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# Comparison of proximate, mineral and phytochemical composition of enset (*Ensete ventricosum* (Welw.) Cheesman) landraces used for a different purpose

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**Enset (Ensete ventricosum (Welw.) Cheesman) is one of the oldest cultivated food security crops in Ethiopia. There are a number of enset landraces used for traditional medicine. These landraces are believed to have better minerals and phytochemical compositions, which are not proved scientifically. The objective of this study was to compare the proximate, mineral and phytochemical compositions of corms of enset landraces used for treating bones illness traditionally, and two other landraces having another use value. Laboratory analysis was made by following standard methods, and the data determined were analyzed using SAS statistical software. Enset landraces, *Kibnar* and *Guarye* showed significantly ($p < 0.05$) higher protein content (4.74 and 4.06%), while *Astara* and *Guarye* were superior in phosphorus content (127.41 and 116.38 m $g^{-2}$) respectively. Similarly, the highest zinc and tannin contents (8.52 and 153.94 m $g^{-2}$) were obtained from *Astara* and *Kibnar* landraces respectively. On the other hand, *Amerat* landrace showed significantly ($p < 0.05$) higher crude fibre content. The three landraces used for traditional medicine showed better performances in protein, phosphorus, zinc and tannin contents than the other two landraces.**

**Key words:** Ensete ventricosum, enset, landrace, corm, proximate composition, mineral, phytochemical.

## INTRODUCTION

Enset (*Ensete ventricosum* (Welw.) Cheesman) belongs to the family Musaceae, and is one of the oldest cultivated herbaceous and monocarpic banana-like food security crops in Ethiopia. It is known to have several uses including food and non-food applications and highly integrated with the economic, social and cultural life of enset growing societies (Admasu and Struik, 2001). It is reported that more than 20 percent of the population in Ethiopia is dependent on enset for human food, fibre, animal forage, construction materials and medicines

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(Brandt et al., 1997). The processed enset (*kocho, bulla* and corm) are rich in carbohydrates, and are good sources of minerals. However, the starch yield and nutrient compositions vary among enset landraces.

Some *E. ventricosum* landraces are believed to have medicinal value and are used by the enset growing community (Belehu and Endale, 1989). The use of pseudostem and seed of related species, *Ensete superbum*, for the treatment of various human ailments like debility, diabetes, kidney stone and for easy delivery was reported (Diana and George, 2013; Prashant and Bhadane, 2008). The use of boiled corm and starchy powder, *bulla,* of *Tayo* enset landrace together with milk for curing ailments such as joint displacement and swelling, broken bone and fracture, in the Bonga area was also reported (Tsehaye and Kebebew, 2006). According to Tadessa and Masayoshi (2016), there is a strong recommendation of an enset variety called *Sweete* for treating bone problems in the Areka area.

In Gurage and some other enset growing society, corms of enset landraces known by local names as *Astara, Guarye* and *Kibnar* are traditionally recommended for treating a bone fracture, breakage and joint displacement. The highest calcium content of the corms of *Astara* landrace, as compared to nine other landraces was reported (Ajebu *et al*., 2008). The selective use of some of enset landraces in traditional treatment of bone-related illness may have a relationship with their calcium, phosphorous or proximate contents, which are known to have biological importance (Marks et al., 2010) or phytochemical content, that have beneficial effects in wound healing. This hypothesis, however, should be justified with research-based investigations. Regard to this, there is only little information published so far. Therefore, the present study was carried out to compare the proximate, mineral and phytochemical contents of three enset landraces used in traditional medicine and two other landraces having another use value, growing in Gurage zone, Southern Nations, Nationalities and People Region (SNNPR), Ethiopia.

