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Nutrient composition of corn OGI prepared by a slightly modified traditional technique

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Ogi was prepared from corn by wet-milling, after steeping in water for 48 h. The traditional procedure was modified by avoiding removal and rejection of the steep- and wash-water, or ogi supernatant. Nutrient losses did not exceed 5%, with the exception of ash for which a total loss of 15% was found. Biological evaluation in rats showed a slight but not significant reduction in the protein efficiency of ogi when compared with corn meal. These observations are discussed in relation to improved ogi processing.

INTRODUCTION

Ogi is typically prepared from corn in most parts of Nigeria, although guinea corn or millet sometimes replaces corn. The traditional method of ogi preparation involves steeping corn grains in tap water for 1–3 days during which variable degrees of fermentation proceed naturally. More detailed descriptions of the procedure have been reported previously (Oke, 1967; Banigo *et al.*, 1974).

Unfortunately, the traditional method of ogi processing is accompanied by severe nutrient losses which aggravate the poor nutritional quality of normal dent corn. For instance, Oke (1967), Banigo *et al.* (1974) and Adeniji & Potter (1978) have reported losses of various nutrients. Up to half of the lysine in corn may be lost during the process. Agbedana & Taylor (1975) reported that long-term feeding of ogi resulted in the development of kwashiorkor in young rats and monkeys.

Limited information was found in the literature concerning previous attempts to reduce nutrient losses during ogi processing. Banigo *et al.* (1974) reported a method of ogi production in which dehulled corn was inoculated with a combination of *Lactobacillus plantarum, Streptococcus lactis* and *Saccharomyces rouxii;* by so doing, the sieving operation was eliminated. The latter workers concluded that nutrient losses were markedly eliminated, and the ogi produced using their technique was nutritionally superior to that from the traditional process. However, they failed to support this claim with biological data.

This report concerns the work that has been done to prepare ogi using the traditional method but taking precautionary measures to avoid those steps in the process in which losses of nutrients are obviously predictable.

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MATERIALS AND METHODS

A preliminary study showed that the pH of steeped corn at ambient temperature dropped to 4·5 in 48 h with little drop subsequently. Therefore 48 h steeping was adopted. Each batch of 100 g clean normal dent corn grains was steeped in 200 ml distilled water in a 1-litre pyrex beaker which was tightly covered with aluminium foil and allowed to stand at ambient temperature for 48 h. Distilled water was used since parts of the experiment involved mineral analysis. Each batch was then milled with the steep water for 5 min at high (100 mark) setting in a Waring blender attached to a Seco Powerstat motor; in the traditional process, the steep water is removed and discarded. The resulting slurry was then sieved through a 20-mesh screen sieve with repeated washing, using a total of 100 ml distilled water. The residue retained on the sieve screen was squeezed out by hand to allow the adhering ogi fraction to pass through the sieve. The total volume of the ogi extract was brought to 500 ml, covered and allowed to stand overnight. The resulting liquor was transferred to a pyrex dish and allowed to freeze overnight at −21°C. The frozen material and the residue were dried *in vacuo* (250–150 millilitres) at 5–10°C over a 4-day period. Several batches were prepared and pooled before analysis.

Proximate analysis was done on the freeze-dried samples using the AOAC (1975) procedures; crude protein was computed as N × 6·25. Amino acid analysis was done as described previously (Aremu, 1990). The protein quality of the ogi was evaluated using bioassays with rats as described previously (Aremu, 1991).

Table 1. Proximate composition[a] of corn meal, freeze-dried ogi and residue

Component	Corn product		
	Meal	Ogi	Residue
Moisture	9·8	4·5	4·2
Dry matter	89·2	77·8	7·0
Protein (N × 6·25)	9·5	9·9	8·3
Lipid[b]	4·4	4·6	2·0
Fibre	2·6	1·4	14·8
Ash	1·6	1·5	1·2
NFE[c]	81·9	82·6	73·7

[a] Expressed as g/100g dry matter (with the exception of dry matter).
[b] As ether extract.
[c] Nitrogen-free extract computed by difference.

RESULTS

Table 1 shows that the values for protein, lipid, ash and nitrogen-free extract (NFE), expressed as g/100g dry matter (DM) were similar in ogi and corn meal. However, DM and fibre were markedly reduced in ogi (DM by 10%, and fibre by almost 50%) when compared with corn meal. The main components of the residue were NFE (73·7 g/100 g DM and fibre (14·8 g/100 g DM). The latter value was markedly higher than that in ogi (1·4 g/100 g DM) or meal (2·6 g/100 g DM).

Most of the DM of corn was recovered in ogi (87%) (Table 2) with a relatively small amount in the residue (8%). Most of the protein (91%), lipid (91%) and NFE (88%) in corn were recovered in ogi, with as little as approximately 3–7% of these nutrients located in the residue. Quantitatively, the fibre in corn was about equally divided between ogi (49%) and the residue (46%). When compared with protein, lipid or NFE, the recovery of ash in ogi (79%) was markedly low. The recovery value in the residue (6%) when added to that in ogi accounted for only 85% of the total ash in corn.

