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Effects of Traditional Methods of Processing on the Nutrient Content and Some Antinutritional Factors in Cowpeas (*Vigna unguiculata*)

I. O. Akinyele

Department of Human Nutrition, University of Ibadan, Ibadan, Nigeria

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ABSTRACT

*Cowpea (*V. unguiculata*) was processed into* ewa, akara, moinmoin *and* gbegiri, *which are the most commonly consumed products of the beans in Nigeria. The traditional household methods were used. The products were significantly different from each other in moisture and lipid content as consumed. The protein content was little affected by processing (DM basis); but the calorie, ether extract, ash and nitrogen-free extracts were significantly affected by the method of preparation. The products varied widely in their mineral contents,* gbegiri *had the lowest amount of phytate, oligosaccharides and trypsin inhibitor activity as consumed, but was, however, lowest in nutrient content. The traditional methods of processing cowpeas are thus appropriate for maximum nutrient retention and utilization.*

INTRODUCTION

Cowpea (*V. unguiculata*) is consumed in various forms by Nigerians. The high demand for it is due to its recognition as a rich source of minerals, carbohydrates, vitamins (Oyenuga, 1968; Ogunmodede *et al.*, 1969) and high quality plant protein (Bressani & Elias, 1980). Processes like dehulling, fermentation and cooking were reported to affect the total solids and ash content of beans (Hussain & Noaman, 1976), phosphorus, magnesium, potassium and proximate composition of mature winged beans (Rockland

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et al., 1979; Ekpenyong & Borchers, 1980) and protein content of cowpea (*V. unguiculata*) processed into *moinmoin* (Edijala, 1980).

Information on the effect of processing on cowpea has been limited to specific, often isolated, processes as against a combination of such processes in household preparations. This paper presents the results of a study on the effect of household preparation methods of cowpea on the nutrient content of the various end products.

METHODS AND MATERIALS

Samples

Clean seeds of four cultivars of cowpeas; Kano 1696, IT82E-60, Tvx 3236 and Ife brown, obtained locally, were processed into *ewa* (boiled whole beans), *akara* (fried dehulled cowpea paste), *moinmoin* (steamed dehulled cowpea paste) and *gbegiri* (Cowpea soup) using traditional processing methods which are shown in Fig. 1. The products, produced in triplicate on different days, were dried in an air-oven (60°C) and milled before analysis.

Chemical Analysis

Proximate composition

The moisture, crude protein (Micro, Kjeldahl, Nx6. 25), fat (ether extract), crude fibre, and nitrogen-free extract (total carbohydrate by difference) were estimated by standard methods (AOAC, 1980).

Trypsin inhibitor activity

Trypsin inhibitor levels were determined by the method of Kakade *et al.* (1974).

Oligosaccharides

The oligosaccharides were determined by paper chromatography (Onigbinde & Akinyele, 1983) after 80% ethanol extraction, concentration and clarification (Southgate, 1969). The sugars were quantified by the phenol–sulfuric acid method (Dubois *et al.*, 1956). Mono and disaccharides were similarly separated by paper chromatography.

Phytate

Phytate was extracted with 3% trichloroacetic acid (TCA) precipitated with 0·2% $FeCl_3$ (in 3% w/v TCA) and converted to ferric hydroxide as described by Wheeler & Ferrel (1971). The ferric hydroxide was quantified by the *o*-

