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Comparative Study of Nutrient Compositions of Some Selected Cereal Grains Available in Shuwarin Market, Jigawa State, Nigeria

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Abstract: *A comparative study of nutritional and mineral compositions of some selected cereals obtained from Shuwarin Market, Jigawa State, Nigeria, was conducted. The nutritional composition analysis was made using the standard laboratory procedures by the Association of Official Analytical Chemists (AOAC), while the mineral elements were determined using Atomic Absorption Spectrophotometer (AAS). The results showed that the analyzed cereals contain an appreciably high quantity of ash content, crude fibers, crude proteins, and carbohydrates. The high quantity of crude fiber obtained indicates that cereals are good sources of dietary fibers. The lower moisture content of the cereals indicates that they can be conserved over a long period. Moreover, the results of the mineral elements analysis showed that the cereal samples contained various concentrations of essential mineral elements. Among all the samples, millet stands out in terms of its desirable nutritional qualities. This is due to its lower moisture content (5.1±0.11%), higher protein (10.9±3.31%) and ash content (3.0±0.11%), as well as a higher concentration of essential minerals compared to other grains. Generally, the concentrations of the mineral elements in the analyzed cereals were within the limit set by the Food & Agricultural Organization of the World Health Organization (FAO/WHO). Hence, these cereal samples should be considered safe for consumption and may as well serves as sources of essential minerals to the population.*

Keywords: *Cereals, Mineral elements, Rice, Millet, Maize, Sorghum*

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1.0 Introduction

Cereal is a member of the grass family (*Gramineae*) cultivated for the edible components of its grain or kernel (Luithui *et al.*, 2019). Throughout the world, a variety of grains are cultivated, such as wheat, maize, sorghum, millet, and rice. These cereals have been vital crops for thousands of years, and their prosperous cultivation, preservation, and utilization have played a noticeable role in worldwide advancement (Rajkumar & Selvakulasingam, 2019).

In current times, there has been extensive research on the significance of grains, specifically those that are whole grain, in our diet due to their dietary fiber and bioactive components (Laskowski *et al.*, 2019). Cereal grains are rich in energy, primarily derived from their starch component, but also their fat and protein components. Except for moisture and indigestible cellulose, cereal grains consist of carbohydrates, mainly starches (which make up around 65 to 75% of their overall weight), along with proteins (6 to 12%) and fats (1 to 5%), as well as small amounts of vitamins and minerals (Mir, *et al.*, 2019). Scientific literature often examines the consumption and nutritional value of cereals and cereal products. Some cereals are said to contain important nutrients such as folate, thiamin, niacin, dietary fiber, iron, manganese, and zinc (Laskowski *et al.,* 2019).

Maize, millet, sorghum, and rice are important cereal grains in Nigeria, providing a significant source of food and income for millions of Nigerians (Adigwe *et al.,* 2022). Maize (*Zea mays* L.), also known as corn, is widely cultivated across Nigeria, particularly in the northern and southern regions. It is a staple food and is used in the preparation of various dishes, such as cornmeal, porridge, and pap. Maize is also used in the production of animal feed and various industrial products such as ethanol, starch, and syrup. Millet (*Pennisetum typhoideum*) and sorghum (*Sorghum bicolor*) are two other cereal grains that are widely cultivated in Nigeria, particularly in the northern region. They are drought-resistant and are known for their high nutritional value, making them an important source of food for both humans and animals. Millet and sorghum are used to make various dishes, such as *tuwo*, a type of porridge, and *kunun zaki*, a popular drink made from millet (Ukwuru *et al.,* 2018). Rice (*Oryza sativa L*.) is another important cereal grain in Nigeria, with the country being the largest importer of rice in West Africa. Rice cultivation in Nigeria has been growing steadily in recent years, with the government implementing various policies to support local rice production. Rice is a staple food in Nigeria, and it is used in the preparation of various dishes such as jollof rice, fried rice, and rice and stew (Macauley & Ramadjita, 2015).

Shuwarin has a variety of cereal grains that are consumed by the locals, but the nutritional value of each type can vary greatly. Hence, it is essential to conduct systematic research to assess the nutritional values of cereal grains that are available in Shuwarin. Therefore, it is in this regard that this study aims to compare the nutritional and mineral compositions of some selected cereal grains available in Shuwarin Market, Jigawa State, Nigeria. The results of this study can give insight into the nutritionally valuable components of the selected grains and also, it can be used by policymakers in curbing food insecurity in Nigeria.

