ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

International Journal of Engineering Technologies and Management Research
A Knowledge Repository
IJETMR

COMPARATIVE STUDY OF NUTRITIONAL, FUNCTIONAL AND ANTI-NUTRITIONAL PROPERTIES OF WHITE SORGHUM BICOLOR (SORGHUM) AND PENNISETUM GLAUCUM (PEARL MILLET)

OJO Olabimpe Iyabo [1], OGUNLADE Ibiyinka [2], OLANIPEKUN Abimbola Deola [2]
[1] College of Education Ikere-Ekiti, Ekiti State, Nigeria
[2] Ekiti State University Ado-Ekiti, Ekiti State, Nigeria

Abstract:
The effects of sprouting on proximate, mineral composition and functional properties of white sorghum bicolor and pennisetum glaucum were evaluated. The sorghum bicolor and pennisetum glaucum kernels obtained from Kings local market in Akure Ondo State, Nigeria and identified in the department of Agronomy Federal University of Technology, Akure were sorted and divided into two portions. The first portion was soaked for 24 hours after which it was spread on trays lined with doth and kept wet by frequent spraying of water each morning and evening for 2 days. The sprouted maize grains were oven dried at 60°C to constant weight and milled into flour. The second portion was processed into flour without sprouting, using the same method. Each of the portions was analyzed for proximate, mineral compositions and functional properties using standard methods. Sprouting of both sorghum bicolor and pennisetum glaucum grains resulted in significant increase (p<0.05) in crude protein, crude fibre, and ash content. The moisture content of sorghum bicolor increases with sprouting while that of pennisetum glaucum decreases. This decrease in the moisture content of pennisetum glaucum with sprouting implies an increase shelf life. Increase in solubility, water absorption and oil absorption capacity observed with sprouting in both sample helps in increasing the palability of the food The results showed that the sprouting process improved the nutrient composition and enhanced the functional properties of both sorghum bicolor and pennisetum glaucum with the pennisetum glaucum being found to be slightly better in terms of shelf life.

Keywords: *Effect; Sprouting, Sorghum Bicolor; Pennisetum Glaucum; Composition and Functional Properties.*

Cite This Article: OJO Olabimpe Iyabo, OGUNLADE Ibiyinka, and OLANIPEKUN Abimbola Deola. (2018). “COMPARATIVE STUDY OF NUTRITIONAL, FUNCTIONAL AND ANTI-NUTRITIONAL PROPERTIES OF WHITE SORGHUM BICOLOR (SORGHUM) AND PENNISETUM GLAUCUM (PEARL MILLET).” *International Journal of Engineering Technologies and Management Research,* 5(3), 151-158. DOI: 10.5281/zenodo.1216867.

1. Introduction

Cereal grains are grasses members of the monocot families poaceae or graminae. Cereal grains are grown in greater quantities and provide more food energy worldwide than any other type of

 ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

crop. Cereals are the most important stable food for many people in the developed and developing countries. In the developed countries, 70% of the cereal production is used as animal food while in the developing countries, like Nigeria, about 68-98% of the cereal production is used for human consumption. The principal cereal crops are millet sorghum, maize, wheat, barley, oats, and rice, Adebayo et al., (2016).

Sorghum, *Sorghum bicolor* (L.) Moench, is known under a variety of names: great millet and guinea com in West Africa; kafir com in South Africa, dura in Sudan; mtama in Eastern Africa, jowar in India and kaoliang in China. In the United States it is usually referred to as milo or milo-maize. Sorghum belongs to the tribe Andropogonae of the grass family Poaceae. Sugarcane, Saceharum officiriarum, is a member of this· tribe and .a close relative of sorghum. The· genus Sorghum is characterized by spikelet's borne in 'pairs. Sorghum is treated as an .annual, although it is a perennial grass and in the tropics it can be harvested many times.

Sorghum bicolor is considered as one of the most important food crops in the world, which provide the staple food of large population in Africa (FAO, 2006) and semi arid part of the topics. Sorghum is commonly consumed by the poor masses of many countries and it forms a major source of vitamins, minerals, protein and calories in the diet of large segment of the population of India and Africa, as well as for the poultry and livestock.