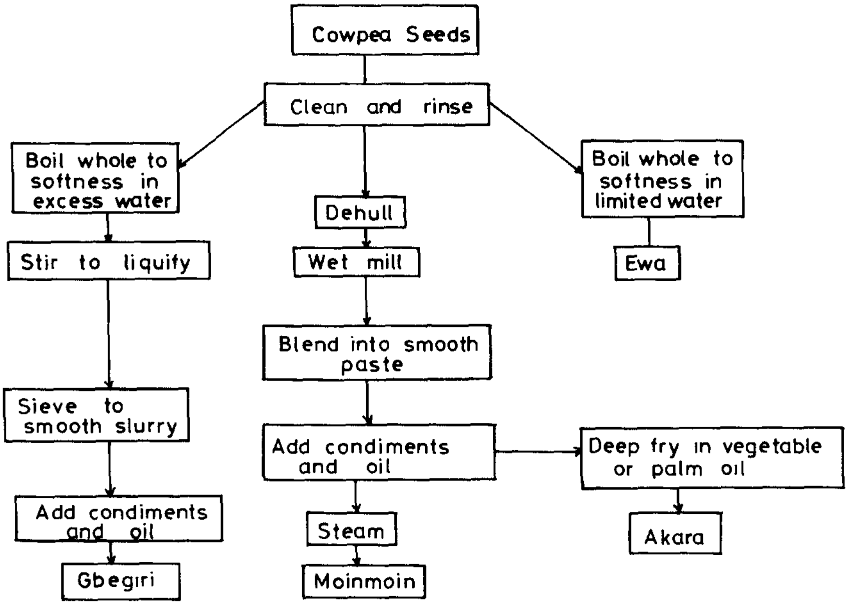

Fig. 1. Flow chart for the preparation of *ewa*, *akara*, *moinmoin* and *gbegiri*, products of cowpea.

phenanthroline method (AOAC, 1980) and phytate was estimated assuming a 4:6 iron–phosphorus ratio by weight.

Energy

The energy value was estimated on a Gallenkamp ballistic bomb calorimeter (Model CB-370) according to the manufacturers' instructions using benzoic acid as standard.

Minerals

The minerals were estimated from a nitric–perchloric acid (10:3 v/v) digest (AOAC, 1980). Sodium and potassium were estimated on a flame photometer (Corning Steel Scientific Instrument, UK) and the other elements on an Atomic Absorption Spectrophotometer (Perkin–Elmer 305B). Using appropriate hollow cathode lamps, analyses were carried out on duplicate samples for each of the triplicates of each product prepared from each of the cultivars.

Statistical analysis

The data were analysed by the analysis of variance (ANOVA) and the significance of difference between samples was determined by the least significant difference (LSD). The coefficient of variation between varieties was computed from the standard error of the means.

RESULTS

The means of duplicate determinations on each of the triplicate samples for each of the four cultivars are presented in Table 1. The mean nutrient contents as consumed and on a dry weight basis for all the cultivars are presented in Table 2. The mineral contents and the amounts of phytic acid, oligosaccharides and trypsin inhibitor activity are shown in Tables 3 and 4, respectively. The conversion to the levels as consumed took into consideration both the moisture and lipid contents of the products.

Effect of processing

The effect of processing varied among the cultivars as shown by the coefficients of variation. The moisture and lipid contents of the dry samples

TABLE 1
Proximate Composition of some Cowpea Preparations (Mean ± SD)

