

NUTRITIONAL CONTENTS OF TWO VARIETIES OF SWEET POTATOES (*Ipomoea batatas* (L.) Lam) CULTIVATED IN NORTH WEST, NIGERIA

ABSTRACT

Background and Objectives

Food insecurity is one of the major issues of public concern. In this study, the nutrients content of the yellow and red-fleshed sweet potatoes varieties cultivated in Nigeria were assessed.

Materials and Methods

The proximate composition, mineral elements analysis, phytochemicals, and vitamins content of the red and yellow-fleshed sweet potatoes were determined using the standard method of analysis.

Results

The moisture and fat content of the yellow sweet potato were significantly ($p < 0.05$) higher than in the red potato. The protein and fiber content of the red potato are higher than in the yellow one. The ash and carbohydrate content were same in both. The red potato exhibits high level of sodium, potassium, and magnesium in contrast to the red potato. Iron and zinc content were comparable in both cultivars while the calcium content of the yellow cultivar is significantly higher than in the red variety. The vitamin A, B and E content of the red potato are significantly ($p < 0.05$) higher than in the yellow potato. There is no significant difference with respect to the vitamin C content of both yellow and red potato. Terpenes and anthocyanins were not found in the yellow cultivar. However, saponins were found in yellow variety but not in the red potato. The tannins, flavonoids and phenols observed in the yellow-fleshed potato are lower than in the corresponding red potato.

Conclusion

The nutritional contents of sweet varieties have been availed which will immensely contribute to reducing the menace of malnutrition in north western part of Nigeria.

Key words: sweet potato, nutrients, proximate, minerals, vitamins, phytochemicals

1. INTRODUCTION:

Malnutrition is one of the devastating global health conditions affecting the developing countries including Nigeria, the Africa's most populous country. Malnutrition results from the improper supply of cellular energy and nutrients required for the growth and maintenance of specialized functions [1]. Taking of inadequate or excess micro and macronutrients such as proteins, minerals and vitamins results in the onset of malnutrition. Malnutrition affects structural and physiological state of brain leading to the growth impairment, tissue damage, impediment of myelination, and reduced activities of neurotransmitters among others [2]. It affect both

children and adults accounting for about 3 million death of children under the age of five annually [3].

According to the Global Nutrition report of 2020, about 149 million children under the age of 5 are stunted, 49.5 million are wasted and 40.1 million are overweight while 677.6 million adults are obese [3]. In Nigeria, 32 % of children below the age 5 are stunted, making the country the second with highest burden of stunted children world-wide. It has been well recognized that poor diet and associated malnutrition are amongst the key public health challenges of nowadays. These challenges has triggered initiation of various programs and campaigns tilted towards boosting the production, utilization and consumption of functional traditional foods[4] . In this respect, cost effective, readily available, and accessible high nutrients foods would be extremely helpful in combating malnutrition and its sound effects.

Sweet potato (*Ipomoea batatas* (L.) Lam); a root and tuber crop is considered as three-in-one food, owing to its composition of high-value nutrients (starch, vitamins and pectin) [5]. It has been identified as the sixth most valuable staple food in the world with consistent increase in its utilization by people. Owing to its nutritional potency, sweet potato is one of the crops chosen by the United State National Aeronautics and Space Administration (NASA) as a primary food source [6] .Sweet potato was thought to be originated from the Central America and introduced to African countries such as Nigeria by European explorers in early 1500s [7]. As of 2019, Nigeria has been listed among the top five global producers of the sweet potato [5] .The plant is herbaceous with heart-shaped leaves and moderately sized flowers. The roots are edible, long and tapered and bears smooth skin. The short cultivation period of 3 to 4 months, high nutritional content and sweet taste of sweet potato makes it a highly valuable crop [7].

The crop is widely used as staple food, processed snack, animal feeds and utilized as important raw material for the production of sugars, starch, alcohol and other useful industrial products[6]. However, with exception of Japan, Taiwan and Korea, roots of the sweet potato are mostly used for human consumption, small portion is utilized as animal feed and insignificantly used by the industries [8] . Sweet potato is a vital nutritional source of carbohydrates, protein, dietary fiber, vitamins such as vitamin A, B₆and C, minerals like sodium, potassium, calcium, manganese, and magnesium. It is also rich in phytochemicals such as β -carotene, anthocyanins, flavonoids, saponins, tannins, carotenoids, phenolic compounds, anthocyanins tocopherols with low cholesterol and fat content. These compounds are found in different proportions depending on the crop's flesh color and variety [5]. [9]-[12] . The main carbohydrate content of sweet potato are sugar and starch with the later accounting for 30 to 85 g per 100 g of the crop [9] . The energy provided by the carbohydrate content is about 450 KJ/100 g, making it an excellent source of calories compared to other root and tuber staples such as taro and yam [13] .The root of the plant has higher protein content than most of the root and tuber crops such as yams and cassava [14] . The fiber content of sweet potato varies depending on the variety and age of the crop as well as the extraction method used [15]. Vitamin A and β -carotene content of the crop is 14187 IU and 8509 μ g respectively; one of the highest value usually found in root-vegetables crops [7].

