 http://dx.doi.org/10.4314/bajopas.v11i1.22S

Bayero Journal of Pure and Applied Sciences, 11(1): 133 - 138
ISSN 2006 – 6996

COMPARISON OF NUTRITIONAL VALUES OF WHEAT (*Triticum aestivum*) AND ACHA (*Digitaria exilis*) GRAINS

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ABSTRACT
This study determined the proximate composition, mineral content and phytochemical screening of wheat (Triticum aestivum) and acha (Digitaria exilis) grains obtained from Garki market, Federal Capital Territory (FCT) Abuja in order to compare the nutritional and medicinal values of the two grains. The results obtained from the proximate analysis of wheat and acha respectively is as follows: moisture content (9.33 ± 0.57% and 10.9 ± 0.05%), ash (1.16 ± 0.28% and 1.16 ± 0.28%), crude fibre (9.83 ± 0.28% and 15.33 ± 0.57%), crude protein (5.76 ± 1.23% and 3.35 ± 1.13%), lipid (1.5 ± 0.70% and 1.00 ± 0%), carbohydrates (72.29 ± 0.72% and 68.46 ± 1.33%), energy value (3.2582 and 2.9432kcal/100mg). The mineral analysis showed that the amount of Fe, K and Mg were higher in acha compared to wheat and Na, Ca, Zn and Pb are higher in wheat compared to acha. Cr was not detected in both samples. The phytochemical screening revealed the presence of carbohydrate, flavonoids and cardiac glycoside in the two samples. Saponins were present in only wheat, whereas alkaloids are present in only acha. However, phenolics, tannins, terpenes and steroids were absent in the two samples. The result of this study has revealed that both samples are rich sources of carbohydrate, crude fibres and essential mineral. In addition, the phytochemical analysis result shows that these cereals are potential sources of therapeutic agents which can help to lower the risk of several diseases.
Keywords: Acha, Nutritional values, Mineral content, Wheat, Phytochemicals

INTRODUCTION

Cereals are plants from the grass family which can yield an edible grain, such as barley, corn, oats, rice, rye, wheat to mention a few. The word cereal is derived from the most important grain deity, the Roman goddess of agriculture Ceres. Wheat and barley are the oldest cultivated cereals. The cultivation started in the fertile crescent of Mesopotamia some 10,000 years ago (Onwueme and Sinha, 1991). The major cereal crops in Nigeria are rice, maize, sorghum, wheat, millet, sugar cane, acha and millet. Cereals are the major dietary energy source and provides significant amount of protein, minerals (potassium and calcium) and vitamins (vitamin A and C) (Idem and Showemimo, 2004). Cereals are consumed in a variety of forms, including pastes, noodles, cakes, breads, and drinks. The by-product of processed cereals; bran, husk and other residues are useful as animal feeds.

Common wheat (*Triticum aestivum*) also known as bread wheat is the most cultivated among the wheat species. About 95% of the wheat produced globally is common wheat. The high demand of wheat in recent years is due to health benefits associated with the plant. Foods like bread, pasta, crackers and cakes are common examples of wheat products. Wheat is rich in catalytic elements and mineral salt. Wheat, like many other natural products, has chemical components. One of the main components that provide nutrition is starch. Starches are present in grains, corn, rice and potatoes. Another component is a protein called gluten. Wheat is the only grain which contains gluten in the proper proportion and of the desired quality essential. It contains all the elements necessary for the growth of the body. This wealth of nutrients is why it is often used as a cultural base or foundation of nourishment issue like anaemia, mineral deficiencies, gall stone and obesity problems are quickly improved by consumed whole wheat (Saeid *et al.*, 2015).

White acha (*Digitaria exilis*) is an annual cereal crop indigenous to West Africa countries, where it is cultivated for its straw and edible grains.