Pearl millet, *Penniserum glaucum*, is also known as spiked millet, bajra (in India). Pearl millet may be considered as a single species but it includes a number of cultivated races. It almost certainly originated in tropical western Africa, where the greatest number of both wild and cultivated forms occurs. About 2 000 years ago the crop was carried to eastern and-central Africa and to India, where because of its excellent tolerance to drought it became established in the drier environments.

Millets are a group of highly variable small seeded grasses widely grown around the word as cereal crops or grains for fodder and human food. Millets do not form a taxonomy group, but rather a functional or agronomic one which are important crops in the semi and tropies of Asia, and Africa (especially in India and Nigeria) with 97% of millet production in developing countries. The most widely grown millet and sorghum are pearl millet and sorghum bicolor respectively. The crops are favored due to its product ad short growing season under dry, high temperature conditions. Sorghum and millets are commonly eaten with the hull which retains the majority of the nutrient, which made them to be highly nutritious but has inferior organoleptic quality due o the presence of anti-nutritional factors such as tannins and phylates. Tannins and phytates complexes with protein and irons, thereby inhibiting protein digestility and absorption of iron, but it can be overcome by adequate process by techniques. Such as sprouting and fermentation Singleton et al., (1999)

Processing methods such as cooking, soaking, sprouting and fermentation has been reported to improve the nutritional and functional properties of plant seed. (Jirapa et al., 2001). This sprouting method was reported to be more superior to any of the processing method, which confirmed it to be used in other to achieve the set goals of this research work. Sprouting process is known as a way to promote changes in the biochemical, sensual and nutritional characteristics of cereal grains (Masood et al., 2014). Sprouting has been reported to improve digestibility,

ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

bioavailability of vitamins, minerals, amino acids proteins, phytochemicals and decrease anti-nutrients and starch of some cereals (Inyang et al., 2008) and thereby improve protein and iron absorption.

There is an increasing rate of population growth coupled with economic crisis and inflation in prices of some commonly consumed imported cereal food items which calls for an in-depth research into local whole cereal grains (white sorghum bicolor and pennisetum glaucum) reported to be major source of nutrient vital for human health in Nigeria, especially in Ekiti ad Ondo state where this cereals are used now by the populace to produce different kind of food and drink items like fortified flours to prepare (Amala) a bolus food, burukutu drink, infant baby food and palp e.t.c. for human consumption.

The various data on previous studies on the effect of sprouting of cereal grains in Nigeria, especially in Ekiti and Ondo states focused mostly on maize varieties and the brownish red sorghum bicolor with sparse information available on white *sorghum bicolor* and *pennisetum glaucum*.

There are no research done on comparative study of the raw sprouted an unsprouted white *sorghum bicolor* and *pennisetum glaucum* popularly used as major ingredients for Kunu (local beverage) commonly consumed recently in an aggressive manner as a substitute to the expensive soft drinks or imported drinks due to financial economic crisis now in Ekiti and Ondo states. Most of the research previously done were on the finished product (Kunu). Hence the aim of this study is to compare and contrast the effect of sprouting on the nutritional, functional, and anti-nutritional properties of white *sorghum bicolor* and *pennisetum glaucum* for improvement of its nutritional quality for modification of food nutrient, both for human consumption and livestock feed.

2. Materials

The sorghum bicolor (white species) and pennisetum glaucum (pearl millet) were purchased from the market Akure, Ondo state Nigeria.

3. Methods

3.1. Sample Preparation

White *sorghum bicolor* and *pennisetum glaucum* were sorted and divided into two portions, the first portion was soaked for 24 hours, after which it was spread on trays lined with cloth and kept wet by frequent spraying of water at every morning and evenings for four days. The sprouted grains were sundried and oven dried at 60^{C} to constant weight and milled into flour in a blender, the second portion was processed into flour without sprouting using the same method, the seed flours were labeled as follows, Unsprouted *sorghnum bicolor* USB, Sprouted *Sorghum bicolor* SSB, Unsprouted *pennisetum glaucum* UPG, Sprouted *pennisetum glaucum* SPG.

 ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

3.2. Chemical Analysis

Proximate Composition

The proximate analysis for the *sorghum bicolor* and *pennisetum glaucum* flour samples were carried out using Association of official Analytical chemists (AOAC, 2005) methods carbohydrate was estimated by subtracting the ash, protein rude fiber and fat percentage from 100%. Mineral composition namely K, Ca, Fe, Na, Cu, Se, Mn, Cr, Ni, Co, Pb, and Cd were determined by wet ashing method (AOAC, 2005) Na and K were determined using a flame photometer as described by AOAC (2005) Ca, Fe, Cu, Se, Mn, Cr, Ni, Co, Pb, and Cd were determined with a bulk scientific spectrophotometer (AAS) model 200 equipped with air acetylene flame (Onianwa et al, 2001), All determinations were made in triplicate.
The detection limits for the metal aqueous solution were determined before the real analysis. Recovery study of the analytical procedure were carried out according to the method of Onianwa et al (2001)

4. Functional Properties Analysis

The functional properties analyses for the whole and refined grains were carried out according to the following methods
Determination of water absorption capacity (WAC,%) were done according to the method of Coffman and Gacial (1977) and Suresh Chadra et. al., (2014), dextermination of oil absorption capacity (OAC, %) were carried out according to the method of Suresh Chadra et. al., (2014), Determination of emmultion capacity (OEC, %) were done according to the method of Suresh and Chadra (2013), etermination of protein solubility (PS) were done according to the method of Adeyeye and Adamu (2009).

Determination of foaming capacity (FC, %) and foaming stability (FS, %) were carried out according to the method of Adeyeye and Adamu (2009), determination of emmultion stability (ES, %) were done according to the method of Ogunlade et al., (2006), Determination of Least Gelatin Concentration (LGC, g) were carried out according to the method of Coffman and Garcia (1977) and Suresh Chandra et al., (2014), Swelling Solubility (SS,) and Swelling power (SP) were done determined according to the method of O. Adebayo et al., (2016), quality Assurance (QA) and Quality Control (QC) were done observed.

5. Statisticl Analysis

All samples were in triplicate. The statical analysis we conducted using one way ANOVA procedures. Statistical differences in samples were tested for at $p<0.05$ Duncan's new multiple range test (DNMRT) was used to separate the mean values.
All analysis were done with spss (11.0) software

ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

6. Result and Discussion

6.1. Proximate Composition

The results of the proximate composition of the sprouted and unsprouted raw sorghum bicolor (Sb) and Pennisetum glaucum (Pg) are shown in Table 1.

Comparatively the protein content of both white sorghum bicolor and Pennisetum glaucum were significantly ($p<0.05$) higher than that of the unsprouted whole cereal grain samples which could be as a result of mobilization of stored nitrogen of the cereal to aid sprouting. This may also be as a result of synthesis of enzymes or compositional change following the degradation of other constituents.

This observation is consistent with the findings of Oluwalana (2014) who reported significant increase in protein content of sprouted sweet white and yellow maize than that of unsprouted ones. Other researchers have also observed significant increase in protein content seed sprouting (Mallesh et al 1989; Enujiugh et al 2000; Fasasi 2009; Ijarotimi and Keshinro 2011).

Table 1: Effect of Sproutig on the proximate Composition (%) Dry weight of Sorghum Bicolor and Pennisetum Glaucum

Sample	Moisture	Protein	Fat	Ash	Fibre	Carbohydrate
USB	9.43±0.06	12.66±0.33	4.61±0.01	1.47±0.02	2.03±0.05	69.67±0.06
SSB	9.69±0.21	13.09±0.01	4.66±0.03	1.71±0.02	2.04±0.02	68.80±0.22
UPG	8.40±0.20	14.13±0.09	6.42±.0.04	1.76±0.01	2.05±0.01	67.23±0.31
SPG	8.34±0.10	17.030.01±	6.50±0.02	1.82±0.02	2.10±0.02	64.21±0.13

The observed reduction in the carbohydrate with sprouting could be due to their utilization as energy sources in the sprouting process (Fasasi 2009; Ijarotimi and Keshinro 2011 and Oluwalana, 2014).

The ash content also increase with sprouting as similarly observed by Oluwalana (2014) and Obasi et al (2009), the moisture content of sorghum bicolor increases with sprouting while that of pennisetum glaucum decreases. This decrease in the moisture content of pennisetum glaucum with sprouting implies an increase shelf life. The crude fibre content for both sorghum bicolor and pennisetum glaucum increases with sprouting. The fat content for both sorghum bicolor and pennisetum glaucum also increases with sprouting. The increase in the crude fat content also implies decrease shelf life for the sprouted seeds compared with the unsprouted ones. This observation is contrary to the decreasing in fat content observed by Oluwalana (2014) in the sprouted maize which implies an increase in shelf life.