As functional food, the phytochemicals present in the sweet potato demonstrate plentiful bioactivities including antioxidant, hepatoprotective, antidiabetic, antimicrobial, neuroprotective and anti-inflammatory activities [16]. These activities were widely reported especially in the color-fleshed varieties of sweet potatoes [17]. Consequently, the outcomes of these activities are

the promotion of human health and well-being. In this study, red and yellow-fleshed sweet potatoes cultivated in Nigeria and used as staple foods were considered, with a view to compare their nutritional contents. The proximate analysis (comprising of moisture, ash, crude protein, crude fat, crude fiber, and carbohydrate contents), mineral elements vitamins and phytochemicals contents of the two sweet potatoes were also determined.

2. MATERIALS AND METHODS

2.1 Sample collection and preparation.

About 9 kg of uninfected sweet potato of the two varieties (red and yellow) were randomly collected from farmers in the local markets of Kano state. The samples were subsequently washed with a clean water and taken to the Biochemistry department of Kano University of Science and Technology Wudil, packed in polyethylene bags and kept in refrigerator until use. The sample used for different analysis were prepared by hand-peeling the potatoes varieties with the aid of stainless-steel knife. The peeled potatoes were sliced to uniform thickness and immediately soaked into hot water (80 °C) for five minutes to avoid browning reaction that may arise from enzymes. To avoid further cooking, the slices of the sweet potatoes were subsequently immersed in cold water and drained using perforated plastic tray. Hot air oven (105 °C) was used to dry the slices following 24 hours. The dried slices were grounded into powder using electric grinder and sieved through 0.425 mm to obtain sweet potatoes powder. The powder obtained was packed in airtight plastic bags and kept at 4 °C until use [12], [18] .

2.2 PROXIMATE ANALYSIS OF TWO VARIETIES OF SWEET POTATOES

The proximate composition (moisture, ash, crude protein, crude fat, crude fiber and carbohydrate) of red and yellow sweet potatoes were measured by AOAC official methods [19].

2.2.1 Moisture content

The moisture content of the sweet potatoes samples was determined by drying a clean porcelain crucible in hot air oven at 110 °C, cooled in desiccator and weighed (W1). 2 g of the sample was weighed into the pre-tagged crucible and re-weighed (W2). The crucible containing the sample was dried in hot air oven until constant weight(W3). The amount of moisture (%) in the samples was determined as follows:

$$\% \text{ Moisture content} = \frac{W2-W3}{W2-W1} \times 100$$

2.2.2 Ash content

To determine the ash content of the sweet potatoes samples, a porcelain crucible was dried in an oven at 100°C for 10 min and thereafter cooled in a desiccator and weighed (W1). Two (2) grams of the powdered sample was placed into a pre-weighed porcelain crucible and reweighed (W2). The sample in the crucible was ignited and transferred into a muffle furnace set at 550°C and allowed to burn for 8 hours. The crucible containing the ash was then removed, cooled in a desiccator, and Weighed (W3).

The percentage ash content was calculated as follows:

$$\% \text{ Ash Content} = \frac{W3-W1}{W2-W1} \times 100$$

2.2.3 Crude protein content

The crude protein was calculated according to the Kjeldahl method. Briefly, the samples were digested with Kjeldahl apparatus resulting in the formation of clear green product. The digest was then cooled and diluted with 100 cm³ distilled water. To distillate the digest, 40 cm³ of 40 % NaOH was added to the flask containing 50 cm³ of 2% boric acid. The conical flask and Kjeldahl flask were placed on Kjeldahl distillation apparatus with the tubes inserted into the conical flask. The heat was applied to distill out ammonia liberated with the distillate collected into the boric acid solution. The distillate was titrated with 0.1 M HCl, and the amount of nitrogen collected was calculated using the relation:

$$\text{Nitrogen (\%)} = \frac{14 \times M \times V_t \times V \times 100}{\text{Weight of sample (mg)}} \times V_a$$

The crude protein was determined from the amount of the nitrogen obtained and a factor 6.25 as:

$$\% \text{ Crude Protein} = \% \text{ N}_2 \text{ (Nitrogen)} \times 6.25$$

where, M is the molarity of Acid, V, the volume of HCl used, V_t is the total volume of diluted digest and V_a is the volume of aliquot distilled.

2.2.4 Crude fat

The crude fat was determined by repeated extraction using Soxhlet apparatus with petroleum ether as extraction solvent [19]. A dried round bottom flask of the Soxhlet extraction unit containing boiling chips and petroleum ether (40-60 °C) was weighed (W₁). The extraction thimble containing the sample weighing 20 g was mounted to the extraction system. Condenser and cooling circulator were fixed on the extraction thimble. The heating mantle was used to heat the round bottom flask containing the boiling chips and extraction solvent, this was carried out for a period of 6 hours. The solvent was recovered, and crude fat was collected in the round bottom flask. The collected fat and the round bottom flask were weighed (W₂) and the percentage crude fat was calculated as:

$$\% \text{ Crude Lipid content} = \frac{W_2 - W_1}{\text{weight of the sample}} \times 100$$

2.2.5 Crude fiber

The crude fiber was determined by the official method of [19]. Briefly, about 2 g of the sample was taken to the round bottom flask containing 100 cm³ of 0.25 M sulphuric acid, the mixture was boiled for 30 minutes. The heated solution was filtered by suction and washed several times with hot water to get rid of any residual acid. The washed residue was transferred to the flask followed by addition of 100 cm³ of 0.31 M hot sodium hydroxide. The mixture was boiled under reflux for 30 minutes, filtered under suction and washed many times with hot water until it is devoid of any base. The residue obtained was dried in an oven at 100 °C, cooled with the aid of

desiccator and weighed as W1. The weighed residue was incinerated in a muffle furnace at 550 °C for 2 hours, cooled in a desiccator and weighed as W2. The percentage crude fiber was calculated as follows:

$$\% \text{ Crude fiber} = \frac{W1 - W2 (\text{loss of weight on incineration})}{\text{weight of the sample (g)}} \times 100$$

