COMPARATIVE STUDY OF THE NUTRITIONAL COMPOSITIONS OF SOME SELECTED CEREALS

LAWAL I A, IMRAN M O, AZEEZ G O & IDRIS S F
Science Laboratory Technology Department,
The Oke-Ogun Polytechnic, Saki.
Corresponding author: elimran2003@yahoo.com.

Abstract

This work was conducted to determine the level of carbohydrate, crude fat, protein, ash content, crude fibre, few phytochemical constituents (saponins, Flavonoids, alkanoids, phenolic, phytate, tannins), minerals elements(calcium, magnesium, iron, zinc and phosphorus) and vitamins(A and E) in three different flours(sorghum, wheat and millet). The results obtained show that carbohydrate was found in appreciable amount in all samples with a range of 82.59±1.00 to 87.63±1.00. The ash content ranged from 0.75±0.10 in sorghum to 1.71±1.00 in wheat. There is no significant difference in crude fiber for all samples and it ranges from 0.46±0.10 in sorghum to 1.05±1.00 in wheat. The crude fat levels ranging from 0.26±0.10 to 0.59±0.10 and the highest level was observed in wheat. Saponin levels were high in wheat and millet (0.38±0.01) and sorghum having the lowest value of (0.09±0.00). A considerable level of alkaloid was present in wheat having the highest amount of 1.81±1.00. There is no significant difference in oxalate present in all samples. 0.80± 0.01 was found in wheat. The highest value of Flavonoids content(0.90±0.01)was found in millet flour. Phenolic was highest in sorghum flour with mean values of (0.84 ±0.01). Vitamin E ranges from 0.67±0.01 in sorghum flour to 0.31±0.01 in wheat flour. Vitamin A level in sorghum (0.05±0.00) was ranked lowest. All the cereals flour were rich in magnesium, iron and phosphorus while a high level of calcium was observed in sorghum (91.50±1.00). Considerate amount of zinc was found in all samples. Cadmium is almost absent in all samples with sorghum and wheat having values of 0.01±0.00 each. Lead was absent in all samples. This study revealed that each cereals is rich in some of the nutrients than others, therefore, combination of these cereals in diet with little quantity of wheat will produced more nutrients to the body than consuming a particular cereals alone when trying to substitute for tuber flour.

Key words: *sorghum flour, wheat flour, millet flour, Minerals, phytochemical, vitamins*

Introduction

A finely ground powder prepared from grain or tuber plant which is being used in making swallows in most African home is referred to as flour. Meawhile, flour can be made from a wide variety of plants such as cereals (wheat, millet, rice, barley, guinea corn, maize, among others), tubers plants (yam, cocoyam, cassava, potatoes among others. Cereals are the grains of the grass family Gramineae (Amadou *et al.*,2013).

Wheat is a major cereal crop in many parts of the world. It belongs to the Triticum family, of which there are many thousands of species (Brigid, 2010).Worldwide, wheat is a nutritious food which provides B-group vitamins, proteins, dietary fiber and minerals needed by the body in more quantity than other cereal crops. Wheat can be used to prepare different kind of food (Afzal *et al.*, 2013). Meanwhile, there must be a limitation in the consumption of wheat as it has been found to posses three dangers which include gluten, high glycemic index and as well an acid forming (Claudia *et al.*,2019 and Peter *et al.*,2015).

Millets are small-seeded with different varieties such as pearl millet *(Pennisetum glaucum*), finger millet (*Eleusine coracana*), kodo millet (*Paspalum setaceum)* among others.They are grown mostly in marginal areas under agricultural conditions in which major cereals fail to give substantial growth. In addition, millet is the major source of carbohydrates and protein for millions of people in Africa. It has been reported that millet has many nutritious and medical functions. Plant nutrients are largely used in the food industry (Amadou *et al.*,2013).