In general pennisetum glaucum tends to have slightly more crude protein, crude fibre, crude fat and ash than sorghum bicolor while the carbohydrate and the moisture content of sorghum bicolor is a little bit higher than that of pennisetum glaucum.

 ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

7. Mineral Composition

The mineral contents of the samples are shown in Table 2.

The mineral contents of the sprouted seed flour of sorghum bicolor and pennisetum glaucum comparatively shows that Co, Cr, Mn, Cu, Zn, Fe, Na, ad K significantly decreases with sprouting while Ca increases. The significant increase in the Ca could be due to the reduction of Phytic acid during sprouting Svanberg and Sandberg(1988). The reduction in the other minerals could be as a result of their leaching into the soak water during the sprouting process (Tatsjieu, 2004)Ni, Se, Pb and Cd were below detection limit. In pennisetum glaucum, the mineral contents of the sprouted seeds flour were higher than that of unsprouted seed flour.
This corroborated with earlier report by Oluwalana (2014) and also Inyang and Zakari (2008). The desirable changes in the nutrient may be due to the breakdown of complex compounds into simpler forms

Table 3: Effect of Sproutig on the functional Properties (%) Dry weight of Sorghum Bicolor and Pennisetum Glaucum

Sample	**BD (g/ml)**	**WAC (%)**	**OAC (%)**	**S c (%)**	**Sw (%)**	**Fc (%)**	**Ec (%)**
USB	0.87±0.02	204.67±1.53	197.87±1.53	1.01±0.02	410.15±1.53	7.08±1.53	99.77±1.53
SSB	0.81±0.02	205.07±1.53	208.87±1.53	4.25±1.53	401.82±1.53	7.51±1.53	191.67±1.53
UPG	0.79±0.02	200.87±1.53	219.37±1.53	6.10±1.53	383.14±1.53	7.51±1.53	206.04±1.53
SPG	0.76±0.02	201.77±1.53	219.97±1.53	4.71±3.51	372.42±1.53	7.59±1.53	206.08±1.53

BD= BULK DENSITY
WAC= WATER ABSORPTION CAPACITY
OAC=OIL ABSORPTION CAPACITY
SC= SOLUBILITY
SW=SWELLING CAPACITY
FC=FOAMING CAPACITY
EC=EMULSION CAPACITY

There was an increase in solubility with sprouting in both cereal samples. This increase could be as a result of the increase in the amount of soluble sugar present in the sprouted flours. The pennisetum glaucum unsprouted sample has higher Swelling Capacity (SC) while the swelling capacity of the sprouted sample is less. The swelling capacity of sorghum bicolor is higher in the sprouted sample.

The higher swelling index observed in the raw (unsprouted) pennisetum glaucum could be as a result of the swelling of the starch granules which leads to disruption of some intermolecular hydrogen bonding. This allowing more water to enter and enlarge the granules (Ihekoronye and Ngoddy, 1985). Swelling capacity can be as an index of stickiness of the resultant product . In general flour with better Water Absorption Capacity (WAC) are easier to reconstitute in water when needed.

Oil absorption capacity is important since oil act as flavor retainer and increase the palability of food (Kinsella, 1976)

ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

8. Contribution to Knowledge

This research study could be a source of enlightenment to the general populace that sprouting of white sorghum bicolor and pennisetum glaucum resulted in the enhancement of its nutritional quality due to the significant increase in quantity of protein, reduced bulk and increased nutrient density.

This study also enable the society to be aware that sprouting of white sorghum bicolor and pennisetum glaucum is associated with reduction in carbohydrate of which could be very useful in the modification of food nutrients for diabetic patients. In general, the observation could be advantageously utilized to improve nutrition of infants, children and diabetic patients particularly in the developing countries like Nigeria where sorghum bicolor and pennisetum glaucum are consumed in large quantity as well as for food products and development in food and livestock feed industries.

9. Recommendation

White sorghum bicolor and pennisetum glaucum varieties are to be included in a daily diet because of their high nutrient density. Since the cereal sample varieties were more efficient in sprouting, this may proved to be best as compared to the unsprouted ones.