2.0 Materials and Methods

2.1 Sample collection

Different types of staple grains (Rice, Maize, Millet, and Sorghum) that are commonly found in Jigawa State were sampled from Shuwarin market. The grains were obtained directly from the marketers who brought them to the market to sell. Impurities like stones and chaff were removed from the sampled grains according to standard procedure (Saidu *et al.,* 2021), and representative composite samples were obtained. Samples were collected in polyethene bags and transported to the laboratory for analysis.

2.2 Sample preparation

Sample preparation was conducted based on the procedure reported in our previous work (Saidu *et al.,* 2021). Four clean crucibles were dried in an oven for 30 min, cooled in desiccators and weighed. 5.00g of each of the cereal samples were weighed into the crucibles and were later ground using mortar and pestle for homogeneity to a relatively fine powder. The weight of the crucibles plus the cereal samples was also taken. These were dried in an oven for about 3 h at 105 ºC to a constant weight and then kept in desiccators for proximate and mineral composition analysis.

2.3 Proximate analysis

The proximate composition of the staple grains (rice, maize, millet, and sorghum) was determined using the official methods of analysis, Association of Official Analytical Chemists (AOAC, 2010). The analysis consists of the analytical determination of ash content, crude fiber, crude protein, and moisture content. Moisture content involved weighing empty crucibles using a weighing balance and recorded as W_1. Then, 2.00g of the finely grounded samples were put into the crucibles and weighed to get the second weight (W_2).

Thereafter, the crucibles containing the samples were placed inside the oven and dried at 100 ºC for 4 h. It was then cooled and weighed to obtain (W_3). The percentage moisture content of each sample was calculated using equation (1)

$$\% \, Moisture = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1} \quad (1)$$

Ash content was determined by weighing 2.00 g of the powdered samples into a 277 tarred porcelain crucible and incinerated at 600 ºC for 6 h in a muffle furnace (Model 1184A Fisher Scientific, Houston, TX) until ash was obtained. The ash was cooled in desiccators and reweighed. The % ash content in each sample was calculated using equation (2),

$$\% \, Ash = \frac{Weight \; of \; ash}{Weight \; of \; original \; Sample} \times \frac{100}{1} \quad (2)$$

The crude fiber was determined using the AOAC method (AOAC, 2010). About 2.00g of each sample was hydrolyzed in a beaker with petroleum ether, after which it was boiled under reflux for 30 min with 200 mL of a solution containing 1.25% H_2SO_4 per 100 mL of solution. The solution was filtered through filter paper onto a fluted funnel. After filtration, the samples were washed with distilled water until they were no longer acidic. Then, the residue was transferred into a beaker and boiled for another 30 min with 200 mL of a solution containing 1.25% NaOH per 100 mL. The boiled samples were washed with distilled water. The residues were filtered through a Gooch filter crucible, dried at 100 ºC for 2 h in an oven, cooled and washed. The percentage of crude fiber in each sample was calculated using equation (3).

$$\% \, Crude \; Fibre = \frac{Weight \; of \; sample \;\; after \; drying}{Weight \; of \; sample} \times \frac{100}{1} \quad (3)$$

The crude protein content was determined using the Micro Kjeldahl method which involved protein digestion and distillation (Jamal *et al.*, 2020).

Percentage carbohydrate content was calculated by the difference method (equation 4), as reported by Rajkumar and Selvakulasingam (2019),

$$\% \, Carbohydrate = 100 - \%(moisture + Crude \; fibre + Protein + lipid + Fact) \quad (4)$$

2.4 Determination of mineral compositions

The wet oxidation method as reported by Sa'idu *et al.* (2013), was employed in the digestion of the samples. During analysis, 2.00g of each sample and 100 mL concentrated nitric acid (HNO_3) were placed in a 400 mL beaker, swirled, and allowed to react for 10 min, then evaporated on a hot plate and allowed to cool. Then, 50 mL of concentrated HNO_3 and 10 mL of per-chloric acid ($HCLO_4$) were added, and evaporation continued until the sample was completely ash (grey). The digest was transferred into a 100 mL volumetric flask and diluted to the mark with deionized water.

