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An assessment of the proximate chemical composition of locally produced spices known as dadawa basso and dadawa kalwa from three markets in Plateau State of Nigeria

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Abstract

Local spices obtained from three markets (Shendam, Chip and Mangu) were analysed. The results show that the spices contain high amounts of fats (22–40%) and crude protein (22–46%). The crude fibre content was found to range from 11 to 25% while the total carbohydrate content was found to range from 7 to 15%. The mineral contents of the spices were also determined and found to be high in potassium, calcium and magnesium. Cobalt, chromium, nickel and manganese are also present in appreciable quantity. The level of lead was below the WHO recommended limit of 50 mg/kg. The amino acid profiles of the spices show that the spices contain both essential and non-essential amino acids. The observed variation in the levels of nutrients between the spices could be due to the methods of preparation and handling as well as on the different materials used for the preparation of the spices.

Keywords: Chemical composition; Locally produced spices; Dadawa

1. Introduction

Most foods consumed in developing countries are deficient in essential nutrients. Some of the food, however, may be rich in nutrients but, because of lack of information about them, their uses as food supplements is limited. Some of these foods are consumed in large quantities while others are eaten in small amounts. Irrespective of the quantity of food used in the diet, it is important to have adequate information on the nutritive value of the food.

The dadawa is processed and used in various forms in soups, meat, cereal foods, contain proteins, minerals, vitamins and other nutrients. These spices are popular, mostly in the northern part of Nigeria. They are obtained from the seeds of *Hisbiscus sabdariffa* and *Parkia biglobosa*. Since different methods may be used to prepare the local spices and the compositions of the spices may vary. This paper reports the proximate composition of locally produced spices, obtained from three markets in the Plateau State of Nigeria.

2. Materials and methods

The spices, dadawa basso and dadawa kalwa were purchased from three markets (Chip, Mangu and Shendam) in Plateau State.

2.1. Dadawa basso

In the preparation of dadawa basso, the seeds of *Hisbiscus sabdariffa*/*cannabinus* or *Ceila pentandra* are cooked in local earth pots for several hours until the seeds became soft. In order to quicken the cooking process, local potash is added. The water is drained from the seeds by pouring the cooked seeds in a local basket or metal bowl with perforated base. After draining the water, the seeds are transferred to a pot and covered properly with a lid. After about 3–4 days, the fermented seeds are transferred to a local mortar and pounded to form a soft paste; warm water is usually added to ease paste formation. Ash, from either millet stalk or leaves of it other local plants, is added to the paste and pounded again until it is thoroughly mixed with the dadawa paste. This is then transferred to a local earth pot, covered tightly and allowed to ferment

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for 3 days. The fermented dadawa basso is then air-dried in loam form as a 'ball' on raffia mats or flat stones.

2.2. Dadawa kalwa

In the preparation of Dadawa kalwa, locust bean seeds are boiled with water for several hours and the water drained using local raffia baskets or basin perforated at the base. The seed coats are removed from the cotyledons which are then boiled with water for about 6 h. The water is drained and the seeds placed in large calabash trays and spread to form layers of about 15 cm deep. After cooking, the seeds are stacked in jute bags and allowed to ferment for about 4 days. The fermented seeds are ground into fine paste using local mills. The paste is then processed into various shapes and air-dried in trays.

2.3. Moisture content

Two grams of the samples, in triplicate, were weighed in preweighed Petri dishes and dried in an oven maintained at 105 °C for 8 h. The samples were removed, cooled in a desiccator and weighed. The percentage loss in weight was expressed as moisture content.

2.4. Ash content

Five grams of the samples in triplicate were weighed in pre-ignited porcelain crucibles and ashed in a furnace, maintained at 650 °C for 8 h. The residues were weighed and expressed as percentage ash.

2.5. Crude fibre (Dashak & Fall, 1993)

For the determination of crude fibre, 2 g of samples were refluxed in 100 ml digestion mixture (450 ml glacial acetic acid, 20 g trichloroacetic acid, 40 ml nitric acid and 500 ml distilled water). This was then filtered through ashless filter paper by suction, washed with 100 ml boiling water, 50 ml ethanol and 50 ml petroleum ether, and dried to constant weight. The residue was then transferred to a crucible and ashed in a Muffle furnace at 750 °C for 8 h. The crude fibre was determined as the difference in weight between residue and ash.

2.6. Oil content

Five grams of the dadawa samples in triplicate were soxhlet extracted using 60–80 °C petroleum ether. The petroleum ether was recovered by rotary evaporation at 28 °C. The flasks containing the extracted oil were weighed and difference in weight expressed as percentage oil content.

