentage (0 – 25%) of bambaranut flour. The increase in the protein content could

178 be due to the added bambaranut which have been confirmed to contained substantial  
179 high level of the same and could be an inexpensive source (Akinkugbe, 2009).

180

181 **Ash Content:** The Ash content of the product increased from 0.5 – 1.1% with  
182 increased concentration (0 – 25%) of added bambaranut flour. High Ash content is  
183 usually as a result of mineral and vitamin which apart from the nutritional value are  
184 good for eye sight, skin, and bones (Akinkugbe, 2009). Ash is a non organic  
185 compound containing mineral content of food and nutritionally it aid in the  
186 metabolism of other compound (De humen, 2003).

187

188 **Crude Fibre:** The crude fibre of the product increased from 1.2 – 4.4% as the  
189 percentage concentration (5 – 25%) of added bambaranut flour increased. The  
190 increase in percentage fibre could be due to high fibre content of bambaranut (4.9)  
191 (Hepper, 1980).

192

193 **Carbohydrate:** The carbohydrate content of the product decrease from 88.2 – 79.2%  
194 with increase proportion of bambara groundnut flour (5 – 25%). The decrease in  
195 carbohydrate content could be as a result of relatively low carbohydrate content of  
196 bambaranut. Carbohydrate is macronutrient needed in the largest amount. According  
197 to Dietary Reference intake published by USDA, 45 – 65% of calories should come  
198 from carbohydrate. Acha has a high carbohydrate content of 75% (Axtell et al., 1996)  
199 and the reduced carbohydrate content could be attributed to the reduction in Acha  
200 flour proportion (100 – 75%) and increase in bambara groundnut flour (5 – 25%).

201

## 202 **Sensory Evaluation of the Fura**

203 The effect of added bambaranut flour on the sensory quality of Acha base fura is  
204 shown in table 3 below.

205 **Table 3: Sensory Evaluation of Instant Fura**

| Acha<br>/g | Bambara-<br>Nut/g | Taste | Odour | Texture | Colour | Overall<br>acceptability |
|------------|-------------------|-------|-------|---------|--------|--------------------------|
| 100        | 0                 | 6.4f  | 7.7f  | 7.1f    | 7.3a   | 6.9a                     |
| 95         | 5                 | 6.95e | 7.2e  | 7.25eh  | 6.7b   | 7.0a                     |
| 90         | 10                | 7.55d | 7.68d | 7.8dh   | 6.0c   | 7.85a                    |

|    |    |       |       |       |      |       |
|----|----|-------|-------|-------|------|-------|
| 85 | 15 | 6.6c  | 6.1c  | 6.5cg | 6.6d | 6.05a |
| 80 | 20 | 6.15b | 6.05b | 5.8bg | 6.2e | 6.0a  |
| 75 | 25 | 6.0a  | 6.55a | 5.18a | 6.1f | 5.2a  |

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208 **Taste:** The addition of bambaranut flour on the quality of acha based instant fura  
 209 decreased the mean score for taste from 7.55 – 6.0 as the concentration of bambaranut  
 210 flour increased (5 – 25%). This increase could be due to increase in concentration of  
 211 bambaranut flour which could have affected the taste.

212

213 **Texture:** The addition of bambaranut flour on the quality of acha based instant fura  
 214 decrease the mean score from 6.7 – 6.1 as the concentration of bambaranut flour  
 215 increases.

216

217 **Colour:** The average mean score of the instant fura colour decreased from 7.2 – 5.55  
 218 with increased in the percentage (5 – 25%) of bambaranut flour. The decrease could  
 219 be due to increased concentration of bambaranut flour. The colour of the biscuit  
 220 shows no significant difference at 100 – 75% concentration of acha and bambaranut  
 221 composite flour.

222

223 **Odour:** The average mean score of the instant Fura odour decreased from 7.8 – 5.18  
 224 with increased percentage flour. The sample with the highest mean score for odour is  
 225 the sample with 5% bambaranut flour. While sample with the least mean score for  
 226 odour is sample with 25% bambaranut flour. The decreased in the sensory evaluation  
 227 of odour could be as a result of odourous compound which is inherent to bambaranut  
 228 flour.

229

230 **General Acceptability:** The average mean score for general acceptability decreases  
 231 from 7.8 – 6.5 with increased percentage concentration of bambaranut flour. The  
 232 sample with 10% bambaranut flour is ranked the best in terms of taste, colour, and  
 233 texture but the sample with 5% bambaranut flour is ranked the best in terms of odour.

234

235 **Effect of added bambaranut flour on Functional Properties of the Instant Fura**

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**Bulk Density:** From the result of the bulk density computed, the addition of bambaranut flour and the bulk density of Acha based instant Fura increased the bulk density from 0.57 – 0.74g/ml( Table 4) which could be as a result of increase percentage concentration (0 – 25%) of bambaranut flour on the product. The increase in bulk density could be an advantage in packaging of the product as it will occupy less space and could also be advantage in solubility as the particles has less tendency of floating during soaking in liquid prior to consumption.

**Foam Capacity:** The foam capacity of the product increased from 6.8 – 12.2% as the percentage concentration (0 – 25%) of bambaranut flour increase. The increase in the foaming capacity could be due to high protein content of the added bambara nut as noted by Iwe (2001). The high foaming capacity could be advantage in the solubility of the product and also high ability in mixing with other food components.

**Water Absorption Capacity:** The result of water absorption capacity shows that it decreases from 55 – 42% as the percentage concentration of bambaranut flour increase. The relatively decrease in the water absorption capacity could be due to the presence of the husk or outer coat of the bambara nut as complete de hulling of the same proved impossible. The presence of the hull which contain principally the cellulose and hemi-cellulose which has poor water absorption capacity.

**Table 4: Water Absorption**

| Acha | Bambaranut | Bulk Density<br>g/ml | Water absorption<br>capacity (%) | Foam capacity<br>(%) |
|------|------------|----------------------|----------------------------------|----------------------|
| 100  | 0          | 0.57                 | 57                               | 5.0                  |
| 95   | 5          | 0.59                 | 55                               | 6.8                  |
| 90   | 10         | 0.60                 | 54                               | 8.2                  |
| 85   | 15         | 0.60                 | 51                               | 8.9                  |
| 80   | 20         | 0.72                 | 42                               | 11.0                 |
| 75   | 25         | 0.71                 | 42                               | 12.2                 |

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## 266 **Conclusion**

267 The addition of defatted bambara nut flour to acha based biscuit has greatly improved  
 268 the quality of the product even at the 10% acceptable level as indicated by the  
 269 panelist. At this level of acceptance the protein, fat and fibre content has been  
 270 improved by 27.5, 37.8 and 31.5% respectively, making the product highly nutritious  
 271 particularly for the diabetes who have been proven to consume acha with less  
 272 difficulty. The pretreatment of the bamabara nut prior to usage could improve the  
 273 water absorption capacity of the product.

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