Influence of cowpea (Vigna unguiculata L Walp) variety on protein quality and sensory properties of akara, a popular West African cowpea-based food

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Abstract: The influence of newly developed cowpea varieties (IT81D-699, IT82E-18, IT84S-2246-4 and TVx3236) on the proximate composition, protein quality and sensory properties of akara, a popular West African cowpea-based food, was investigated and the results obtained were compared with those for akara prepared from a local blackeye cowpea variety. Protein quality was evaluated using weanling albino rats fed diets which were formulated to supply 10% protein using defatted akara samples, with casein as a control. Akara samples prepared from IT81D-699 and TVx3236 had crude protein contents, texture and overall acceptability comparable to those of akara prepared from the blackeye variety. Also, akara diets formulated using IT81D-699 and TVx3236 showed significantly (p < 0.05) higher values for weight gain, protein efficiency ratio, net protein ratio and true digestibility than diets formulated with IT82E-18, IT84S-2246-4 and blackeye, suggesting an improvement in the nutritional quality of akara produced using these (IT81D-699 and TVx3236) newly developed cowpea varieties.

Keywords: akara; cowpea varieties; protein quality; sensory assessment

INTRODUCTION

Cowpeas (Vigna unguiculata L Walp) are an important source of protein and other nutrients in many developing countries. They are incorporated into soups or stews or processed into paste or flour and used as a food ingredient or starting material for a variety of local foods, weaning foods and snack foods such as chin-chin, puff-puff, moin-moin and akara. Akara has been described as the most popular cowpea-based food product in West Africa, which makes its contribution to the diet particularly important. It is made by deep fat frying of whipped cowpea paste or flour flavoured with onions, salt and pepper and is consumed as a breakfast or snack food by both children and adults. Various aspects of production of akara from cowpea and other legumes have been studied.

Because of the importance of cowpeas in the nutrition of Africans, efforts aimed at breeding and improvement of cowpea varieties for specific characteristics such as desired seed quality and improved nutritional attributes have been reported. Advanced lines of cowpeas with good agronomic performance have been developed and released for cultivation by the International Institute for Tropical Agriculture (IITA) (Ibadan, Nigeria), including IT81D-699, IT82E-18, IT84S-2246-4 and TVx3236. Characterisation of these advanced cowpea lines for physico-chemical, functional and cooking properties has been reported in previous studies. In Nigeria, akara is produced by street and market vendors, as well as in the home, using a local cowpea variety, the blackeye. Studies on the production of akara using these newly developed cowpea lines have not been done. The aim of this study, therefore, was to evaluate the proximate composition, nutritional properties and acceptability of akara prepared using these new cowpea lines and to compare the results obtained with those for akara prepared from the local blackeye cowpea variety.

EXPERIMENTAL

Materials

Seeds of blackeye variety and four advanced lines (IT81D-699, IT82E-18, IT84S-2246-4 and TVx3236) of cowpea (Vigna unguiculata L Walp) with good agronomic performance (high yield, resistance to diseases, early maturity) were obtained from IITA’s Onne substation (Nigeria). Weanling male albino rats (Wistar strain) and vitamin and mineral premixes were
obtained from the University of Port Harcourt (Nigeria). All reagents used were of analytical grade (BDH Chemicals, Poole, UK).

Preparation of flour samples
The procedure described by Odum et al\textsuperscript{15} was used for the preparation of cowpea flour. Whole seed samples (1 kg batches) of cowpeas were soaked at room temperature (28 ± 1 °C) in tap water at a bean/water ratio of 1:5 for 12 h. Presoaked cowpeas (manually dehulled) were autoclaved (121 °C, 1.05 kg cm\textsuperscript{-2}) for 15 min and oven dried (60 °C) for 24 h in a hot air fan oven (model QUB 305010G, Gallenkamp, Loughborough, UK). Dried, dehulled cowpeas were ground using a laboratory mill (Numex Pep grinding mill, Numex Pep Mill Ltd, Mumbai, India) and screened through a 0.25 mm British Standard sieve (model BS410, Endecotts Ltd, London, UK) to obtain flour samples.

Akara preparation
A modified recipe of McWatters\textsuperscript{9} and the procedure outlined by Ngoddy et al\textsuperscript{10} were used for akara preparation. The basic ingredients used were 200 g of cowpea flour, 20 g of dried red pepper, 20 g of fresh onions and 3 g of salt. Cowpea flour was mixed with 170 ml of warm water (35 °C) in a mixing bowl using a wooden ladle to form a smooth paste. Fresh onions and dried red pepper, which were ground using an electric blender (model NR 2817/A, Philips, Mexico City, Mexico), together with salt were added to the paste and whipped for 2 min in a Kenwood blender (model A 907D, Gallenkamp) at a speed of 5000 rpm to incorporate air. Portions (12 ± 1 g) of the whipped batter were scooped using a wooden spoon, dropped into 11 of refined palm oil (King’s Brand, Devon Ind, Singapore) at 185–190 °C and fried for 4 min to yield akara balls. The fried products were divided into two lots. One lot was drained on absorbent paper and stored at 0 °C until used for proximate analysis or mixed in a diet for rat assay.

Proximate analyses of akara
The crude protein (N × 6.25), moisture, ether extract, total ash and crude fibre contents of the akara samples were determined by the AOAC\textsuperscript{16} standard methods 2.057, 14.004, 7.062, 14.006 and 7.070 respectively. Carbohydrate was calculated by difference.

