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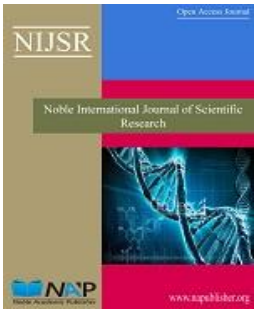

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A Preliminary Study of Effects of Preservation on the Biochemical and Microbial Deterioration of Acha (Digitaria exilis, Stapf) in Plateau State, Nigeria

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Abstract: Research and Development on the indigenous African cereal grains, Acha (Digitaria exilis Stapf.) is experiencing renewed interest not just in Africa but the rest of the world. It is believed that acha may have nutraceutical properties, as it is used in some areas for managing diabetes. These grains may also contribute in addressing some very relevant challenges in today's food formulation- both from functionality and health perspectives. This study was undertaken to hopefully provide a lead to increase the understanding of the health effects of grain components and to increase the intake of health protective grain components,the result of this investigation showed that six(6) different species of fungi were associated with stored and newly harvested acha grains. On the proximate analysis, the very low moisture content suggests that acha loses a considerable of water during storage resulting in longer shelf life. Eight amino acids (leucine, lysine, threonine, methionine, phenylalanine, valine, tyrosine and cystine) were detected except tryptophan which shows the cereal grain is a rich source of fibre and phytonutrients. However, there was no significant difference ($p>0.05$) between stored and newly harvested acha in terms of their biochemical compositions. We concluded that proper cleaning(winnowing) of acha and longer period of drying to determine the more effective way of preservation should be practiced before storage and consumption, the production of acha in view of the presence of these essential amino acids be encouraged, while further investigations should be carried out to ascertain the level of deterioration under storage.

Keywords: Preliminary Studies, Effects of Preservation, Biochemical and Microbial Deterioration, Acha (Digitaria exilis Stapf.)

1. Introduction

The world continues to depend on and receives sustenance from grain crops [1] including the continent of Africa [2]. The traditional cereals, still constitute the stable diet for human consumption, and play an essential role in providing not just food but healthy food for the poorest populations and regions. Acha is the most important of a diverse group of wild and domesticated Digitaria species that are harvested in the savannas of West Africa. It has the smallest seeds of all species of millet. It has potential to improve nutrition, boost food security, foster rural development and support sustainable use of the land. It has continued to be important locally because it is both nutritious and one of the World's fastest growing cereals, reaching maturity in as little as six to eight weeks after planting. It is a crop that can be relied on in semi-arid areas with poor soils, where rains are brief and unreliable. The grains are used making porridge and coucous, for bread and beer.

Acha (Digitaria exilis, Stapf) also known as fonio, fundi or hungry rice belongs to the family graminae and the tribe Poaceae. It grows under varying conditions. The small grain has promising unique nutritional qualities. Nutrition experts have acknowledged it as exceptional. Its seed has a high protein content of about 8.7%-11.8%; the grains are rich in methionine, cystine and other amino acids vital to human health but deficient in today's major cereals such as wheat, rice, maize, sorghum, barley and rye [3, 4].

The growing popularity of whole grains has opened up opportunities for more novel, flavourful and lesser-known types of grains. Acha grains are mostly consumed whole, perhaps because of their small sizes. The consumption of acha should no longer be regarded as a coping strategy for increasing household food security, considering the high comparative cost of this traditional cereal in the areas of production [5, 6] and the fact that they are sold to African emigrants in Europe and United States.

Incidentally, the crop has received only about a fraction of the attention accorded to sorghum, pearl millet and maize. This is due partly to its low yield, the misleading use of the term 'hungry rice' by Europeans who knew little about why the farmers cultivated this crop, reduction in areas devoted to, reduction in areas devoted to the acha production as a result of its high labour demands and for economic reasons, farmers have shifted to the production of other crops such as maize and sorghum.

The consumption of acha is growing rapidly among Nigerians as an alternative for rice and experts knowledge that it has exceptional nutritional qualities. In Mali the price of acha triples that of millet and doubles the price of rice or millet flour. In Nigeria, the price of acha competes with those of other cereals such as rice and doubles others.

It would be helpful to know the amounts and composition of bioactive components, including dietary fibre and phytochemicals whether these can be exploited to produce new types of grains with enhanced health benefits. This is the motivation that informed the current study.

2. Materials and Method

2.1. Collection of materials

Acha grains were collected from farmers in the ten Local Government Areas known for its cultivation. These samples were made up of freshly harvested and stored acha. Soil samples were also collected from fields used for the cultivation of acha. These samples were collected in sterile polythene bags and taken to the laboratory for processing.

