



## **Sweet Potato Varietal Evaluation Trial for Food Nutritional Values**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author AA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ARSS and CAA managed the analyses of the study. Author DP managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aim:** To explore the nutrients, minerals, beta-carotene and total carotenoid contents of five sweet potato varieties viz., Agric orange flesh, Agric white, Red skin, Orange flesh and T.U. purple.

**Study Design:** The sweet potato vines at six week stage were cut into 1.2 m each and transplanted in parallel lines on the same 1.2 m x 2.6 m bed, spaced about 0.52 m from each other in Dukumah Garden. There were five such beds and vine cuttings transplanted in the same order on each bed.

**Study Site:** The study, which took four months, was conducted in the Dukumah Garden in Bolgatanga Municipality (10.7875°N, 0.8580°W) of the Upper East Region of Ghana.

**Methodology:** The sweet potatoes were harvested four months after transplanting on the same day. Samples of the various varieties were collected, parcelled, appropriately labelled and hand-delivered to the Food Chemistry Laboratory of Kwame Nkrumah University of Science and

Technology for the analysis of proximate analysis (%), total carotenoids and beta-carotene concentrations in mg/g and concentrations of the minerals, namely magnesium (Mg), sodium (Na), potassium (K), calcium (Ca), iron (Fe) and zinc (Zn) in mg/kg.

**Results:** All the five varieties of sweet potato were found to be nutritious. Protein content ranged from 3.82% in Agric white variety to 0.11% in Agric orange flesh. Fat content ranged from 4.84% in orange flesh variety to 1.74% in red skin. Crude fibre content was between 1.77% in Agric orange flesh and 0.10% in T.U. purple. Total carbohydrate varied from 23.2% in Agric orange flesh variety to 15.8% in Agric white one. Moisture was high in all the varieties, ranging from 75.78% in Agric white variety to 71.04% in Orange flesh one. The Orange flesh variety had the highest ash content of 1.56%. All the varieties contained high concentrations of Mg but low concentrations of Na and K. The highest concentration of Ca ( $8250.70 \pm 0.06$  mg/kg) was recorded in T.U. purple. The concentrations of Fe in the sweet potato varieties decreased in the following order: T.U. purple > Red skin > Orange flesh > Agric orange flesh > Agric white. The highest ( $123.12 \pm 0.00$  mg/kg) and the lowest ( $33.10 \pm 0.00$  mg/kg) Zn concentration were recorded in the orange flesh and Agric white varieties, respectively. The concentration of beta-carotene (mg/kg) in five sweet potato varieties was in the following order: Agric orange flesh << Agric white < Red skin < Orange flesh < T.U. purple.

**Conclusion:** The five varieties of sweet potato were found to be rich in proteins, total carbohydrates and fats. They were observed to vary in macro- and micronutrients, beta-carotene and total carotenoids contents. T.U. purple variety was identified to be the richest source of Ca and beta-carotene. Thus, the sweet potato varieties may be of considerable importance in ameliorating nutrient, mineral as well as beta-carotene malnutrition in poorly resourced areas of the developing countries.

*Keywords: Sweet potato varieties; nutrient; minerals; beta carotene.*

## 1. INTRODUCTION

Varieties of *Ipomea batatas*, commonly called sweet potatoes, are recognisable by the different skin colours like white, cream, yellow, orange, pink, red or purple and/or flesh colours of white or cream, yellow, orange or purple [1,2]. The vegetable tuber crop, sweet potato, ranks among the top five most important staple food crops in the world, including rice, wheat, maize and cassava. Sweet potatoes are not only rich in the major minerals such as potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), sulphur (S) and phosphorus (P) which are associated with carbohydrates, proteins and fats but also in vitamins A and C, as well as the trace elements; zinc (Zn), manganese (Mn), iron (Fe), copper (Cu) and iodine (I) [3,4,1,5,6,7,8,2]. Sweet potato is also known to contain many valuable phytochemicals like phenol-related chlorogenic acid, anthocyanins; antioxidants; anti-cancer chemicals and carotenoids [9,10].