Sensory evaluation
A 10-member trained panel consisting of staff members and students of the Rivers State University of Science and Technology (Port Harcourt, Nigeria) was selected based on experience and familiarity with akara for sensory evaluation. This number of panellists is considered adequate for evaluating preference/acceptance sensory tests.\textsuperscript{17} Panellists were trained in the use of sensory evaluation procedures and the meaning of the descriptive terms used. At each session, samples (two akara balls per cowpea variety, of similar size) were served plain on white saucers coded with three-digit numbers, with tap water to rinse the mouth between evaluations. Akara balls prepared from the new cowpea varieties were compared with those prepared from the blackeye variety and evaluated for colour texture, flavour and overall acceptability. Each attribute was rated on a nine-point hedonic scale of 1–9 as described by Larmond,\textsuperscript{17} using the sensory scale outlined by Ngoddy et al\textsuperscript{10} for akara as follows—colour of crumb: 1 = very brown, 9 = very white; texture: 1 = very heavy, 9 = very spongy; flavour: 1 = very burnt, 9 = very beany; overall acceptability: 1 = very undesirable, 9 = very desirable.

Protein quality evaluation
Protein quality of akara prepared from the various cowpea varieties was evaluated using a rat bioassay. A basal diet was prepared based on the formulation of Achinewhu and Isichei.\textsuperscript{18} The basal diet had the following ingredient composition: crude protein 10%, corn oil 8%, salt mixture 5%, vitamin mixture 1%, cellulose 1% and cassava starch 75%. Akara balls were oven dried (70 °C) for 24 h in a hot air fan oven and milled to pass through a 0.25 mm sieve. Flours obtained were defatted by solvent extraction in a Soxhlet apparatus (Tecator Inc, CO, USA) for 8 h using n-hexane. Five experimental diets were prepared by incorporating the defatted flours from akara samples into the basal diet at the expense of cassava starch such that they provided 10% crude protein in the final diets. Seventy (70) weanling male albino rats, 28 days old and weighing between 34 and 36 g, were grouped by a randomised block statistical design into seven groups of rats so that the average weight of the groups differed by no more than ±0.5 g. Each group consisted of 10 rats, and the groups were housed in individual wire-bottom cages that allowed for easy faecal collection and measurement of food intake. The temperature of the laboratory was 28 ± 1 °C, with alternate periods of light and dark of 12 h. One group of 10 rats was fed a nitrogen-free diet which consisted entirely of the basal diet, another group was fed casein (control), while the remaining five groups of rats were fed the experimental diets. The rats were given the diets with tap drinking water \textit{ad libitum} for 28 days, the duration of the experiment for the protein efficiency ratio (PER) study. The digestibility study was started on the 14th day of the PER study and lasted for 7 days, while the net protein ratio (NPR) determination was done on the 10th day of the PER study. Daily records on weight gain, food and protein intakes and faecal output by rats were taken and used in calculating the PER, NPR and apparent and true digestibilities using standard procedures.\textsuperscript{19}
Properties of akara from newly developed cowpea varieties

Table 2. Influence of cowpea variety on mean sensory cowpea varieties

<table>
<thead>
<tr>
<th>Cowpea variety</th>
<th>n</th>
<th>Flavour</th>
<th>Textures</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT81D-699</td>
<td>18</td>
<td>4.5c</td>
<td>8.4a</td>
<td>8.2a</td>
</tr>
<tr>
<td>IT82E-18</td>
<td>22</td>
<td>4.5c</td>
<td>8.4a</td>
<td>8.2a</td>
</tr>
<tr>
<td>IT84S-2246-4</td>
<td>22</td>
<td>4.5c</td>
<td>8.4a</td>
<td>8.2a</td>
</tr>
<tr>
<td>TV x3236</td>
<td>22</td>
<td>4.5c</td>
<td>8.4a</td>
<td>8.2a</td>
</tr>
</tbody>
</table>

*Mean hedonic scores, where 9 = like extremely, 1 = dislike extremely, n = 10 assessors, duplicates. Means with the same letter within a row do not differ significantly (p > 0.05).

Results and Discussion

The results on the proximate composition of akara prepared from new cowpea varieties are presented in Table 1. The crude protein contents of akara prepared from IT81D-699 (20.8%) and TV x3236 (21.0%) were not significantly (p>0.05) different from the crude protein value of 20.6% obtained for akara prepared from the blackeye variety. These crude protein values were comparable to the crude protein values of 19.5–20.9% reported for akara by other researchers.

The high fat absorption capacity of cowpea varieties (IT81D-699 and TV x3236) have been reported previously to have relatively lower levels of phytic acid compared with the levels encountered in raw and processed samples of IT82E-18 and IT84S-2246-4. Besides lowering the bioavailability of minerals and inhibiting the digestibility of proteins, phytic acid is also implicated in the hard-to-cook phenomenon of legumes.

In conclusion, this study has shown that akara samples prepared from IT81D-699 and TV x3236 cowpea varieties had more acceptable colour and flavour and showed superior nutritional quality compared with samples prepared from IT82E-18, IT84S-2246-4 and the local blackeye. These cowpea...
varieties (IT81D-699 and TV$_v$3236) that look very promising from a nutritional standpoint seem desirable.

### References