2.2. Analytical Methods

The total ash, crude lipid and crude protein were determined according to the recommended procedures. Amino acid composition were determined using methods described by Speakman and Moore [7]; where the acha grains were dried to constant weight, defatted, hydrolysed and evaporated in a Technicon Sequential Multisample amino acid analyser (TSM). Deffating of acha was done using Soxhlet extraction apparatus as described by A.O.A.C. [8].

2.3. Results and Discussion

The results of this investigation showed that six (6) different species of fungi were associated with stored and newly harvested acha grains (table 1). The presence of Aspergillus species raises much concern for food technologies especially for their mycotoxin production. They were known to produce lethal effects on rabbits and guinea pigs. In separate studies, Ogbonna and Apeji [9] reported that *Aspergillus niger* were associated with stored and deteriorated acha grains repectively. *Aspergillus flavus* usually persists as mycelia in plant debris left in the field after harvest [9-11].

Rhizopus stolonifer and R. oryzae are known to produce metabolites (ergosinine) which are toxic to man. They may also produce certain allergic reactions in man when consumed. Besides, they also impart discolorations on the grains, thereby reducing their economic values. Reduced carbohydrates, fatty acids and protein contents of stored acha grains by fungi have been reported [11].

Table 1: Frequency of occurrence of fungi associated with newly harvested and stored acha.

Micro-organisms	Stored acha	Newly harvested acha
Aspergillusoryzae	+++	+
A. flavus	++	-
A.niger	+	+++
Rhizopusstolonifer	+++	++
R. oryzae	+++	+
R. oligosporus	+	-
Ulocladium species	++	-
Bacteria	-	-

Key : +++ 75% and above colonization, ++ 50-74%, + 0-49% , - nil

Proximate analysis indicated that newly harvested acha grains contained slightly higher proportions of crude proteins, crude fats and ash compared to stored acha (table 2). However, there was no significant difference ($p>0.05$) between stored and newly harvested acha grains in terms of their biochemical composition. The result of this study agrees with previous works [12, 13] who indicated research and development on acha grains experiencing renewed interest, particularly for its flavor and nutritional qualities. Acha proteins have been shown to be less susceptible to deneturation. Preliminary results show that these grains, based on the functionality of the grains of the protein, can be used to create a number of value added food products [14].

The very low moisture content suggests that acha loses a considerable amount of water during storage resulting in a longer shelf life. The crude fibre content of acha is lower than in sorghum and maize, but higher than the values for millet and rice [12] had reported higher values for all proximate constituents compared to the result of the current studies.

Table 2: Proximate analysis of newly harvested and stored acha.

Component /constituent	Stored acha	Newly harvested acha
Crude proteins	6.06	7.91
Crude fibre	2.71	2.19
Crude fats	5.02	5.10
Carbohydrates	76.83	75.13
Ash	1.82	2.15
Moisture	7.56	7.52

The preliminary result of the essential amino acid profiles of stored acha grains and newly harvested in comparism with the F.A.O. [15] preference is presented in table 3 below. Out of nine (Leucine, lysine, threonine, methionine, phnylalanine. Valine, tyrosine, tryptophan and cystine), eight were detected on the two samples at varied degrees except for one (Tryptophan) which was not detected in any of the samples, probably destroyed during acid hydrolysis. The amino acid profiles showed higher concentrations of threonine, leucine, methionine and valine which are above the FAO reference values (Table 3).

Table 3: Essential amino acid profiles of stored and newly harvested acha grains compared with F.A.O. [15] preference.

Amino acid	Stored acha Grains	Newly harvested acha Grains	F.A.O. preference (1970)
Leucine	7.22	8.52	4.2
lysine	2.50	2.56	4.2
Threonine	3.87	3.95	2.8
Methionine	4.29	4.85	2.2
Phenylalanine	4.24	4.59	4.2
Valine	4.72	4.84	2.8
Tyrosine	2.87	2.87	2.8
Tryptophan	-	-	1.4
Cystine	2.06	2.20	2.0

The findings of this study differs with the previous work of Temple and Basa [12] where they detected tryptophan and our values for all amino acid groups implicated. The results indicated that acha is a cheap source of carbohydrates for man and livestock, particularly in dry, infertile areas in the tropics. Other works [2, 4, 13, 14] had maintained that acha is a rich source of fibre and other phytonutrients and that they can be used as ingredients helping to improve nutritional profiles without compromising taste and quality in products.

3. Conclusion

Acha cereal grains have received some attention and showed an impressive future and huge potential for wider use. Acha grains would therefore be suitable as a good source of calories and digestible proteints for many people in and beyond the semi-arid tropics who largely depend largely on maize, sorghum and millet grain supplies. Proper winnowing(cleaning) and longer periods drying to determine more efficient and safe way of preservation before storage and consumption. In view of the presence of

essential amino acids, the production and consumption of acha should be encouraged; while further investigation should be carried out to ascertain the level of acha deterioration under storage.

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