Investigation of Nutritional Values of Selected Taro Varieties (Colocasia Esculenta) Grown in Hadero Tunto Zuria Woreda, Kembata Tembaro, Snnpr, Ethiopia

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Abstract
Taro (colocasia esculenta L. Schott) of the family Aracea is a staple food throughout subtropical and tropical parts of the world. The objectives of the study were to investigate proximate composition and level of selected minerals: Na, K, Mg, Fe, Cu, Zn and Co in Boloso-1 and shishiya taro varieties from three kebeles of the study areas. Oven dried flour of samples were prepared from both taro varieties. Samples were digested in wet digestion using 5mL of HNO_3 and 5mL of $HClO_4$ for 2hrs at variable temperature in Topwave microwave digester. The quantity of minerals was analyzed using Flame Photometer and GFAAS. Proximate analysis revealed by percentage (%): Dry matter (94.17 ±0.05 and 93.78 ±0.32), moisture (5.83 ±0.08 and 6.22 ±0.03), ash (4.58 ±0.04 and 3.42 ±0.2), fiber (2.59±0.03 and 1.83±0.92), fat (0.46± 0.01and 0.56±0.01), protein (5.06±0.08 and 4.16±0.09), Carbohydrate (81.64±0.19 and 83.81±0.21) and energy (350.99±0.08 and 356.95±1.02), minerals in mg/100g: K (35.53±3.11 and 33.43±1.55), Na (7.51±2.09 and 11.62±1.38), Mg (41.19±0.81 and 41.74±0.78), Fe (7.03±1.11 and 6.49±0.16), Cu (2.31±0.1 and 2.39±0.02). Zn (17.8±2.45 and 12.43±1.14) and Co (0.28±0.02 and 0.37±0.01 were in Boloso-1 and shishiya taro varieties respectively. Low fat content, higher carbohydrate and energy content were recorded in both taro varieties. Both taro varieties were rich in K and Mg when compared to other minerals. However, Co was found to be lowest in both taro varieties.
Keywords: Aracea, Colocasia, Functional properties, Mineral contents, Proximate, Taro.
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1. Introduction

1.1. Background of the Study

Roots and tuber crops are the most important food crops since ancient time in the tropical and subtropical areas [1]. These crops are important cultivated staple energy sources, second to cereals in tropical regions in the world. However, roots and tuber crops are bulky in nature with high moisture content of 60–90% leading them to be associated with high transportation cost, short shelf life and limited market margin in developing countries even where they are mainly cultivated [2].

The principal root and tuber crops grown in Ethiopia are enset, potato, taro, yam, cassava, tannia and sweet potato [3]. These crops are related to household food security. Root crops play great role in highly populated area such as SNNPR in fulfilling the critical periods from March to June [4].

Aroids are plants subfamily to the family Araceae [5]. Main edible aroid includes four types: colocasia esculenta, tannia (xanthosoma), Gaint taro (alocasia macrorrhizos) and Gaint swamp taro (*Cyrtosperma chamissonis*). Three of them are commonly used for human consumption [6, 7]. Taro is a common name of tubers crops among several plants in this family, within the family araceae there is one ‘‘taro’’ namely Colocasia esculenta *L. Schott* [6]. Taro (colocasia esculenta) is one root crop grown in the tropical and subtropical parts of the world [8, 9] in order to get edible corms. In these areas, water availability is considered as the first priority in taro production [10]. This root crop can grow up to 1meter in height and have heart-shaped leaves [11].

In Ethiopia, taro is mostly grown in south and south western parts of the country including Wolaita, Kambata and Jima [15]. It is used as a potential crop in Ethiopia since 1984 famine. In some parts in Ethiopia, taro root crop is used as fill seasonal food gaps when other crops are not found in the field [16]. It is also the third most important root crop after yam and cassava [17]. Taro has been consumed in different ways as potato and sweet potato [18]. It has also comparable nutritional value as sweet potatoes and potatoes [14]. In its raw form, the plant is toxic due to the presence of calcium oxalate. Its toxicity can be avoided by cooking or steeping taro root in cold water overnight [19].