2.2.6 Carbohydrate

The total carbohydrate was determined by difference [18]. The sum of moisture, ash, crude lipid, crude protein, and crude fiber percentages were subtracted from 100 to obtain the percentage of the total carbohydrate as indicated in the relation below.

$$\% \text{ Total carbohydrate} = 100 - (\% \text{ moisture} + \% \text{ Ash} + \% \text{ fat} + \% \text{ Protein} + \% \text{ Fiber})$$

2.3 MINERAL ELEMENTS EVALUATION OF TWO VARIETIES OF SWEET POTATOES.

The mineral elements (Na, K, Ca, Mg, Fe and Zn) were determined by Atomic Absorption Spectrophotometry (AAS) according to [19] method. Briefly, about 2 g of the sample of each sweet potato variety were dried using hot oven at 100 °C for 30 minutes. The dried samples were paced on hot plate until smoke-free. Subsequently, furnace set at 550 °C for 3 hours was used to obtain white ash of the samples. The ash was dissolved in 5 ml of 6 M HCl by warming on hot plate for 2-3 minutes. The solution obtained was taken to 50 ml flask followed by addition of 1 M HNO₃. Dry ashing was used to removed organic materials from the solution followed by dissolving the residue in diluted acid. The standard solution of the mineral elements was prepared by dissolving the stock standard in 0.3 N HCl to the desired concentrations. The AAS was calibrated using the standard solution. The solutions were sprayed into the Atomic Absorption Spectrophotometer (AAS) and minerals were quantified by taking the absorbance at a specific wavelength of the elements.

2.4 VITAMINS CONTENT DETERMINATION OF TWO VARIETIES OF SWEET POTATOES.

Vitamin A was determined by the calorimetric method [20]. About 1 g each of the sample and standard were combined with 30 ml of absolute alcohol. Afterward, 3 ml of 5% KOH solution was added to the solution and boiled for 30 min under reflux. Vitamin A was extracted with 150ml of diethyl ether. The extract was be evaporated to dryness at low temperature and then dissolved in 10 ml of isopropyl alcohol. About 1 ml of the prepared standard Vitamin A and that of the dissolved extract were transferred to separate cuvettes and their respective absorbance were read in a spectrophotometer at 325 nm. The concentration of vitamin A was obtained from the relation below.

$$\text{Vitamin A concentration} = \frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times \text{conc. of standard}$$

Vitamin B1 (thiamine) was determined by spectrophotometric method, described by Okwu [21]. Nearly 5 g of each sweet potato variety was mixed with 50 ml of 1N ethanolic sodium hydroxide (NaOH). The homogenate was filtered to obtain the filtrate used for the analysis. Ten milliliter of the filtrate was mixed with equal volume of 0.1N potassium dichromate (K₂Cr₂O₇) solution in a flask. The Standard solution of the thiamine was prepared and mixed with 10 ml of the potassium dichromate solution. The reagent blank was obtained by treating 10 ml of the

ethanolic NaOH with the potassium dichromate solution. The absorbance of the sample and the standard solutions were measured in a spectrophotometer at a wavelength of 360 nm. Vitamin C content of the sweet potato varieties was determined by spectrophotometric method as described by [20]. Vitamin E was assessed according to method reported by [21].

2.5 PHYTOCHEMICALS ANALYSIS OF TWO VARIETIES OF SWEET POTATOES.

Tannins in the roots of red and yellow-fleshed sweet potatoes were determined using the method described by Okoth *et al.* [22]. About 10 ml of 70 % acetone was mixed with 0.2 g of the powdered sample in a 50 ml bottle. The bottle was shaken in ice shaker for 2 hours at 30 °C and centrifuged, the supernatant was kept in ice. 0.2 ml and 0.8 ml of the supernatant and distilled water were mixed in a test tube to obtain a test solution of 1 ml. 0.5 mg/ml of the Standard tannate stock was treated with 0.5 ml distilled to make a standard solution of 1 ml. 0.5 ml of Folinicalteu reagent and 2.5 ml of 20 % Na₂CO₃ were added to both test sample and standard solutions, vortexed and incubated at room temperature for 40 minutes. The absorbances were read at 725 nm and the concentrations of tannins were extrapolated from the calibration curve of standard tannate. For the determination of glycosides, the chloroform solution of the sample was filtered into 100 ml flask followed by addition of 10 ml of pyridine and 2 ml of 29 % of sodium nitroprusside. Addition of 3 ml of 20 % NaOH to the solution result in the development of brownish yellow color. The glycosides standard with concentration within the range of 0-50 mg/ml was used to prepare standard calibration curve, the absorbance of the sample and standard was taken at 510 nm. Saponins and flavonoids were assessed by the method explained by [23]. The phenolics content of the powdered samples of the sweet potatoes varieties were determined according to the method described by [24]. Anthocyanins were analyzed based on the procedure reported by [25].

2.6 Data Analysis

The data obtained was analyzed using one way analysis of variance (ANOVA) through Minitab 18 software. All the measurement were performed in triplicate and used to obtain the average values and standard deviations. Tukey' pairwise comparisons was used to compare the relationship between the mean data and significance difference was considered at p<0.05

3. RESULTS

3.1 Proximate composition of two varieties sweet potatoes

The proximate composition of yellow and red sweet potatoes was presented in table 1. A high variation between the two potato cultivars with regards to their proximate composition was observed. Moisture, crude protein, crude fat, and crude fiber content were significantly different (p<0.05). However, the carbohydrate and ash content did not differ substantially.