2.7. Total carbohydrate (Baker, 1982)

The samples were acid-hydrolysed as follows: 50 mg of moisture-free milled dadawa samples were moistened with 2.0 ml of 72% sulphuric acid and allowed to stand at room temperature for 3 h in test tubes. The contents were then diluted to ca. 1.0 M (as H_2SO_4) and the tubes sealed. The samples were then heated in an oven at 100 °C for 6 h. The tubes were then cooled to room temperature, cut open and the solutions filtered by suction using a sintered crucible No. 4, rinsed several times with distilled water and made up to 100 ml in a volumetric flask.

The hydrolysed solutions were assayed for total carbohydrate using the L-cysteine-sulphuric acid method. The cysteine-sulphuric acid reagent (70 mg of L-cysteine hydrochloride monohydrate in 100 ml 86% sulphuric acid) was added to a portion of the sample/standard such that the ratio of reagent to sample/standard was 5:1 (i.e. 10 ml of reagent:2 ml of sample/standard) in test tubes immersed in an ice bath for 3 min, after which the tubes were removed and cooled to room temperature. The absorbances of the solutions were measured at 420 nm and the carbohydrate concentration obtained using calibration graphs from a standard solution of glucose.

2.8. Crude protein

Two grams of the samples, in triplicate, were placed in 500 ml Kjeldahl digestion flasks. Seven grams of digestion mixture (98 g Na_2SO_4, 1 g $CuSO_45H_2O$, 1 g SeO_2), and 25 ml of concentrated sulphuric acid were added and the samples digested gently until frothing stopped. The mixtures were then boiled until the solutions became clear. After cooling, the digested samples were transferred to 100-ml standard volumetric flasks and made up to 100 ml with distilled water. To the solution (10 ml) was added 30 ml of 40% NaOH, and the mixture distilled. The ammonia was collected over 50 ml of 0.1 M NaOH. The percentage nitrogen in the samples was calculated while the % crude protein was expressed as % nitrogen$\times$6.25.

2.9. Mineral content

Two grams of sample were placed in porcelain crucibles and ashed in a muffle furnace at 750 °C for 6 h. The ashes were transferred to 150-ml beakers and treated successively with 10 ml each of water, concentrated perchloric acid, concentrated hydrochloric acid and concentrated nitric acid. The mixtures were heated at 120 °C on a hot plate until the brown fumes were driven off and the sides of the beakers were rinsed with water and the solutions concentrated to about 5 ml. The beakers were cooled and 10 ml concentrated nitric acid and 50 ml water were added and boiled for 5 min. The

solutions were filtered into 100-ml standard flasks and made up to the mark with distilled water. Standards of various metals were prepared from analytical grade reagents for calibration graphs. The absorbance readings for both standard and samples were obtained using an atomic absorption spectrophotometer (SP-PYE UNICAM).

3. Results and discussion

The proximate analyses of the local spices, dadawa kalwa samples A, B and C and dadawa basso samples D,E,F,G and H are shown in Table 1. The mineral composition and the amino acid profiles are shown in Tables 2 and 3, respectively.

The moisture content of the spice samples was found to range from 2.4 to 7.0% for dadawa kalwa and 2.9 to 4.6% for dadawa basso. Low values of moisture usually increase the shelf-life of foods during storage and packaging. They also limit deterioration due to fungal and microbial contamination. The results are similar to those reported by Oyenuga (1978), Dashak and Fali (1993), Dashak and Nwanegbo (2000) and Rao (1994) for some foodstuffs and seeds.

The ash contents of dadawa kalwa (samples A, B, and C) are lower than the ash content of dadawa basso (samples D, E, F, G and H). The variation in the ash contents is likely to be due to the processing methods. Since ash from external sources is usually added to the dadawa basso during its preparation, this tends to increase the ash content of dadawa basso. The addition of ash is usually to assist in the complete fermentation of the cooked seeds, which is consistent with the observation made by Odunfi and Adewuyi (1985).

The carbohydrate values of the two spices are variable and reflect the type of seeds used for preparing the dadawa. Thus dadawa kalwa samples made from locus bean seeds (A, B and C) have carbohydrate contents of 9–12% while dadawa basso samples made from cotton and *H. sabdariffa* seeds (D, E, F, G and H) have carbohydrate contents of 7–16%. Carbohydrate contents for locus bean seeds, *H. sabdariffa* seeds and cotton seed have been found to be 35, 25 and 31%, respectively (Dashak & Nwanegbo, 2000; Oyenuga, 1978). The substantial reduction in the amount of the carbohydrate observed in dadawa samples, compared to the seeds used in preparing them, may be due to the methods of processing, as part of the soluble carbohydrates are removed during the cooking and washing of the seeds. In addition to this, the carbohydrate is also utilized to support the microorganisms that effect the fermentation of the seeds during the production of dadawa.

