

Full Length Research Paper

Physico-chemical properties and consumer acceptance of instant cowpea (*Vigna unguiculata*) powder for complementary food

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Two cultivars of cowpea (white and brown testa coloured) were processed by pre-cooking for 10min. and dry-toasting (170°C, 10min) to render them ready-to-eat and to inactivate the anti-nutritional factors. The samples were dry-milled into powders. Ogi, traditional gruel from maize, was produced into powder. Five different blends of ogi and cowpea powder were prepared. Proximate chemical composition including Trypsin inhibition activity of the various blends was investigated. Also functional characteristics of the samples including bulk density, gelation capacity and water absorption capacity were investigated. Ogi supplemented with cowpea powder and 100% ogi were prepared into porridges which were presented for sensory evaluation among members of the university community. Each sample was evaluated for colour, taste, mouth-feel, flavour and overall acceptance. Moisture content values of the processed cowpeas ranged from 6.05 to 7.22% for boiled white cowpea and boiled brown cowpea respectively. Protein content ranged between 22.8% in the boiled white cowpea and 25.4% in the raw brown cowpea. There were 88.6-93.3% and 77.7-88.6% reduction in Trypsin inhibitor activity (TIA) of both white and brown cultivars of cowpea respectively. Sensory evaluation of ogi supplemented with cowpea revealed that supplementation at level above 30% is not acceptable among the panel. Brown cultivar of cowpea was preferred to the white cultivar.

Keywords: Cowpea flour, ogi flour, supplementation, antinutritional factor, consumer acceptance.

INTRODUCTION

In developing countries, especially African countries, malnutrition remains a major health problem in infants and pre- school children. The weaning period is the most critical in the life of infants and pre-school children with serious consequences for growth, resistance to diseases, intellectual development and survival if the child's nutritional needs are not met. Consequently, considerable efforts to improve health and nutritional status of growing children have focused on the production of nutritious low-cost complementary foods (Osundahunsi and Aworh, 2003). Unfortunately, in African countries, traditional infant foods are made from cereals, starchy roots and tubers that provide mainly carbohydrates with low quality proteins. These infant foods, exemplified by 'ogi', a fermented gruel or porridge

made from maize, sorghum or millet, are the leading cause of protein-energy malnutrition in infants and pre-school children in Africa (Osundahunsi and Aworh, 2001). Cereals, in general, are low in protein and are limiting in some essential amino-acids, notably lysine and tryptophan. Supplementation of cereals with locally available legumes that are high in protein and lysine, although often limiting in sulphur-containing amino-acids, increases protein content of cereal-legume blends and their protein quality through mutual complementation of their individual amino-acids. Unfortunately, the presence of naturally occurring nutritional stress factors including protease inhibitors, haemagglutinins, tannins and phytates impair the utilization of legumes (Osundahunsi and Aworh, 2003). Thus, there is the need to process legumes for good digestibility. Cowpea, commonly known as beans, is a major source of protein in Nigerian diet. Because of its importance in the diet of most developing countries, cowpea has been accorded priority research

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status by the Protein Advisory Group of FAO/UNO (Phillips, 1982). Cowpea generally undergoes one form of processing or the other to convert it into consumable forms and achieve the necessary digestibility and palatability. Considerable interests have evolved in expanding the use of cowpea in other forms such as production of ready-to-use (semi-instant) powder (McWatters, 1983; Ngoddy *et al.*, 1986; Olapade *et al.*, 2003; Olapade *et al.*, 2004; Olapade *et al.*, 2005). The aim of this study was to produce ready-to-eat (instant) cowpea powder for complementary food for infants.

MATERIALS AND METHODS

Procurement of materials

The two cultivars of cowpea seeds used for this study, IT97K-499-3S (white-coloured testa) and IT98K-131-2 (brown-coloured testa) were obtained from International Institute of Tropical Agriculture (IITA) in Ibadan. The seeds were cleaned, packaged in moisture proof polyethylene bags and stored under refrigeration condition (4°C) until used. White cultivars of maize and granulated sugar were obtained from Bodija market in Ibadan.

Preparation of instant cowpea powder

Each cultivar was divided into three batches each of 500 kg. The first batch was steeped in 1500 ml distilled water for 10 min and wet-dehulled. The cotyledons were then cooked in 1500 ml distilled water for 10 min and the cooking broth was discarded. The beans were dried in a cabinet drier at 60 °C for 8 h and then milled and sieved through 200 µm to obtain cooked cowpea powder. The second batch was conditioned by adding 10% distilled water, then allowed to equilibrate in a moisture proof polyethylene bag for 4 h and dried at 65 °C for 4 h, then toasted for 10 min at 120 °C with constant stirring in an oven, allowed to cool, then cracked and winnowed. The cotyledons were milled and sieved through 200 µm to obtain toasted cowpea powder. The third batch was steeped in 1500 ml distilled water for 10 min and wet-dehulled. The beans were dried in a cabinet drier at 60 °C for 8 h and then milled and sieved through 200 µm to obtain raw cowpea powder.