It is probably the oldest African cereal, consumed as either the staple food or a major part of the diet. In Nigeria, *D. exilis* grains are pulverized into flour used to prepare local beverages and other delicacies; the grains can also be cooked in various forms with fish, meat, legumes or vegetables. The grains are also used to prepare feeds, for animals (Philip and Itodo, 2006). Acha grains have played a vital role in providing nourishment to Nigerians over the years. Due to its high fibre content, this grain is also recommended for the elderly and people suffering from digestive problem, in addition, because of its insulin secreting ability, it is recommended for diabetic patients (Jideani and Akinbala, 1993). Unlike wheat, acha does not contain any gluten or gliadin proteins. The main objective of this study is to compare the nutritional composition of wheat and acha sold in Garki market Abuja, Nigeria.

MATERIALS AND METHODS

Sampling and Sample Preparation

The wheat and acha grains used in this study were purchased from Garki market, Abuja, Nigeria. The grains were identified and authenticated by a taxonomist in the Herbarium unit of National Institute for Pharmaceutical Research and Development, Abuja. The grains were sorted-out, to remove foreign matter, the clean grains were pulverized using mortar and pestle and packaged in an air-tight plastic container.

Proximate analysis

The determination of moisture, ash, crude protein, crude lipid and crude fibre content were done in accordance to the recommended methods of the Association of Official Analytical Chemists (AOAC, 2006). The carbohydrates content were determined by subtracting the sum of the moisture, ash, crude protein, crude lipid and crude fibre contents from 100%. Calorific value (CV) was determined using the following equations: CV (kcal/100g) = (CHO ×4) × (CL × 9) × (CP × 4) (Hassan *et al.*, 2008)

Mineral Analysis

Quantitative determination of Mn, Fe, Zn, Pb, Cr, Mg, Na and Ca was done with the aid of GBC Avanta version 2.0 Model of Atomic Absorption Spectrometer (AAS). The concentrations of each element were determined in the samples by using the formula:

$$\text{Metal content } (\mu\frac{g}{g}) = \frac{C \times V \times d.f}{W}$$

Where C is the concentration of the sample solution in µg/mL from AAS analysis; V is the volume of the prepared sample solutions in mL; W is the weight of the sample in grams and d.f is the dilution factor, if used (AAS Manual, 1996; Brunelle *et al.*, 1970; Edward *et al.*, 1971).

Phytochemical Screening

The phytochemical screening was carried out according to the methods outlined in (Trease and Evans, 1989; Sofowora, 1993; Evans, 2004).

Statistical analysis

The data generated for the different parameters were subjected to statistical analysis using Microsoft Office excel® software. The results are presented as mean ± standard deviation (SD). Furthermore, the significance differences were tested using student *t-test* $p < 0.05$.

RESULTS AND DISCUSSION

Results of the proximate composition (% dry matter), elemental analysis and phytochemical screening of wheat and acha are presented in Table I, II and III respectively.

The results indicated higher percentage of moisture in acha compared to wheat from Table I below. The *t-test* analysis of percentage moisture content in the samples indicated p-value as $p<0.023$ which means there is significant difference between the moisture content of the two samples. High moisture content can cause caking especially in flour, moisture content affect the storage, shelve life and viability of microbial growth (Adeyeye *et al.*, 2000).

Table I: Proximate composition of Wheat and Acha (%dry matter)

Parameter	Wheat	Acha	P value*
Moisture	9.33± 0.57	10.9 ± 0.05	0.023*
Ash	1.16 ± 0.28	1.16 ± 0.28	0.50
Crude lipid	1.50 ± 0.70	1.00 ± 0.00	0.11
Crude protein	5.76 ± 1.23	3.35±1.13	0.0001*
Crude fibre	9.83 ± 0.28	15.33 ± 0.57	0.004*
Carbohydrate	72.29 ± 0.72	68.46 ± 1.33	0.017*

Values are expressed as mean ± standard deviation of triplicate determinations.
*Values with statistical significant differences ($p<0.05$)

Ash content gives an insight into the amount of inorganic and salty constituents of the plant. It is a measure of the total amount of minerals present within a sample. Determination of the ash and mineral content of sample is important for nutritional labelling and food quality.