Sorghum species (Sorghum vulgare and Sorghum bicolor) are members of the grass family. Sorghum is known by a variety of names: great millet and guinea corn in West Africa; kafir corn in South Africa; dura in Sudan; mtama in eastern Africa; jowar in India, and kaoliang in China (Raghavan, 2009).Guinea corn (Sorghum vulgare) is a member of the grass family which can grow in hot areas with little or less rainfall providing nutrients for millions of people (Oyetayo, *et al.*, 2012). The grains are small, round with varieties of colours (white. brown, red and blackSorghum is

rich in protein, carbohydrate, and minerals such as selenium, calcium, iron and manganese in which the bioavailability depends on the level of interactions with various antinutrients (Oyetayo*et al.,* 2012). It is also rich in B-complex vitamins. Sorghum, likewise as many cereals, is a good source of energy and protein. It is a gluten-free cereal.The phenolic compounds and flavonoids, which have been found to inhibit the growth of tumour are present in sorghum (Raghavan, 2009).The main aim of this study was to determine the nutritional composition of some selected cereals

Methodology

Sample collection

Three types of cereals commonly consumed; wheat, millet and sorghum were obtained from Sango market in Saki Oyo state, Nigeria; along Latitude 8^0N and Longitude 3^0E. Each was collected in polythene bags and transported to the laboratory for analysis.

Fig 1: Wheat Millet Sorghum

Samples preparation

Proximate composition

Standard methods by the Association of Analytical Chemist(AOAC) were used in the analysis. The system consists of the analytical determinations of moisture content, ash, crude fat, crude protein, carbohydrates and crude fibre. 0.50 g of each of the powdered sample in a 50 ml beaker was wet digested using 30ml of HNO_3 / $HClO_4$ acid solution (2:1 volume) on a hot digestion system, heated until the sample turn completely to colourless solution. After digestion was complete, the solution of each sample was transferred into a 50ml calibrated sample bottle and the solution was diluted to the mark with distilled water. Mg, Ca, p, Fe, Pb, Cd, Zn, and Cu in all the five samples were determined by flame atomic absorption spectrophotometer, using a working standard of 10ppm for each of the samples (A.O.A.C, 2005).

Preparation of millet flour

Millet flour was produced using method described by James (2015);the grains were manually cleaned to remove extraneous materials and stones after which they were soaked for 24hrs at normal room temperature. The soaked grain were wet milled using laboratory mortar and pestle, after which it was oven dried for 4hrs at 80°C. The dried flour lumps were broken down and milled into finer flour and passed through 0.25mm sieve. The prepared flours were packed in a sample nylon after which it's taken for further analysis.

Wheat flour preparation

The wheat grains were cleaned to remove dirt. The grains were washed multiple times with water and the soaked for 24hrs at room temperature, after which the grains were drained and then wet milled with laboratory mortar and pestle and the oven dried for 4hrs at 80°C. The dried grains were ground into a fine powder and sieve through 0.25mm sieve to obtain a fine powder. The flour was packed in a sample nylon and taken for further analysis.

Sorghum flour preparation

Guinea corn grains were washed to remove stones and extraneous materials, after which the grains were soaked for 24hrs at 23°C. The soaked grains were oven dried for 4hrs at 80°C. The dried grains were powdered into fine flour

and made to passed through 0.25mm sieve to obtained finer flour. The flour is kept in an air tight material before taken for further analysis.

A-Sorghum flour

B- Millet flour,

C- Wheat flour

Results and discussion

Table 1.proximate analysis of analyzed samples

Sample	Moisture	Protein	Ash	Crude Fibre	Fat	CHO
A	4.00^{b}±1.00	7.47^{a}±1.00	0.75^{a}±0.10	0.46^{a}±0.10	0.26^{b}±0.10	87.07^{a}±1.00
B	6.27^{a}±1.00	4.00^{b}±1.00	1.08^{a}±1.00	0.66^{a}±0.10	0.37^{b}±0.10	87.63^{a}±1.00
C	2.47^{b}±1.00	7.11^{a}±1.00	1.71^{a}±1.00	1.05^{a}±1.00	0.59^{a}±0.10	87.06^{a}±1.00

Mean value with the same alphabet are not significantly different from each other

Table1 Present the moisture content to be highest in millet flour(6.60±1.00) and lowest in wheat (2.47±1.00). Sorghum has the value of (4.00±1.00), (6.50±1.00) and Millet (6.27±1.00). The lower moisture content of the wheat flour indicates that it would have a good keeping quality than the other with higher value. The low moisture content of wheat is a good indicator of their potential to have longer shelf life, this is indicated in the findings of (Laminu *et al.,* 2014). Food spoilage microorganism thrives where there is adequate moisture.

Protein being the body building nutrients was found to be highest in sorghum (7.47±1.00) and wheat (7.11±1.00). This implies that the sorghum flour is useful in reducing the prevalence of kwashiorkor. Investigation has also shown that protein content of cereal-legume combination is better than those produced from cereal alone (Abdulrahman *et al.,*2016).