## MATERIALS AND METHODS

### Plant material

The study was carried out on three enset landraces known by local names *Astara, Guarye* and *Kibnar* which are used in traditional medicine (for treating broken bones and bone fractures) and two other landraces (*Amerat* and *Yeshrakinqe*) that have other use values. The former is known for good quality product of enset, *kocho*, in terms of colour and taste, and the later produced for its high yielding and disease resistance character as presented in Table 1. For each landrace, corm samples from three plants at the commonly used age for traditional medicine (4-5 years) were collected from farmers' fields in Gurage zone, SNNP region of Ethiopia, in August 2016. To represent the different enset growing agro-ecology of the zone, the samples were collected from three different altitudes (1900, 2100 and 2300 m) above sea level, and to reduce soil nutrient effect, each replication was collected from one farm (when possible) or from two border farms.

### Sample preparation

The collected corm samples were washed, sliced into pieces (ca.5 mm) separately and dried in an oven (Binder GMBH, Model; M-115, Germany) at 70°C until constant weight was attained. The dried samples were then finely ground using laboratory miller and packed in airtight plastic cups. The samples were then stored in desiccators for further analyses at Ethiopian Public Health Institute and Addis Ababa University, Centre of Food Science and Nutrition laboratories.

### Proximate analysis

#### *Moisture content*

Moisture content was determined by the method of the Association of Official Analytical Chemists (AOAC) (2005), using the official method 930.15. After the cleaned and dried crucibles were placed in desiccators and weighed ($W_1$). The sample around 40 g was accurately weighed ($W_2$) in a previously weighed crucible and put in desiccators every step. Then the crucible with its content was put into an oven (Binder GMBH, Model; M-115, Germany) at 70°C for 42 h until constant mass was attained, and after cooling in desiccators to room temperature, they were weighted again ($W_3$). The moisture content was determined using the equation below:

$$\text{Moisture content in percent (\%)} = \left(\frac{W_2 - W_3}{W_2 - W_1}\right) \times 100 \qquad (1)$$

#### *Crude fibre content*

Crude fibre content was determined by the method of International Organization for Standardization (ISO 5498) (2002). A two-gram sample was transferred to 600 ml beaker and boiled with 200 ml 1.25% sulphuric acid for 30 min. After digestion by 20 ml 28% NaOH for 30 min, the mixtures were filtered through a crucible filled with a layer of sea-sand using a vacuum pump and the residues were washed with hot distilled water several times. The residue left was washed three times under vacuum, each time with 30 ml of 1% sulphuric acid solution and then distilled water, 1% sodium hydroxide solution and then distilled water and acetone and dried by suction. It was then dried at 130°C for 2 h, cooled in desiccators and weighed (W1). After incinerating the samples in a muffle furnace at 550°C for 2 h, they were cooled in desiccators and weighed again (W2). The total crude fibre was expressed in percentage as:

$$\text{Crude fibre} = \left(\frac{W_1 - W_2}{W_3}\right) \times 100 \qquad (2)$$

Where; $W_3$ is the weight of samples

#### *Ash content*

Ash was determined by the method of AOAC (2016), using the official method 923.03. Clean crucibles, dried at 100°C in an oven were cooled in desiccators and weighed ($W_1$). Then 3 g sample was weighed into a previously weighed crucible ($W_2$). Then crucibles with their contents were burned in a muffle furnace (Stuart SF, U.K) set at 550°C for 2 h until light gray ash resulted and then weighed (W3) after cooling. The weight of the ash was expressed as a

**Table 1.** Enset (*Ensete ventricosum*) landraces used for proximate, mineral and phytochemical composition analysis collected from SNNPR.

| S/N | Name of enset landrace | Major use | Predominant character | Collection zone |
|---|---|---|---|---|
| 1 | *Amerat* | food | good *kocho* quality | Gurage |
| 2 | *Astara* | food and traditional medicine | sweet corm | Gurage |
| 3 | *Guarye* | food and traditional medicine | sweet corm | Gurage |
| 4 | *Kibnar* | food and traditional medicine | sweet corm | Gurage |
| 5 | *Yeshirakinqe* | Food | high yielding and disease resistance | Gurage |

percentage of the initial weight of the sample as follows:

$$\text{Total Ash (\%)} = \left(\frac{W_2 - W_3}{W_2 - W_1}\right) \times 100 \quad (3)$$

