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QUALITY ASSESSMENT OF COMPLEMENTARY FOODS MADE FROM ACHA (Digitaria exilis stapf) FLOUR SUPPLEMENTED WITH COWPEA (Vigna unguiculata L. walp) FLOUR

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Abstract: **This study evaluates the proximate, functional and pasting properties of complementary food made from acha flour fortified with cowpea flour. Acha flours were substituted with cowpea flour at 10, 20, 30 and 40% proportions. An increase in the level of acha flour substitution resulted in a decrease in the protein content of the supplemented flour. However, addition of cowpea our resulted in an increase in the protein content, fat, crude fibre WAC and bulk density. Peak viscosity values ranged from 145.83 - 174.25RVU. Acha flour had higher peak viscosity while 40% substituted flour had the least peak viscosity as values decreased with increase in cowpea substitution. Trough and breakdown values ranged from 88.92-104.5 and 55.92-75.08RVU respectively. Final viscosity and setback values ranged from 204.92-214.08 and 105.42-124.17RVU respectively. Peak time and pasting temperature ranged from 5.02-5.21 min and 50.15-50.24^{0}C respectively. Inclusion of cowpea increased the nutritional value of acha flour and substitution up to 20% of cowpea compared well with the gruels from the Acha flour.**

Keywords: **Acha Flour, Cowpea Flour, Pasting properties, Sensory properties, Complementary food.**

I. INTRODUCTION

Breast milk provides all the nourishment a baby needs for the first six months of life. Infant formula is a suitable alternative to breast milk and will also cater for the baby's nutritional needs up to 6 months [1]. However, once a baby reaches 6 months, it is important to introduce solid food into the baby's diet both for the baby's nutrition and for their development. This gradual process of introducing solid foods into the baby's diet is known as weaning. The department of health recommends that weaning starts when the baby is six months old if breast-fed and 4-6 months old if formula-fed.

The normal infant experiences a 3-fold increase in weight and a 2-fold increase in length over the first year of life and also experiences dramatic developmental changes in organ function and body composition. This rapid rate of growth and development impose unique nutritional needs over and above relatively high maintenance needs incident to the higher metabolic and nutrient turnover rate of infant versus adults [2].

By age 4-6 months the infant capacity to digest and absorb a variety of dietary components as well as metabolize, use, and excrete the absorbed products of digestion is near capacity of an adult. In contrast the volume of milk produced by many women is not adequate to meet all nutrient needs of the breast-fed infant beyond age 4-6 months. Thus, for these infants, complementary foods are an important source of nutrients. In most developing countries, the high cost of fortified nutritious proprietary complementary foods is always, if not prohibitive, beyond the reach of most Nigerian families.

Such families often depend on inadequately processed traditional foods consisting mainly of un-supplemented cereal porridges made from maize, sorghum and millet. In view of this, appropriate processing and blending of locally available food commodities have been carried out and researched into by a number of researchers [3][4]. Such blends have been found to improve nutrient density of the complementary food and improved nutrient intake, which resulted in the prevention of malnutrition problems. This approach would require knowledge about the nutritive values of a variety of local food commodities, indigenous to the affected communities.

A number of cereal and legumes that are readily available have found to have nutrient potentials that could complement one another if properly processed and blended [5] [6]. Therefore it is imperative that efforts to formulate and evaluate composite blends are carried out to ascertain the nutritive adequacy of these locally available blends (cereal and legumes) for use as complementary foods, especially by the rural and the poor urban mothers during weaning period.

The objective of this research work was to evaluate the effects of cowpea flour substitution on the proximate, pasting and functional properties of the acha flour.

II. MATERIALS AND METHODS

Preparation of materials:

White acha variety (Digitaria exilis) was purchased from a local market in Jos, Plateau State, Nigeria while the Cowpea bean(Vigna unguiculata) the black eye peas variety was purchased from Bodija market, Ibadan, Oyo State, Nigeria.

Acha flour was prepared as earlier described by [7] with little modifications while the Cowpea flour was prepared as described by [8].All the floursproduced were packaged in air tight polythene bags and refrigerated till they were used in blend preparations. The substitution of Acha flour with cowpea flour was shown in table I.