'Ogi' cake was prepared as described by Akingbala *et al.*, (1981). The cake was dried at 50 °C for 2 h then milled into powder using a hammer mill through 0.8 mm screen.

Chemical analyses

Proximate chemical composition of the powders including

moisture, crude fibre, fat, ash and crude protein (N x6.25), was determined using AOAC (2000) methods. Carbohydrate content was determined by difference. Trypsin inhibition activity was determined according to the modified method of Kakade *et al.* (1974).

Functional properties of powders

Functional properties of powders including foaming capacity, water absorption capacity, gelation capacity and bulk density were investigated as previously described (Olapade *et al.*, 2003). Swelling power was determined as described by Leach *et al.* (1959).

Preparation of complementary foods

Different blends of ogi and cowpea powder at 80:20, 70:30, 60:40 and 50:50 (w/w) respectively were prepared and thoroughly blended using a warring blender. Each blend (20 g) was reconstituted with 10 ml water and stirred into smooth slurry followed by addition of boiling water (40ml) and stirring to obtain consistent paste, which was sweetened with 5 g granulated sugar. Ogi (100%) was used as control.

Sensory evaluation

Coded samples were presented to a twenty-five member panel, which are familiar with the ogi for sensory evaluation. The panellists rated the colour, taste, flavour, mouth feel and overall acceptance using a nine point hedonic scale, where 9 indicated 'like extremely' and 1 'dislike extremely'.

Statistical analysis

Data obtained were tested for differences using Analysis of Variance and means were separated by Duncan's multiple range tests using SPSS 11.0 package.

RESULTS AND DISCUSSION

Chemical composition

The proximate composition of the cowpea powders was essentially similar (Table 1) and within the range generally reported for cowpea (McWatters 1983, Ngoddy *et al.* 1986, Olapade *et al.* 2003). There were significant differences in chemical composition between the cultivars used in this study ($p < 0.05$). Protein, fat and crude fibres were higher in the brown cultivars while the white cultivar

Table 1 Proximate chemical composition of cowpea powders

Sample	Moisture %	Protein %	Fat %	Crude fibre %	Ash %	Carbohydrate %	TIA TIU/g sample
Raw white cowpea	11.2b	23.4cd	1.64c	1.89b	3.20b	58.7e	10.6b
Raw Brown cowpea	12.3a	25.4a	2.00b	2.40a	2.13d	56.1f	18.4a
Boiled white cowpea	6.05e	22.8d	0.84e	1.76b	4.34a	64.2b	0.71e
Boiled Brown cowpea	7.22c	24.9ab	1.12d	2.10ab	3.45b	61.2d	2.10d
Toasted white cowpea	6.70cd	23.9bc	0.97de	1.90b	2.50c	64.0b	1.21e
Toasted Brown cowpea	6.55cd	25.1a	1.01d	2.11ab	2.14d	63.1c	4.10c
Ogi	6.57cd	9.81e	3.53a	1.81b	2.01d	76.3a	ND

Means are of triplicate trials

Means with the same subscripts in a column are not different ($p < 0.05$)

ND= Not determined

was higher in ash. Trypsin inhibition activity (TIA) was higher in brown cultivar (Table 1). There were significant reductions in TIA as a result of the treatments ($p < 0.05$). Cooking with water resulted in higher reduction of TIA than dry toasting of cowpea. Heat treatment especially cooking was reported to reduce Trypsin inhibition activity by 96-100% in legumes (Satwadhari *et al.* 1981, Chung *et al.* 1981, Adewusi and Osuntogun 1991, Apata and Ologhobo, 1997). Akinyele (1989) also reported 82% reduction in the TIA of cooked cowpea dishes. Bressani (1985) attributed loss of toxicity of proteinaceous anti nutritional factors and ease of digestion of legume globulins to the effect of heating. The proximate composition of the blends was not determined but it is expected that increase in level of cowpea substitution would result in increased protein content of the blends. Previous workers have reported increased protein content with increased legume substitution of cereals in complementary food formulations (McWatters, 1982; Ossai and Malomo, 1988; Ashaye *et al.*, 2000; Obatolu *et al.*, 2000; Osundahunsi and Aworh, 2001).

