MINERAL COMPOSITION OF GRUEL PRODUCED FROM MAIZE (YELLOW), MILLET, SORGHUM, SOYBEAN, GROUNDNUT, TIGERNUT, DATEPALM, CRAYFISH AND UNRIPE PLANTAIN.

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Abstract

The objective of the study was to ascertain the mineral composition of gruel produced from nine (9) ingredients (maize (yellow), millet, sorghum, soybean, groundnut, tigernut, datepalm, crayfish and unripe plantain). Standard laboratory analytical method of AOAC procedure was used to determine the mineral composition of the sample. The mineral elements analysed in the sample were calcium (Ca), magnesium (mg), sodium (Na), Zinc (Zn) and Iron (Fe). The results on mineral composition shows that the gruel contained high calcium (320.47mg/100g), high magnesium (270.13mg/100g), low sodium (4.40mg/100g), low zinc (3.03mg/100g) and iron (18.49mg/100g). The result obtained showed that the gruel contained an appreciable amount of calcium, magnesium, iron and could be incorporated into diets or used as complementary foods for children to enhance growth.

Keywords: Gruel, Mineral composition, Calcium, Magnesium, Iron.

Introduction

Gruel is a food consisting of some types of cereal – such as ground oats, wheat, rye or rice, heated or boiled in water or milk. It is a thinner version of porridge that may be more often drunk rather than eaten and may not need to be cooked. Historically, gruel has been a staple of the western diet, especially for peasants (Maguelonne and Anthea, 2009). Gruel has been considered an important form of sustenance for the sick and recently weaned children. In these nutritionally conscious times, gruel is an all-rounder because it has all the carbohydrate and water the body needs to survive. Gruels made from maize, millet, sorghum, soybean, groundnut, tigernut, datepalm, crayfish and unripe plantain can provide essential nutrient that the body needs for sustenance and growth.

Maize (*zea mays*) is a starchy vegetable that comes as kernels on a cob, covered by a husk. It is a major cereal crop for both livestock feed and human nutrition (Ridhi, 2014). Maize has become a staple food in many parts of the world, with the total production of maize surpassing that of wheat or rice. In addition to being consumed directly by humans, maize is also used for corn ethanol, animal feed and other maize products, such as corn starch and corn syrup (Foley, Jonathon, 2019). With its high content of carbohydrates fats, proteins, some of the important vitamins and minerals, maize acquired a well-deserved reputation as a poor man's "nutria-cereal" (Ridhi, 2014). It is rich in vitamin C, an anti-oxidant that helps protect the cells from damage and wards off diseases like cancer and heart disease. Maize contains a fair amount of selenium that helps improve thyroid gland and play important role in proper functioning of the immune system (Dilip and Aditya, 2013). Maize is the third most important cereal in the world after rice and wheat and ranks fourth after millet, sorghum and rice in Nigeria (FAO, 2009). It can be processed into a wide range of food items and gruel.

Millets are a group of highly variable small-seeded grain widely grown around the world as cereal crops or grains for fodder and human food. They are important crops in the semiarid tropics of Asia and Africa (especially in India, Mali, Nigeria and Niger), with 97% of millet production in developing countries (McDonough, Cassandrea et al., 2000). Millet contains 9% water, 73% carbohydrate, 4% fat and 11% protein. It also contains dietary fibre, several B-vitamins such as Vitamin B2, B3, B5, B6 and B9 and numerous dietary minerals such as calcium, iron, magnesium, manganese, phosphorus, potassium, sodium and zinc. People affected by gluten related disorders, such as coeliac disease, non-celiac gluten-sensitivity and wheat allergy sufferers, who need a gluten – free diet, can replace gluten-containing cereals in their diet with millet (Saturni L et al., 2010).

Sorghum, also known as great millet (USDA, 2016) is a grass specie cultivated for its grain, which is used for food or humans, animal feed, and ethanol production. Sorghum originated in Africa, and is now cultivated widely in tropical and subtropical regions. It is high in carbohydrate with 10% protein and 3.4% fat, and contains calcium, small amounts of iron, vitamin B1 and niacin. Sorghum grain is gluten-free, high in resistant starch and more abundant in phenolic compounds and flavonoids (Awika et al., 2006). Antioxidant activity is high in sorghum having dark pericarp and pigmented testa (Dykes et al., 2006). The antioxidant activity of

sorghum may explain the reduced incidence of certain cancers in populations consuming sorghum. Sorghum has been used for gruel production or as breakfast meals which are in turn produced into pap, "ogi" etc. and are taken with other desired snacks for adequate nourishment (Khetarpaul N. et al., 2004). The grain is also used in making edible oil, starch, dextrose (a sugar), paste and alcoholic beverages.