Methods	*Cultivars*	*Moisture (%)*	*Gross energy (kcal)*	*Protein (%)*	*Ether extract (%)*	*Ash (%)*	*NFE (%)*	*Crude fibre (%)*
Raw	Kano 1696	14·5 ± 0·7	576·5	28·1 ± 1·4	2·5 ± 0·3	4·7 ± 0·2	62·7 ± 1·0	1·1
	IT82E-60	15·2 ± 1·1	545·3	25·6 ± 2·8	2·1 ± 0·1	4·0 ± 0·4	65·7 ± 1·7	1·0
	Tvx 3236	12·3 ± 0·5	514·1	21·2 ± 1·6	1·8 ± 0·2	3·5 ± 0·4	70·8 ± 1·1	1·6
	Ife Brown	11·5 ± 0·7	662·2	24·7 ± 2·3	2·0 ± 0·2	3·9 ± 0·3	66·8 ± 1·2	1·2
Boiled whole	Kano 1696	48·0 ± 0·9	560·9	25·6 ± 2·0	2·0 ± 0·2	3·0 ± 0·3	65·8 ± 1·3	1·1
	IT82E-60	40·0 ± 0·9	584·3	23·3 ± 1·6	2·6 ± 0·2	3·6 ± 0·1	67·8 ± 0·0	0·8
	Tvx 3236	60·0 ± 3·2	560·9	23·0 ± 1·2	1·5 ± 0·1	3·2 ± 0·5	69·9 ± 0·9	1·5
	Ife Brown	56·0 ± 1·2	662·2	26·3 ± 1·7	2·1 ± 0·2	3·1 ± 0·1	66·1 ± 1·0	1·4
Boiled *gbegiri*	Kano 1696	67·4 ± 3·2	658·3	25·7 ± 3·2	18·4 ± 0·7	5·4 ± 0·2	47·8 ± 2·1	0·7
	IT82E-60	68·1 ± 4·3	683·2	24·2 ± 2·1	22·9 ± 1·0	5·1 ± 0·7	45·3 ± 2·0	0·7
	Tvx 3236	80·0 ± 4·0	568·7	23·4 ± 1·7	19·0 ± 0·6	5·0 ± 0·4	50·1 ± 1·4	1·2
	Ife Brown	76·0 ± 2·3	646·6	33·9 ± 1·8	24·6 ± 0·8	4·9 ± 0·3	34·0 ± 1·5	1·2
Fried (*akara*)	Kano 1696	32·8 ± 1·6	599·8	24·5 ± 2·4	21·8 ± 1·3	5·0 ± 0·4	45·8 ± 2·1	0·9
	IT82E-60	32·8 ± 2·0	599·8	20·9 ± 1·9	34·4 ± 0·8	6·8 ± 0·5	35·5 ± 1·6	0·8
	Tvx 3236	37·5 ± 3·2	576·5	23·9 ± 3·1	25·0 ± 0·5	4·5 ± 0·3	43·5 ± 2·0	1·5
	Ife Brown	40·2 ± 0·8	646·6	31·7 ± 2·5	28·0 ± 0·5	4·1 ± 0·2	33·3 ± 1·6	1·3
Steamed (*moinmoin*)	Kano 1696	39·8 ± 2·4	592·0	20·7 ± 2·3	10·0 ± 0·6	2·7 ± 0·4	64·3 ± 1·7	0·7
	IT82E-60	36·8 ± 1·8	615·4	20·5 ± 2·5	11·5 ± 0·8	2·6 ± 0·3	62·8 ± 1·8	0·8
	Tvx 3236	41·0 ± 3·2	560·9	23·2 ± 1·6	12·5 ± 0·8	3·0 ± 0·4	58·9 ± 1·4	1·1
	Ife Brown	38·5 ± 1·3	677·7	31·7 ± 2·0	14·0 ± 1·0	3·2 ± 0·5	48·2 ± 1·8	1·2

TABLE 2
Proximate Nutrient Composition of Some Local Preparations of Cowpea (*V. unguiculata*)

		Raw	Ewa	Akara	Gbegiri	Moinmoin
Protein	A	24·9 (10·0)	24·6 (5·7)	26·3 (15·8)	26·8 (15·7)	24·0 (19·2)
(%)	B		12·0^{a}	16·2^{a}	6·0^{b}	14·6^{a}
Calorie	A	574·2 (9·6)	592·1 (7·0)	605·7 (4·2)	639·2 (6.7)	611·5 (7·9)
(kcal)	B		289·0^{d}	388·9^{d}	171·8^{e}	389·9^{d}
Ether extract	A	2·1 (14·3)	2·1 (19·1)	27·3 (17·3)	21·2 (12·3)	12·0 (12·5)
(%)	B		1·0^{e}	17·5^{f}	6·0^{g}	7·3^{g}
Ash	A	4·0 (10·0)	3·2 (6·3)	5·1 (19·6)	5·1 (3·9)	2·9 (6·9)
(%)	B		1·6^{h}	3·3^{j}	1·4^{h}	1·8^{h}
Crude fibre	A	3·1 (22·6)	3·0 (26·7)	2·9 (27·6)	2·4 (29·2)	2·4 (25·0)
(%)	B		1·5^{k}	1·9^{l}	0·7^{m}	1·5^{k}
NFE	A	64·7 (4·6)	65·8 (3·3)	37·8 (16·1)	42·9 (17·0)	57·1 (13·3)
(%)	B		32·7^{r}	25·3^{r}	14·0^{s}	35·8^{r}