***Crude protein content***

Crude protein was determined by the Kjeldahl method (AOAC, 2016), official method 2001.11. 1 g of the sample was weighed into a digestion flask and 12 ml of concentrated $H_2SO_4$ was carefully added to each flask and 3 ml of 30% hydrogen peroxide was added step by step after mixed carefully. As soon as a violent reaction ceased, the tubes were shaken and 3 g catalyst, a mixture of copper sulphate with potassium sulphate was added and digested by heating at 420°C. After the digestion had been completed, the digestion flasks were connected to a receiving flask containing 2% boric acid and indicators methyl red and bromocresol green. The solution in the digestion flask was then made alkaline by addition of 40% NaOH to liberate ammonia gas into receiving flask where it converts the boric acid to the borate ion. Finally, the distillate was titrated with standard 0.1 M HCl and crude protein content was calculated as total nitrogen, according to AOAC (2016).

***Crude fat content***

Crude fat was determined based on the Soxhlet extraction method (AOAC, 2003), using the official method 2003.06. After aluminium cups with boiling chips were dried in drying oven at 102 ± 2°C for at least 30 min, they were cooled in the desiccators to room temperature and weighed (W1). Five gram of sample was weighed into thimbles and extracted with 70 ml diethyl ether. After finishing the extraction process, the cups were removed from the extractor and dried in 102 ± 2°C oven for 30 min to evaporate the solvent. The extraction cups were cooled in desiccators for 30 min and weighed (W2) immediately after taken out from the desiccators. The fat obtained was expressed as a percentage of the initial weight of the sample using the formula:

$$\text{Crude fat (\%)} = \left(\frac{W2 - W1}{SW}\right) \times 100 \quad (4)$$

Where; SW is the weight of the sample

***Total carbohydrate content***

The percentage of total carbohydrate was determined by difference, which involves adding the total values of crude protein, crude fat, moisture and ash constituents of the sample and subtracting it from 100%. It is determined as follows:

$$\text{Total\% Carbohydrate} = 100 - (\%M + \%P + \%F + \%A) \quad (5)$$

Where; M = moisture, P = protein, F = fat and A= ash contents

**Mineral analysis**

Approximately 3 g of each powdered enset corm sample was ignited to ash at 550°C in a muffle furnace and dissolved in 20% HCl and boiled to bring the ash into solution form. The solution was cooled and filtered through a filter paper (42 mm Whatman) into 100 ml acid washed volumetric flask. The residue was dissolved and transferred to the volumetric flask and the volume was adjusted with distilled, deionised water. Blank solution was prepared in a similar way and the minerals calcium, magnesium, iron, zinc, manganese and copper were determined using atomic absorption spectrometer (Shimadzu, model AA-6800, Tokyo, Japan). Phosphorus was determined by using UV-VIS spectrophotometer (Thermoscientific model; evolution 220, USA) based on AOAC (1990), while, sodium and potassium contents were determined by employing flame photometry (Jenway model; pfp7, UK) as per (Osborne and Voogt, 1978).

**Phytochemical analysis**

Laboratory procedure for the determination of phytate was as outlined by Latta and Eskin (1980) and later modified by Vaintraub and Lapteva (1988). For analysis of phytate, the supernatant was extracted from 0.5 g sample with 10 ml of 0.2 N HCl and 2 ml wade reagent and then the absorbance at 500 nm was measured using spectrophotometer (Thermo Scientific model; evolution 220, USA). For analysis of tannin concentration, a supernatant was extracted from a 1 g sample and after centrifuging at 1000 g for 5 min, the solutions were mixed with 5 ml vanillin-HCl reagent. Then the absorbance was read at 500 nm on a spectrophotometer, based on Burns (1971) principle, as modified by Maxson and Rooney (1972).