Soybean (Glycine max) is an annual legume of the pea family (*fabaceae*). It is economically the most important bean in the world, providing vegetable protein for millions of people and ingredients for hundreds of chemical products (Heuze V. et al., 2020). Soybean are a rich source of essential nutrients, providing in a 100g serving, high contents of protein (36%), dietary fibre (37%), iron (121%), manganese (120%), phosphorus (101%) and several B vitamins including folate (94%). High contents also exist for vitamin K, magnesium 79%, zinc 51% and potassium. For human consumption, soybeans must be cooked with "wet" heat to destroy the trypsin inhibitors (serine protease inhibitors) which can prevent digestion. Soy protein products can be good substitutes for animal products because, unlike some other beans, soy offers a 'complete' protein profile.

Tigernut (*cyperusesculentus*) is a crop of the sedge family widespread across much of the world. It is found in most of the Eastern Hermisphere, including southern Europe, Africa and Madagascar, as well as the Middle East and the Indian sub-continent. In both their raw and ground forms, tigernuts contain vitamin C, B6 and E as well as Iron, magnesium, zinc, potassium, phosphorus and calcium. Tigernut flour does not lose any of its nutritional properties in the milling process (Salau et al., 2012).

Date fruit known as 'dabino' in Hausa and 'tamr' in Arabic is a palm plant belonging to the family of Arecaceae. The tree is commonly found in the canary Island, northern Africa, Arabia and South west of Asia to Pakistan and India. Date fruits are considered a complete diet and a very important item of food. In a 100g reference amount, dates supply 282 calories and are a moderate source (10-19% of the daily value) of pantothemic acid, vitamin B6, and the dietary minerals-magnesium, manganese, potassium, calcium with other micronutrients in low amounts. Dates play an important role in the diet and treatment of obesity and are the most important sources of energy and food in date producing and non-date producing areas (Foroogh, 2009). In Nigeria, particularly in the Northern part, dates have become a major source of nutrition and energy source among Muslims and even the non-Muslims community. For Muslims, it is a customary religious meal for breaking day-long fast during the holy month of Ramadan (Ahmad et al., 2013).

Crayfish are freshwater crustaceans resembling small lobsters (to which they are related). Categorized as seafood, studies have shown that cooked crayfish is rich in VitaminB, copper, selenium, protein, iron, zinc and amino acids. They help promote body metabolism as regenerating body cells. Crayfish also contains Omega-3 fatty acids, which helps in the promotion of healthy joints and overall body health. There is also protein in crayfish, and it serves as building block for bones, muscles, cartilage, skin and blood. Crayfish helps to promote eye health, help combat depression as a result of Omega-3 fatty acids inherent in it.

Groundnut (Arachis hypogea) is a legume crop grown mainly for its edible seeds. It is classified as both a grain legume and due to its high oil content, an oil crop. Groundnuts are rich in several B vitamins such as vitamin B1, B2, B3, B5 and B6, vitamin E, several dietary minerals such as manganese (95% daily value) magnesium (52% daily value), and phosphorus (48% daily value) and dietary fibre (USDA, 2015). Ranked second after soybeans, groundnuts are the world largest source of vegetable oil. They are the main constituent of margarine and are produced commercially as salad and cooking oil. Groundnut flour can be used in many confections and in cooking gluten-free diets.

Plantains also known as *plantanos* are the less-sweet, starchier equivalent to the banana. In Nigeria and many other parts of Africa, plantain (*Musa paradisiaca*) serves as a major staple food (Oladele and Khokhar, 2011). Plantains can be consumed in the unripe, fairly ripe, ripe and overripe stages (Okorie et al, 2015). Unripe plantain is loaded with numerous essential minerals and vitamins such as fibre, potassium, iron, magnesium, manganese, vitamin B complex. Unripe plantain is very low in sugar and this makes it ideal for diabetes especially when combined with fiber or protein-rich food such as green vegetables. It is rich in calcium, which is an essential mineral for bone mineralization, muscles, teeth and nail formation. Plantain helps to lower cholesterol, prevent constipation and hence prevent the occurrence of colon cancer.

Thus, producing a gruel containing the blends of all these nine ingredients will help to promote a healthy living, boost the immune system and reduce micro nutrients deficiency as they contain reasonable amounts of nutrients needed in a food for a healthy living.

Purpose of the Study

The main purpose of this study was to produce gruel from the blends of maize, sorghum, millet, soybean, tigernut, groundnut, datepalm, crayfish and unripe plantain.

Materials and Methods

Materials

Maize (yellow), millet, sorghum, soybean, groundnut, tigernut, datepalm, crayfish and unripe plantain were obtained from Ogbete main market, Enugu in Enugu state of Nigeria.