Most varieties of taro do not tolerate drought, an annual rainfall of approximately 250 cm is recommended [11]. It is harvested at maturity in nine-ten months after planting [20]. Cultivating such a nutritionally rich root

crop at large scale increase total food production and income of the farmers [21]. But the majority of the Ethiopian population depends mainly on cereal crops as food source. Despite of its importance, the production, productivity and the yield of taro became low in Ethiopia [22]. The food potential of horticultural of taro crops has not been fully exploited towards as food security, income generation, provision of food energy [23].
In SNNPR, Ethiopia including Kembata Tembaro Zone, Hadero Tunto Zuria woreda, there is high production and productivity of root and tuber crops. Some of tubular roots are taro, yam, potatoes, sweet potatoes, enset and cassava. These are cultural staple food to improve food security in the study areas. There are also different varieties of taro root crops in the study areas: old taro such as shishiya, moliya, gasa (local name) and Boloso-1(new name of taro). Even if the reason is unknown, most time people in the study areas has given priority to new taro Boloso-1 rather than old taro. This study was aimed to investigate nutritional value of one of old taro (local name: shishiya) and Boloso-1taro varieties that are good in production and productivity in the woreda and to address their proximate composition, mineral contents as well as some functional properties and ascorbic acid content.

2. REVIEW LITERATURE

2.1. Origin and Distribution of Taro Globally

Taro (colocasia esculenta) is the Araceae family mostly cultivated in tropical and subtropical parts of the world [27]. The origin of this root crop is from tropical region between India and Indonesia [6] and spread eastward into south east Asia, eastern Asia and Pacific Island, westward to Egypt and the eastern Mediterranean and then southward and westward from there into East Africa and West Africa, whence it spread to the Caribbean and America by different settlers and slave ship. It is native to South India and Southeast Asia [20, 28]. Colocasia esculenta, commonly known as taro, is a staple vegetable crop that has been used as food for over many years, this making it as one of the world oldest food crop. This crop is used as a source of protein, starch, minerals and vitamins. It is toxic when raw but edible after cooked [29].

In the world, taro production is about 9.22 million tons per 1.57 million ha. As different researches have exhibited that mostly taro root crop is covering South East Asia, Pacific Islands, Hawaii, Philippines, Africa, Egypt, West Indies and certain areas of South America [30]. The root crop is grown as a root vegetable for its edible starchy corm, and as a leaf vegetable. It is also a staple food and sources of carbohydrate for people in African, Oceanic and South Indian cultures [28, 32]. About 60% of the world production of taro is grown in Africa and most of the remaining 40% in Asia and Pacific [32]. Taro crop is a globally important crop, ranked fifth in production after cassava, potato, sweet potato and yam [22, 32].

2.2. Taro Production in Ethiopia

Ethiopia is characterized by a complex livelihood system due to its diverse topography, seasonality, and multi-ethnicity from which 84 percent live in rural areas [4]. Ethiopia has also diverse agro-ecological and climate condition suitable for the production of various crops including root and tuber crops. However, the food potential of root and tuber crops has not yet been exploited which have a great role in food security of the people of Ethiopia [29] instead the majority of Ethiopian population depends mainly on cereal crop as food source such as teff, maize, barley and wheat.

Root crops have great role to assure food security in the country. Always food security should be seen to have three specific elements: ensuring production of adequate food supplies, maximizing stability in the flow of supplies and securing access to available supplies on the part of those who need them. Moreover, setting national and international goals to achieve food security becomes even more difficult for two reasons. First, rural food consumption patterns are diverse involving the consumption of different crops and second, their diversity aggravates the problem of ensuring rural food security through formal ways [33]. Currently most of the root and tuber crops are grown as security crops to bridge the food scarcity months because of their ability to reach maturity during these ‘hunger months’ [3].

In Ethiopia, root crops are widely grown in the southern part of the country. Among the root crops, taro is one of the most important food crops as well as income source to the farmers. It has a great potential to supply high quality food and one of the cheapest source of energy and the most underutilized root crop. People are eating taro corm as boiled, but there is no awareness about the quality the leaf due to lack of research in it [34]. The national agricultural production and productivity of root and tuber crops mostly taro in Ethiopia is lower than most neighboring and other **developing countries** due to lack of improved production technologies [15] and lack of more researches about it. Root and tuber crops are widely cultivated in southern Ethiopia and support a considerable portion of the country’s population as source of food. Among them potato, sweet potato, Enset, taro and yams are known [28].

Taro is widely cultivated in densely populated areas of south, southwest and western parts of the country as food and fill economic problem [34]. Additionally, it is cultivated highly because of its resistance of diseases, pests and ecological adaption but most other root crops are affected by different diseases like enset by bacteria, sweet potato by butterfly [22]. In our country Ethiopia, mostly in Kembata Tembaro zone, taro is planted between late dry season March and April and harvested in nine-ten months. As different researches have exhibited, taro production in the part of world is ranged between 21-73t/ha. Its average production per household growing, the crop in Ethiopia is 434.4 according to '2012 Ethiopia ATA baseline survey' [36]. One of the highest yielding cultivars is Boloso, in the southern Ethiopia 67 t/ha [31]. The total area of cultivation of taro in Ethiopia is 26,506.36ha, out of which 20,100.48ha cultivated in SNNPR, 6,147.87ha in Oromia, 231.84ha in Gambela and 9.36ha in Benishangule Gumuz region. In Wolaita Zone, the total area under taro cultivation is 4,202.46ha [3].