The total ash content of wheat and acha is the same. The *t-test analysis* of Ash content indicated that there is no significant difference among the samples. The low ash content of the samples showed that the samples have low amount essential minerals.

Crude fibre has a range of health benefits, it lowers risk of heart diseases, reduce risk of type 2 diabetes, improved weight control, improved digestive health, reduce inflammation, and help to boost immune system (Onimawo *et al.,* 2003). In this study, the fibre content of acha is higher than that of Wheat. The analysis of variance reveals there is a significant difference in crude fibre of the samples.

From Table 1 above, the protein content of wheat is higher than that of acha. The analysis of variance also shows that there is significant difference in the protein content of samples. Protein is an essential component of diet which plays many vitals roles in the human body system, such as; providing structure and strength to cells and tissues, controlling biochemical reactions and aiding immune system. The crude protein content of the samples are very low compared to other sources of protein rich foods such as soybeans, cowpeas, pigeon peas and gourd seeds (Olaofe *et al.,* 1994).

The result obtained in this study indicated that the percentage lipid content of wheat is higher than that of acha. A significant difference was observed among the samples from the analysis of variance of crude lipid content. Lipids are the universal storage form of energy in living organism. Lipids presents in cereals are complex as they consist of a large number of chemical classes and individuals compound. In a previous study; wheat, rice, corn, barley, rye, and acha contain 1-2 % lipids (Nelson and Cox, 2008). The low lipid content foods are recommended as part of weight reducing diet, since low fat containing food reduces cholesterol level and obesity (Gordon and Kessel, 2002).

Table I shows that wheat contains higher amount of carbohydrate compared to acha. The *t-test analysis* indicates a significant difference in the carbohydrate content of the two samples. Cereal grains are reported to contain 66-76% carbohydrates from previous studies. The samples were very high in carbohydrate content hence can be good sources of energy. Carbohydrates are good sources of energy they are stored as glycogen which is the reservoir for glucose (Freedland and Briggs, 1997). In this study, the energy value of wheat (3.2582kcal/100g) appeared to be higher than acha (2.9432kcal/100g). The report of Sharma *et al.,* (2002) showed that samples with higher energy value may contribute in giving energy; the energy value of food is a measure of the heat energy available by the complete combustion of a specific weight of the food.

Mineral composition

The result of mineral content of wheat and acha are presented in Table II below. The results shows K, Ca, Fe, Na, Mg, Zn and Pb are present in both samples, while Mn is detected in wheat only. Cr was not present in both samples. It is observed that the content of Na, Ca, Zn and Pb is higher in wheat while the content of Fe, K, and Mg is higher in acha. Both Acha and wheat are rich in K. K is a very important mineral for the proper functions of all cells, tissues and organs in the body. K is crucial to heart function and pays a key role in skeletal and smooth contraction, making it important for normal digestive and muscular function (Adrogue and Madias 2014).

Table II: Mineral Composition of Wheat (*Triticum aestivum)* and Acha (*Digitaria exilis)* (µg/g)

Mineral	Wheat	Acha
Sodium	56.03 ± 0.32	30.73 ± 0.10
Calcium	211 ± 3.18	44.64 ± 1.75
Iron	131.04 ± 26.07	133.6 ± 0.3
Potassium	140.75 ± 5.52	1090.0 ± 6.3
Magnesium	30.71 ± 1.71	849.0 ± 0.3
Zinc	115.02 ± 1.74	20.72 ± 0.09
Manganese	30.24 ± 1.17	ND
Lead	59.75 ± 8.13	33.18 ± 16.75
Chromium	ND	ND

Values are expressed as mean ± standard deviation of three triplicate ND= Not Detected

Cereals can be a good source of Fe, Zn, Ca, and Mg. Fe is an important mineral, it helps the red blood cells to deliver oxygen to other organs of the body, it helps in the functioning of the central nervous system and in the oxidation of carbohydrates, proteins and fats (Adeyeye and Otokiti, 1999). Lead is a trace metal which does not have any beneficial value in either human's body or plants, its toxicity is apparent even at low concentration.