All glassware used were washed with detergent and rinsed several times with deionized water. Buck Scientific Model Atomic Absorption Spectrophotometer (AAS, Model 210VGP) was used for the analysis of Fe, Cu, Zn, and Mn.

3.0 Results and Discussion

The results for the determination of proximate composition in various cereal samples were presented in Table 1. As can be seen from the table, moisture content varies from 5.1±0.11% – 9.7±0.00% among the studied samples, with sorghum having the highest moisture content (9.7±0.00%), while maize with the lowest (5.1±0.11%). The results tally well with that reported by Iyabo *et al.* (2018), who reported 9.69±0.21% for sorghum in a related study. Similarly, moisture content values of 7.46% were recommended by (FAO/WHO, 1998). However, Jocelyne *et al.* (2020), reported moisture content values of 10.7±1.05, 11.51±0.82%, 11.57±0.75%, 11.31±0.42%, and 11.72±0.20% for wheat, maize, sorghum, millet, and fonio, respectively, in a related study. Likewise, higher moisture content values of beans (11.07%), wheat (12.7%), maize (12.05%) and finger millet (14.07%) were reported in a related study (Rajkumar & Selvakulasingam, 2019). The moisture content of any food is an indicator of its water activity and is used as a measure of stability and vulnerability to microbial contamination (Musa *et al.*, 2022). Food with high moisture content facilitates the growth of microorganisms which resulted in food spoilage, while low moisture content in food samples increased the storage periods of the food products (Rajkumar & Selvakulasingam, 2019). Therefore, the lower moisture content values of the cereals in the present study indicate that they would have a good storage quality.

The quantity of ash content in a food material is a reflection of its mineral content (Musa *et al.*, 2022). As seen from Table 1, millet has the highest ash content (3.0±0.11%), while rice has the lowest (0.9±0.13%). The results agree with 0.79 ± 0.07% and 1.46± 0.03% for maize and millet respectively, as reported by (Yankah *et al.*, 2020). Similarly, Iyabo et al. (2018), reported the ash content values of unsprouted *sorghum bicolar* to be 1.47±0.02%, in a related study. However, while comparing the nutrient composition of some selected cereal grains available in Jaffna, Sri Lanka, Rajkumar and Selvakulasingam (2019) reported slightly higher ash content values. The variation in the ash content of samples in different studies may be due to the nature and amount of ions present in the soil from which plants draw their nutrients (Musa *et al.*, 2022).

The crude fiber tells about the quantity of indigestible pentose, cellulose, lignin, and other constituents of this nature present in foods (Musa *et al.*, 2022). As shown in Table 1, the highest crude fibre content obtained in this study was 4.4±1.13% (millet), which is higher than the 2.03±0.05% reported for unsprouted *sorghum bicolar* (Iyabo *et al.*, 2018). Similarly, comparable crude fibre values, 2.81 ± 0.26% (wheat), 6.69±0.15% (maize), 8.14±1.07% (sorghum), 3.89±0.51% (millet), and 3.38±1.04% (fonio) were reported by Jocelyne *et al*. (2020), in a related study. The substantial high quantity of crude fiber obtained in the present study indicates that the cereals are good sources of dietary fiber, which is vital for a good bowel movement and could help in the prevention of obesity, diabetes, colon cancer, and other ailments related to the gastrointestinal tract (Musa *et al.,* 2022).

Protein is the most important macronutrient necessary for growth and bodybuilding (Rajkumar & Selvakulasingam, 2019). The values of crude protein obtained in this study vary from 8.8±2.21% - 10.9±3.31%, with millet having the highest values, and maize with the lowest values. The values of crude protein reported here are in agreement with those reported by Jocelyne *et al*. (2020), in a related study. The results also tally with 12.66±0.33% reported by Iyabo *et al.* (2018), for unsprouted *sorghum bicolar*. In a related study, Rajkumar and Selvakulasingam (2019), studied the nutrient composition of some selected cereal grains available in Jaffna, Sri Lanka and reported 15.23%, 10.85%, and 9.19% for wheat, maize and finger millet respectively. However, Yankah *et al.* (2020), reported lower crude protein values of 4.28±0.19 for brown rice in a similar study. The presence of high protein content in the studied cereals indicates that cereals can be considered a good source of protein-rich food (Musa *et al*., 2022).

