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Chemical composition of four varieties of Nigerian benniseed (*Sesamum indicum*)

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The chemical compositions of four varieties of Nigerian benniseed (*Sesamum indicum*) were determined and found to contain high amounts of protein, oil and essential amino acids. The ash, moisture and carbohydrate contents were found to be low. The iodine values and saponification values of the oils were high, indicating that they contained unsaturated fatty acids. The mineral compositions of the benniseed samples were also determined.

INTRODUCTION

Benniseed (*Sesamum indicum*) is an important oil-bearing annual crop known by various names such as sesame, benniseed, til, gingelly, and simsim (Joshi, 1961). It is cultivated extensively in India, Burma, Indo-China, Japan and some parts of Africa, the Mediterranean and, more recently, in the USA, Mexico and other Latin American countries (Joshi, 1961).

Sesamum indicum is commonly known as benniseed in Nigeria. It is cultivated in some parts of Benue, Plateau, Kwara and Niger States of Nigeria. In Nigeria, benniseed is used mainly for making soups, Amora and other dishes. It is also eaten mixed with meat and with other grains. The use of benniseed as an oil-producing seed has not been properly exploited in Nigeria.

About 97% of the export gradings in 1967/68 was produced in Benue State (Agboola, 1979).

There are many varieties of benniseed, but only two main varieties are grown in Nigeria, *Sesamum indicum* and *S. radiatum*. *Sesamum angustifolium* is grown in tropical East Africa while *S. alatum* is grown in Ivory Coast, Upper Volta, Guinea and Mali for its oil and medicinal value (Joshi, 1961; Agboola, 1979).

The seeds of different varieties have various colours, such as creamy white, dark red, brown, and yellow (Irvine, 1969).

Among the important uses of benniseed is the production of high quality odourless vegetable oil, which can substitute for olive oil (Ochse *et al.*, 1966). The oil has found many uses in industry e.g. for manufacture of soap, cosmetics, perfume and pharmaceutical products (Ochse *et al.*, 1966). The oil contains, in addition to phytosterol and tocopherol, two compounds which are not found in any other oil, namely sesamolin; this, upon hydrolysis, yielded sesamol, which is responsible for the antioxidant behaviour of benniseed oil (Joshi, 1961).

Benniseed has been found to contain up to about 3·4% methionine, an essential amino acid required in livestock feeds, especially chick meals, for the development of quality eggs. Benniseed is also rich in vitamin E and calcium (Joshi, 1961).

It has been reported that the chemical composition of benniseed varies with variety and location where the crop is grown (Joshi, 1961).

This paper reports on the chemical composition of four varieties of benniseed grown in Nigeria.

MATERIALS AND METHODS

The four varieties of benniseed (*Sesamum indicum*) were obtained from Namu market in Quaan Pan LGC of Plateau State. All chemicals used were of analytical grade obtained from BDH (Poole, Dorset, UK).

The benniseed samples were ground into flour and used for the analysis.

The ground samples (5·0 g) were dried in an oven at 110°C for 24 h. The percentage loss in weight was expressed as the moisture content.

Reducing sugars were assayed by the method of Miller *et al.* (1960). Total carbohydrate was assayed by the L-cysteine–sulphuric acid method (Peplow & Somers, 1969).

For crude protein determination, 0·2 g of moisture-free samples of the ground benniseed were weighed, and crude protein was determined by the Kjeldahl method (Rankin & Mildreth, 1976).

Digestible protein was determined by the method of Shambe *et al.* (1973).

For the determination of crude fibre, 2·00 g of samples were refluxed in 100 ml digestion mixture (450 ml

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glacial acetic acid, 20 g trichloroacetic acid, 50 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 ashed in a crucible at 750°C and the crude fibre was determined as the different in weight between residue and ash.

The lignin composition was determined by the method of Crampton and Maynard (1938).

To determine crude oil content, 5·0 g of moisture-free samples were placed in fat-free thimbles. They were then Soxhlet-extracted using petroleum ether (60–80°C boiling range) placed in a pre-weighed flask for 8 h. The solvent was then removed by rotary evaporation at 30°C and the flask containing the oil was weighed. The difference in weight was expressed as percentage crude oil.

Ash content was determined as follows: 5·0 g of moisture-free samples were each weighed in a pre-ignited crucible and placed in a muffle furnace. The samples were then ashed at 800°C for 6 h. The weight of residue was expressed as the ash content.

Amino acid analysis was performed using a Technicon Tsm-1 amino acid analyser, and the results expressed as grams of amino acid/16 g N.

AOAC methods were used in the determination of peroxide, saponification, and iodine values.

The mineral contents were determined using an atomic absorption spectrophotometer (SP-9 Pye Unicam).

The phosphorus was determined using a UV–visible spectrophotometer (SP 6–450 Pye Unicam).

RESULTS AND DISCUSSION

Table 1 shows the proximate analysis of four varieties of benniseed; Table 2 shows their amino acid profile and Table 3 shows the mineral composition.

The moisture content of the benniseed is low and comparable to that reported for Acha and groundnuts (Rudrapatnam *et al.*, 1975; Temple & Bassa, 1991). This shows that benniseed has a longer shelf life than most cereals, since the high moisture content of cereals causes deterioration due to insect and fungal attacks.