Foaming capacity

Foaming capacity ranged from 6.3% for boiled white cowpea powder to 11.7% for toasted brown cowpea powder (Table 2). Boiling in water resulted in lower foaming capacity than toasting of cowpeas. There was no significant difference ($p < 0.05$) between the cultivars used but difference was observed for the treatments used.

Water and fat absorption capacities

Water absorption capacity ranged from 121% in the

boiled white cowpea powder to 162% in the toasted white cowpea powder. The fat absorption capacity was highest in brown cowpea (118%) and toasted white cowpea powder (117%). Boiling in water resulted in reduction of both water and fat absorption capacities of the cowpeas. Heat denaturation of cowpea protein has been associated with high fat absorption capacity of cowpea (Henshaw and Lawal, 1993). The results obtained were essentially within the range of earlier values reported for some cowpea flours (Olapade *et al.* 2003; Henshaw and Lawal, 1993).

Gelation capacity

The least gelation concentrations of the powders ranged from 17% to 19% (Table 2). The values obtained were similar to the values earlier reported for some cowpea flours (Abbey, 1988; Olapade *et al.*, 2003).

Bulk density

Bulk density values ranged from 0.646 to 0.807g/ml for raw white cowpea and boiled brown cowpea powders respectively. Boiling in water resulted in greater value of bulk density for both cultivars used compared to toasting of cowpea. This may be attributed to partial gelatinisation of cowpea starch during boiling.

Swelling power

Swelling power values ranged from 3.07 in the boiled brown cowpea to 4.70 in the toasted brown cowpea powders. Toasting of cowpea produced greater swelling

Table 2 Functional properties of cowpea powders

Sample		Foam Capacity %	Water Absorption Capacity %	Swelling Power %	Gelation Capacity %	Bulk Density g/ml
Raw white cowpea		ND	131d	ND	ND	0.646c
Raw cowpea	Brown	ND	152b	ND	ND	0.680b
Boiled cowpea	white	6.0	121e	3.33b	17b	0.790a
Boiled cowpea	Brown	7.0	123e	3.07b	18ab	0.807a
Toasted cowpea	white	10.2	162a	3.67a	19a	0.650c
Toasted cowpea	Brown	12.0	147c	4.70a	17b	0.700b

Means are of triplicate trials

Means with the same subscripts in a column are not different ($p < 0.05$)

ND – Not determined

Table 3 Sensory evaluation scores of complementary foods

Percentage supplementation of instant cowpea	Colour	Taste	Flavour	Mouth-feel	Overall acceptance
20% boiled white cowpea	7.7ab	8.2a	7.4bc	8.2a	7.9a
20% boiled brown cowpea	8.0a	8.1a	7.7ab	7.9a	7.9a
30% boiled white cowpea	7.3ab	7.9a	6.4d	8.0a	7.3b
30% boiled brown cowpea	6.7b	7.2a	6.2d	6.4c	6.1c
40% boiled white cowpea	5.3c	4.5b	5.4e	4.9de	5.1e
40% boiled brown cowpea	5.0c	5.4b	6.0d	5.2de	4.9e
20% toasted white cowpea	7.7ab	7.8a	8.0a	8.0a	8.1a
20% toasted brown cowpea	7.9a	8.1a	8.1a	7.9a	8.1a
30% toasted white cowpea	7.0ab	7.1a	7.1c	7.9a	7.1b
30% toasted brown cowpea	8.0a	7.4a	8.1a	8.2a	7.9a
40% toasted white cowpea	6.7b	5.4b	5.0e	5.4d	5.1e
40% toasted brown cowpea	6.7b	4.8b	5.4e	4.9e	5.4d
Ogi (control)	7.1ab	7.7a	7.2bc	7.1b	7.3b

Means with the same subscripts in a column are not different ($P = 0.05$)

power than boiling of cowpea. This may be attributed to partial gelatinisation of cowpea starch and denaturation of cowpea protein during boiling.

Sensory evaluation

Complementary foods containing 20% cowpea powder

were comparable with ogi, the traditional weaning food, in sensory qualities (Table 3). Complementary foods containing 30% cowpea powder made from boiled beans received poorer scores for flavour (6.4 for white cowpea and 6.2 for brown cowpea) relative to ogi (7.2) and those made from toasted cowpea (7.1 for white cowpea and 8.1 for brown cowpea). Products containing 40% cowpea received significantly poorer scores for taste, flavour,

mouth-feel and overall-acceptability (Table 3).

CONCLUSION

Ogi can be enriched with toasted cowpea powder at a level of up to 30% without adverse effects on sensory qualities.