Carbohydrates are one of the main sources of energy for the body (Musa *et al*., 2022). As shown in Table 1, the values of the carbohydrate content in this study vary from 77.2±4.12% (millet) to 80.6±3.11% (maize). The carbohydrates content of millet, brown rice and maize according to Yankah *et al*. (2020), were reported to be 70.41±1.0%, 77.94±0.32% and 73.94±0.51%, respectively. Similarly, Kumar *et al.* (2016), reported carbohydrate content for brown rice, millet, and maize to be 76.2%, 67.5%, and 74.3%, respectively, which agrees well with the present study. Generally, the present study showed that all the studied cereals have appreciably high carbohydrate content.

Table 1: Variation in proximate composition (%) observed in the four different cereals in Shuwarin market

Cereals	Ash content	Crude fiber	Crude protein	Moisture	Carbohydrate
Rice	0.9±0.13	2.5±1.33	10.1±2.00	9.1±0.21	76.4±3.33
Millet	3.0±0.11	4.4±1.13	10.9±3.31	5.1±0.11	77.2±4.12
Sorghum	2.4±0.21	2.2±1.01	9.8±2.13	9.7±0.00	75.6±2.13
Maize	2.8±0.10	2.3±1.30	8.8±2.21	5.5±0.14	80.6±3.11
Average	2.3±0.14	2.4±1.19	9.9±2.41	7.4±0.12	77.5±3.17
FAO/WHO	3.4	7.20	11.8	7.46	80.5

Values are mean ± standard deviation.

The results of the analysis of mineral contents in some selected cereals available in Shuwarin market is presented in Table 2. The results show that the concentration of Fe in the cereals under study ranged from 18.1±0.10 to 29.7±0.02 mg/100g. Iron is the most abundant metal in the human body. The Fe content in the body is approximately 3-4 g, which almost corresponds to a concentration of 40 – 50 mg of Fe per kilogram of body weight. The Recommended Dietary Allowance (RDA) for Fe varies by age, sex, and physiological status as shown in Table 3. For adults aged 19 – 50 years, the RDA is 8 mg/day for men and 18 mg/day for women. The RDA for pregnant women is 27 mg/day (Egedigwe-Ekeleme, 2023). As shown in Table 2, the lowest and the highest concentrations of Fe were accumulated by millet (29.7±0.02 mg/100g) and sorghum (18.1±0.10 mg/100 g), respectively. These values are higher than 2.92±0.06, 10.05±0.45, and 15.29±0.01 for maize, sorghum and millet, respectively reported by Jocelyne *et al.* (2020). Copper (Cu) is the third most abundant essential trace element in the body after iron and zinc. Cu is an essential trace element in plants and animals. The human body only contains about 150 mg of this vital mineral (Silva *et al.*, 2019). As shown in Table 2, the maximum concentration of Cu was found in millet (3.8±0.00 mg/100 g), and the minimum in maize (1.3±0.02 mg/100 g) among all the samples. The mean Cu level in the present study (2.6±0.06 mg/100g) was higher than 0.64±0.08 mg/100 g, 0.74±0.13 mg/100 g, and 1.98±0.33 mg/100 g for maize, sorghum and millet, respectively reported in a related study (Egedigwe-Ekeleme, 2023).