The ash content, which is an index of minerals content was found in the range of 0.75-1.71. Wheat having the highest value contained a greater proportion of non-endosperm material because ash value indicates the level to which non endosperm component are present, and lowest ash content was found in sorghum.

Crude fibre was found higher in wheat (1.05±1.00), followed by millet (0.66±0.10 and found to be lowest in sorghum(0.46±0.10). The high fibre contents of wheat and millet) can have some biological beneficial effects such as laxative effects on gastrointestinal tract, and reduction in plasma cholesterol level(Abdulrahman *et al*., 2016). Benefits such as decreasing rate of sugar uptake and binding carcinogens are also confirmed.

Highest crude fat content was recorded in wheat (0.59±0.10) and lowest level of crude fat was observed in sorghum (0.26±0.10). The low percentage of crude fat in sorghum indicates that prolong storage of the flour may not affect the quality as poor storage causes rancidity which can impact unpleasant odour and reduced intake of food and nutrient.

Carbohydrate are major food component of the flours. It was discovered in the wide ranges of 87.63±1.00 for millet, 87.63±1.00 for sorghum and 87.06±1.00 for wheat. The results was in line with that of FAO which reported that staple foods such as millet and sorghum are high in starch which makes them absorbed a lot of water during cooking. This makes them bulky and thus, infants need to consume them in large quantities to get enough energy and nutrients.

On comparison between each of the cereals flours being analyzed, it is observed that all the cereals flour have no significance difference in crude fiber, carbohydrates, ash content, with slight difference in fat. Millet is seen to have low protein concentration with sorghum having the highest, moisture content is low in wheat which is an advantage of having longer shelf life than other cereals samples.

Table 2. Anti nutrient analysis of analyzed samples

Sample	Tannin	Phytate	Oxalate	Saponin	Alkaloid
A	0.59^{a}±0.01	1.15^{ab}±1.00	0.77^{a}±0.01	0.09^{b}±0.00	1.72^{a}±0.01
B	0.35^{b}±0.01	0.79^{b}±0.01	0.73^{a}±0.01	0.37^{a}±0.01	1.64^{a}±1.00
C	0.29^{b}±0.01	2.06^{a}±1.00	0.80^{a}±0.01	0.38^{a}±0.01	1.81^{a}±1.00

Mean value with the same alphabet are not significantly different from each other

Table 2 shows that tannins concentrations ranges from 0.02±0.01 to 0.59±0.01, with sorghum having the highest value and wheat with the lowest. Millet has 0.35±0.01 and wheat 0.29±0.01. Odoemelan *et al.,*2009), reported that tannins may decrease protein quality by decreasing digestibility and palatability and may cause damage to intestinal tract.

Phytate depletes iron, chromium, copper, calcium, zinc, manganese, magnesium. It limit protein and starch digestibility, hinder mineral bioavailability (Odoemelan *et al.,* 2009). Wheat has the highest concentration phytate when compared to other samples being studied. The results obtained were higher than those reported by Odoemelan *et al.,* 2009. It's best to reduce phytates by eating grains, nuts, seeds, and beans that are soaked and sprouted, the phytic acids are released into the water where they can be strained and rinsed off.

Saponin highest concentration was recorded in wheat (0.38±0.01), millet (0.37±0.01), and cocoyam (0.13±0.01). Sorghum and yam flour with the lowest saponin value with 0.09±0.01 and 0.05±0.01 respectively. The result obtained go in line with those reported by Odoemelan, *et al.,* (2009).

Alkaloids is found in highest concentrations in wheat (1.82±1.00) and sorghum (1.72±1.00), millet (1.64±0.01). The mean value of the oxalate present in the samples being investigated are very close with wheat flour having the highest concentration of oxalate with (0.80±0.01) and millet flour having the lowest with (0.73±0.01).Sorghum having value of (0.77±0.01). However, excess amounts accumulate in the body system especially in the kidneys where they can cause the buildup of crystals. Oxalate depletes magnesium, iron, and calcium.

Comparison between the cereals flour based on their anti-nutrients properties shows that all cereals has low anti nutrients properties except wheat which has high concentration in some cases like high mean value recorded in its phytate constituents. It is also noted that wheat recorded highest values in alkaloids, saponin, and oxalate properties. This indicates wheat has high tendency of forming complexes with minerals composition present in it.

