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Proximate Chemical Composition of Acha (*Digitaria exilis* and *Digitaria iburua*) Grains

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Abstract: Established standard methods of analysis were used to determine the proximate composition of acha grains as part of their nutritional evaluation. The results showed that the lipid content and ash value of acha are higher than the reported values for most cereal grains. The protein content of acha is high compared with that of other grains. The fibre content of acha is lower than the values for sorghum and maize but higher than those for millet and rice. The caloric value of acha compares well with those for most cereals. Acha is richer in calcium, magnesium, iron and copper than most cereals but poorer in potassium, sodium, lead and manganese. With the exception of methionine the essential amino acid content of acha is lower than that for most grains while the leucine, methionine and cysteine values are slightly higher than the values in the FAO reference protein. It was concluded that acha is a cheap source of carbohydrate for man and livestock.

Key words: Acha grains, amino acids, *Digitaria exilis*, *Digitaria iburua*, proximate composition

INTRODUCTION

Acha (*Digitaria exilis* and *Digitaria iburua*) is an annual cereal crop indigenous to West Africa where it is cultivated for its straw and edible grains. It is probably the oldest African cereal. For thousands of years, West Africans have cultivated it across the savannah. Indeed, it was once their major food crop. This crop is important in areas scattered from Cape Verde to Lake Chad, in certain regions of Mali, Burkina Faso, Guinea and Nigeria. It is widely grown in Nigeria in the cool region of Plateau State, part of Bauchi, Kebbi, Taraba, Kaduna and Niger States. It is either the staple food or a major part of the diet. Each year West African farmers devote approximately 300,000 ha to acha cultivation and yields of 600-700 kg ha^{-1} are recorded which translate to 180,000-210,000 tonnes of grains annually. The crop supplies food to 3-4 million people (Jideani, 1990; NRC, 1996).

The crop grows well on poor, sandy or ironstone soils in areas of low rainfall. In northern Nigeria, the grains of *Digitaria exilis* (white) and *Digitaria iburua* (brown) commonly called acha or hungry rice, are harvested 3-4 months after sowing. Acha remains vital to the food security of millions of African farmers who use acha in several ways. Acha grains can be ground into flour and used to prepare local beverages; it can be cooked in various forms with fish, meat, legumes or vegetables. The grains are also used to prepare feeds for domestic animals. Acha is used: as brewer's grain, for making couscous and in porridge. It is mixed with other flours to make bread while the husk is a source of domestic fuel for cooking. Acha protein is reported to be unique in that it has greater methionine content than other cereal proteins (Jideani and Akingbala, 1993). The two species of Acha are high in digestible energy but low in oil and minerals.

However, in Nigeria and many other countries in Africa little or no information exists about acha and its proximate chemical composition. Although it is sold in the open markets, most Africans do not know the importance of it in human diets.

The main objective of this study is to analyse or evaluate the nutritional composition of acha. Knowledge of the nutritional composition of acha will help to qualify it for other uses apart from its current staple food status. It will also provide a guide on the handling, processing and other unit operations such as heat treatment processes that acha grains may be subjected. Information on proximate composition (e.g., moisture content) is required for the storage and enhancement of stability of stored acha both in raw and processed forms.

MATERIALS AND METHODS

Acha grains (*D. exilis* and *D. iburua*) obtained from Minna Central Market were dried at 60°C to constant weight (AOAC, 1980) and milled into fine powder. The total ash, crude lipid and crude protein (N×6.25) were

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determined according to the recommended AOAC (1980) procedures. Crude fibre estimation was according to Joslyn (1990). A Gallenkamp automatic adiabatic bomb calorimeter was used for caloric value estimation. Mineral elements were determined using an atomic absorption spectrophotometer. Amino acid composition was estimated by the procedure of Spackman *et al*. (1984) and cysteine by the procedure of Gaitonde (1987).

RESULTS AND DISCUSSION

The proximate composition of acha (*Digitaria exilis* and *Digitaria iburua*) is shown in Table 1 and its amino acid composition in Table 2. The very low moisture contents for the two varieties (14.8% for white acha and 22% for brown acha) suggest that acha loses a considerable amount of water during storage resulting in a longer shelf life. This is a positive development.