Zinc (Zn) is an essential trace element that functions as a cofactor for certain enzymes involved in metabolism and cell growth (Cannas *et al.*, 2020). Zn is involved in the metabolism of proteins, carbohydrates, lipids, and energy. It plays an important role in various biochemical pathways. It is particularly important for healthy skin and is essential for a healthy immune system and resistance to infection (Al-Fartusie & Mohssan, 2017). The RDA for zinc is 8 mg/day for women, 11 mg/day for men and between 3 and 5 mg/day for children (Table 3). The highest concentration of Zn in this study was found in rice (14.818.1±0.11 mg/100g), and the lowest in sorghum (10.418.1±0.02 mg/100g). These values are higher than 0.83±0.04 mg (maize), 1.40±0.24 mg (sorghum) and 0.95±0.08 mg (millet) reported in another study (Jocelyne *et al.*, 2020). Similarly, Yankah *et al*. (2020), reported the Zn content of maize, rice and millet to be 11.70 mg/100, 12.00 mg/100, and 11.30 mg/100, respectively. This is an indication of a very high content of zinc in the samples analyzed. Manganese (Mn) is an essential element found in various enzymes such as hydrolases, kinases, decarboxylases, and transferases. Insufficient intake of Mn can lead to various health problems such as stunted growth, decreased reproductive function, abnormalities in the skeletal system, and issues with the metabolism of lipids and carbohydrates (Ikem, *et al*., 2023). Mn concentrations across the cereal grains were maximal in millet (1.32±0.10 mg/100) and lowest in sorghum (0.80±0.00 mg/100). The mean Mn concentration in this study (1.12 mg/100) was comparable to 1.16 mg/100g reported in other published work (Ikem *et al.*, 2023).

Table 2: **Variation in mineral composition (mg/100 g) observed in the four different grains in Shuwarin market**

Cereals	Fe	Cu	Zn	Mn
Rice	27.8±0.00	2.5±0.10	14.8±0.11	1.23±0.01
Millet	29.7±0.02	3.8±0.00	13.9±0.02	1.32±0.10
Sorghum	18.1±0.10	2.9±0.10	10.4±0.02	0.80±0.00
Maize	22.0±0.01	1.3±0.02	11.4±0.10	1.11±0.00
Mean	24.4±0.03	2.6±0.06	12.6±0.18	1.12±0.03
FAO/WHO	42.5	13.5	20	3.20

Values are mean ± standard deviation.

Table 3: Recommended Dietary Allowances (RDA) for some mineral elements (Egedigwe-Ekeleme, 2023)

Mineral Element Life stage	Fe (mg/day)	Cu (mg/day)	Zn (mg/day)	Mn (mg/day)
Children (1 – 3 years)	7	340	3	1.2
Children (4 – 8 years)	10	440	5	1.5
Adult Male	8	900	11	2.3
Adult Female	18	900	8	1.8
Pregnancy	27	1000	11	2
Lactation	9	1300	12	2.6

4.0 Conclusion

The proximate analysis of some selected cereal grains available in Shuwarin Market, Jigawa State, Nigeria, showed that the studied cereals (rice, sorghum, millet, and maize) are rich in carbohydrates, protein, and crude fiber content. The lower moisture content values in the studied cereals indicate that they would have a good storage quality. Moreover, the mineral content analysis revealed that the cereal samples contained various concentrations of mineral elements. Among all the samples, millet possesses some desirable nutritional attributes over other grains concerning lower moisture content and greater protein and ash content, as well as a higher content of essential minerals. Generally, the concentrations of the mineral elements in all the analyzed cereals were within the safe limit set by FAO/WHO. Therefore, these cereal samples should be considered safe for consumption and may as well serves as sources of essential minerals to the population.

5.0 References

Adigwe, O. P., John, J. E., & Emeje, M. O. (2022). History, evolution and future of starch industry in Nigeria. *Starch: Evolution and Recent Advances*, 9. doi: 10.5772/intechopen.102712

Al-Fartusie, F. S., & Mohssan, S. N. (2017). Essential trace elements and their vital roles in the human body. *Indian J Adv Chem Sci,* 5, 3, pp. 127-136.

Association of Official Analytical Chemists (AOAC) (2010). Official method of analysis, 18th ed., Washington DC.

Cannas, D., Loi, E., Serra, M., Firinu, D., Valera, P., & Zavattari, P. (2020). Relevance of essential trace elements in nutrition and drinking water for human health and autoimmune disease risk. *Nutrients*, 12, 7, 2074. doi:10.3390/ -nu12072074.

Egedigwe-Ekeleme, C. A. F., Ademola C Egedigwe, Uchenna O Onyeabo, Chimaraoke Kanu, Shedrach C Ogunwa, Shedrack C Onuora, Chinwendu A Agbo, Anthonia O. (2023). Comparative studies on the amino acids, pesticide residue content, biogenic and toxic elements in an underutilized nut: Bambara groundnut (Vigna subterranea). *Journal of Trace Elements and Minerals, 3*(100051), https://doi.org/10.1016/j.jtemin.2023.100051.