**Statistical analysis**

The data determined on proximate, mineral and phytochemical contents of five enset landraces with three replications were subjected to analysis of variance using SAS statistical software, version 9.2 (SAS, 2002). When a significant difference existed between the landraces, comparisons of means were made using Duncan's multiple range test at 5% probability levels.

## RESULTS

In order to measure the difference in proximate, mineral

**Table 2.** The mean proximate composition (on dry matter basis) of corms of 3 enset landraces used in traditional medicine and 2 other landraces, for 3 replications.

| Enset landrace | Proximate composition (%) | | | | | |
|---|---|---|---|---|---|---|
| | Moisture content | Crude fibre | Ash | Crude fat | Crude protein | Total carbohydrate |
| Astara | 68.57[a] | 2.99[b] | 2.97[a] | 0.62[a] | 3.36[b] | 77.62[a] |
| Guarye | 65.30[a] | 2.93[b] | 2.64[a] | 0.62[a] | 4.06[ab] | 79.85[a] |
| Kibnar | 67.06[a] | 2.38[b] | 2.88[a] | 0.52[a] | 4.74[a] | 75.84[a] |
| Amerat | 69.06[a] | 4.43[a] | 2.22[a] | 0.64[a] | 3.37[b] | 79.39[a] |
| Yeshirakinqe | 71.94[a] | 2.87b | 3.22[a] | 0.56[a] | 2.42[c] | 77.49[a] |

Value with different superscript in the same column is statistically different at probability p < 0.05.

**Table 3.** The mean mineral composition of corms of three enset landraces used for traditional medicine and two other landraces that have other use values, for 3 replication.

| Enset landraces | Mineral composition (mg $g^{-2}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ca | Mg | P | K | Na | Fe | Zn | Cu | Mn |
| *Astara* | 114.27[a] | 14.31[a] | 127.41[a] | 1440.9[ab] | 21.06[a] | 2.83[a] | 8.52[a] | 0.80[a] | 0.92[a] |
| *Guarye* | 99.10[a] | 13.69[a] | 116.38[ab] | 1160.17[c] | 19.16[a] | 2.66[a] | 4.84[b] | 0.60[a] | 0.72[a] |
| *Kibnar* | 97.27[a] | 14.12[a] | 99.97[dc] | 1261b[c] | 14.58[a] | 2.05[a] | 5.06[b] | 0.53[a] | 0.62[a] |
| YK* | 101[a] | 12.99[a] | 111.31[bc] | 790.8[d] | 17.86[a] | 2.5[a] | 4.49[b] | 0.56[a] | 1.22[a] |
| *Amerat* | 114.1[a] | 15.52[a] | 94.76[d] | 1654.2[a] | 22.5[a] | 2.81[a] | 5.22[b] | 0.71[a] | 1.08[a] |

Value with different superscript in the same column are statistically different at probability $p < 0.05$, *YK =*Yeshirakinqe* landrace.

and phytochemical composition of enset corms, three landraces used in traditional treatment of bone fracture and related illness and two other purpose landraces were analyzed.

## Proximate composition

Analysis of variance showed significant differences ($p < 0.05$) only in crude fibre and crude protein contents of corms of enset landraces on a dry weight basis as presented in Table 2. The moisture content of the corm samples analyzed varied from 65.3-71.94%, while the crude fibre content was from 2.38-4.43%, significantly highest ($p < 0.05$) value (4.43%) was obtained from *Amerat* enset landrace as shown in Table 2. The ash and crude fat contents of the landraces ranged from 2.22-3.22% and 0.52-0.64% respectively as presented in Table 2. Significantly highest ($p < 0.05$) crude protein contents (4.74 and 4.06%), which are statistically at par, were obtained from the two enset landraces *Kibnar* and *Guarye* respectively, whereas, the lowest (2.42) from *Yeshirakinqe*, no significant difference was observed in the total carbohydrate content of the landraces as presented in Table 2.

## Mineral composition

Analysis of variance showed a significant difference ($p < 0.05$) only in phosphorus, potassium and zinc contents among the five enset landraces analyzed, whereas, no significant difference was observed in calcium, magnesium, sodium, iron, copper and manganese contents as shown in Table 3.