The amino acid profile in ogi, expressed as g/100 g protein (Table 3), was similar to that in meal. Biological evaluation (Table 4) revealed the following for meal and ogi, respectively: food intake, 143 ± 18, 112 ± 16 ($P < 0·10$); protein intake, 11·4 ± 1·5, 9·1 ± 1·3 ($P < 0·10$); weight gain, 22·6 ± 3·9, 16·4 ± 2·1 g ($P < 0·05$); and corrected PER, 1·40 ± 0·13, 1·28 ± 0·31 ($P > 0·10$).

Table 2. Percentage recoveries of nutrients in ogi and residue

Nutrient[a]	Ogi	Residue	Total
Dry matter	87·2	8·0	95
Protein	91·0	7·0	98
Lipid	91·0	3·7	95
Fibre	49·2	46·3	96
Ash	79·2	6·1	85
NFE	87·9	7·2	95

[a] Each nutrient is expressed as a percentage of the corresponding nutrient in meal (Table 1).

Table 3. Amino acid compositions of normal dent corn meal and freeze-dried ogi[a]

Amino acid	Corn product	
	Meal	Ogi
Lysine	2·94	3·33
Histidine	2·63	2·89
Arginine	4·21	4·29
Aspartic acid	7·89	8·37
Threonine	3·26	3·43
Serine	4·21	4·29
Glutamic acid	15·25	15·77
Proline	8·30	9·01
Glycine	3·68	3·97
Alanine	6·62	7·40
Valine	3·68	4·07
Methionine	0·51	0·75
Isoleucine	2·52	2·78
Leucine	9·78	10·62
Tyrosine	3·05	3·43
Phenylalanine	3·99	4·29

[a] Expressed as g/100 g protein—each value represents the mean of duplicate determinations; tryptophan and cysteine could not be determined.

DISCUSSION

The results of this work suggested that nutrient losses during the traditional processing of ogi from corn could be markedly reduced by taking certain relatively simple precautionary measures. These include

(1) avoiding spillages through all the stages,
(2) wet-milling steeped corn with the steep water which should be measured appropriately, and
(3) avoiding the decanting and discarding of ogi supernate (i.e. wash-water) after wet-milling steeped corn when further fermentation is often required.

Table 4. Biological evaluation of the protein efficiency[a] of ogi in comparison with corn

Diet	Food Intake[b] (g)	Protein Intake[b] (g)	Weight Gain[b] (g)	Corrected PER[c]
Casein (control)	215 ± 9	17·1 ± 0·8	60·7 ± 3·2	2·50 ± 0·18
Corn:				
Meal	143 ± 18	11·4 ± 1·5	22·6 ± 3·9	1·40 ± 0·13
Ogi	112 ± 16	9·1 ± 1·3	16·4 ± 2·1	1·28 ± 0·31
s^2	580	3·94	19·64	0·11
$s_{\bar{x}_1-\bar{x}_2}$	12·87	1·06	2·37	0·18
t	2·409	2·170	2·616	0·667
P	< 0·10	< 0·10	< 0·05	> 0·10

[a] Protein efficiency was evaluated at 8% protein in the diet over a 21-day period (Aremu, 1991).
[b] Each figure represents the group mean total value ± SEM over 21 days ($n = 7$).
[c] Each value represents the group mean ± SEM computed as: Observed Test PER/Observed Casein Control PER × 2·50 (Aremu, 1991); the observed PER for casein was 3·54 ± 0·25.

By taking these precautionary measures, it was possible to recover approx 80–90% of any of the nutrients in corn when processed to ogi. This marked a major improvement over nutrient losses of up to 50% reported previously (Oke, 1967; Banigo *et al.*, 1974; Adeniji & Potter, 1978). The only exception was fibre of which only about half was recovered in ogi. This, however, does not appear to constitute a nutritional problem since fibre is not typically limiting in most ordinary Nigerian diets. Most of the portions of nutrients not recovered in ogi were located in the residue. Quantitatively, the residue constituted only about 8% of the total DM in corn.

Therefore the loss of nutrients via the residue did not seem to constitute a serious problem, especially considering the fact that it was composed of almost 50% fibre. In fact the residue is normally employed in animal feeding, so that there is little or no wastage.

Ogi produced using this modified method had an amino acid profile comparable to that of meal, agreeing with the report of Banigo *et al.* (1974) that corn could be processed into ogi without losing amino acids. The mean gain in weight among rats fed ogi protein was, however, significantly lower than in those animals fed corn meal protein, although protein efficiency was not. This reduction in weight gain could have been a direct consequence of the lower protein intake in the ogi group rather than a loss in protein quality (Table 3). It is noteworthy that, when supplemented with minerals and vitamins, ogi supported some growth in young rats for 21 days although Agbedana & Taylor (1975) have suggested that ogi could not support long-term growth in animals.

Additional work should help in determining the acceptability by humans of ogi produced using this modified procedure, since the taste of ogi may vary depending on the method of processing.

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