Studies have shown that the nutrient or chemical content of crops stems from the soil on which they grow [1,5,6,7,2]. It has also been found that even when cultivars of the same crop are cultivated adjacent to each other under the same edaphic conditions, the concentrations of these nutrients and chemicals still vary in the different varieties. This

suggests that the genetic constitution of crops play a role in their nutrient and chemical enrichment [11].

According to Mitra [12], sweet potatoes can help to heal liver injury. They are among the cheapest biofortified food resources, easily accessed by the average person. They can thus help to mitigate nutrient deficient conditions in humans. Their versatility and relative ease of cultivation, impregnation with vitamin A precursors, vitamin C and minerals coupled with rich sources of proteins and carbohydrates enabled their cultivation in more than a hundred countries in the world, though appreciable tonnage is produced in China and other developing countries [1,5,6,7,8,12, 2,9,10].

Recent world statistical data [13] reported China as the lead producer of sweet potatoes accounting for 70,526,000 metric tons per year, which constitute more than half (68.60%) of the total global production. Tanzania and Nigeria follow in that order with 3,470,304 metric tons and 3,450,000 metric tons respectively, each sharing a proportion of 3.30% of the world's production. Indonesia and Uganda are fourth and fifth in the world respectively, in terms of sweet potato cultivation, contributing a combined 4.00% of total production.

Ghana produced 143,111 tons of sweet potatoes in 2016 from an area covering 76,594 ha of land. This constituted a share of 0.10% of total potato production in the world during 2016 and ranked Ghana at number 37 in the world with respect to sweet potato production [14]. The data show that the production of the crop in Ghana has increased in a decade, given that earlier records, posted a production of 90,000 tons from an area of 65,000 ha [13,15]. A field survey in 2012 by the Ministry of Food and Agriculture (MoFA) reported that in Ghana, upper east is the region with the highest sweet potato cultivation, producing

46,000 metric tons, with 34.90% total production in Ghana, from an area of land covering 5,550 ha, which is 57.70% of total land used for the crop production in Ghana [15]. Northern and upper west regions follow in that order with respect to both the area of land devoted to potato production and the tonnage produced per annum.

However, data from the upper east regional office of the MoFA show a steady decline in the production of sweet potatoes from 2008 to 2017, after a steep rise in production from 2007 to 2008 (Fig. 1).

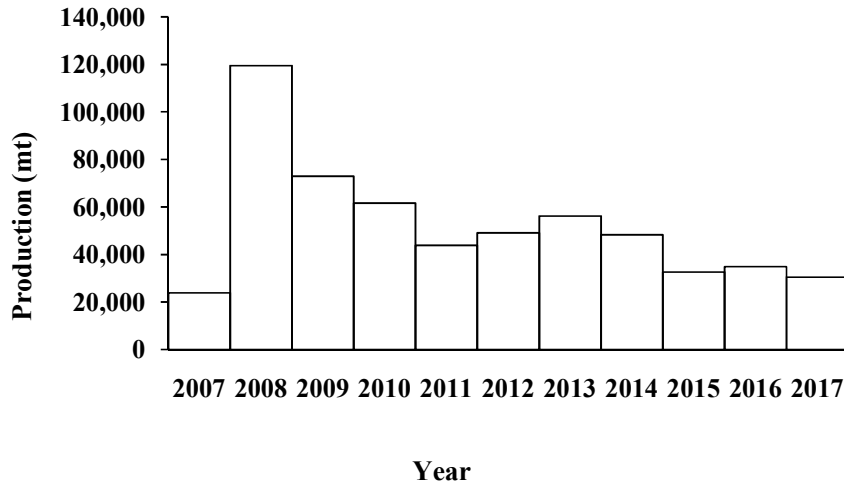


Fig. 1. Annual production of sweet potatoes in metric tons (mt) from 2007 to 2017