The calcium content of enset corm samples analyzed varied from 97.27 to 114.27 mg $g^{-2}$ and no significant difference was observed between the landraces used for traditional medicine and other types of landraces as presented in Table 3. The magnesium content ranged from 12.99 to 15.52 mg $g^{-2}$ and there was no significant difference among the landraces, whereas a significant variation ($p < 0.05$) in phosphorus content was observed as shown in Table 3. The highest phosphorus contents (127.41 and 116.38 mg $g^{-2}$) were found from *Astara* and *Guarye* landraces respectively, while the lowest (94.76 mg) from *Amerat* landrace.

Among the landraces, there was a significant difference ($p < 0.05$) in potassium content as shown in Table 3. The highest values (1654.2 and 1440.9 mg $g^{-2}$), which are statistically at par, were obtained from *Amerat* and *Astara* enset landraces respectively. On the other hand, the lowest value (790.8 mg $g^{-2}$) was obtained from the *Yeshirakinqe* enset landrace. The sodium content ranged from 14.58 to 22.5 mg $g^{-2}$ and there was no significant difference statistically, while iron content was in a range of 2.05 to 2.83 mg $g^{-2}$ as presented in Table 3.

Analysis of variance showed a significant difference ($p < 0.05$) in zinc content of enset landraces, the highest value (8.52 mg $g^{-2}$) was obtained from *Astara* landrace, while the remaining were statistically similar as shown in

**Table 4.** Comparison of some of the proximate and mineral composition of enset with other root and tuber crops.

| | proximate (%) and minerals (mg g$^{-2}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of food** | **Protein** | **Fat** | **Tot CHO** | **Calcium** | **Phosphorus** | **Iron** | **Zinc** | **Reference** |
| *Enset* corm | 2.4-4.7 | 0.5-0.6 | 75.8-79.9 | 97.3-114.3 | 94.8-127.4 | 2.1-2.8 | 4.5-8.5 | Present study |
| Sweet potato | 2.1-2.8 | 1.3-1.5 | 90-91.5 | 20.7-25.1 | 5.1-5.5 | 5.1-10.2 | 2.2-3.2 | Mitiku and Teka (2017). |
| Taro | 0.9-1.7 | 0.1-0.2 | 97.6-98 | 55 | Nd* | 2.95 | 1.67 | Alcantara et al. (2013) and Tattiyakul et al. (2006). |
| Yam | 3.1-5.4 | 0.3-1.2 | Nd* | 31-118.8 | 15.1-56.5 | 20.3-69.7 | 0.5-0.8 | Atnafua and Endashaw (2018). |
| Cassava | 1.2-1.8 | 0.1-0.8 | 80.1-86.3 | 32-44 | 98-118 | 0.6-7.8 | 0.7-2.0 | Rojas et al. (2007) and Charles et al. (2005). |
| Irish potato | 4.8 | 1.6 | 73.8 | Nd* | 14.4-35.8 | 1.7-16.4 | 0.8-2 | Abebe et al. (2012) Adegunloye and Oparinde (2017). |

Nd*= not determined.

**Table 5**. The mean phytate and tannin composition of corms of three enset landraces used for traditional medicine and two other landraces, for 3 replications.

| ***Enset* landrace** | **Phytochemical composition (mg g$^{-2}$)** | |
|---|---|---|
| | **Phytate** | **Tannin** |
| Astara | 172.06$^{a}$ | 65.23$^{bc}$ |
| Guarye | 149.33$^{a}$ | 50.48$^{c}$ |
| Kibnar | 166.04$^{a}$ | 153.94$^{a}$ |
| Amerat | 152.12$^{a}$ | 103.56$^{b}$ |
| Yeshirakinqe | 195.15$^{a}$ | 68.50$^{bc}$ |

Value with different superscript in the same column are statistically different at probability $p < 0$.

