British Journal of Nutrition (1985), **54**, 343–347

The use of cowpeas (*Vigna unguiculata*) in improving a popular Nigerian weaning food

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(*Received 8 March 1984 – Accepted 25 March 1985*)

1. A weaning food commonly used in Nigeria was simulated by mixing processed sorghum (*Sorghum bicolor*) with skim-milk powder (830:170, w/w).

2. Replacing 310 g/kg sorghum with processed cowpeas (*Vigna unguiculata*) resulted in an increase in protein content from 96 to 113 g/kg and an increase in biological value of the protein from 0·74 to 0·87.

3. The two mixtures were compared with an established commercial baby food by a panel of Nigerian mothers and all three foods were found to be equally acceptable.

4. Processing the cowpeas by pressure cooking followed by roller-drying reduced the trypsin-inhibitor content to minimum levels.

5. It is concluded that the protein content and quality of the weaning mixture popularly used in Nigeria could be improved by partially replacing the sorghum with cowpeas.

Protein–energy malnutrition of infants is one of the major nutritional problems in the world. It is due to several causes including lack of weaning foods, the provision of weaning foods with inadequate protein content, and to the use of foods too low in energy density to satisfy the needs of the growing infant.

A weaning food commonly used in Nigeria is composed largely of sorghum (*Sorghum bicolor*) with a limited amount of dried-milk powder, usually in the ratio 5:1. Such mixtures have been shown to be poor in protein content and quality (Akinrele & Bassir, 1967; Oyeleke, 1977). A more suitable weaning food has been prepared based on soya-bean and maize flour enriched with vitamins, soy-ogi (Akinrele *et al.* 1970), but is not yet available. Consequently an attempt was made to improve the quality of the popular mixture by replacing part of the sorghum with cowpeas (*Vigna unguiculata*).

MATERIALS AND METHODS

Ingredients

Cowpeas of unknown origin were purchased locally.

White-seeded sorghum grains, guinea corn, were supplied by the National Seed Services, Institute for Agricultural Research, Ahmadu Bello University, Nigeria.

Spray-dried skim-milk powder was obtained from the English Milk Marketing Board, Thames Ditton, Surrey.

The three ingredients contained respectively 233, 91 and 322 g protein/kg dry matter.

A sample of a commercial baby food (Farlene; Glaxo Laboratories Ltd) was purchased locally. This contained (g/kg): 200 protein, 45 fat, 747 carbohydrate.

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Processing

The cowpeas were soaked in tap-water at 25° for 16 h and dehusked by hand-rubbing. The dehusked peas were cooked for 15 min under 15 psi pressure, purèed and dried on an atmospheric double-roller dryer.

Sorghum grains were made into a paste, locally called ogi, by following the traditional method. The dry grains were first dehusked in a mill, ground to a powder and then soaked for 48 h in 3 vol. tap-water at room temperature. The wet cake, ogi, was boiled for 5 min with continuous stirring, diluted to 25% solids and dried on the roller dryer (Akinrele, 1966).

Diets

Mixture 1 was prepared to simulate the popular sorghum–milk preparation with sorghum–dried milk (830:170, w/w). In mixture 2, part of the sorghum was replaced with cowpeas: sorghum–cowpeas–milk powder (580:280:160, by wt).

Experimental diets for feeding to the animals were composed of (g/kg): 120 sucrose, 50 Solkafloc, 80 groundnut oil, 20 vitamin mixture, 40 mineral mixture with the addition of mixture 1, mixture 2 or Farlene to provide protein at a level of 100 g/kg; the diets were made up to 1 kg with maize starch.

Protein assay

The quality of the proteins of the three preparations was measured by the method of Miller & Bender (1955) using male rats of the hooded Lister strain maintained at Queen Elizabeth College.

The diets were given at a crude protein (nitrogen × 6·25) level of 100 g/kg diet for 10 d and the amount of N retained in the carcasses was measured by comparison with a group given a protein-free diet.

Sensory analysis

The palatabilities of mixtures 1 and 2 were compared with that of Farlene by a tasting panel of thirty Nigerian mothers. The powders were mixed with water to provide 250 g total solids/kg and presented at 37° to the panel using the hedonic scale questionnaire. To minimize bias the samples were coded and offered in random order; ratings were given numerical values from 1 to 9 and the results analysed statistically (Larmond, 1977).

Chemical analysis

The trypsin-inhibitor activity was determined according to the method of Kakade *et al.* (1974). Haemagglutinin content was determined by the photometric method (Liener, 1954) modified by Marquardt *et al.* (1975). Samples for amino acid analysis were hydrolysed with constant-boiling (6 M) hydrochloric acid in sealed ampoules under N_2 at 110 ± 1° for 24 h. Hydrolysates were analysed in a Technicon TSM AutoAnalyzer.

The proximate composition was determined following standard methods of the Association of Official Analytical Chemists (1980).

RESULTS

The partial replacement of sorghum with cowpeas in mixture 2 resulted in an increase in the crude protein level from 96 to 133 g/kg (Table 1).

The essential amino acids increased (Table 2) with a corresponding increase in biological value from 0·74 to 0·87 (Table 3). This was slightly greater than that of Farlene at 0·80. The net dietary protein energy ratio (NDpER) was increased from 0·05 to 0·08.