FAO/WHO. (1998). Obesity: Managing the Global Epidemic. *World Health Organization (WHO), technical report, Geneva, Switzerland*, pp. 11-12.

Ikem, A., Odumosu, P. O., & Udousoro, I. (2023). Elemental composition of cereal grains and the contribution to the dietary intake in the Nigerian population. *Journal of Food Composition and Analysis, 118*, 105207, https://doi.org/10.1016/j.jfca.2 -023.105207

Iyabo, O., Ibiyinka, O., & Abimbola Deola, O. (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,* pp. 151-158, https://doi.org/10.29121/ -ijetmr.v5.i3.2018.187.

Jocelyne, R. E., Béhiblo, K., & Ernest, A. K. (2020). Comparative study of the nutritional value of wheat, maize, sorghum, millet, and fonio: some cereals commonly consumed in Cote d'Ivoire. *European Science Journal*, 16, 2, pp. 118-131, https://doi.org/10.19044/esj.2020.v16n21p118.

Kumar, A., Metwal, M., Kaur, S., Gupta, A. K., Puranik, S., Singh, S., . . . Sood, S. (2016). Nutraceutical value of finger millet [Eleusine coracana (L.) Gaertn.], and their improvement using omics approaches. *Frontiers in plant science, 7*, 934. https://doi.org/10.3389/fpls.2016.00934.

Laskowski, W., Górska-Warsewicz, H., Rejman, K., Czeczotko, M., & Zwolińska, J. (2019). How important are cereals and cereal products in the average Polish diet? *Nutrients*, 11, 3, 679, http://dx.doi.org/10. -3390/nu11030679

Luithui, Y., Nisha, R. B., & Meera, M. (2019). Cereal by-products as an important functional ingredient: effect of processing. *Journal of Food Science and Technology*, 56, 1, pp. 1-11, https://doi.org/10.1007%2Fs13197-018-3461-y

Macauley, H., Ramadjita, T. (2015). *Cereal crops: Rice, maize, millet, sorghum, wheat.* Feeding Africa International Conference, 21-23 October 2015, Organised by Tabo Ramadjita, ICRISAT

Mir, N. A., Yousuf, B., Gul, K., Riar, C. S., & Singh, S. (2019). Cereals and pseudocereals: Genera introduction, classification, and nutritional properties *Food Bioactives*, pp. 281-322, Apple Academic Press.

Musa, O. S., Chadi, A. S., Saidu, U., & Daniel, O. O. (2022). Proximate and Elemental Analysis of Dried Watermelon (*Citrullus lanatus*) Seeds. *SLU Journal of Science and Technology*, 3, 1, 2, pp., 16-22.

Rajkumar, G., & Selvakulasingam, B. (2019). Comparative Study of Nutrient Composition of Selected Cereal Grains Available in Jaffna, Sri Lanka. *Annals of Biological Research*, 10, 2, pp. 21-24.

Sa'idu, U., Sa'id, M., & Ayodele, J. (2013). Analysis of Some Heavy Metals in Grass (Paspalum Orbiculare) and Soil Samples Along Major Highways in Kano. *ChemSearch Journal*, 4, 1, pp. 6-13.

Saidu, U., Kamalu, T., Suwaibatu, M., & Abubakar, C. S. (2021). Proximate Analysis and Mineral Compositions of some Cereals commonly sold in Kafin Hausa Market, Jigawa State, Nigeria. *Dutse Journal of Pure and Applied Sciences,* 7, 2, pp. 22-29.

Silva, C. S., Moutinho, C., Ferreira da Vinha, A., & Matos, C. (2019). Trace minerals in human health: iron, zinc, copper, manganese and fluorine. *International Journal of Science and Research Methodology,* 13, 3, pp. 57-80.

Ukwuru, M., Muritala, A., & Iheofor, A. (2018). Cereal utilization in Nigeria. *Research Journal of Food and Nutrition*, 2, 3, pp. 1-12.

Yankah, N., Intiful, F. D., & Tette, E. M. (2020). Comparative study of the nutritional composition of local brown rice, maize (obaatanpa), and millet—A baseline research for varietal complementary feeding. *Food science & nutrition,*8, 6, pp. 2692-2698.

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Not Applicable

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