TABLE I: Proportion of samples used.

Sample	Proportion
A	100% Acha flour
B Acha :Cowpea flour	90:10
C Acha: cowpea flour	80:10
D Acha: cowpea flour	70:30
E Acha: Cowpea flour	60:40

Proximate Analysis:

The blends were analyzed for proximate composition according to standard methods [9]. The conversion factor for relating kjeldahl nitrogen of the flours to protein content was calculated on the basis of the proportion of total protein provided by each of the protein containing constituents, that is, the acha flour and cowpea flour. The carbohydrate content was obtained by difference.

Functional Analysis:

Bulk density was determined according to the procedures of [10] while Water Absorption capacity determined by the method of [11].Pasting properties were determined using a Rapid Visco Analyzer RVA-4(Newport Scientific, warriewood Australia) according to the AACC 76-21 method [12]. Standard method 1(STD 1) provided by the instrument manufacturer was used with 3.5g of flour (corrected to 14% moisture content).

Statistical analysis:

Data were analyzed using analysis of variance and the significance of the observed differences between means was separated with Duncan Multiple Range Test procedure using SPSS version 20.

III. RESULT AND DISCUSSION

Proximate Analysis:

The result of the proximate analysis carried out on the acha and cowpea flour are shown in table II. There was significant variation ($P<0.05$) in the protein content of the weaning food formulations. The protein content of the weaning food increased as the proportion of cowpea blends increases (6.7-12.8%). Similar result was reported by [13]. The crude fibre,

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carbohydrate and fat content decreased from 7.4-5.7%, 67.6-64.3% and 3.4-2.5% respectively with increase in the percentage of cowpea flower (0-40%). There was no significant difference in the moisture content and ash content among the samples. 100% acha had the highest Crude fibre content. Carbohydrate content ranged from 64.3-67.7% with 100% acha flour having the highest value (67.6%). These values decreased as the percentage of cowpea flour added increased. Similar result was reported by [14].

TABLE II: Proximate composition of Acha-cowpea flour blends.

Parameter (%)	A	B	C	D	E
Moisture content	11±0.01^{a}	10.7±0.01^{a}	10.9±0.01^{a}	11.2±0.04^{a}	11.0±0.01^{a}
Fat	3.4±0.03^{a}	3.1±0.02^{ab}	3.0±0.01^{b}	2.8±0.02^{bc}	2.5±0.02^{c}
Crude Protein	6.7±0.01^{e}	8.1±0.02^{d}	9.6±0.03^{c}	11.4±0.01^{b}	12.8±0.01^{a}
Crude Fiber	7.4±0.01^{a}	7.0±0.01^{b}	6.7±0.01^{c}	6.1±0.01^{d}	5.7±0.18^{e}
Ash	3.9±0.04^{a}	3.9±0.01^{a}	3.8±0.03^{a}	3.8±0.03^{a}	3.7±0.03^{a}
Carbohydrates	67.6±0.02^{a}	67.2±0.01^{a}	66.0±0.01^{ab}	64.7±0.01^{b}	64.3±0.12^{b}

Means in the same row with different superscript are significantly different ($p < .05$).

Mean ± Standard Deviation for 3 determination

Functional Properties:

The results of the functional properties of the various blends were reported on table III.

It was observed that the water absorption capacity reduced as the proportion of the cowpea blend increases with the 100% acha flour having the highest value 127.5%. This indication shows that 100% acha flour can form viscous gel in hot condition than the substituted flour samples. The bulk densities of the flour ranged from 0.90 to 0.85g/cm^3**.** The 100% acha had the highest bulk densities of all the samples. The 60% acha: 40% cowpea flour sample has the lowest bulk density of 0.85g/cm^3. This reduction may be attributed to the substitution of the acha flour with the cowpea flour. The low values is important in complementary foods because high bulk density limits, the caloric and commercial diet in take per feed per child and infants are sometimes unable to consume enough to satisfy their energy and commercial diet requirements [15].