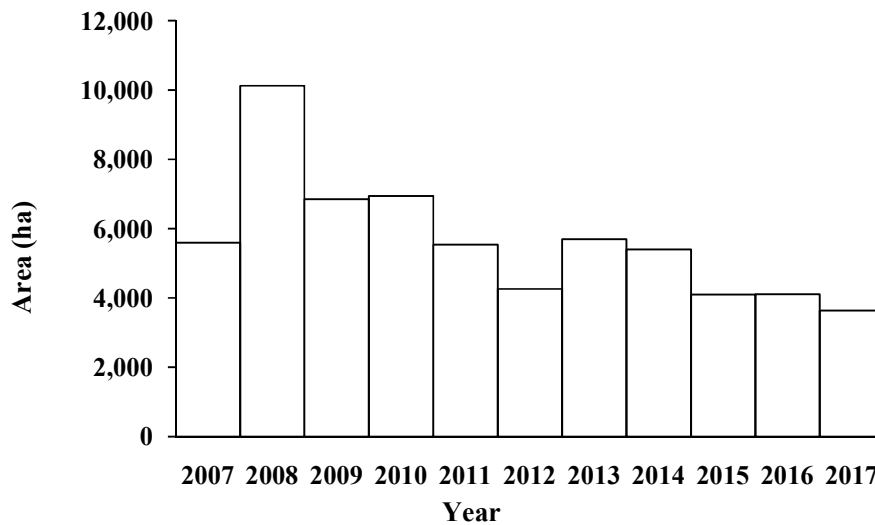


Fig. 2. Area of land (ha) used in the production of sweet potatoes from 2007 to 2017

The data also show that farmers progressively devoted less land for the cultivation of this crop (Fig. 2). Farmers in this region reported lack of planting materials (sweet potato seeds/slips), farm inputs, implements and a ready market to purchase their farm produce to be the factors militating against increased sweet potato production [15]. This may account for the loss of interest in cultivating this crop. Though provision of above inputs may improve the production, portraying the nutrients available in the crop may encourage the consumption of the crop produced, a major determining factor to increase the demand for the crop thereby enhancing market and increasing sweet potato production. The nutrient content of different varieties of the crop was investigated and reported by various scientists. However, it has been an established fact that the type and concentration of macro- or micronutrients, as well as other phytochemicals in any given crop, is dependent on the respective availability and concentration of the same in the soil on which the crop is grown [1,5,16,6,7,2]. Thus, the same crop grown in different geographic regions may be biofortified with different concentrations of the same or different elements altogether. Therefore, it is necessary for crops, grown in different geographic locations to be analysed to ascertain their nutrient worth and biofortification with vitamins or minerals which have health benefits. However, the nutrient content of different varieties of a crop can be compared when they are cultivated at the same location with similar soil conditions. The study aimed to find out the proportions of food substances such as crude protein, carbohydrates and fat; total carotenoids and beta-carotene as well as some macro and micronutrients in sweet potatoes grown in parts of the Upper East Region.

## **2. METHODOLOGY**

### **2.1 The Study Site**

The Bolgatanga Municipality (10.7875°N, 0.8580°W) is a developing city (Figs. 3 and 4) with a total population of 131,550, more than half (52.3%) of which is females with males constituting 47.70% of the population. About half (50.20%) of the population in the municipality is rural [17].

The municipality experiences a longer dry season from October to May and a shorter rainy season which may begin in June or July and end in October. The mean annual rainfall ranges

between 600 mm and 1400 mm. The mean temperature is about 21°C which can rise to 45°C in March or April. The municipality has “upland soil” originating from the granite rocks. It is shallow, generally not very fertile in terms of humus enrichment and largely coarse in texture. However, some places on lowlands possess sandy loamy soils with high organic matter content. The effect of these conditions is a natural vegetation comprising mainly of guinea savannah woodland. Plant species are deciduous trees widely spaced and a ground flora, which gets spent due to the scorching by the sun and animal grazing during the long dry season. Eighty percent of the economically active population engage mainly in subsistent agriculture, cultivating maize, millet, guinea-corn, sorghum, rice, groundnuts, beans and sweet potatoes during the rainy season. However, in the dry season, tomatoes, onions and rice are grown in the irrigated areas.

### **2.2 Acquisition of Sweet Potato Vine Cuttings**

Vine cuttings of the five different varieties of sweet potato were acquired from the Dukumah Garden (Agric orange flesh and Agric white) in Blogatanga and other farms in Sumbungu (Orange flesh, Red skin and T.U. purple).