The typical symptoms of lead poisoning are colic, anaemia, headache, convulsions and chronic nephritis of the kidneys, brain damage and central nervous system disorders (Khan *et al.*, 2008). The concentrations of lead in the samples are higher that the permissible limit of Pb in the blood. Similarly, the results indicated all the samples contained lead above WHO (2007) specified limit for lead in edible plants. This could be due to high Pb content in the sites where the plant were cultivated or cross contamination resulting from poor collection and storage of the samples (Kawatra and Bakhtetia, 2008).

Phytochemical screening

Plants have been a source of both food and medicine for man owning to the fact that plants can synthesis organic compounds that have both nutritional and medicinal properties. These compounds provide definite physiological action on the human body. Therefore, the knowledge of these chemical constituents in cereals is desirable because such information will be valued for human health benefits.

The phytochemical contents of wheat and acha is presented in Table III below. This study reveals that carbohydrate, flavonoids and cardiac glycoside are detected in both. Saponins is only detected in wheat and alkaloids are only present in Acha. However, phenols, tannins, terpenes, and steroids were not detected in the samples.

Table III: Phytochemical screening of Wheat (*Triticun aestivum* and Acha (*Digitaria exilis)*

Phytochemicals	Wheat	Acha
Carbohydrate	+	+
Reducing sugar	+	+
Flavonoid	+	-
Saponins	+	-
Phenol	-	-
Tannis	-	-
Alkaloids	-	+
Steroids and terpenes	-	-
Cardiac glycoside	+	+

Keys: + = Presence; - = Absence.

Wheat and Acha are rich in multiple nutrients and dietary fibre, therefore they are considered as a significant source of food for human nutrition (Shewry and Hey, 2015). However, wheat is reported to lower the risk of several diseases such as; coronary heart disease, stroke, cancer and type 2 diabetes due to the presence of secondary metabolite in it (Williams, 2014; Aune *et al.*, 2016). This study reveals that wheat and acha contains important phytochemicals like flavonoids a well-known natural free radical scavenger and antioxidant agent, which might be responsible for the anti-cancer properties of both grains. The presence of flavonoids in the grains suggest that they may have biological functions such as protection against allergies, inflammation, free radical, platelet aggregation, microbes, ulcers, hepatoxins, viruses and tumour according to (Okwu, 2004). Saponins have hypotensive and cardio depressant properties (Olaleye, 2007), Saponins also produces inhibitory effect on inflammation. The anti carcinogenic properties, immune modulation activities and regulation of cell proliferation as well as other health benefits such as cholesterol lowering activity of saponins is reported by (Odoemelam and Osu, 2009). Cardiac glycosides are natural cardioactive drugs which can lower blood pressure. Hence, they are used for managing heart failure and cardiac arrhythmia (Brain *et al.*, 1985). The presence of cardiac glycosides and saponins in the wheat might be responsible for its ability to ameliorate coronary heart disease. The proximate analysis (Table I) suggests that wheat and acha are rich sources of carbohydrate and fibres. Furthermore they are also rich sources of vital micro nutrients from Table II. However it is worrisome that the Pb content in both samples is significantly higher than the allowable limit of Pb in edible grains.

CONCLUSION

Wheat and acha are common grains consumed in Nigeria, this two grains are popular due to their nutritive and medicinal values.

This study has shown that both grains are rich in carbohydrate and dietary fibre; in addition they contain essential mineral elements like Na, Ca, Fe, K, Mg and Zn in varying concentrations. Cr was not detected in both grains, however high amount of Pb a very toxic element was detected in both sample, this is worrisome and the authors attribute the high Pb content to cross contamination due to poor collection and storage of both grains. Bioactive phytochemicals were also detected in the grains, this suggest that consumption of this grains can help to reduce the risk of several diseases. Although the nutritional and medicinal values of both grains are somewhat similar, the health benefit of consuming more acha could outwit that of wheat since acha contains more fibres content and higher concentrations of the essential mineral element when compared with wheat.

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