The crude protein contents of dadawa kalwa (samples A, B and C) are higher than the crude protein content of dadawa basso (samples D, E, F, G and H). The observation supports the views of local communities that dadawa kalwa are more nutritive than dadawa basso and are usually preferred as low-cost meat substitutes (Odunfa & Adewuyi, 1985). The normal daily protein requirement of a healthy person is 45–50 g (Fisher & Bender, 1977). Thus dadawa kalwa spices could be used as good protein supplements, since they are always eaten with carbohydrate foods made from cereals with low protein content.

The dadawa kalwa samples (A, B and C) have higher fat contents (35–40%) than dadawa basso (D, E, F, G and H) samples (22–33% fat). Similar values of fat content have been reported for some oil seeds (Oyenuga, 1978; Panford & deMan, 1990; Rao, 1994). Vegetables oils are usually associated with high contents of unsaturated fatty acids (Dashak & Fali, 1993; Huang et al., 1994; Panford & dMan, 1990). Unsaturated fatty acids are prone to oxidation to carbonyl compounds and other volatile products. These compounds may be responsible for the offensive odour that is associated with dadawa. The local method of drying dadawa is by spreading on flat sheets of wood, trays or stones, to dry under sunlight. Sunlight is capable of initiating free radical decomposition of the unsaturated bonds of the

Table 1
Proximate chemical compositions of dadawa samples from Chip, Mangu and Shendam markets[a]

Analysis	A	B	C	D	E	F	G	H
Moisture (%)	7.0	4.1	2.4	3.7	4.6	3.0	3.4	2.9
Ash (%)	6.3	2.5	5.8	10.4	15.5	14.4	23.5	13.7
Total carbohydrate (%)	11.1	11.8	8.9	9.9	7.4	15.8	9.0	12.1
Crude protein (%)	36.4	38.6	45.5	22.2	21.3	15.6	26.3	22.0
Crude fibre (%)	12.0	9.8	18.8	16.9	11.0	25.4	16.3	23.2
Crude fat (%)	40.3	34.8	36.3	21.8	30.3	24.4	29.2	32.5
Energy (kcal/100 g)	551	512	545	324	386	341	402	426

A, Dadawa kalwa (*Parkia biglobosa*) or locust bean seeds) from Chip market; B, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Mangu market; C, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Shendam market; D, Dadawa basso (*Ceiba pentandra* or Rimi seeds) from Chip market; E, Dadawa basso (*Ceiba pentandra* or Rimi seeds) from Shendam market; F, Dadawa basso (*Hibiscus sabdariffa* or Yakwa seeds) from Chip market; G, Dadawa basso (*Hibiscus sabdariffa* or Yakwa seeds) from Shendam market; H, Dadawa basso (*Hibiscus cannabinus* or Rama seeds) from Mangu market.

[a] Results are means of triplicate determination.

fatty acids, leading to formation of peroxides. The peroxides are easily converted to carbonyl compounds (Schwartz & Rady, 1990). Foods with high fat content usually contribute to the calorie requirement of the body.

Carbohydrates, proteins and fats are food macronutrients that are considered as energy providers. Dadawa kalwa has a higher calorie value than dadawa basso, possibly due to the fact that it contains more carbohydrates, protein and fat than dadawa basso.

The ammo acid profile of the dadawa spices show that dadawa kalwa (A, B and C) are rich in lysine, threonine, leucine, phenylalanine and histidine. Methionine and valine are the limiting essential amino acids in sample B of dadawa kalwa spices. The dadawa basso samples (D, E, F, G and H) are also rich in lysine, histidine, arginine, threonine, isoluecine, leucine and phenylalanine (essential amino acid). The variation in the levels of the essential amino acids between the samples is a reflection of the types of seeds used to produce the

Table 2
Mineral contents of dadawa samples from Chip, Mangu and Shendam markets

Element	Concentration (mg/100 g dry wt.)							
	A	B	C	D	E	F	G	H
K	262	252	245	1543	50	1492	265	1913
Na	18.8	2.4	36.2	7.3	41.6	13.9	5.9	8.5
Ca	474	102	448	812	704	711	965	1111
Mg	201	183	146	493	12	7.19	11	328
Zn	10.2	9.2	6.8	22.1	11.4	9.7	7.6	10.9
Pb	1.6	2.6	2.1	2.5	2.8	3.0	1.9	1.8
Cu	1.2	1.8	1.4	3.2	2.9	0.8	1.4	1.9
Fe	40.0	12.9	28.5	41.4	33.5	164.5	29.1	58.7
Co	0.5	0.7	0.5	0.7	0.5	0.7′	0.5	0.5
Cr	6.0	9.9	5.0	10.0	8.6	12.2	5.2	7.9
Mn	8.8	15.6	4.2	5.7	6.3	168	9.2	11.4
Ni	1.8	2.6	1.1	2.7	2.2	3.0	1.2	2.2

A, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Chip market; B, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Mangu market; C, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Shendam market; D, Dadawa basso (*Ceiba pentandra* or Rimi seeds) from Chip market; E, Dadawa basso (*Ceiba pentandra* or Rimi seeds) from Shendam market; F, Dadawa basso (*Hibiscus sabdariffa* or Yakwa seeds) from Chip market; G, Dadawa basso (*Hibiscus sabdariffa* or Yakwa seeds) from Shendam market; H, Dadawa basso (*hibiscus cannabinus* or Rama seeds) from Mangu market.

Table 3
Amino acid compositions of dadawa samples from Chip, Mangu and Shendam markets

Amino acid	Concentration (g/16 g N_2)								
	A	B	C	D	E	F	C	H	FAO (1965)
LYS	7.2	4.1	6.9	7.4	6.1	3.9	1.1	4.8	4.2
HIS	3.0	2.9	3.7	3.3	2.6	3.0	1.8	2.6	
ARC	2.5	1.0	2.5	2.7	1.9	2.0	2.1	0.9	
ASP	11.1	14.2	13.4	9.9	9.7	4.2	1.1	7.7	
THR	3.6	3.9	0.9	3.3	3.4	1.5	3.0	1.9	2.8
SER	3.4	2.9	8.5	3.8	2.9	1.8	6.4	2.3	
GLU	14.7	20.2	16.0	18.6	16.3	10.4	12.4	11.8	
PRO	3.2	2.5	3.2	3.1	2.6	1.0	1.5	1.6	
CLV	4.7	4.7	6.3	3.8	3.2	2.2	2.1	4.3	
ALA	5.0	5.4	8.5	4.9	3.8	2.6	3.5	4.5	
CYS	2.2	10.7	2.5	3.0	1.8	0.8	1.0	1.4	2.0
VAL	1.3	0.6	1.5	1.5	1.1	1.0	2.2	1.8	4.2
MET	1.6	0.5	1.6	1.8	2.0	0.9	0.7	1.0	2.2
ILEU	1.8	1.9	1.6	2.2	2.0	0.9	1.3	1.1	4.2
LEU	5.1	3.3	3.3	7,3	3.4	1.7	2.4	2.8	4.2
TYR	5.8	3.4	4.9	3.9	2.4	2.5	3.!	2.0	2.8
PHE	6.4	4.2	8.3	4.1	2.6	1.9	3.5	2.9	2.8

A, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Chip market; B, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Mangu market; C, Dadawa kalwa (*Parkia biglobosa* or locust bean seeds) from Shendam market; D, Dadawa basso (*Ceiba pentandra* or Rimi seeds) from Chip market; E, Dadawa basso (*Ceiha pentandra* or Rimi seeds) from Shendam market; F, Dadawa basso (*Hibiscus sabdariffa* or Yakwa seeds) from Chip market; G, Dadawa basso (*Hibiscus sabdariffa* or Yakwa seeds) from Shendam market; H, Dadawa basso (*Hibiscus cannabinus* or Rama seeds) from Mangu market.

dadawa basso. The dadawa basso produced from rimi seeds (D and E) have similar levels of the essential amino acids while the dadawa basso samples produced from *Hibiscus sabdariffa* seeds (F and G) have similar levels of essential amino acids. The pattern of essential amino acids for sample H is different from those of samples D, E, F and G.

The mineral profiles of the samples show that the dadawa basso (samples D, E, F, G and H) are richer in minerals than dadawa kalwa (A, B and C). The reason for the difference in the levels of minerals in the spices could be the result of the addition of ash to dadawa basso as it is being produced. The removal of the seed coat and washing of the locust bean seeds, when preparing dadawa kalwa, may add to the low level of minerals in dadawa kalwa.

However, the level of minerals, in both dadawa basso and kalwa, is similar to the values reported for some oil seeds and cereals (Dashak & Fali, 1993; Dashak & Nwanegbo, 2000; Oyenuga, 1978; Plessi & Monzani, 1990; Rao, 1994; Schwartz & Rady, 1990; Temple & Bassa, 1991). The level of lead is below the WHO 50 mg/kg required for samples to be considered unfit for human consumption.

Since about 100–150 g of dadawa basso and dadawa kalwa may be used for preparing 1000 ml of soup, substantial amounts of the minerals are consumed. This is more so as the soup may be used up to three times per day.

The results of this work show that dadawa samples contain appreciable levels of nutrients which could be used as food supplements to augment the deficiencies that are usually associated with most foods in developing countries.

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