Preparation of Materials/Sample

1500g of maize, millet, sorghum, groundnut, tigernut, datepalm were all sorted/deseeded manually, washed, sundried and roasted. 1500g of soybeans was also sorted manually, washed, boiled for 45minutes to destroy trypsin inhibitors. After boiling, the soybeans was drained, dehulled and washed thoroughly after which it was sundried and roasted.

1500g of unripe plantain was washed and peeled. It was then cut into thin slices and sundried. 1500g of crayfish was sorted, washed and sundried. All these local ingredients were milled together with a hammer mill of El-max524 model and sieved into flour.

The flour blend that resulted was prepared with hot water into a gruel.

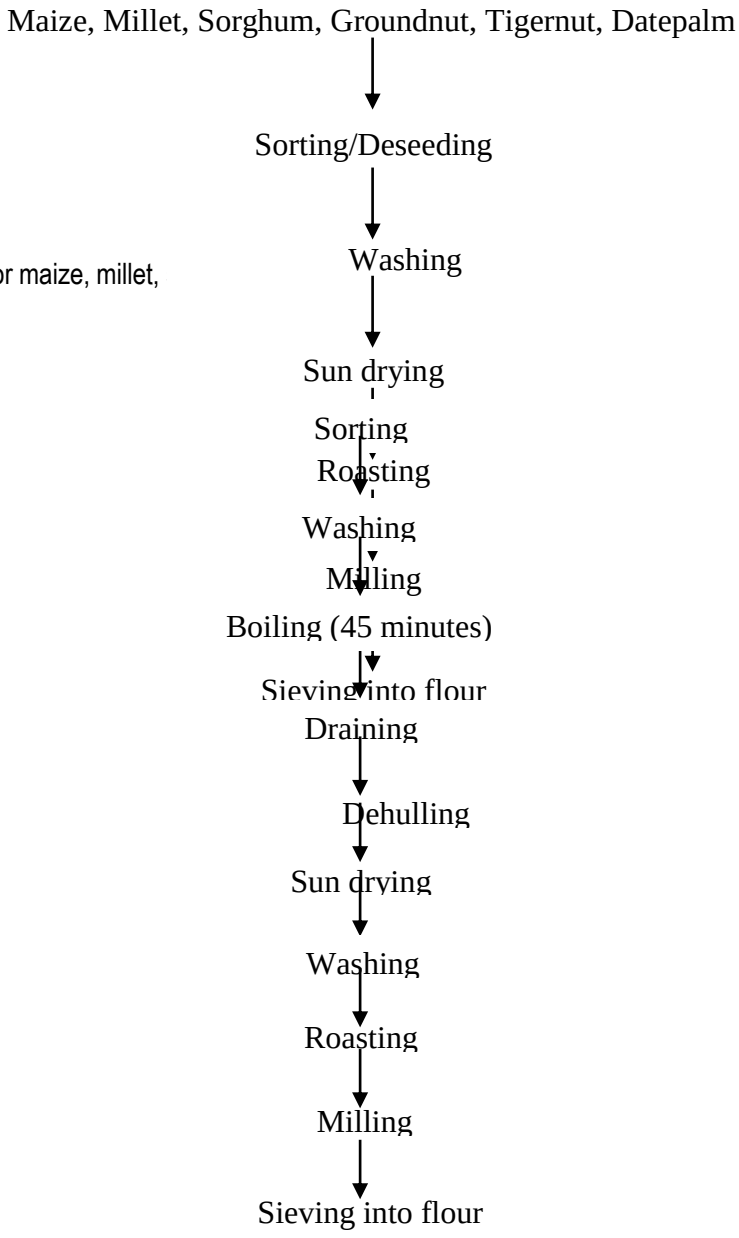


Figure 1: Flow chart for maize, millet,

Figure 2: flow chart for soybean flour

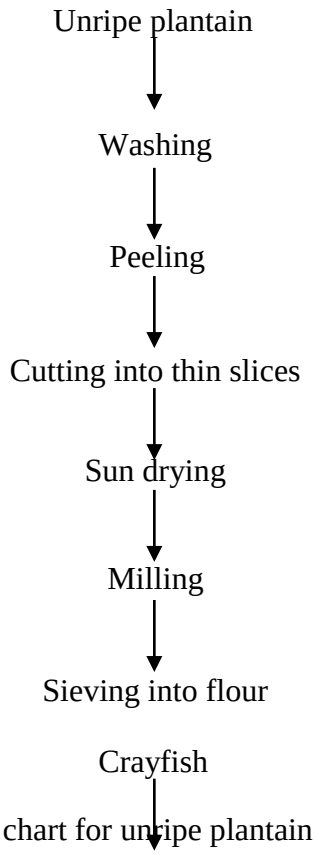
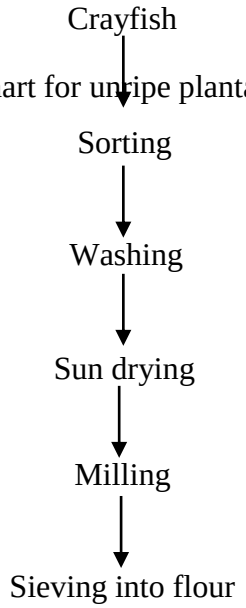