Table 1. Proximate composition of yellow and red sweet potatoes

Parameter	Yellow sweet potato	Red sweet potato
moisture (%)	17.927 ± 0.438 ^a	16.683 ± 0.189 ^b
Ash (%)	15.270 ± 0.419 ^a	15.373 ± 0.246 ^a
Crude protein (%)	12.987 ± 0.356 ^a	14.280 ± 0.322 ^b

Crude fat (%)	2.703 ± 0.262 ^a	1.693 ± 0.475 ^b
Crude fiber (%)	10.443 ± 2.100 ^a	14.577 ± 0.492 ^b
Carbohydrate (%)	40.653 ± 2.110 ^a	37.393 ± 0.396 ^a

Values are presented as mean ± standard deviation. Values with different letters in the same row are significantly different at p<0.05

3.2 Mineral elements Composition of Two Varieties of Potatoes

The mineral elements contents of the sweet potatoes' varieties were presented in **figure 1**. Both yellow and red sweet potatoes contain varied mineral elements including sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe) and zinc (Zn). Sodium, magnesium, and iron were found to be the most abundant amongst the 6 quantified minerals in both potato varieties. Other less abundant mineral elements compared to sodium, magnesium, and iron in yellow and red sweet potatoes are potassium, calcium, and zinc.

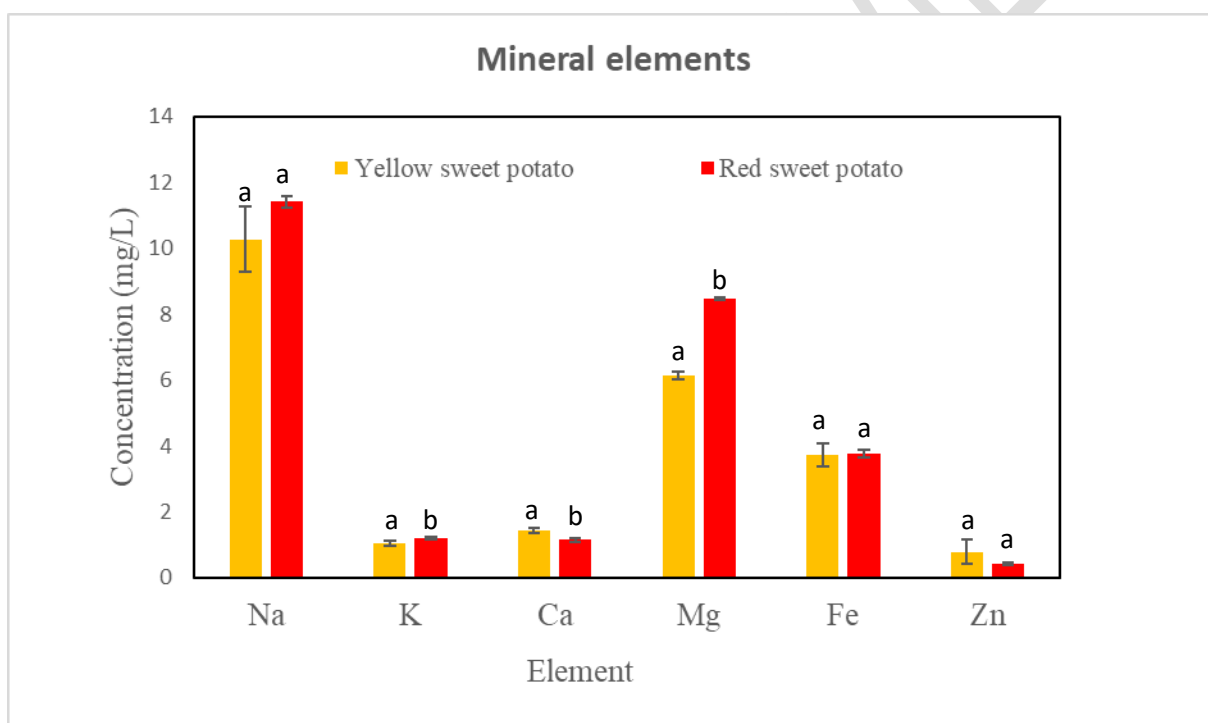


Figure 1. Mineral elements content of yellow and red sweet potatoes.

3.4 Vitamins Content of Two Varieties of Sweet Potatoes

The vitamins content of yellow and red sweet potatoes is presented in table 2. The red cultivar has significantly high content of fat-soluble vitamins (vitamin A and E) in comparison to the yellow cultivar. Furthermore, vitamin B1 content (a water-soluble vitamin) of the red sweet potato is higher compared to the yellow potato. There is no observed significant variation in vitamin A content between the two cultivars.