2.3. Economic Importance of Taro

In Pacific Island countries and Africa, taro is used as staple food crop after sweet potato in terms of consumptions as energy source [12, 28]. It is also processed as a food ingredient, animal feed, earning foreign currency as being a cash crop [28]. In other parts of the world, taro is made into ice cream and drinks, fresh or fermented paste, fried or mixed with other products [36].

Taro root crop is important household food security and income crop in many developing countries but less important than yam, cassava, sweet potatoes and potatoes [38]. It can be also consumed by children who are sensitive to milk due to its easy digestibility [24]. The major economic part of taro is corm and cormels as well as leaves [3, 38]. The main use of taro is as a vegetable when the leaves or corms are eaten after baking, roasting, or boiling them and consumed in conjunction with other foods like fish and coconut preparations in Nigeria [9, 29]. Flour of taro is also very useful to substitute wheat flour to prepare bread, baking flours, formulation of baby food, soup formulation, snacks, and breakfast products, also in beverages, as porridge and in producing foods for people with gastrointestinal disorders. Industrially taro root crop is used in preparation of drugs, oil and paper production in Egypt, Nigeria and other world parts [37, 39]. Its flour can also be used for the preparation of biscuits, and puddings. Other uses taro includes; Cormels are peeled, cut into necessary pieces then fried and eaten [40].

In Pacific Island countries of Melanesia, leaves and rhizomes of taro are consumed in sauces, soups or stews depending on the cultivar and the culture [3, 41]. Leaves of taro (colocasia) are cooked and eaten as vegetable [40] but in Ethiopia these are not common. So taro root is ranked third in importance after yam and cassava in extent of production among the root and tuber crops of economic value in Nigeria [41]. West Africa sub-region including Ghana substituting the wheat flour by flour of locally starch food crops that including taro crops that has been found to be important calories source. Bread from wheat flour is quite expensive since wheat is not produced by any of West African [42].

3. MATERIALS AND METHODS

3.1. Description of the Study Area

Hadero Tunto Zuria woreda is located at about 159 km south west of Hawasa and 291km from south of Addis Ababa, particularly found in Kembata Tembaro Administrative Zone. The woreda is located astronomically at the latitude of 7^0 10'0"N – $7^0$15'0" N and longitude of $37^0$38' 0"-$37^0$40"0' E (Ethio- GPS 2017 from Hadero Tunto Zuria woreda Agricultural department). It covers an area of 190km^2. Administratively, the woreda is one of the seven woreda at the Kembata Tembaro Zone and it comprises16 kebeles**.** Soil type of the study area is Eutric nitosole (reddish brown). Topography of the woreda is 1634m above sea level. Average annual rainfall is 1201-1400mm. Further the temperature of the study area is moderate temperate and its mean annual temperature varies between about 17.6-22.5ºC.

3.2. Sample Collection Techniques

The samples were collected from three kebeles of Hadero Tunto Zuria woreda farmers. The method includes stratification sampling techniques from the mentioned site based on productivity of taro plants. In two kebeles Hadero-1 and Hadero-2, there were high taro production where as in Chacho kebele, there was low taro production. Two taro varieties are named 'Boloso-1' taro and old taro or 'shishiya' taro were collected from these kebeles.

3.3. Chemicals and Reagents

All analytical graded chemicals and reagents were used without further purification throughout the experimental works. These chemicals were Petrol ether (40–60°C), aceton, H_2SO_4 solution (0.255 N H_2SO_4 or 1.25% (w/v) H_2SO_4), NaOH solution (0.313 M NaOH or 1.25% (w/v) NaOH), De-ionized water, distilled water, K, Na, Mg, Fe, Cu, Co and Zn stock solution, Conc. HNO_3, Perchloric acid, peroxide, Boric acid, selenium, methyl red, 0.1NHCl, methyl red indicator (for total nitrogen content analysis in the sample for the sake of protein content determination), buffer solution for calibration of pH-meter prob, K_2SO_4, H_2O_2, NaOH, 1% soluble starch (indicator of vitamin C), KI pellet, KIO, and L-Ascorbic acid.