Figure 3: Flow chart for unripe plantain flour production



Laboratory/Mineral Analysis

The calcium, magnesium, zinc and iron content of the sample were determined spectrophotometrically by using Buck 200 atomic absorption spectrophotometer (Buck Scientific, Norwalk) and their absorption compared with absorption of standard laboratory analytical method, Association of Official Analytical Chemist (AOAC, 2005). The sodium content of the sample was determined by digesting the sample ash with per chloric acid and nitric acid, and then taking the readings on Jenway digital flame photmeter (Spectromic 20).

Data Analysis

Three sets of data were collected for each nutrient. Data were analysed using means, and standard deviation.

Findings

Mineral composition of Gruel produced from blends of maize, millet, sorghum, groundnut, tigernut, datepalm, crayfish, unripe plantain and soybean flour.

Mineral Element	**Mg/100g**
Calcium	320.47 ± 0.02
Magnesium	270.13 ± 0.02
Sodium	4.40 ± 0.02
Zinc	3.03 ± 0.02
Iron	18.49 ± 0.02

All values are means of triplicate determinations ± standard deviation (S.D)

The result showed the calcium content of the gruel to be 320.47 (mg/100g), the magnesium content is 270.13mg/100g, the sodium content is 4.40mg/100g, the zinc content is 3.03mg/100g while the iron content of the sample is 18.49mg/100g.

Discussion

The high calcium content of the sample could be attributed to the raw materials used in making the gruel especially millet, tigernut and datepalm which contain reasonable amounts of calcium both in their raw and processed form. The high calcium content of the sample makes it a good supplement or complementary feeding as calcium is an essential micronutrient in infants and young children for blood clotting and for immune defense (Rashida et al., 2014). The magnesium content of the sample was (270.13 ± 0.02mg/100g). The high value may be due to the addition of tigernut, soybean, groundnut and plantain flour to the cereals used in the preparation of the sample. This is in line with Noah Aduke's report (2017) that addition of soybean and plantain flour to other cereals increases the mineral content of the food. The sodium content of the sample (4.40mg/shows the presence of millet and tigernut flour in the sample as tigernut has a unique low sodium content which is suitable for infants. The zinc content of the sample ranged from 3.00 to 3.03mg/100g. The addition of crayfish and plantain flours resulted in increase in the zinc content of the sample and this is in agreement with the report that crayfish is a good source of zinc (Onabanjo et al., 2009). Zinc plays a central role in cell division, protein synthesis and growth. The observed increase in the iron content of the sample is an indication that crayfish and sorghum are good sources of iron and their combination could bring about an increase in the mineral content of a food. Iron is essential for the formulation of blood cells and prevention of anaemia in infants and children. The values obtained in this study compares favourably with that by Aduke (2017) for maize, plantain and soybean complementary foods.

Conclusion

It has been observed that gruel made from flour blends of millet, maize, sorghum, groundnut, crayfish, tigernut, datepalm, unripe plantain and soybean investigated in this study contained considerable amounts of minerals such as calcium, magnesium, sodium, zinc and iron in varying proportions. The low sodium content of the sample makes it a suitable complementary food for infants and people suffering from heart related diseases like hypertension. The presence of millet, sorghum and tigernut flour in the sample makes it suitable for people having gluten related disorders such as coeliac disease as these ingredients are gluten-free. The high

magnesium content of the sample which is as a result of the presence of tigernut, soybean, groundnut and plantain in the sample can help reduce cellular aging through fighting damaging free radicals to control blood pressure and promote a healthy digestive system. The results obtained from this study indicate that acceptable complementary food could be produced from maize flour fortified with millet, groundnut, tigernut, sorghum, datepalm, crayfish, soybean and unripe plantain flour.

Recommendations

1. Since the gruel made from flour blends of millet, maize, sorghum groundnut, crayfish, tigernut, datepalm, unripe plantain and soybeans contained reasonable amounts of minerals such as calcium, magnesium, sodium, zinc and iron, it is suggested that the gruel should be taken as food or added to food as a supplement or complementary food as its consumption poses no danger to human health, rather a more healthy living.
2. It is also beneficial in the reduction of micronutrient deficiency related diseases for the vulnerable group like women, children and the elderly.
3. The availability and affordability of the local ingredients used in this study will help in alleviating some economic and time related constraints faced in child feeding practices.
4. More research studies should be carried out on most common foods consumed and accessible to the rural and poor urban people.

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