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REFERENCES

- Abbey BW (1988). Functional properties of raw and heat processed cowpea (*Vigna unguiculata*) flours. *Journal of Food Science* 49: 1534
- Adewusi SRA, Osuntogun BA (1991). Effect of cooking on tannin content, Trypsin inhibitor activity and in vitro digestibility of some legume seeds in Nigeria. *Nigerian Food J.* vol. 9, 139-145.
- Akingbala JO, Rooney LW, Faubian JM (1981). A laboratory procedure for the preparation of ogi a Nigerian fermented food. *J. Food sci.*, 46, 1523-1536.
- Akinyele IO (1989). Effects of traditional methods of processing on the nutrient content and some anti-nutritional factors in cowpeas (*Vigna unguiculata*). *Food Chemistr.* 33: 291-299.
- AOAC (2000). Official methods of analysis. Association of Official Analytical Chemists, Washington DC.
- Apata DF, Ologhobo AD (1997). Trypsin inhibitor and other anti-nutrition factors in tropical legume seeds. *Tropical Science* 37, 52-59.
- Ashaye OA, Fasoyiro SB, Kehinde RO (2000). Effect of processing on the chemical and sensory quality of ogi fortified with full fat cowpea flour. *Moor J. Agri. Sci.*, 1: 115-123.
- Bressani R. (1985). Nutritive value of cowpea. In: *Cowpea research, production and utilisation*. Singh S.R. and Rachie K.O. edited. John Wiley and sons, New York. 353-359.
- Chung SY, Morr CV, Jen JJ (1981). Effect of microwave and conventional cooking on nutritive value of colossus peas (*Vigna unguiculata*). *J. Food Sci.*, 46: 272-273.
- Henshaw FO, Lawal SA (1993). Effect of processing methods on the functional properties of cowpea flour. *J. Tropical sci.* 33:377-385.
- Kakade M, Rackis JJ, McGhee JE, Puski G (1974). Determination of Trypsin inhibitor activity of soy products: a collaborative analysis of an improved procedure. *Cereal Chemistry*, 51:376
- Leach HW, McGowan LD, Schoch TJ (1959). Structure of the starch granule I: Swelling and solubility patterns of various starches. *Cereal Chemistry*, 36, 534-544.
- McWatters K.H. (1982). Peanut and cowpea meals as replacement for wheat flour in cake-type doughnuts. *Peanut Science*, 9: 101-103.
- McWatters KH (1983). Compositional, physical and sensory characteristics of akara processed from cowpea paste and Nigerian cowpea flour. *Cereal Chemistry*, 60, 333.
- Ngoddy PO, Enwere NJ, Onuorah VT (1986). Cowpea flour performance in akara and moin-moin preparation. *Cowpea Science*, 26: 101-109.
- Obatolu VA, Cole AH, Maziya-Dixon BB (2000). Nutritional quality of complimentary food prepared from malted and unmalted maize fortified with cowpea using extrusion cooking. *J. Sci. Food Agri.*, 80, 646-650.
- Olapade AA, Akingbala JO, Oguntunde AO, Falade KO (2003). Effect of processing method on the quality of cowpea (*Vigna unguiculata*) flour for akara preparation. *Plants Foods for Human Nutrition*, 58:1-10.
- Olapade AA, Ugokwe PU, Ozumba AU, Solomon HM, Olatunji O, Adelaja SO (2004). Physico-chemical properties of pre-mixes for preparation of akara. *Nigerian Food J.* Vol. 22, 54-58.
- Olapade AA, Ozumba AU, Solomon HM, Olatunji O, Adelaja SO (2005). Rheological properties and consumer acceptance of moin-moin premix. *Nigerian Food J.* Vol. 23, 144-147.
- Ossai GEA Malomo O (1988). Nutritional and sensory evaluation of a new cereal-legume weaning food. *Nigerian Food J.*, vol. 6, 23-34.
- Osundahunsi OF, Aworh OC (2001). A preliminary study on the use of tempe-based formula as weaning diets in Nigeria. *Plant Foods for Human Nutrition*, 57, 365-376.
- Osundahunsi OF, Aworh OC (2003). Nutritional evaluation, with emphasis on protein quality, of maize-based complementary foods enriched with soya bean and cowpea tempe. *International J. Food Sci. Technol.* 38, 809-813.
- Phillips RD (1982). Preparation and composition of a dry-milled flour from cowpea. *Cereal science.* 59:8, 351-353
- Satwadhar PN, Kadam SS, Salunkhe DK (1981). Effects of germination and cooking on polyphenols and in vitro digestibility of horse gram and moth bean. *Plant Foods for Human Nutrition.* 31: 71-80.