Table 1. *Nutrient content of infant foods (g/kg moisture-free basis)*
(Mean values of duplicate determinations)

Infant food*...	Mixture 1	Mixture 2	Soy-ogi
Moisture	50	50	47
Crude protein (nitrogen × 6·25)	96	133	203
Fat	18	17	63
Carbohydrate	809	778	637
Ash	17	12	30
Calcium	2·1	4·0	4·3
Phosphorus	3·8	4·5	4·4
Iron	0·03	0·08	—

* Mixture 1, sorghum (*Sorghum bicolor*)–milk mixture (830:170, w/w); mixture 2, sorghum–cowpea (*Vigna unguiculata*)–milk mixture (580:260:160, by wt); soy-ogi, soya-bean–maize-flour mixture (Akinrele & Edwards, 1971).

Table 2. *Amino acid composition of infant foods (g/16 g nitrogen)*
(Mean values of duplicate determinations)

Infant food*...	Mixture 1	Mixture 2	Soy-ogi	Pattern of infant requirements†
Lysine	4·1	4·7	4·6	5·2
Tryptophan	0·5	0·6	1·0	0·9
Threonine	3·2	4·1	3·7	4·4
Valine	4·8	5·4	4·8	4·7
Methionine	1·0	1·1	1·4	2·2
Isoleucine	4·2	4·5	4·3	3·5
Leucine	6·9	7·4	8·7	8·0
Phenylalanine	2·1	2·6	5·2	4·8
Total sulphur amino acids	2·5	3·0	2·8	2·9
Total aromatic amino acids	5·5	6·7	7·6	6·3
Total essential amino acids	31·7	36·4	37·7	35·9

* Mixture 1, sorghum (*Sorghum bicolor*)–milk mixture (830:170, w/w); mixture 2, sorghum–cowpea (*Vigna unguiculata*)–milk powder (580:260:160, by wt); soy-ogi, soya-bean–maize-flour mixture (Akinrele & Edwards, 1971).
† World Health Organization, 1965.

The raw cowpeas contained 19·8 (SE 0·3) trypsin inhibitor units (TIU)/g; after pressure cooking and roller-drying this was reduced to 1·2 (SE 0·1) TIU/g, which appears to be the minimum level that can be achieved.

Haemagglutinins were shown to be absent from the raw materials.

Sensory analysis

No significant differences were recorded in the overall quality between the two mixtures and the commercial infant food ($f < 0{\cdot}27$; $P < 0{\cdot}05$). The panellists were unable to detect any beany taste nor was there any difference between the two mixtures in appearance, taste, flavour or texture. Both mixtures were rated as acceptable by the panel and compared well with the commercial food although the latter was rated highest in the four attributes measured.

Table 3. *Biological evaluation of infant foods*

Diet*	BV	TND	NPU	NDpER
Mixture 1†	0·74	0·79	0·58	0·05
Mixture 2†	0·87	0·79	0·69	0·08
Farlene‡	0·80	0·80	0·64	0·14

BV, biological value; TND, true nitrogen digestibility; NPU, net protein utilization; NDpER, net dietary protein energy ratio.

Mixture 1, mixture 2, or Farlene were added to the diet to provide 100 g crude protein (N × 6·25)/kg. See p. 344 for details.

† Mixture 1, sorghum (*Sorghum bicolor*)–milk mixture (830:170, w/w; mixture 2, sorghum–cowpea (*Vigna unguiculata*)–milk powder (580:260:160, by wt).

‡ Glaxo Laboratories Ltd.

DISCUSSION

Cowpeas are considerably richer in protein than sorghum, 23·3 compared with 9·1 g/kg, with higher lysine and sulphur amino acid contents, i.e. 5 g lysine/kg cowpeas compared with 1·1 g/kg sorghum, 2·4 g cystine plus methionine/kg cowpeas compared with 1·8 g/kg sorghum. Cowpeas are richer in these amino acids than milk (2·5 g lysine/kg and 1·0 g cystine plus methionine/kg). Consequently, cowpeas can make a useful contribution towards infant food formulations.

The biological value of the proteins of mixture 2, which included cowpeas, was higher, at 0·87, than that of Farlene at 0·80. An apparently low value of 0·6 for soy-ogi was reported by Akinrele & Edwards (1971) but this was net protein utilization (NPU) operative, i.e. fed at 200 g protein/kg level, compared with the values for NPU fed at 100 g protein/kg level reported here.

The NDpER of mixture 1 was lower than the value of 0·08 recommended for children (World Health Organization, 1965) and the value was increased to 0·08 in mixture 2. The higher levels of protein in Farlene and soy-ogi result in NDpER of 0·14 and 0·108 respectively (Akinrele & Edwards, 1971).

Toxins

Problems can arise from toxins such as trypsin inhibitors and haemagglutinins in beans (*Vicia faba*) but the latter were absent from the sample of cowpeas tested, and trypsin inhibitors were reduced to a minimum through the double effect of cooking under pressure and roller-drying. Roller-drying alone is not sufficient to destroy the trypsin inhibitors completely.

Sensory analysis

It is difficult to determine whether an infant food will prove acceptable to the potential consumer but since the first stage in acceptability depends on the mother the formulations were tested on a group of thirty Nigerian mothers residing in London.

The two formulations, mixture 1 intended to simulate the food popular in Nigeria, and mixture 2 as a nutritionally-improved variety, were found to be as acceptable as the well-established commercial infant food tested at the same time.

Cowpeas, adequately heat-treated, would thus seem to be a valuable ingredient in infant foods since they are commonly available and the processing required is simple. There is need for further work to increase energy-density content without impairing acceptability.

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Printed in Great Britain