3.4. Equipments and Apparatus

Plastic material was used to cut samples, oven (model BV16OC, serial no. Y2J098, England) was used to dry taro varieties sample, electric miller (kali Bari, Ambala Cantt 1300, India) was used to grind and powdered the sample in flour form, 25-mesh (to sieve flour), analytical balance (UK, model RE200, and AQT 1500) was used to weigh the sample, porcelain crucibles (were used to ash sample flour), spatula, muffle furnace (UK by BIBBY), tong, desiccators with fresh silica gel desiccants, beakers, measuring cylinder, hotplate (UK model SB160), SG-deionizer (Germany, model: SG-2000) was used to de-ionize water, Hood (NORDIA, laboratory design and engineering division WALTHAMSTOW) was used to put corrosive and poisonous chemicals, soxhlet apparatus with mantles (to extract fat), rotator evaporator with condenser and water bath (U.K. Model: RE200, serial no. RE20645 to separate petroleum ether from extracted fat, round bottle boiling flask, stirrers, thermometer Kjeldigester (K-446), Kjeldahl tubes, titrette (Germany, machine for titration in N-determination), refrigerator (Hitachi, Tokyo, Japan) was used to keep the digested sample till analysis, GFAAS- analytikjena (Germany, model novAA 400P) was used for analysis of the analyte metals, analytikjena digester (for sample digestion) and Flame photometer (JENWAY PFP 7) was used to analysis K and Na in the sample, 25ml, 50ml, 100ml, 125ml, 500ml and 1L volumetric flasks, micropipette was used to measure different solutions in micro level, condenser with ice bath, content), pH-meter (model 3310, JENWAY), dropper, volumetric pipette, burette was used for titration process, erlenmeyer flask was used for different reactions, stand (with white based), funnel, Whatchman filter paper (was used to filtrate solution) were used in this study.

3.5. Taro Flour Preparation

One Kg corms of taro representative sample from the sites was collected and packaged in polyethylene bag. Then it was transported to AMU laboratories. During preparation of flour, the corms were cleaned to remove foreign matter with tap water then distilled water and deionized water. The corms were peeled carefully using plastic materials. The peeled two taro varieties' corms and cormels were washed with distilled water then deionized water and finally sliced. The slices were dried overnight in a hot air oven at 45°C. The dried taro chip was milled using electrical mill and sieved to pass through 25-mesh sieve. Finally, the flour was placed in polyethylene bag for further analyses.

3.6. Determination of Proximate Composition of Taro Flour

3.6.1. Determination of Dry Matter

Empty porcelain crucibles were dried overnight at 105°C, then cooled in desiccators at room temperature and oven-dry crucible was weighed (w_1). Approximately 2g of grounded sample was added to dried crucible and recorded weighed (w_2), then dried overnight at 105°C. Finally it was cooled in desiccators at room temperature. Oven-dry crucible + sample weighed (w_3) [44].

$$\%DM = \frac{W_3 - W_1}{W_2} \times 100 \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots eqn.\ 3.1$$

3.6.2. Determination of Ash

Empty porcelain crucibles were weighed and 2g sample taro flour was added into the porcelain crucible. Then the crucible was put in temperature controlled muffle furnace at about 550°C and for 2hrs. Finally the crucible was transferred directly to desiccators, cooled and weighed immediately, results of % ash was expressed in the formula below [59].

$$\%\ Ash = \frac{weight\ ash}{weight\ of\ sample\ taken} \times 100 \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots eqn.\ 3.2$$

3.6.3. Determination of Moisture Content

Empty containers were placed in the drying oven at 100±5°C until constant weight (1-2hrs) and cooled in desiccators for 30min and weigh (w_1). 3.5g sample were weighed in duplicate accurately and into a pre-weighed drying container (weight of container + sample before drying) (w_2). The container with sample was put in the air oven pre-heated to 100±5°C for 3 hrs. Then the container with the dried sample was transferred into desiccators, and cooled for 30 min and weigh (g) (w_3). The heating procedure was repeated until constant weight [43, 47].

$$moisture\ content(\%) = \frac{w_2 - w_3}{w_2 - w_1} \times_{100} \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots eqn.\ 3.3$$

3.6.4. Determination of Crude Fat

The crude fat in the sample flour was determined using soxhlet extraction for 5hrs. 5g of the sample was weighed accurately into labeled thimbles. The dried boiling round flat bottom flask (250mL) was weighed and then filled with 150mL petroleum ether. The extraction thimble was plugged tightly with cotton wool into the soxhlet. After that the soxlet apparatus was assembled with the flask that was placed into the fat extraction system and allowed to reflux for 5hrs and water was turned on to cool them. The thimbles were removed with care and petroleum ether was collected from the top of container by using rotator evaporator with condenser and water bath and then finally drained into another container for re-use. After that, the bottle was placed at 80ºC- 90ºC in air-oven until the solvent completely evaporate. After drying, it was cooled in desiccators and weighed [46, 65].