### **2.3 Cultivation of Sweet Potato Varieties**

The sweet potato vines at six week stage, were cut into 1.2 m each and transplanted in parallel lines on the same 1.2 m x 2.6 m bed in the Dukumah Garden. Thus, each bed had five equal lines of vine cuttings, each line being a variety of sweet potato, spaced about 0.52 m from each other, so that their performance with respect to nutrient content can be compared. Vine cuttings were transplanted in the same order in all five beds. The sweet potatoes were transplanted in June, 2017. Organic manure obtained from the Dukuma Garden was prepared by fermenting together rice straw, ground nuts plant parts and cattle dander in a pit over a two year period, and was applied evenly to all lines on the same day. The Dukumah Garden has sandy loamy soil. No synthetic fertiliser was applied.

### **2.4 Harvesting and Nutrient Analysis of Sweet Potato Varieties**

The sweet potatoes were harvested after four months of transplanting, in October, on the same day. Samples of the various varieties were

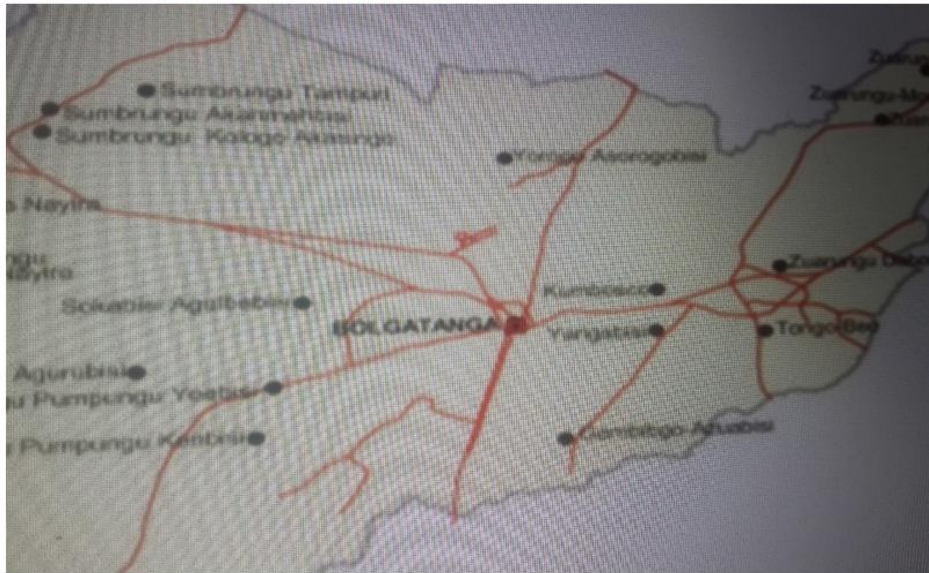


Fig. 3. Map of Bolgatanga municipality



Fig. 4. Map of Ghana showing location of Bolgatanga (B) in UER [17]

collected from only one bed, parcelled, appropriately labelled and hand-delivered to the Food Chemistry laboratory of Kwame Nkrumah University of Science and Technology for the following analysis:

- i. The proximate analysis (%),
- ii. The concentration of the minerals, namely magnesium (Mg), sodium (Na), potassium (K), calcium (Ca) iron (Fe) and zinc (Zn) mg/kg and
- iii. Concentrations of beta-carotene and total carotenoids in mg/g.

Whereas the determinations of the proximate, beta-carotene and total carotenoids concentrations were done following the standard published official methods of the Association of Official Analytical Chemist (AOAC) [18,19], the concentrations of the minerals was done by using atomic absorption spectrophotometer; AAS Model Nov AA 400 p.

### 2.5 Data Analysis

Each treatment (variety) samples were analysed in duplicates and the average values were recorded with standard deviations (SD).

### 3. RESULTS

#### 3.1 Colours of the Different Varieties

The colours of the five different varieties of sweet potatoes grown in the Bolgatanga Municipality which has been analysed are shown with their vines in plates 1 to 5. Three varieties had coloured flesh. They were Agric orange flesh and Orange flesh which are much alike, having both skin and flesh in orange colour and T.U. purple whose skin and flesh were purple in colour. The remaining two varieties were Agric white that had white skin and flesh while the Red skin had a red skin but a white flesh.