The ash, crude protein and crude oil contents are similar to the values reported for non-Nigerian benniseed (Joshi, 1961). The percentage digestible protein shows that most of the protein in the benniseed is digestible. The yellow variety is particularly rich in oil compared to the other varieties; thus for purposes of oil production it is preferable. However, the other varieties have higher values of digestible protein and carbohydrate. The variation in the values of crude fibre and carbohydrate could be a reflection of variety and location. Saponification and iodine values are similar to those reported for cottonseed oil, and similar to values reported for non-Nigerian benniseed oil. The high iodine value suggests that the benniseed oil contains unsaturated fatty acids.

Table 1. Proximate compositions of four varieties of Nigerian benniseed

Analysis	Benniseed samples			
	Black	Brown	White	Yellow
Moisture (%)	4·73±0·02	4·12±0·01	4·14±0·05	4·28±0·26
Ash (%)	4·01±0·10	5·19±0·14	10·1±0·04	6·09±0·04
Crude protein (%)	17·2±0·12	20·2±0·09	20·8±0·14	22·0±0·44
Digestible protein (%)	17·2±0·12	20·2±0·08	20·8±0·14	13·0±0·10
Crude fibre (%)	19·6±0·38	18·6±0·19	14·2±0·15	13·0±0·10
Lignin (%)	22·6±0·83	22·3±1·56	11·5±0·63	4·45±0·21
Crude oil (%)	35·8±0·17	41·3±0·10	34·6±0·11	53·8±0·17
Total carbohydrate (%)	9·19±0·01	10·3±0·01	9·19±0·01	6·85±0·00
Reducing sugar (%)	6·31±0·01	6·67±0·01	6·67±0·01	5·04±0·00
Saponification value of oil (Mg KOH/g)	188±0·28	191±0·28	189±0·56	178±1·40
Iodine value of oil (%)	106±0·18	110±0·04	106±0·19	1·2±0·00
Peroxide value (meg/kg)	10·5±0·04	10·7±0·04	10·5±0·00	11·3±0·00

The yellow variety has a high percentage of amino acid compared to the other varieties, and reported values for Acha and rice, and even higher than the FAO values (Temple & Bassa, 1991). All the varieties have higher values of methionine than reported values for Acha and rice (Fali *et al.*, 1990; Temple & Bassa, 1991). The black variety is a poor source of tryptophan and tyrosine. It is also lower in lysine, methionine, tryptophan, alanine and tyrosine than values reported for Acha and rice (Joshi, 1961; Fali *et al.*, 1990; Temple & Bassa, 1991).

Benniseed is usually eaten together with foods such as rice, Guinea-corn, maize, millet and meat, in various preparations. These foods are usually poor sources of

Table 2. Amino acid profiles of the benniseed samples

Amino acid	Concentration in g/16 g N				FAO reference protein (1965)
	Black	Brown	White	Yellow	
Lysine	1·83	2·88	2·57	4·66	4·2
Histidine	2·38	2·55	2·67	4·72	
Arginine	6·80	11·7	12·5	22·6	
Aspartic acid	7·28	6·31	9·19	13·5	
Threonine	3·02	4·31	3·23	4·73	2·8
Serine	3·81	4·23	4·26	7·13	
Glutamic acid	14·7	21·5	22·8	32·2	
Proline	3·24	4·02	4·72	8·49	
Glycine	3·88	4·89	5·14	7·97	
Alanine	3·40	4·01	4·45	6·53	
Cysteine	3·04	3·88	3·86	4·67	2·00
Valine	3·72	4·53	4·11	6·34	4·20
Methionine	1·83	3·43	2·99	3·70	3·20
Isoleucine	3·30	3·52	3·28	5·15	4·20
Leucine	6·08	6·77	7·51	10·38	4·20
Tryptophan	0·31	1·72	2·05	4·57	1·4
Phenylalanine	5·82	3·81	2·96	4·02	2·8
Tyrosine	0·31	1·72	2·05	4·57	2·8

Table 3. Mineral compositions of the benniseed samples

Mineral determined	Concentration of mineral in g/100 g dry weight of benniseed			
	Black	Brown	White	Yellow
Potassium	2·25	2·90	2·75	3·70
Sodium	0·40	2·80	2·40	0·16
Calcium	0·90	0·90	1·01	0·75
Magnesium	0·25	0·27	0·25	0·32
Zinc	0·041	0·043	0·038	0·053
Copper	0·017	0·015	0·013	0·018
Manganese	0·040	0·053	0·053	0·030
Iron	0·045	0·045	0·080	0·050
Phosphorus	0·410	0·430	0·440	0·600

lysine and sulphur-containing amino acids (FAO, 1965; Oyenuga, 1978).

The results of this work have shown that benniseed, especially the yellow variety, is rich in lysine, methionine and cysteine. Therefore, when eaten together with the cereals, it helps in supplementing the deficiency of these amino acids in the meals.

The variation in mineral composition could be due to differences in variety and location. Generally, the different samples have high values of potassium, calcium and phosphorus.

All the samples have higher values of minerals compared to reported values for Acha (Temple & Bassa, 1991). The values for calcium and phosphorus are similar to reported values for non-Nigerian benniseed.

From these results, it is evident that the Nigerian-grown benniseed is rich in protein and contains high amounts of essential amino acid, especially methionine.

As an oil-seed, the yellow variety would be more useful in oil-production due to its high oil content.

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