Table 2. Vitamin content of two sweet potato varieties

Vitamins	Yellow sweet potato	Red sweet potato
Vitamin A ($\mu\text{mol/L}$)	6.047 ± 0.065^a	8.740 ± 0.325^b
Vitamin B1 (mg/dL)	1.680 ± 0.295^a	2.977 ± 0.247^b
Vitamin C (mg/dL)	12.520 ± 0.460^a	11.85 ± 0.137^a
Vitamin E (mg/dL)	11.110 ± 0.654^a	13.267 ± 0.362^b

Values are presented as mean \pm standard deviation. Values with different letters in the same row are significantly different at $p < 0.05$

3.5 Phytochemicals Composition of Two Varieties of Sweet Potatoes

The analysis of phytochemicals in yellow and red sweet potatoes has revealed a wide range of phytochemical diversity of phytonutrients ranging from tannins, glycosides, saponins, phenols, terpenes, and anthocyanins. The content of these compounds is presented in **Figure 2**. Quantitative analysis revealed that the yellow sweet potato contains tannins, glycosides, saponins, flavonoids and phenols while terpenes and anthocyanins could not be detected. In contrast, anthocyanins, terpenes, phenols, flavonoids, glycosides, and tannins were quantified in the red sweet potato while saponins were not found. The red variety has significantly high content of tannins, flavonoids and phenols compared to the yellow variety. However, the yellow cultivar has glycoside in significant amount in contrast to the red cultivar.

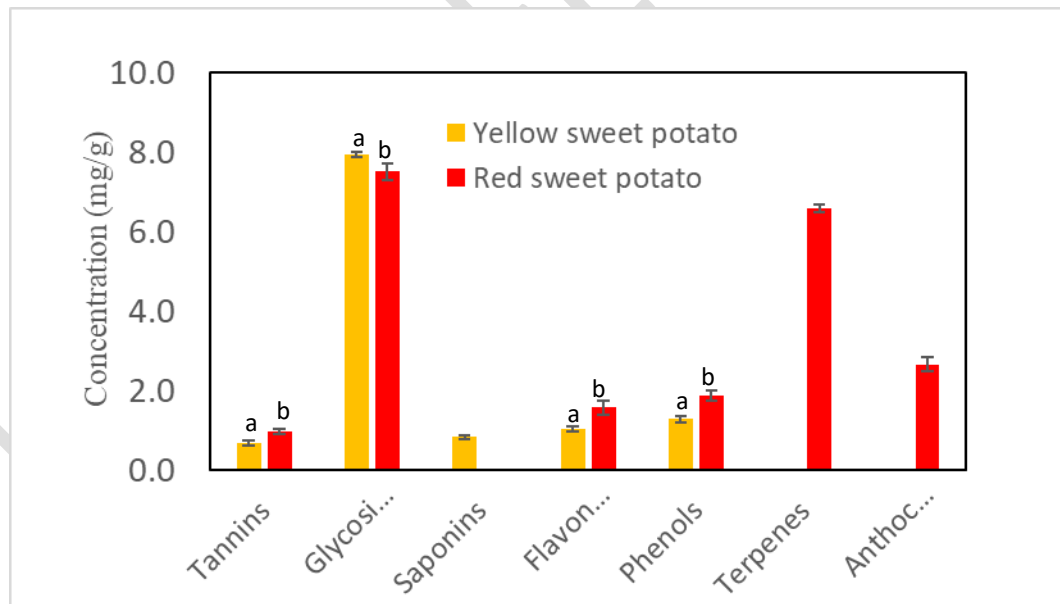


Figure 2. Phytochemical content of yellow and red sweet potatoes. Different letters on the bars represent statistically significant variation in the phytonutrients of the two sweet potato cultivars.

4. DISCUSSION

The proximate composition, mineral elements, vitamins, and some phytochemicals were analyzed in two different sweet potatoes varieties cultivated in Nigeria. The proximate analysis

has revealed that yellow sweet potato contains significantly ($p < 0.05$) high moisture in contrast to the red sweet potato (**Table 1**). This implies that red sweet potato may be less prone to damage by insect, mold and sprouting in relation to the yellow sweet potato. This is particularly crucial for the processing, storage, stability, and enhancement of the shelf life of the cultivar. The ash content of the yellow (15.270 ± 0.419) and red sweet potatoes (15.373 ± 0.246) (**Table 1**) did not differ significantly. It could thus be stated that the two cultivars may have a comparable total mineral content. The two potato varieties are thus good source of minerals which plays an important roles in the metabolic processes [11]. The crude protein of the red-fleshed sweet potato is significantly ($p < 0.05$) higher (9.96 %) than that of the yellow-fleshed potato (**Table 1**). This is in contrast to the finding reported by [11] who stated that the protein content of some potato cultivars was in the range of 6.8 to 8.2 %. The protein content found in the two potato cultivars in this study could be useful to gain an insight on the proper diet formulation especially for the infants and children in order to provide them food with balanced nutrients. Proteins are critical macromolecules required for the proper growth and development of the human body. The yellow sweet potato has the highest content of fat (2.703 %) in contrast to the red cultivar (1.693 %). This content is higher than the result found by [26] and [10]. The variation in the fat content of the two potato varieties might be attributed to the differences in their genetic composition and nutrients diversity. Fats, protein, and carbohydrate contributes to the total energy demand by the body. However, inappropriate amount of these nutrients is implicated in the development of many chronic diseases, thus it is required to eat and maintain a balanced diet. The carbohydrate content of yellow and red sweet potato is 40.653 % and 37.393 % respectively (**Table 1**). This amount did not vary significantly between the two cultivars. Earlier studies by [11] have indicated that the carbohydrate content of sweet potato is 35.47 %; a content lower than those found in this study. A study of different sweet potato varieties by [12] have demonstrated that the carbohydrate content varies from 87.7 % to 89.6 %. This content is quite higher compared to our finding suggesting that soil type, soil nutrients, climatic condition and cultivar variety may play important role in the determination of the nutrient composition of potato cultivars. The fiber composition of the yellow and red sweet potatoes was 10.443 % and 14.577 % respectively (**Table 1**). The analysis of variance has revealed that the red cultivar has significantly ($p < 0.005$) higher fiber content than the yellow variety. There is an inverse correlation between taking diet rich in fiber and development of many diseases [27].