#### 3.2 Proximate Analysis

The proximate composition of the varieties is shown in Table 1.

The results revealed that the AW variety had the highest moisture of 75.79%, protein content of 3.82% and the lowest total carbohydrate content of 15.80%, being 15.69% nitrogen-free extract (NFE) and 0.11% crude fibre. The AO variety, on the other hand, had the lowest protein content of 0.11% but the highest total carbohydrate percentage of 23.20%, with 1.77% crude fibre and 21.43% NFE. The OF variety had the second highest protein proportion of 1.53% after



Plate 1. Agric orange flesh



Plate 2. Agric white



Plate 3. Red skin



Plate 4. Orange flesh



Plate 5. T.U. purple

**Table 1. Proximate analysis of five varieties of sweet potatoes**

SPV	% Moisture	%Ash	%Crude fibre	%Protein	%Fat	%NFE	%TC
AO	73.38± 0.65	0.10± 0.00	1.77± 0.04	0.11± 0.03	3.22± 0.40	21.43± 1.03	23.20± 1.07
RS	73.84± 0.45	0.83± 0.00	0.99± 0.03	0.62± 0.04	1.74± 0.10	21.98± 0.48	22.96± 0.51
AW	75.78± 4.30	1.23± 0.01	0.11± 0.00	3.82± 0.03	3.37±0.58	15.69± 4.9	15.80± 4.93
OF	71.04± 0.06	1.56± 0.00	0.64± 0.00	1.53± 0.04	4.84± 0.95	20.39± 0.84	21.03± 0.84
TP	74.42± 0.43	0.76± 0.00	0.10± 0.00	0.68±0.04	2.76±0.62	21.29± 1.09	21.38± 1.09

SPV: Sweet potato variety, AO: Agric orange flesh, RS: Red skin, AW: Agric white, OF: Orange flesh, TP: T.U. purple  
NFE: nitrogen free extract, TC: total carbohydrates.

**Table 2. Mineral composition of the five sweet potato varieties**

SPV	Concentration in mg/kg					
	Mg	Na	K	Ca	Fe	Zn
AO	13322.44±0.10	2810.54±0.05	4444.77±0.03	6282.49±0.20	38.47±0.01	36.49±0.00
RS	9651.17±0.02	1887.24±0.10	3711.48±0.19	3944.48±0.13	85.91±0.01	105.16±0.00
AW	12253.99±0.10	1786.77±0.07	4882.07±0.08	4704.79±0.08	7.71±0.00	33.10±0.00
OF	13713.44±0.07	1669.88±0.05	5265.03±0.02	4707.05±0.02	47.62±0.01	123.12±0.00
TP	10788.31±0.07	2073.07±0.10	4382.20±0.08	18250.70±0.06	101.33±0.01	66.35±0.01

SPV: Sweet potato variety, AO: Agric orange flesh, RS: Red skin, AW: Agric white, OF: Orange flesh, TP: T.U. purple

AW, while the latter also contained the second highest composition of fat (3.37%), after the former (OF), which had the highest lipid composition of 4.84%.

### 3.3 Mineral Composition of the Five Sweet Potato Varieties

Concentrations of four macronutrients, Mg, Na, K, Ca, and two micronutrients, Fe and Zn are presented in Table 2.

All five varieties of sweet potatoes contained these elements in varying concentrations in milligrams per kilogram (mg/kg). All the varieties of sweet potato tested contained Mg in appreciably high concentrations. The T.U. purple variety recorded the highest concentration of Ca (18250.70±0.062 mg/kg) than the other varieties, which recorded moderate concentrations of it. In a similar vein, all the varieties contained low concentrations of Na and K. The varieties TP, RS and OF contained comparatively higher concentrations of Fe and Zn than varieties AO and AW.