Table 3: Anti-oxidant analysis of analyzed samples

Sample	Flavonoid	Phenolic	Carotenoid
A	0.79^{a}±0.01	0.84^{a}±0.01	0.48^{b}±0.01
B	0.90^{a}±0.01	0.33^{bc}±0.01	1.63^{ab}±1.00
C	0.36^{b}±0.01	0.43^{b}±0.01	0.78^{b}±0.01

Mean value with the same alphabet are not significantly different from each other

Flavonoids is found in highest concentration in millet flour and sorghum flour with the mean value of 0. 90±0.01 and 0.79±0.01 respectively. Flavonoids have attracted attention as potentially important dietary cancer chemo protectiveagents(Odoemelan *et al*., 2009). Flavonoids is required to prevent cancer and inhibits the growth of certain tumor in humans when adequate quantities are consumed regularly. Flavonoids have been reported to possess certain biological properties such as antibacterial, antitoxic, and often function as strong antioxidants, free radical scavengers and metal chelators. (Odoemelan *et al*., 2009).

Highest concentration of phenolic is recorded in sorghum with value of 0.84±0.01 and least in millet (0.33±0.01). Phenolic are beneficial to the health because they prevent cellular damage due to free radicals oxidation reaction. They also promote anti-inflammatory condition in the body when consumed regularly (Odoemelan *et al*., 2009).

Increase in carotenoids level is an advantage in increasing β_carotene which have been found to function as a free radical trapping agent and single oxygen quencher and have anti mutagenic, chemo preventive, photo protective and immune enhancing properties (Ayo *et al.*, 2018).Millet flour has the highest carotenoids concentrations(1.63±1.00) and lowest in sorghum (0.48±0.01). Anti-oxidants properties are found to have no significance difference in all cereals flour being considered for analysis. With sorghum recording the highest in value and wheat having the lowest but in considerable amount.

Table 4.: Vitamins analysis of analyzed samples

Sample	Vit E	Vit A
A	0.67^{a}±0.01	0.05^{b}±0.00
B	0.37^{bc}±0.01	0.16^{ab}±0.01
C	0.31^{c}±0.01	0.08^{b}±0.00

Mean value with the same alphabet are not significantly different from each other

Sorghum has the highest concentration of vitamin E (0.67) when compare to other samples been analyzed. Wheat flour has the lowest value of (0.31). This indicates that frequent consumption of sorghum flour aids the important antioxidant that protect the cells and tissue from harmful substances and free radicals. Deficiencies are not very common but may include some nerve damage (Odoemelan *et al*., 2009).Millet flour has the highest vitamin A content with mean value of (0.16±0.01) when compare with sorghum.Vitamin E is high is sorghum and ranked the highest among the cereal but vitamin A is seen to be low in sorghum, with millet having the highest vitamin A among the analysed cereals.

Table 5: Mineral composition analysis of analyzed samples.

Sample	Mg	Zn	Fe	P	Ca	Cu	Co	Pb
A	43.26^{a}± 1.00	1.62^{a}± 1.00	5.30^{a}± 1.00	40.67^{a}± 1.00	91.50^{a}± 1.00	1.03^{b}± 1.00	0.01^{a}±0.00	0.00±0.00
B	41.09^{b}± 1.00	1.83^{a}± 1.00	2.19^{b}± 1.00	12.90^{b}± 1.00	29.02^{c}± 1.00	1.50^{b}± 1.00	0.00^{a}±0.00	0.00±0.00
C	43.80^{a}± 1.00	2.29^{a}± 1.00	2.67^{b}± 1.00	13.97^{b}± 1.00	31.43^{b}± 1.00	2.67^{ab}± 1.00	0.01^{a}±0.00	0.00±0.00

Mean value with the same alphabet are not significantly different from each other

Table 5 shows that sorghum contains highest level of calcium (91.50±1.00) when compare to wheat (31.43±1.00) and millet (29.02±1.00). Calcium to be an important constituents of bones and teeth and it involved in signal transaction in physiology (Laminu *et al*, 2014). Zinc plays a role in normal growth and development of immunity, gene expression, cell regulations and cell differentiation. (Laminu *et al*, 2014). Zinc was found to be highest in cocoyam(2.42±1.00), wheat(2.29±1.00), millet (1.83±1.00), yam flour (1.76±1.00) and sorghum with the lowest(1.62±1.00).Magnesium is highest in wheat(43.80±1.00) and sorghum (43.26±1.00) when compare to other flours. Millet(41.09±1.00). Iron is an important element in the formation of red blood cells and plays an essential role in the transportation of oxygen through the body system (Laminu *et al*, 2014). Iron concentrations in sorghum is

twice higher when compare to other sample. Millet(2.19±1.00) and wheat(2.67±1.00). Infants and toddler needs more iron than adult because their bodies is growing quickly therefore addition of sorghum in their daily diet is prescribed.