Figures in parentheses are the percentage variation among the cultivars. A = dry weight basis; B = as consumed. Figures in the same row with different superscripts are significantly different ($P < 0·05$).

varied significantly ($P < 0·05$) while the variation in other proximate components became significant only on a wet weight basis. Table 2 shows increase in the protein (28%) and ash content of cowpea as *akara* and *gbegiri*. The protein content as *ewa* and *moinmoin* was not affected, but the ash content decreased ($P < 0·05$). The sodium, calcium and phosphorus content increased in *ewa*, *akara* and *moinmoin*. Manganese decreased in all the products; iron increased in *akara* (9·7%), zinc in *moinmoin* (5·6%) and magnesium in *ewa* (7·2%) only.

Comparison of the four preparations of cowpea (Table 2) shows that *ewa* had the lowest calorie content, ether extract and ash, while *gbegiri* had the highest protein and calorie contents per unit dry weight.

On a dry matter basis (Table 3) *akara* had the highest content of sodium and iron, *ewa* had the highest potassium and magnesium, and *moinmoin* had the highest phosphorus, manganese, zinc and copper. As consumed, however, *gbegiri* had the lowest content of each of all the mineral elements; *akara* and *ewa* were highest in sodium and iron; *ewa* was highest in potassium and magnesium and *moinmoin* in calcium, phosphorus, manganese, zinc and copper.

Antinutritional factors

There was about 82% reduction in the trypsin inhibitor activity of cowpea on processing into the local products (Table 4). There were no differences in

TABLE 3
The Mineral Content of some Local Preparations of Cowpea (*V. unguiculata*) (mg/100 g)

Samples		*Major elements*					*Trace elements*			
		Na	*K*	*Mg*	*Ca*	*P*	*Mn*	*Zn*	*Fe*	*Cu*
Raw	A	53·5 (13·1)	167·0 (3·8)	52·5 (9·5)	42·5 (7·1)	700·0 (1·4)	8·9 (27·0)	5·4 (55·6)	3·1 (25·8)	1·3 (30·8)
Ewa	A	130·2 (3·5)	467·6 (6·4)	56·3 (11·0)	41·8 (8·1)	784·0 (7·7)	5·7 (21·1)	3·3 (30·3)	2·4 (16·7)	0·9 (22·2)
	B	63·5^{a}	228·2^{a}	27·5^{p}	20·4^{g}	382·6^{k}	2·8	1·6	1·2	0·4^{c}
Gbegiri	A	118·8 (5·6)	113·9 (20·2)	21·5 (27·9)	29·7 (22·6)	701·0 (7·1)	5·0 (24·0)	0·9 (22·2)	1·0 (30·0)	0·6 (33·3)
	B	33·4^{d}	32·0^{e}	6·0^{f}	8·4^{h}	197·0^{l}	1·4	0·3^{x}	0·3^{b}	0·2^{d}
Akara	A	388·5 (3·4)	151·0 (19·1)	19·5 (5·0)	40·6 (5·4)	1 055·0 (2·5)	4·7 (34·0)	2·9 (37·9)	3·4 (3·7)	1·0 (40·0)
	B	249·4^{c}	97·4^{f}	12·5^{j}	26·1	677·3	3·0	1·9	3·5^{c}	0·6
Moinmoin	A	133·0 (15·0)	241·5 (20·7)	29·1 (18·9)	45·5 (10·0)	1 120·4 (3·6)	4·5 (25·3)	5·7 (49·0)	2·4 (8·3)	1·1 (18·2)
	B	81·1	147·3^{g}	17·8^{q}	27·8	683·2	4·6^{t}	3·5^{z}	1·5	0·7

Figures in parentheses are the percentage variation among the cultivars. A = dry weight basis; B = as consumed.
Figures in the same row with different superscripts are significantly different ($P < 0·05$).