The OF variety had the highest concentration of Mg (13713.44±0.069 mg/Kg), K (5265.03±0.023 mg/kg) and Zn (123.12±0.004 mg/Kg) but the lowest concentration of Na (1669.88±0.051 mg/kg). The RS variety had the second highest concentration of the minor minerals, Fe (85.91±0.007 mg/Kg) and Zn (105.18±0.001 mg/Kg) while the variety AO recorded the second highest concentration of Mg (13322.44±0.098 mg/Kg) and Ca (6282.49±0.200 mg/Kg). On the other hand, the AW variety had the second highest concentration of K (4882.07±0.078

mg/Kg). The variety TP had the highest concentration of Fe (101.33 ± 0.007 mg/Kg) and Ca (18250.70±0.062 mg/Kg). The AW variety contained the lowest concentration in mg/kg of the trace elements: Fe (7.71 ± 0.003) and Zn (33.10±0.00) while the lowest concentrations in mg/kg of Mg (9651.17 ± 0.017), K (3711.48 ± 0.191) and Ca (3944.48 ± 0.126) were recorded in the RS variety.

### 3.4 Total Carotenoids and Beta-carotene

Figs. 5 and 6 illustrate the beta-carotene and total carotenoids, respectively, found in the five sweet potato varieties. The OF variety recorded the highest concentration of total carotenoids (1.6454) while TP contained the highest concentration of beta-carotene (0.0130). The lowest concentrations of total carotenoids and beta-carotene were observed in the RS (0.1097) and AO (0.0009) respectively.

## 4. DISCUSSION

The research was aimed to grow the varieties of sweet potato together on the same farm and under the same edaphic conditions so that their respective nutrients, minerals, beta-carotene and total carotenoid content capabilities could be explored. The findings showed that all five varieties of sweet potato were nutritious, with protein content ranging from the highest of 3.82% in the AW variety to the lowest of 0.11% in the AO. This finding is different from Benin [20], who reported that white-fleshed sweet potato local varieties contain less protein than the coloured flesh ones. The range of the protein content observed from the current study

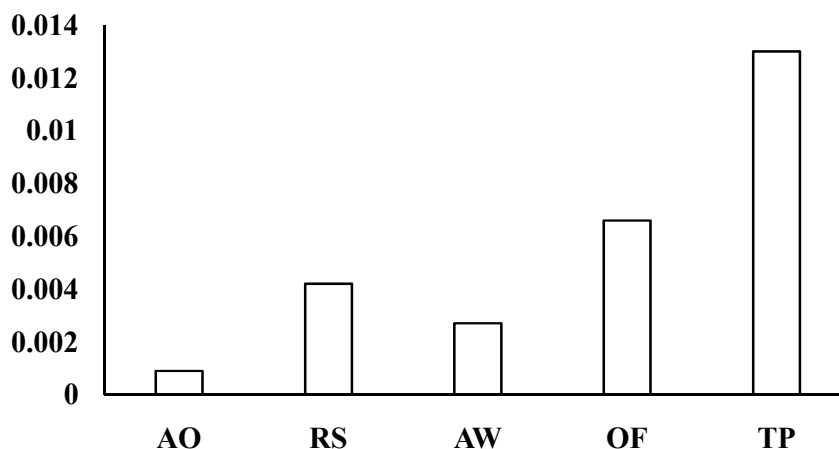
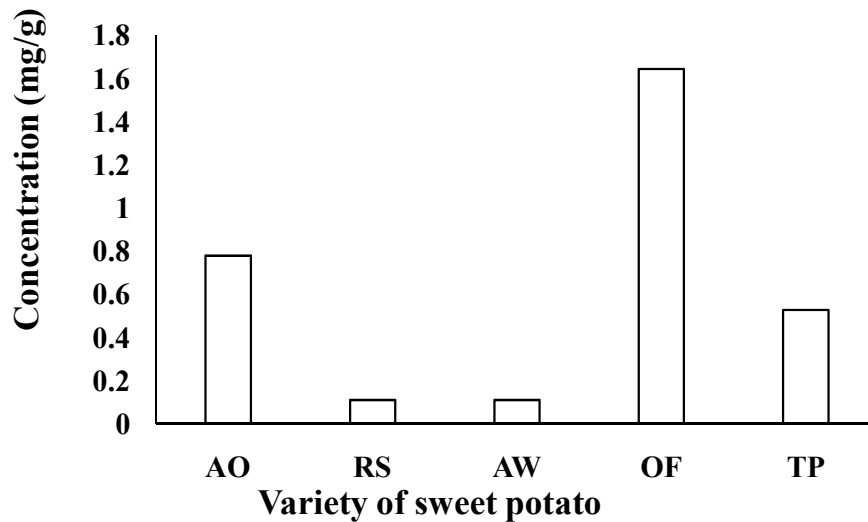