$$weight\ of\ fat\ = (weight\ of\ flask\ +\ fat) - weight\ of\ flask \cdots\cdots\cdots eqn.\ 3.4$$

$$fat(\%)\ =\ \frac{weight\ of\ fat}{weight\ of\ original\ sample} \times 100 \cdots\cdots\cdots eqn.\ 3.5$$

3.6.5. Determination of Crude Fiber

About 2g sample (W_s) was added into a fiber flask and then 100ml of 0.255 N 1.25% (w/v) H_2SO_4 solution was added. The mixture was heated under reflux with heating mantle for one hour. The hot mixture was filtered through a fiber sieve cloth. The difference obtained was thrown off and the residue was returned to the flask to which 100ml of 0.313N 1.25% (w/v) NaOH solution was added and heated under reflux for another one hour. The mixture was filtered through a fiber sieve cloth and 10mL of acetone was added to dissolve any organic constituent. The residue was washed with 50mL of hot water twice on the sieve cloth before it was finally transferred in the pre-weighed crucible. The crucible with the residue was oven dried at 105ºC overnight to drive off moisture. The oven dried crucible containing the residue was cooled in a desiccators and latter weighted (w_1) for ashing at 550ºC for 4hr [47, 59, 66]. The crucible containing white and grey ash was cooled in desiccators and weighted to obtain W_2.

$$Fiber(\%)\ =\ \frac{w_1 - w_2}{w_s} \times 100 \cdots\cdots\cdots eqn.\ 3.6$$

3.6.6. Determination of Crude Protein by Kjeldahl Method

Crude protein is total nitrogen multiplied by protein factor because most proteins contain 16%N. It is expressed in mg per 100g sample.

Digestion

About 2g sample of taro flour was placed in digestion tube or Kjeldahl tube and added 10mL H_2SO_4 and 1g catalysts (contain K_2SO_4, $CuSO_4$ and selenium powder). Digestion was taken place in digestion tube until clear solution being observed for 3hrs at 370ºC in Kjeldahl digester in Fume Hood and also to get complete breakdown of organic matter. The catalyst was mixture of 100g K_2SO_4, 10g $CuSO_4$ and 1g selenium powder.

Neutralization and distillation

During this process, 50mL of 40% (w/v) boric acid was put to a 250-500mL Erlenmeyer flask. Then100mL of H_2O and 70mL of 50% (w/v) NaOH were added to the digest and start distillation. Excess NaOH was added to neutralize H_2SO_4, then it was distilled until to get >150mL distillate.

Titration

Approximately, 2-3 drops of methyl red indicator was added and then, it was titrated the distillate with standardized 0.1NHCl until the first appearance of pink color [46, 47].

$$\%N = \frac{(ml\ 0.1NHCl_S - ml\ 0.1NHCl_B) \times 0.014 \times 0.1NHCl}{weight\ of\ sample} \times 100 \cdots\cdots\cdots eqn.\ 3.7$$

$$\%\ protein\ \left({}^{mg}\!/_{100g}\right) = \%\ N \times 6.25 \cdots\cdots\cdots eqn.\ 3.8$$

Where: 6.25 is factor of N= 100/16.
mL 0.1N HCl sample- amount of acid to titrate sample solution.
mL 0.1N HCl blank- amount of acid to titrate blank solution.

3.6.7. Determination of Crude Carbohydrate Content

This measures the carbohydrate content and in most cases includes the fiber content of the sample. This would be conveniently done by the difference method that is:

$$Total\ CHO = 100 - (\%fat + \%ash + \%moisture + \%protein + \%fiber)\ [67]. \cdots\cdots\cdots eqn.\ 3.9$$

3.6.8. Determination of Energy Value

The energy value of the samples was determined by multiplying the protein content by 4, carbohydrate content by 4 and fat content by 9.

$$Energy\ value = (crude\ protein \times 4) + (total\ CHO \times 4) + (crude\ fat \times 9)\ [64]. \cdots\cdots\cdots eqn.\ 3.10$$

3.7. Determination of Selected Minerals In Taro Flour

3.7.1. Mineral Analysis by Flame GFAAS

Graphite furnace atomic absorption spectrometry (GFAAS) is a type of spectrometry that uses a graphite-coated furnace to vaporize the sample. It is non-flame methods involving electrically heat graphite tubes or rods.

Standard solutions

Stock solution of each mineral was used to prepare working standard solution for calibration curve. So the stock solutions of K, Na, Mg, Fe, Cu, Zn and Co were used for these purposes.