Phosphorus present in sorghum is three times much more than any other samples being analyzed. Sorghum contain (40.67±1.00) of phosphorus when compared to wheat (13.97±1.00), millet (12.90±1.00). Copper is found to be the highest in wheat flour (2.67±1.00) and lowest in sorghum(1.03±1.00) Cadmium is almost absence in all samples but found in little and considerable quantities in sorghum and wheat. High concentration of cadmium in food is toxic, it's damages the gastrointestinal tract as well as affecting the proper functions of the liver. Lead is found to be absent in all samples being analyzed. It indicates that all the cereals are rich in minerals but sorghum had the highest concentrations of the analyzed minerals(Laminu *et al*, 2014).

Conclusion and recommendation

This study indicates that all the samples are rich in minerals but sorghum had the highest concentrations of minerals composition. Wheat has high antinutrient properties that reduce the body's ability to absorb nutrients from diet. Wheat is rich in nutrient but it's adverse effect cannot be overlooked. According to this study sorghum has the highest concentration of vitamin E (0.67), calcium (91.50±1.00), iron (5.30±1.00), tannins (0.59±0.01) among others, when compare to other samples been analyzed. Millet is also blessed with vitamins, and they both have appreciable levels of crude protein, carbohydrate, crude fibre making them useful component of dietary and nutritional balance in diet. This study also revealed that each cereals is rich in some of the nutrients than others, hence, combination of these cereals in diet with little quantity of wheat due to its adverse effects will produced more nutrients to the body than consuming a particular cereals alone when trying to substitute for tuber flour.

References

Abdulrahman, W. F and Omoniyi, A. O. (2016). Proximate analysis and mineral composition of different cereals available in Gwagwalada market, FCT, Abuja, Nigeria. *Journal of Advances in Food Science and Technology*, 3(2):50-55.

Afzal Sana, Aamir shehzad, muhammed Atif randhawa, Ali Asghar, Muhammed shoib, Muhammed Ahmer Jahangir, (2013). *Health benefits and importance of utilizing wheat and rye*. Food science 23 (4).

Amadou Issoufou., Mahamadou E. Gounga and Guo-Wei le. (2013*). Millets: Nutritional composition, some healthbenefits and processing - a review.* Emir. J. Food agric. 25(7): 501-508

A.O.A.C (2005). "Official methods of analysis, association of official analytical chemists". Washington D.C, U.S.A.

Ayo, J. A., Ojo, M. ONILE, J. (2018). *Proximate composition, functional and phytochemical properties of pre-heated aerial yam flour*. Research journal of food science and nutrition, vol 3(1), pp 1-8.

Brigid Mc. Kevith, (2010). *Nutritional aspects of cereals*. British nutrition Foundation.

Claudia, E.O., Jaime, H. M. and Sachin R. (2019). *Gluten detection methods and their critical role in assuming safe diet for celiac patients*. 11 (12):2920

James S. Oloyede O. O., Ocheme O. B., Chinma C. E. and Agbejule, A. Y. (2015). *Proximate, anti-nutrient and sensory properties of Ogi, a millet based gruel supplemented with treated African oil bean seed flour.* Vol. 9(3) pp. 136-141

Laminu, HH. Modu, s. and Muhammad AA. (2014). *Evaluation of the chemical composition, anti-nutrient and minerals element level of a composite meal from pearl millet, wheat, cowpea and groundnut.* Sky Journal of food science Vol. 3(6), pp. 061-070.

Odoemelan, S. A. and C. I. Osu, (2009). *Evaluation of the phytochemicals contents of some edible grains marketed in Nigeria.* E-journal of chemistry, 6(4): 1193-1199.

Oyetayo, FL., Ogunrotimi, AI., (2012). *Guinea corn leaf, a potential source of nutrients and phytochemicals.* Food and health, 2(6): 228-230

Peter, R.S. and Sandra H. (2015). *The contribution of wheat to human diet and heat* 4 (3): 1178 - 202

Raghavan, G.S, Venkatesh sosle, (2009). *Nutritional and rheological properties of sorghum*. *International journal of food properties*.