The mineral elements content of the yellow and red sweet potatoes respectively is sodium (10.270mg/l, 11.420 mg/l), magnesium (6.127mg/l, 8.468mg/l) and iron (3.715 mg/l, 3.749 mg/l) (**Figure 1**). The content of sodium is slightly higher in the red variety compared to the yellow one, however the difference is not statistically significant ($p < 0.05$). Sodium is very vital mineral element that helps in the maintenance of electrical potential and regulation of body fluids (28). The World Health Organization recommended that the dietary allowance of sodium in children and adult should be 400 mg/ day and 500 mg/ day respectively [29]. Our result has shown that the sweet potato varieties could contribute to the total sodium requirement by the body. The red sweet potato has significantly ($p < 0.05$) higher content of magnesium compared to the yellow sweet potato. Magnesium is an important element involved in calcium metabolism, regulation of blood pressure, insulin secretion and in the prevention of circulatory diseases [28]. The higher magnesium content of the red variety in comparison to the yellow sweet potato may be due to the variation in the cultivation land or flesh color. The recommended dietary allowance (RDA) of magnesium is 350 mg/ 100 g in adult and 170 mg/ 100g in children. Both sweet potatoes varieties could help in the nutritional provision of magnesium required by the body. The amount of iron in both varieties does not vary pronouncedly. Iron is an important component of all living organisms. It is required in the synthesis of heme, an important component of the red blood cells.

It is also vital in the synthesis of deoxyribonucleic acid (DNA) and essential component of electron transport chain [30]. The RDA of iron in female is higher (15 mg/ day) than in adult and children (10 mg/ day) (28) . The red sweet and yellow sweet potatoes are therefore considered as important source of iron.

The red sweet potato has significantly higher content of potassium (1.206mg/l) in contrast to the yellow variety (1.035mg/l). Potassium is an important mineral element in the extracellular fluids and aids in the regulation of acid-base balance, osmotic pressure, nerve impulse conduction and muscle contraction [31]. However, the yellow sweet potato has markedly high content of calcium (1.444 mg/l) compared to the red sweet potato which contain 1.144 mg/l of the elements. Calcium is the amplest mineral element in the body and participates in the regulation of several cellular processes such as nerves impulse conduction, skeletal muscle function and fibrin polymerization [32]. Although the level of calcium in both potato varieties under study is below world health organization recommended value (800 mg/ day) [28], it is imperative to suggest that dietary intake of sweet potatoes particularly yellow-fleshed one will help to provides some amount of calcium needed by the body. The zinc content of yellow (0.784mg/l) and red (0.428mg/l) sweet potatoes do not vary significantly. It has been well recognized that zinc is critical during early stage of growth at both prenatal and postnatal periods. It is also required in the normal function of tissues with high turnover and proliferation rates such as gastrointestinal tract and immune system [33].

The vitamins contents of the potato cultivars are presented in **Table 2**. Analysis of variance have shown that, red potato cultivar has significantly high content of vitamin A, B and E in contrast to the yellow cultivar, while both cultivars have comparable vitamin C content (**Table 2**). Vitamins plays numerous physiological roles such as in the maintenance of healthy skin, facilitation of body metabolism, act as antioxidant and aids in the formation of connective tissues [11]. The phytochemicals analysis of the two potatoes varieties has revealed variable content of phytochemicals (**Figure 2**). Both cultivars contain tannins, cardiac glycosides, flavonoids, and phenols. In addition, the red cultivar is composed of terpenes and anthocyanins which were not detected in the yellow cultivar. However, the yellow cultivar contains saponins. Statistical analysis has shown that, tannins, flavonoids, and phenols content in red potato cultivar is significantly higher than in the yellow cultivar. In contrast, the cardiac glycosides were markedly high in the yellow sweet potato. Recent investigation have found that different potato varieties contain different phytochemicals depending on the environmental genetic factors [5]. Phytochemicals either singly or in combined form displays sugar lowering, antioxidant, hepatoprotective and neuroprotective activities among others [16].

5. CONCLUSION

The study has shown that, the both cultivars of sweet potatoes contain different nutrients in varying amounts such as Moisture, crude protein, crude fat, and crude fiber content, ash content, carbohydrate minerals elements and vitamins, hence sweet potatoes can be incorporated in our daily diet in order to reduced the level of malnutrition in north west, Nigeria , In addition to their phytochemicals constitutes both varieties of the sweet potatoes can be regarded as functional foods and will help in busting body immunity.