Microwave Sample digestion

Microwave digestion is wet acid digestion method. 0.5g of taro flour sample was weighed and added into sample holder of Top wave microwave digester. 5mL HNO_3 acid was added and 5mL perchloric acid was also added to the holder. The digester was set up at different temperature, pressure and time interval at 120°C and 20 bar for 10 min; 150°C and 10 bar for 15 min; and 150°C and 20 bar for 15min respectively. This process was repeated three times until clear solution of the digestion was obtained for 2hrs totally [47].

$$metal\ content\ in \left({}^{mg}\!\diagup_{100g} \right) = \frac{(a - b)}{10\ w} \times v \cdots\cdots\cdots\cdots\cdots\cdots\cdots eqn.\ 3.11$$

Where: w is weight of the sample
V is volume in mL of the extract
a is concentration in ppm of sample solution
b is concentration in ppm of blank solution

3.8. Data Analysis

The data analysis involved various descriptive statistics such as mean, percent, SD, tables, bar graphs, and explanation building descriptive statistical methods that were used to analyze the findings. Originlab 8.1 software was used for data analysis, to determine mean, percent and SD by ANOVA–descriptive at significant level of $p < 0.05$ with 95% CL. The results were expressed in mean ± SD. of three different kebeles' analyzed data determination.

4. RESULTS AND DISCUSSIONS

Table 4.1 Proximate composition of two taro varieties

No.	Proximate composition	Two taro varieties	
		Boloso-1 Taro	Shishiya taro
1	Moisture Content (%)	$5.83 \pm .08/ 60.1^{*a}$	$6.22 \pm .03/ 65.2^{*b}$
2	Dry matter (%)	$94.17 \pm .05^{a}$	$93.78 \pm .32^{a}$
3	Ash Content (%)	$4.57 \pm .04^{a}$	$3.42 \pm .20^{b}$
4	Fat content (%)	$.46 \pm .01^{a}$	$.56 \pm .01^{b}$
5	Fiber content (%)	$2.59 \pm .03^{a}$	$1.83 \pm .92^{b}$
6	Protein content (%)	$5.06 \pm .06^{a}$	$4.15 \pm .09^{b}$
7	Carbohydrate content	$81.64 \pm .19^{a}$	$83.81 \pm .21^{a}$
8	Energy content	$350.99 \pm .68^{a}$	356.95 ± 1.02^{b}

Results: mean ± standard deviation. Mean not followed by the same superscript letters in the same row of the same parameter are significantly different (P<0.05), *indicates moisture content of fresh taro.

Table 4.2: Selected Minerals in two taro varieties (mg/100g)

No.	Chemical compositions	Two taro varieties	
		Boloso-1 taro	Shishiya taro/ local taro
1	Sodium (Na)	7.51 ± 2.92^{a}	11.62 ± 1.38^{b}
2	Potassium (K)	35.53 ± 3.11^{a}	33.43 ± 1.55^{b}
3	Magnesium (Mg)	$41.40 \pm .81^{a}$	$41.74 \pm .78^{a}$
4	Iron (Fe)	7.03 ± 1.11^{a}	$6.49 \pm .16^{b}$
5	Zinc (Zn)	17.80 ± 2.45^{a}	12.43 ± 1.14^{b}
6	Copper (Cu)	$2.31 \pm .01^{a}$	$2.39 \pm .02^{b}$
7	Cobalt (Co)	$.28 \pm .02^{a}$	$.37 \pm .01^{b}$

Results: mean ± standard deviation, Mean not followed by the same superscript letters in the same row of the same parameter are significantly different (P<0.05).

4.1 Proximate composition of two taro varieties

Dry matter of both Boloso-1 and shishiya taro varieties root flour was in the Table 4.1. Dry matter content of Boloso-1 taro variety dry was 94.17% while shishiya /local taro was 93.78%. Boloso-1 and shishiya taro varieties had similar dry matter content. The mean dry matter content in shishiya taro variety was not significantly different from dry matter in Boloso-1 taro variety. The percentage of dry matter of both taro varieties was higher than dry matter of taro in Ghana that is 85.32% as reported in [45].

Moisture content

Moisture content in Boloso-1 taro variety was 5.83% less than moisture content in shishiya taro variety was 6.21% as recorded in Table 4.1. The result has revealed that moisture content of Boloso-1 taro variety exhibited a significant difference when compared to the shishiya taro variety ($p < 0.05$). The value of moisture content in both taro varieties were lower than moisture content of taro that was 6.3% as reported in FAO [7] and 10.5% as reported in [68]. This might be because of the difference in the plants and in the environment that the plants were grown [38].

The food with higher moisture content helps that body does not use its own water to digest but use less energy and resources to digest and assimilate all nutrients much easier by less pressure in digestive system [59]. So shishiya taro variety was very easier to be digested than Boloso-1 taro variety due to its higher moisture content. This content is an indicator of shelf stability, increasing in moisture content enhances microbial contamination and reduces food quality and stability [72].