Table 1: Proximate composition of acha in g kgG^{1} DM (mean of 3 determinations±SD)

Component	*Digitaria exilis*	*Digitaria iburua*
Crude fibre	19.0±2.0	11.5±2.0
Crude protein	106.0±2.0	125.0±2.0
Total lipid	22.0±1.0	52.0±1.0
Total ash	36.0±0.3	42.0±0.3
Nitrogen-Free Extract (NFE)	817.0±5.0	769.5±5.0
Potassium	1.072±0.06	1.097±0.06
Sodium	0.0532±0.003	0.0653±0.003
Calcium	0.067±0.002	0.087±0.002
Magnesium	0.835±0.05	0.875±0.05
Manganese	0.027±0.001	0.031±0.001
Iron	0.1286±0.03	0.1382±0.03
Zinc	0.0417±0.001	0.0422±0.001
Copper	0.00153±0.0001	0.00174±0.0001
Lead	0.00019±0.0001	0.00022±0.0001

DM = Dry Matter; SD = Standard Deviation

Table 2: Amino acid composition of acha in g per 16 g N (mean of 3 determinations±SD)

Amino acid	*Digitaria exilis*	*Digitaria iburua*	FAO (1970) reference protein
Isoleucine	1.37±0.03	1.41±0.03	4.20
Leucine	4.40±0.02	4.43±0.02	4.20
Lysine	1.90±0.01	1.91±0.01	4.20
Methionine	2.98±0.02	3.12±0.02	2.20
Threonine	1.89±0.02	1.92±0.02	2.80
Phenylalanine	2.37±0.01	2.35±0.01	2.80
Valine	2.34±0.01	2.38±0.01	4.20
Tyrosine	0.91±0.01	0.90±0.01	2.80
Tryptophan	0.95±0.03	0.92±0.03	1.40
Cysteine	3.10±0.04	3.30±0.04	2.00
Arginine	1.34±0.02	1.36±0.02	
Histidine	1.33±0.02	1.34±0.02	
Alanine	4.28±0.01	4.24±0.01	
Serine	2.10±0.03	2.22±0.03	
Proline	3.26±0.02	3.23±0.02	
Glycine	1.93±0.01	1.94±0.01	
Glutamic acid	6.97±0.04	6.99±0.04	
Aspartic acid	3.50±0.02	3.49±0.02	

SD = Standard Deviation

The total lipid value is higher than the reported values for polished and unpolished rice, wheat and barley but lower than the values for maize, millet and sorghum (Oyenuga, 1968). The protein content of acha (106.0 g kgG^{1} for white variety and 125.0 g kgG^{1} for brown variety) is high compared with rice, millet, maize and sorghum (Oyenuga, 1968; Temple and Bassa, 1991). The total ash value for acha (36.0-42.0 g kgG^{1}) is higher than the range 10.9-31.3 g kgG^{1} reported for millet, wheat, oats, sorghum and maize (Oyenuga, 1968; Temple and Bassa, 1991). The crude fibre content of acha is lower than in sorghum and maize but higher than the values for millet and rice (Oyenuga, 1968). The high Nitrogen Free Extract (NFE) content (769.5-817.0 g kgG^{1}) is indicative of the non-waxy type of endosperm in acha grains.

The caloric value of acha (16.264±0.245 MJ kgG^{1} for white variety and 16.462±0.238 MJ kgG^{1} for brown variety) compares well with the values (13.975±1.7313 kgG^{1}) reported for most cereals (Oyenuga, 1968; Temple and Bassa, 1991). Acha is richer in calcium, magnesium, iron and copper than most cereals but poorer in potassium, sodium, lead and manganese (Oyenuga, 1968; Temple and Bassa, 1991). With the exception of methionine the essential amino acid content of acha is lower than in maize, rice, sorghum, millet, wheat, barley and oats (Oyenuga, 1968; Temple and Bassa, 1991). The leucine, methionine and cysteine values in acha are slightly higher than the values in the FAO reference protein (FAO, 1970).

CONCLUSION

The results from this study indicate that acha is a cheap source of carbohydrate for man and livestock, particularly in dry, infertile areas in the tropics. It should be supplemented, however, with protein-rich foods to make a balanced diet. This agrees with the findings of Temple and Bassa (1991). The properties of acha also make it a good candidate for use as edible grain and as raw material for several domestic and industrial purposes like making beer, alcoholic drinks and other applications. In medical sector, acha is recommended as a dietary supplement for diabetic patients due to its protein quality (methionine), easily broken-down starch and high fibre content.

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