References

1. Anstead G. M., Chandrasekar B., Zhao W., Yang J., Perez L. E., and Melby P. C. "Malnutrition alters the innate immune response and increases early visceralization following *Leishmania donovani* infection," *Infect. Immun.* 2001: vol. 69, no. 8, pp. 4709–4718, doi: [10.1128/IAI.69.8.4709-4718.2001](https://doi.org/10.1128/IAI.69.8.4709-4718.2001).
2. Batool R., Butt M. S., Sultan M. T., Saeed F., and Naz R., "Protein-Energy Malnutrition: A Risk Factor for Various Ailments," *Crit. Rev. Food Sci. Nutr.*, vol. 55, no. 2, pp. 242–253, 2015, doi: [10.1080/10408398.2011.651543](https://doi.org/10.1080/10408398.2011.651543)
3. Afeye O. A., A. Eric Msughter A., Mustapha N. H., and Nongubee T. "Hyper Prevalence of Malnutrition in Nigerian Context. Bi-omed," *J Sci Tech Res*, 2021:vol. 39, no. 1, pp. 30916–30925, doi: [10.26717/BJSTR.2021.39.006237](https://doi.org/10.26717/BJSTR.2021.39.006237).
4. Abubakar H. N., Olayiwola I. O., Sanni S. A., and Idowu M. A., "Chemical composition of sweet potato (*Ipomea batatas* Lam) dishes as consumed in Kwara state, Nigeria," *Int. Food Res. J.*, 2010; vol. 17, no. 2, pp. 411–416
5. Amagloh F. C., Yada B., Tumuhimbise G. A., Amagloh F. K., and Kaaya A. N., "The potential of sweetpotato as a functional food in sub-saharan africa and its implications for health: A review," *Molecules*, 2021,vol. 26, no. 10, pp. 1–21, doi: [10.3390/molecules26102971](https://doi.org/10.3390/molecules26102971).
6. Ishrar Islam, Z. Adam, Shahidul Islam. Soybean (*Glycine Max*): Alternative Sources of Human Nutrition and Bioenergy for the 21st Century. *American Journal of Food Science and Technology*. 2019; 7(1):1-6. doi: [10.12691/ajfst-7-1-1](https://doi.org/10.12691/ajfst-7-1-1).
7. Mohanraj R. and Sivasankar S., "Sweet potato (*Ipomoea batatas* [L.] Lam) - A valuable medicinal food: A review," *J. Med. Food*, 2014,vol. 17, no. 7, pp. 733–741, doi: [10.1089/jmf.2013.2818](https://doi.org/10.1089/jmf.2013.2818).
8. Lin S. S. M., Peet C. C., Chen D. M., and Lo H. F., "Sweet potato production and utilization in asia and the Pacific," *Sweet Potato Prod. A Nat. Resour. Trop.*, no. Id, 2018, pp. 139–148, doi: [10.1201/9781351077033](https://doi.org/10.1201/9781351077033).
9. Cartier A., "Physiochemical, nutritional and antioxidant properties of fourteen Virginia-grown sweet potato varieties," *J. Food Meas. Charact.*, 2017, vol. 11, no. 3, pp. 1333–1341, doi: [10.1007/s11694-017-9511-8](https://doi.org/10.1007/s11694-017-9511-8).
10. Senthilkumar R., "Nutrient Analysis of Sweet Potato and Its Health Benefits," *Indian J. Pure Appl. Biosci.*, 2020, vol. 8, no. 3, pp. 614–618, doi: [10.18782/2582-2845.7933](https://doi.org/10.18782/2582-2845.7933).
11. Suparno A., Prabawardani S., and Pattikawa A. B., "The Nutritional Value of Sweet Potato Tubers [*Ipomoea batatas* (L.) Lamb.] Consumed by Infants and Children of Dani Tribe in Kurulu District, Baliem-Jayawijaya," *J. Agric. Sci.*, 2016, vol. 8, no. 3, p. 64, 2016, doi: [10.5539/jas.v8n3p64](https://doi.org/10.5539/jas.v8n3p64).
12. Boni T., Digbeu Y. D., Dje M. K., Kouamé L. P., and Dué E. A., "Proximate and Mineral Composition and Some Anti-Nutritional Factors of Flour From Five Improved Sweet Potato (*Ipomoea Batatas* (L.) Lam) Varieties Roots," *Eur. J. Pharm. Med. Res.*, 2018, vol. 5, no. 11, pp. 126–137.
13. Tortoe C., Akonor P. T., Koch K., Menzel C., and Adofo K. "Physicochemical and functional properties of flour from twelve varieties of Ghanaian sweet potatoes," *Int. Food Res. J.*, 2017, vol. 24, no. 6, pp. 2549–2556.
14. Oloo B. O., Shitandi A., Mahungu S., Malinga J. B., and Rose O. B., "Effects of lactic acid fermentation on the retention of beta-carotene content in orange fleshed sweet potatoes," *Int. J. Food Stud.*, 2014, vol. 3, no. 1, pp. 13–33, 2014, doi: [10.7455/ijfs/3.1.2014.a2](https://doi.org/10.7455/ijfs/3.1.2014.a2).
15. Haile A. and Getahun D., "Evaluation of Nutritional and Anti Nutrition Factors of Orange-fleshed Sweet Potato and Haricot Bean Blended Mashed Food for Pre-school