Fig. 5. Beta-carotene concentration (mg/g) in the sweet potato varieties





**Fig. 6. Total carotenoids concentration (mg/g) in the sweet potato varieties**

was found similar to the range of 3.30% to 1.20% reported from five varieties in Sri Lanka [21]. It was, however, much higher than the range of 0.91% to 0.05% reported in Rwanda [6]. The observed protein range was lower than the range of protein content (4.16% to 3.28) recorded in Nigeria [22], China (6.53% to 4.86%) [23] and Benin (4.09 to 1.97%) [20]. Thus the AW variety, with its high protein content, can be utilised as a protein-rich food in poorly resourced areas of the developing countries.

All five varieties of sweet potato contained a considerable percentage of fat, ranging from 4.84% in the OF variety to 1.74% in the RS one. The content of fat in the five varieties was in the order of RS<TP<AO<AW<OF. A much higher range of fat content ( $8.88 \pm 0.30\%$  to  $0.54 \pm 0.13\%$ ) was recorded in Benin [20]. Given the importance of lipids as a component of lipopolysaccharide in the plasma membranes of cells, the considerable fortification of some of the sweet potato varieties with fat may help to improve the health-status of the poor rural people. On the other hand, the moderate fat content in the other varieties, especially RS and TP, makes them useful food for people who are concerned about consuming high fatty foods.

Crude fibre content was found to range between 1.77% in the AO and 0.10% in TP in this study, which is much higher than the range of 0.14% to 0.11% reported earlier in Rwanda [6]; but much lower than the range (2.35% - 1.85%) reported in China [8]. The range of 13.60% to 2.10% was

observed in Sri Lanka [21]; the range of 5.40 to 3.30% was recorded in Martinique [24] and the range of 3.00 to 1.81% was found in Benin [20]. Foods rich in crude fibre may reduce the likelihood of one experiencing various sicknesses such as those related to the digestive system; sugar related health issues and heart problems [6,25].

Total carbohydrate content in the varieties of sweet potato studied, ranged from 23.20% in the AO variety to 15.80% in AW, which was lower than the range ( $38.92 \pm 0.04$  to  $14.46 \pm 0.07\%$ ) reported in Benin [20]. Thus, sweet potato cultivating rural folks of developing countries have access to a cheap but good source of calories from this crop.

Moisture content ranging from 75.78% in the AW variety to 71.04% in the OF, was observed in this work, which is higher than the finding of a range between 64.34% and 62.58% in Rwanda [6] and 70.00% to 61.00% in Nigeria [22]. This shows that the five sweet potato varieties have a very high moisture content. This may impact on the taste when freshly harvested sweet potatoes are cooked immediately. The average high moisture content in the five varieties may account for the general low ash content, given that the OF variety which recorded the lowest moisture of 71.04% had the highest ash content of 1.56%. According to Ingabire and Vasanthakaalam [6], high moisture in sweet potatoes is the cause of their low ash content.

The study revealed varying concentrations of Mg, Na, K, Ca, Fe and Zn in the tested sweet potato varieties. The highest concentration of Mg ( $13713.44 \pm 0.07$  mg/kg) was found in the OF variety whereas its lowest concentration ( $9651.17 \pm 0.02$  mg/kg) was recorded in the RS variety. Mg was observed at higher concentrations in all five varieties of sweet potato in this study. Thus, any of the five varieties is a good source of this major mineral. A recent study with ten elite sweet potato cultivars in Bennis reported a lower concentration range of Mg (2540.00 to 2130.00 mg/kg) than that of the current study [26].

Of the four major minerals studied, the lowest Na concentration was recorded in all five sweet potato varieties with an average value of 2044.29 mg/kg. This concentration of Na is lower than the range of 3400.00 to 2900.00 mg/kg reported in Bennis [26].