Ash content

The percentage of ash gives ideas about the content of inorganic or mineral of a food that indicates total mineral residue left after incineration of organic matter [47]. Total ash content directly proportional with inorganic element content. Hence the samples with high percentages ash contents were expected to have high concentrations of various mineral elements [73]. As it has presented in Table 4.1, ash content of two varieties Boloso-1 and shishiya taro/local taro were 4.57 % and 3.42 % respectively. These results have revealed that mineral content of Boloso-1 (new taro) was significantly ($p<0.05$) higher than ash content of shishiya (old taro). The analyzed amount of ash of two taro varieties in this study was also higher than of reported percentage of ash in [58].

Crude fiber

The crude fiber content of Bolsoso-1 taro was 2.59% while shishiya taro was 1.83% as presented in (Table 4.1). The flour derived from Boloso-1 varieties has exhibited higher fiber content relatively to the flour of shishiya taro variety. Fiber contents of taro varieties of the study areas were also higher than that of Mozambique's taro fiber [70] but lower than Bangladesh's taro fiber [71]. The value of fiber in both taro varieties was lower when compared with fiber content of taro that was 4.1 in FAO [64]. The results in current study were also lower than fiber content of taro 5% was reported previously in [38].

Crude Fat

As it has presented in Table 4.1, crude fat content of flour derived from Boloso-1 taro variety was 0.46% while of shishiya taro variety was 0.56%. Fat content of Boloso-1 taro variety was not significant different to fat content of shishiya taro variety. Crude fat content of flour obtained from both taro varieties were higher than fat content of taro of Mozambique [70] and Bangladesh [71]. Amount of fat content that measured in the current study were found in the range 0.3-0.6% as reported in FAO [56]. As fat content in many other root and tuber crops, fat content of both taro varieties were very low [59]. The low fat content can enhances the storage life of the flour due to lowered chance of rancid flavor development [19].

Crude Protein

From the result obtained, the value of protein content in Boloso-1 taro variety was 5.06% while value of protein content in shishiya taro variety was 4.15% in (Table 4.1). Significant differences existed in protein content in flour of both taro varieties at $p<0.05$. The flour of Boloso-1 taro variety having the higher protein content when compared with protein in the flour obtained from shishiya taro variety. Protein content of flour obtained from both Boloso-1 and shishiya taro varieties were higher than protein content of Mozambique's and Bangladesh's taro 1.1% and 2.2% respectively as reported in [70, 71]. Boloso-1 taro variety had higher protein content than protein content of taro that was 4.5 % as reported in [38] but shishiya taro variety had lower protein content. As results in the present study exhibited, protein content of the taro varieties was higher when compared with protein content of taro 1.4% in FAO [7].

Carbohydrate content

Carbohydrates are plant products which are synthesized as the by-product of photosynthesis processes that is consumed by human and animals as the major source of energy. Carbohydrates are hydrolyzed in the body to yield glucose [90]. Carbohydrate content of Boloso-1 taro variety was 81.64% while of Shishiya taro variety was 83.81%. These results have revealed that carbohydrate content of Boloso-1 taro was not significantly different when compared to mean carbohydrate content of shishiya taro in (Table 4.1). Both taro varieties' carbohydrate content were in agreement with the reported value of carbohydrate content of taro was 82% [39] but higher than the range of carbohydrate content of taro root crops 72.53-75.49% as reported in [74] and 27.4% in FAO [64].

Energy Content

As it has presented in the Table 4.1, energy content of flour prepared from Boloso-1 taro variety was 350.99 kcal while energy content in shishiya taro variety was 356.95 kcal. Mean energy content of Boloso-1 taro variety was significantly ($p<0.05$) lower than mean energy content of shishiya taro variety. Energy value of both taro varieties were lowest when compared to energy value of Mozambique and Bangladesh's taro that were 499kcal and 435kcal respectively as reported in [70, 71] as indicated in the Table 4.4. The highest energy content existed in shishiya taro flour than energy content in Boloso-1 taro variety. Energy content is associated with carbohydrate content and flour samples with highest carbohydrate held highest energy content [35].

4.2 Selected mineral in two taro varieties

Sodium (Na)

Level of Sodium content of flour obtained from Boloso-1 taro variety was 7.51mg/100g while in flour of shishiya taro variety was 11.62mg/100g as presented in the Table 4.2. The flour derived from Shishiya taro variety had significantly ($p<0.05$) higher sodium content than sodium content in flour of Boloso-1 taro variety. Amount of sodium content in both Boloso-1 and shishiya taro varieties were higher than sodium amount of taro of Mozambique [970] but lower than Bangladesh [71] but lower when compared with sodium content of taro 25.6 as it was reported in [38].