- Children: The Case of Dale Woreda, Southern Ethiopia,” *Food Sci. Technol.*, 2018, vol. 6, no. 1, pp. 10–19, 2018, doi: [10.13189/fst.2018.060102](https://doi.org/10.13189/fst.2018.060102).
16. Panda V. and Sonkamble M., “Phytochemical constituents and pharmacological activities of *Ipomoea batatas* L. (Lam) – A review,” *Int. J. Res. Phytochem. Pharmacol.*, 2012, vol. 2, no. 1, pp. 25–34.
 17. Zhang H. Ji, H., Li H, and Li Y., “Analysis on the Nutrition Composition and Antioxidant Activity of Different Types of Sweet Potato Cultivars,” *Food Nutr. Sci.*, 2015, vol. 06, no. 01, pp. 161–167, 2015, doi: [10.4236/fns.2015.61017](https://doi.org/10.4236/fns.2015.61017).
 18. Dako E., Retta N., and Desse G., “Comparison of Three Sweet Potato (*Ipomoea Batatas* (L.) Lam) Varieties on Nutritional and Anti-Nutritional Factors,” *Glob. J. Sci. Front. Res.*, 2016, vol. 16, no. 4, pp. 62–72, [Online]. Available: <https://pdfs.semanticscholar.org/61c8/0293d9cc811632c40ad096d0d59ebaa9433c.pdf>.
 19. Baur F. J. and Ensminger L. G., “The Association of Official Analytical Chemists (AOAC),” *J. Am. Oil Chem. Soc.*, 1977, vol. 54, no. 4, pp. 171–172, doi: [10.1007/BF02670789](https://doi.org/10.1007/BF02670789).
 20. Alam M. K., Rana Z. H., Islam S. N., and Akhtaruzzaman M., “Comparative assessment of nutritional composition, polyphenol profile, antidiabetic and antioxidative properties of selected edible wild plant species of Bangladesh,” *Food Chem.*, 2019, vol. 320, p. 126646, 2020, doi: [10.1016/j.foodchem.2020.126646](https://doi.org/10.1016/j.foodchem.2020.126646).
 21. Chukwu O. and N. G., “Effects of Cooking and Frying on Antioxidants Present in Sweet Potatoes (*Ipomoea Batatas*),” *Acad. Res. Int.*, 2012 vol. 2, no. 2, pp. 104–109.
 22. Ooko A G., “Phytochemicals in Leaves and Roots of Selected Kenyan Orange Fleshed Sweet Potato (OFSP) Varieties,” *Int. J. Food Sci.*, vol. 2020, doi: [10.1155/2020/3567972](https://doi.org/10.1155/2020/3567972).
 23. Bao J., Cai Y., Sun M., Wang G., and Corke H., “Anthocyanins, flavonols, and free radical scavenging activity of Chinese Bayberry (*Myrica rubra*) extracts and their color properties and stability,” *J. Agric. Food Chem.*, 2005, vol. 53, no. 6, pp. 2327–2332, doi: [10.1021/jf048312z](https://doi.org/10.1021/jf048312z).
 24. Yamin., “Determination of total phenolic and flavonoid contents of Jackfruit peel and in vitro antiradical test,” *Food Res.*, 2021, vol. 5, no. 1, pp. 84–90, doi: [10.26656/fr.2017.5\(1\).350](https://doi.org/10.26656/fr.2017.5(1).350).
 25. El-Far M. M. M. and Taie H. A. A., “Antioxidant activities, total anthocyanins, phenolics and flavonoids contents of some sweetpotato genotypes under stress of different concentrations of sucrose and sorbitol,” *Aust. J. Basic Appl. Sci.*, 2009, vol. 3, no. 4, pp. 3609–3616.
 26. Islam S., “Concise Reviews / Hypotheses in Food Science Sweetpotato (*Ipomoea batatas* L.) Leaf: Its Potential Effect on Human Health and Nutrition,” *J. Food Sci.*, 2006, vol. 71, no. 2, pp. 13–21.
 27. Dhingra D., Michael M., Rajput H., and Patil R. T., “Dietary fibre in foods: A review,” *J. Food Sci. Technol.*, vol. 49, no. 3, pp. 255–266, 2012, doi: [10.1007/s13197-011-0365-5](https://doi.org/10.1007/s13197-011-0365-5).
 28. I. J. Alinnor and R. Oze, “Chemical evaluation of the nutritive value of *Pentaclethra macrophylla* tenth (African oil bean) seeds,” *Pakistan J. Nutr.*, vol. 10, no. 4, pp. 355–359, 2011, doi: [10.3923/pjn.2011.355.359](https://doi.org/10.3923/pjn.2011.355.359).
 29. A. F. Sanoussi, A. Adjatin, A. Dansi, A. Adebowale, L. O. Sanni, and A. Sanni, “Mineral Composition of Ten Elites Sweet Potato (*Ipomoea Batatas* [L] Lam) Landraces of Benin,” *Int. J. Curr. Microbiol. Appl. Sci.*, vol. 5, no. 1, pp. 103–115, 2016, doi: [10.20546/ijcmas.2016.501.009](https://doi.org/10.20546/ijcmas.2016.501.009).
 30. Abbaspour N., Hurrell R., and Kelishadi R., “Review on iron and its importance for human health,” *J. Res. Med. Sci.*, 2014, vol. 19, no. 2, pp. 164–174.

31. Anavi S., “Nutrition and Health - The Importance of Potassium,” 2013,pp. 1–16, doi: [10.3235/978-3-905887-08-2](https://doi.org/10.3235/978-3-905887-08-2).
32. Tandoğan B. and Ulusu N. N., “Importance of calcium,” *Turkish J. Med. Sci.*, 2005, vol. 35, no. 4, pp. 197–201.
33. Brown K. H., Wuehler S. E., and Peerson J. M., “The importance of zinc in human nutrition and estimation of the global prevalence of zinc deficiency,” *Food Nutr. Bull.*, 2001, vol. 22, no. 2, pp. 113–125, doi: [10.1177/156482650102200201](https://doi.org/10.1177/156482650102200201).
34. Kirk, R. S., Sawyer, R., & Egan, H. *Pearson's composition and analysis of foods*. 1991.8th Edition, Churchill Living Stone, London,

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