The concentration of K was low in all five sweet potato varieties, averaging 4537.11 mg/kg, though this was more than twice the average concentration of Na. Thus, these sweet potato varieties may not be rich sources of K and Na, more so, the latter. The level of K concentration was much lower than that reported in Western Kenya (16838.00-1040.00 mg/kg) [2] and in Bennis (32867.00 to 30867.00 mg/kg) [26]. The TP variety, by virtue of its richness in concentration (mg/kg) of Ca ( $18250.70 \pm 0.062$ ) and Fe ( $101.33 \pm 0.01$  mg/kg), could be the richest source of minerals, out of the five varieties. Thus, the concentrations of Fe in the sweet potato varieties were in the following order: TP>RS>OF>AO>AW. The Ca concentrations recorded in this work is much higher than that recorded by Senanayake et al. in Sri Lanka (590.00 to 210.00 mg/Kg) [21]. However, the previously reported Fe concentration (630.00 to 420.00 mg/Kg) [21], was much higher than that observed from the current research work. In a similar vein, the Ca concentration recorded in the current study was much higher than the concentration range of 2735.00 to 1850.00 mg/kg in varieties of sweet potato reported in Western Kenya [2] while their Fe concentration of (140.00-103.00 mg/kg) was higher than that recorded by the varieties used in this study. Again, the current finding showed a higher concentration ranges of these minerals than that found in Bennis [26] between 2997.00 and 2304.00 mg/kg for Ca and 73.00 to 53.00 mg/kg for Fe.

The trace element, Zn was recorded highest in the concentration of  $123.12 \pm 0.004$  mg/kg in the OF variety and lowest ( $33.10 \pm 0.002$  mg/kg) in the AW variety. Similarly, the concentrations of Zn in the sweet potato varieties was recorded in the following order: OF>RS>TP>AO>AW. This concentration range of Zn was much higher than the range of 27.00 to 23.00 mg/kg recorded in Benin recently [26].

The concentration of beta-carotene (mg/kg) in the five sweet potato varieties increased in the order of: AO<<AW<RS<OF<TP, where the highest concentration of 0.0130 mg/kg was recorded in the TP variety while the lowest concentration of 0.0009 mg/kg was recorded in the AO variety. An earlier study [22] reported beta-carotene content ranging from 0.0071 to 0.0060 mg/kg in Nigeria, which is within the range of recorded current values. The white coloured variety (AW) contained 0.0027 mg/kg and the red skinned but white fleshed variety (RS) recorded 0.0042 mg/kg of beta-carotene, contrasting from earlier findings of no beta-carotene at all in white sweet potato varieties [6,2]. In this study, TP is the variety that may be recommended as a beta-carotene supplementary food, followed by OF variety.

However, in accordance with earlier reports [6,2], the two white fleshed varieties (AW and RS) recorded the lowest concentration of total carotenoids of 0.11 mg/kg each while the OF variety has the highest content of 1.6454 mg/kg.

Given that all the varieties were cultivated on the same beds in the same loamy soil type, soil nutrient content and moisture, their levels of nutrient fortification can be attributed solely to the variety of sweet potato and not variation in the soil type or conditions [1,5,16,6,7,2].

## 5. CONCLUSION

The five varieties of sweet potato were not only rich in varying degrees of protein, carbohydrate and fat contents but were also impregnated with both macro- and micronutrients, beta-carotene and total carotenoids. AW and OF varieties were found to be the highest sources of protein and fat, respectively whereas the AO variety contained the greatest proportions of both total carbohydrate and crude fibre. All varieties contained high amounts of Mg. The TP variety was the richest source of Ca, Fe and beta-carotene, compared to the rest. All the varieties of sweet potato recorded moderate to low

concentrations of K and Na, respectively. Thus the varieties of sweet potato may be of considerable importance in the amelioration of nutrient, mineral and beta-carotene malnutrition in poorly resourced areas of the developing countries.

## 6. RECOMMENDATION

A follow-up study to assess the nutrient status of other varieties of sweet potato in the area and other factors such as phytochemicals, vitamins or their precursors would provide a complete picture of the nutrient worth of the varieties of sweet potato grown in the study location. Again, given that the leaves are being used by the rural folks in Ghana for the preparation of soup and stew, while some even use them for the treatment of some illnesses, it is necessary to explore their nutrient, vitamin, mineral and phytochemical composition also.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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