Potassium (K)

As it has presented in Table 4.2, potassium content of Boloso-1 taro variety was 35.53mg/100g while shishiya/ local taro was 33.43mg/100g.These have exhibited that level of potassium content in Boloso-1 taro variety significantly ($p<0.05$) higher than potassium content in shishiya taro variety. The level of potassium in flour derived from both taro varieties were lower than level of potassium in taro of Mozambique as reported in [70] and Bangladesh as reported in [71]. So both taro varieties are good source of potassium.

Magnesium (Mg)

Magnesium content of flour derived from Boloso-1 taro variety was 41.40 mg/100g while shishiya taro variety was 41.74 mg/100g (Table 4.2). This has indicated that magnesium content in both taro varieties was not significantly differences. Magnesium level of taro varieties in the current study was lower than that of Mozambique's taro but higher than Bangladesh's taro as reported in [71]. The results were higher when compared with Mg content of taro was 13mg/100g in FAO [64].The results have exhibited both Boloso-1 and shishiya taro varieties are good source of magnesium. Relatively higher magnesium content was found in these root crops.

Iron (Fe)

Amount of iron in flour obtained from Boloso-1 taro variety was 7.03 mg/100g while 6.49 mg/100g amount of iron found in flour of shishiya taro variety as recorded in the Table 4.2. These results have exhibited that flour of Boloso-1 taro variety had significantly ($p<0.05$) higher iron level than iron level of flour of shishiya taro variety. The value of iron content in flour of Boloso-1 and shishiya taro varieties was higher when compared with iron amount in taro of Mozambique and Bangladesh that were 0.48 mg/100g and 0.7mg/100g respectively as reported in [70, 71].

Zinc (Zn)

As described in this study, zinc content in Boloso-1taro variety was 17.80 mg/100g while in shishiya taro variety was 12.43 mg/100g in (Table 4.2). These have exhibited that level of zinc content in the flour obtained from Boloso-1 taro variety was significantly ($p< 0.05$) higher when compared with zinc content in the flour of shishiya taro variety. Zinc content of flour of both Boloso-1 and shishiya taro varieties were higher than zinc content in taro reported in [70, 71]. The results of the current study were also higher when compared with zinc content in taro 0.8 mg/100g in [53]. This might be the reason that plant absorbs minerals from soil in which Zn content vary from place to place. Most time plants mineral content depends on soil nature. Zinc is found in all body tissues and fluids.

Copper (Cu)

From the results recorded in Table 4.2, Cu content in Boloso-1 taro variety was 2.31mg/100g while in shishiya taro variety was 2.38mg/100g. The results have exhibited copper content of both Boloso-1 and shishiya taro varieties were not significantly difference. The composition of Cu of both taro varieties were the least and this is an advantage since Cu is an essential mineral for normal body function in a very small quantity [68]. So using taro root crops as staple food is very important to contribute least amount of copper mineral to human bodies.

Cobalt (Co)

The cobalt content in Boloso-1 taro and shishiya taro varieties were 0.28mg/100g and 0.37mg/100g respectively as recorded in the Table 4.2. These results have explained level of cobalt in shishiya taro significantly ($p < 0.05$) higher than that of Boloso-1 taro. Higher cobalt content in food is very essential to develop vitamin B_{12} since cobalt is a core element of vitamin B_{12}. Cobalt contributes to resistance against parasites and infection, together with other trace elements such as copper, zinc and iron. Cobalt is actually a plant "bio-stimulant," similar to molybdenum, because it is required by nitrogen-fixing bacteria, especially on the root nodules of legumes.

Deficiency of cobalt could results in nitrogen deficiency symptoms in plant [75] and vitamin B_{12} deficiency.

5. Conclusions

In conclusion, this study provides proximate composition, some selected minerals like potassium, sodium, magnesium, iron, copper, zinc and cobalt, bulky density, swelling index, pH value and ascorbic acid content of Boloso-1 and shishiya taro varieties. As indicated in the present study, corms of both taro varieties were good source of carbohydrate and energy contents. Low content protein and fat were measured in both taro varieties. Due to higher content of carbohydrate and energy in both taro varieties, these root crops are good staple and important household food security and income crops for developing countries including Ethiopia. Relatively higher level of magnesium and potassium were found in two taro varieties in the study while the lowest cobalt content of taro was recorded. Limit utilization of taro crops is observed in national level though it has good nutritional value as that of other tuber crops. The main reason for low product and productivity of taro crops in most part Ethiopia including the study areas was traditional agricultural practices of planting and traditional ways of using products of taro root crops. Taro guarantees food security and stability to the household economy in most part of southern of Ethiopia next to cereal crops. Nutritional contents like carbohydrate, energy content, swelling index and bulky density of both taro varieties have relative quantities.

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