TABLE III: Functional properties of Acha-Cowpea flour blends

Parameter (%)	A	B	C	D	E
Water Absorption Capacity (%)	127.5±0.5^{a}	122.0±1.0^{b}	119.0±0.5^{c}	117.6±0.1^{d}	116.3±0.5^{e}
Bulk Density(g/cm^3)	0.9±0.002^{a}	0.89±0.003^{b}	0.89±0.005^{b}	0.86±0.003^{c}	0.85±0.002^{d}

Means in the same row with different superscript are significantly different ($p < .05$).

Mean ± Standard Deviation for 3 determination

Pasting Properties:

The pasting properties of flour substituted with cowpea flour are shown in table IV. Peak viscosity values ranged from 145.83-174.25 RVU. 100% acha flour had higher peak viscosity (174.25RVU) while 60% acha: 40% cowpea flour had the least peak viscosity. The values decreased with increase in cowpea substitution. 100% acha was significantly different (P<0.05) from the sample substituted with cowpea. High peak viscosity is an index of high starch content [16] hence, the reason for the highest obtainable value in 100% acha flour as compared to the blends. The peak viscosity obtained was lower than the values (434.75-837.17 RVU) reported for six varieties of banana flour by [17]and also the peak viscosity obtained in 100% acha flour was also lower than the values reported for 3 varieties of yam flour used for Amala (Efuru 206.04 RVU, Ise-Osi 242.75 RVU and Abuja 241.25 RVU) [18]. Breakdown values decreased down with increase in cowpea addition and it ranged from 55.92.75.08RVU. The substituted flour sample will be more stable than the acha flour. 60%acha: 40% cowpea had the highest resistance to heating due to its least breakdown value. Breakdown is a measure of susceptibility of cooked starch granules to disintegrate and has been reported by [19] to affect the stability of the flour products. Final viscosity and setback values were lower in 100% acha flour than other samples. These were significantly different (P<0.05) from the substituted flour samples. The values ranged from 204.92-214.08RVU and

105.75-124.17RVU respectively. There was no significant difference in the pasting temperature (P>0.05). Pasting temperature provides an indication of the minimum temperature required to cook a given sample, which can have implication on the stability of other components in the flour and also indicate energy cost [19]. Addition of cowpea flour increased the viscosity of the acha flour as against the reported by [14]. The peak time range from 5.02 – 5.21mins and it increased as substitution of cowpea increased .The decrease in pasting attributes (except pasting temperature) with increasing protein may be due to the effect of protein on the starch as reported by [21], [22].

TABLE IV: Pasting properties of Acha-Cowpea flours

Sample	Pasting temperature (^{0}C)	Peak viscosity (RVU)	Trough (RVU)	Breakdown (RVU)	Final viscosity (RVU)	Setback (RVU)	Peak time (min)
A	50.25±0.18^a	174.25±0.43^a	99.17±1.00^b	75.08±1.00^a	204.92±1.00^e	105.75±0.34^d	5.12±0.10^b
B	50.20±0.19^a	172.5±0.43^a	104.5±1.00^a	68.0±0.58^b	209.92±1.00^c	105.42±1.00^d	5.21±1.00^a
C	50.15±0.19^a	166.25±1.00^b	98.08±1.00^c	68.17±0.58^b	206.5±1.00^d	108.42±1.00^c	5.08±0.10^{bc}
D	50.25±0.19^a	157.42±1.00^c	93.83±1.00^d	63.58±1.00^c	211.75±1.00^b	117.92±1.00^b	5.05±0.12^{cd}
E	50.15±0.19^a	145.83±1.00^d	88.92±1.00^e	55.92±1.00^d	214.08±1.00^a	124.17±1.00^a	5.02±0.21^d

Means in the same row with different superscript are significantly different ($p < .05$).

Mean ± Standard Deviation for 3 determination

IV. CONCLUSION

Increase in level of substitution significantly affects the protein, crude fibre, carbohydrate, fat content, water absorption capacity, bulk density and pasting properties of the composite flours. These properties are quality indicators of food. Substitution of Acha flour with Cowpea flour improved the nutritional profile and utilization of acha. These blends have been found to improve nutrient density of the complementary food and improved nutrient intake, which can result in the prevention of malnutrition problems. This also provides a cheap and cost-effective alternative to the commercial products which are rather expensive.

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