References

[1] Adebayo R. O, Olayiwola O.A. et al., (2016): Functional Properties and anti-nutritional factors of some selected Nigerian cereals. *Comprehensive Research Journal of Agric. Sci.* Vol. 1 (1) pp 008-012.
[2] AOAC (Association of Offloal Analytical Cherrusts) 2005. Official methods of analysis of the Association of analytical chemists international, 18th Ed Gathersburg, MD USA official methods 2005. 08.
[3] Enujiugha VN, Badejo AA, Iyiola SO, Oluwamukomi MO. 2003. Effect of germination on the nutritional and functional properties of African oil bean (Pmtadethra macrophylla Benth) Seed flour. Food Agric. Environ. 1(384), 72~75.
[4] F. A. O (2006). Official Agricultural statistics 18th edition, *Food and Agricultural Organization, Canada.* Pg 1002 - 1004.
[5] Fasasi OS. 2009 Proximate, antinutritional factors and functional properties of processed pearl millet Permiseturn glaucum) .I. Food Tech., 7 (3), 92 97.
[6] Ijarotimi O.S. and O.O. Kehinro (2012): Effect of Thermal Processing on biochemical composition, antinutritional factors and functional properties of Benished (Sesaniu indicum) our *Am. Med. J. Biochem* Mol. Biol 2, 175-182.
[7] Ijarotimi O.S. and O.O. Kehinro (2011): Determination of Amino acid, Mineral, Functional and choking Properties of Germinated and fermented popcorn, European Journal of Food Research & Review, 1 (2):102-122,
[8] Inyang CU, Zakari UM (2008). Effect of germination and fermentation of pearl millet of proximate chemical and sensory properties of instant Fura- a Nigerian Cereal Food. *Pakistan J. Nutr*., 7(1): 9-12.
[9] Jirapa P.H., Normah, M.M, Zamaliah, R, Asmah, and K. Mohamed (2001). Nutritional quality of germinated cowpea and (vigna ungriculata) and its application in home prepared weaning foods Plant Foods Hum. Nutr. 56: 203-216.

ISSN: 2454-1907
DOI: 10.5281/zenodo.1216867

[10] Khalil Ahmed et al., (2014): Chemical analysis of different cereals to access nutritional components vital for human health. *Int. Journal of Chemical & Biochem. Sciences*.

[11] Kinsella JE, 1976. Functional properties of novel proteins; Alfalfa leaf protein. Journal of Food Science, vol ume 41, issue 2, 286 292.

[12] Masood T, H. U. Shah and A. Zeb (2014): Effect of Sprouting time on proximate composition and ascorbic acid level of Mung Bean (*Vigna radiate* l.) and chickpea (*cicer arietinum* l.) seeds. *The Journal of Animal & Plant Sciences*, 24(3):, Page: 850-859.

[13] Mora.Escobedo R, Paredes Lopes O. Gutierrez Lopes F. 1991 Effect of germinaion on the rheological and functional properties of amaralth seeds. Lebensnltte S4P WiSSEflschaft and Technol, 24,241-244.

[14] Obasi NE, Agim L, Uchechukwu N, 2009. Effect of different soaking periods on the chemica composition of pearl millet grains (Pennisetum glaucum). Proceedings of the AGM/conference, (AGMC' 09), Nigerian Institute of Food Science and Technology, Y 01 a, pp 57-58

[15] Oluwalana Isaac Babatunde (2014). Comparative effects of sprouting on proximate mineral composition and functional properties of white and yellow sweet maize (*ZEA MAYS VARSACCHARATA*) Journal of emerging trends in engineering and applied sciences 5(7)111-115

[16] Oyarekwa MA, Adeyeye EI. 2009. Comparative evaluation of the nutritional quality, functional properties and amino acid profile of co·-fermented maize/cowpea and sorghum/cowpea ogi as infant complementary food. Asian J. Clin. Nutri, 1(1) 31-39

[17] Singleton, V.L.; Orthofer, R.; Lamuela-Raventos, R.M. Analysis 'of total phenols and other oxidation substrates and antioxidants by means of Folin- Ciocalteau reagent. Methods Enzymol. 1999, 299, 152-178.

[18] Tatsadjieu, N.L (2004): *The Journal of Food Technology in Africa* 9:7

[19] Ihekoronye AI, Ngoddy PO, 1985. Integrated food science and technology for the tropics Macmillan Publishers, London, pp 252 253.