TABLE 4
Some Antinutritional Components of some Local Preparations of Cowpeas (*V. unguiculata*)

		TIU (*ml*)	*Phytin* (*mg*/100 *g*)	*Stachyose* (*g*%)	*Sucrose* (*g*%)	*Raffinose* (*g*%)
Raw	A	15·1 (12·6)	335·0 (10·5)	2·9 (3·5)	0·8 (6·0)	2·4 (4·2)
Ewa	A	2·7 (3·7)	265·0 (13·2)	2·4 (4·2)	0·9 (11·1)	2·6 (11·5)
	B		129·9[a]	1·2	0·4	1·3
Gbegiri	A	2·7 (11·1)	182·3 (8·2)	2·1 (9·5)	2·1 (9·5)	2·1 (4·8)
	B		51·0	0·6	0·2	0·6
Akara	A	2·6 (3·9)	173·9 (2·9)	1·9 (5·3)	0·7 (14·3)	1·6 (18·8)
	B		11·3	1·2	0·5	1·0
Moinmoin	A	2·7 (7·4)	207·0 (4·8)	2·4 (8·3)	1·1 (18·2)	2·2 (18·2)
	B		126·3	1·5	0·7	1·3

A = dry weight basis.
B = as consumed.
Figures in parentheses are the percentage variation among the four cultivars.

the trypsin inhibitor activities of the four products ($P > 0{\cdot}05$). The phytate level decreased by 21% in *ewa* and 46% in *akara*. All the processing methods caused a decrease in the stachyose content of cowpea but with slight increase in raffinose and sucrose contents.

DISCUSSION

The apparent insignificant changes in the proximate composition (DM) with the exception of ether extract and moisture content show that the processes were efficient in terms of nutrient retention. This agreed with the reports of Rockland *et al.* (1979) and Edijala (1980). The decrease in the trypsin inhibition and phytate support the observation of Ekpenyong & Borchers (1980) and Toma & Tabekhia (1979).

The variation in the mineral retention coefficients for the boiled beans (*ewa*) is a reflection of the non-uniformity in the effects of cooking on the mineral contents of legumes reported in the literature. While Rockland *et al.* (1979) reported little effect of cooking on the mineral contents of wing beans apart from a 78% decrease in potassium, Ekpenyong & Borchers (1980) reported significant losses in phosphorus and magnesium. Increase in calcium, phosphorus and iron content of kidney beans by boiling was observed by El Nahry *et al.* (1977) while Augustin *et al.* (1981) reported decreases in phosphorus, iron and some other minerals with increase only in calcium and manganese (also of kidney beans). This variation can be associated with differences in the cooking method and duration, and the structural and chemical composition among cultivars and varieties (Longe, 1983; Akinyele *et al.*, 1986).

The higher mineral contents of the cowpea products (DM) than raw beans could be attributed to the ingredients added, such as table salt, addition of condiments and the blending of the beans with cooking water, as is the practice among most consumers.

The high gross energy content of *moinmoin*, *akara*, and *gbegiri* was due to the addition of palm oil. The low nutrient density of *gbegiri* was due to the high moisture content, although the product contained the lowest level of the antinutritional factors as consumed.

In conclusion, the traditional methods of processing cowpeas in Nigeria more than compensate for any nutrient losses in cowpeas associated with isolated treatments such as soaking, dehulling and cooking and ensure a significant reduction in the antinutritional factors and maximum retention of nutrients.

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