Table 3. The copper and manganese contents were in a range of 0.53-0.8 and 0.62-1.22 mg g$^{-2}$ respectively, with no significant difference among the landraces as presented in Table 3.

### Comparison of proximate and mineral composition of enset corm with other root and tuber crops

Some of the proximate and mineral compositions of enset corm obtained in the present study were compared with commonly used root and tuber crops (sweet potato, taro, yam, cassava and Irish potato) as reported in Table 4. The protein contents of enset (2.4-4.7%) were slightly lower than yam (3.1-5.4%) and Irish potato (4.8%), but it is better than sweet potato (2.1-2.8%), cassava (1.2-1.8%) and taro (0.9-1.7%). Total carbohydrate (75.8-79.9%) was comparable to Irish potato (73.8%) and cassava (80.1-86.3%), while it was slightly lower than taro (97.6-98%) and sweet potato (90-91.5%). The fat content of enset corm was lower than sweet potato, Irish potato and yam, while it was better than taro and cassava.

The calcium composition of enset (97.3-114.3 mg g$^{-2}$) obtained in the present study was superior to sweet potato (20.7-25.1 mg g$^{-2}$), taro (55 mg g$^{-2}$), yam (31-118.8 mg g$^{-2}$) and cassava (32-44 mg g$^{-2}$), as reported by different authors in Table 4. The phosphorus content (94.8-127.4 mg g$^{-2}$) of enset was also the highest of all root and tuber crops compared, while the zinc content (4.5-8.5 mg g$^{-2}$) of enset corm was extremely superior to all root and tuber crops. On the other hand, the enset corm showed inferiority in iron content as compared to all root and tuber crops as presented in Table 4.

### Phytochemical composition

The phytate contents of the five enset landraces corm ranged from 149.33-195.15 mg g$^{-2}$ but there was no significant difference among the landraces as shown in Table 5. Analysis of variance showed a significant difference ($p < 0.05$) among enset landraces in their tannin content as presented in Table 5. The highest tannin content (153.94 mg g$^{-2}$) was observed in *Kibnar* landrace, and it was followed by *Amerat* landrace. The remaining three landraces did not show a significant difference.

## DISCUSSION

### Proximate composition

The moisture contents obtained were by far lower than the value (85.92%) reported by Mohammed et al. (2013) for unspecified enset landrace, the variation could be due to varietal, age, harvesting period or environmental difference (Alphonse et al., 2018). The crude fibre contents obtained in the current study were slightly lower than the value (5.65%) reported by Mohammed et al. (2013) for unspecified enset landrace, whereas, quite lower than 17.4% reported by Tadessa and Masayoshi (2016) for *Naqaqa* enset landrace of unspecified age. The wider variations could be related to genotype growing, environment or harvesting period differences. The ash content was similar to the value (3.2%) reported by Tadessa and Masayoshi (2016) for *Naqaqa* enset landrace. Whereas, this finding was quite lower than the value (5.2%) reported by Forsido et al. (2013) for the *Nobo* enset landrace, the variation could be due to genotype, growing environment or harvesting period differences (Alphonse et al., 2018).

The current result on crude fat content was similar to the value (0.6%) reported by Tadessa and Masayoshi (2016) for *Naqaqa* enset landrace, whereas, Mohammed *et al*. (2013) reported 0.4%. On the other hand, relatively higher fat content (1.24%) of the *Nobo* enset landrace was reported by Forsido et al. (2013). The wider variation could be related to the difference in genotype, age, growing environment or harvesting period (Alphonse et al., 2018). The highest protein content was obtained from the two enset landraces used in traditional treatment of bone breakage (*Kibnar* and *Guarye)*. Probably this could be the reason for selective use of these landraces for the treatment of bone fracture and breakage, traditionally. Mohammed et al. (2013) reported comparable crude protein content of 3.33% to the current finding from corms of unspecified enset landrace. However, larger crude protein contents of 8.3% from *Naqaqa* and 8.23% from *Nobo* landraces were reported by Tadessa and Masayoshi (2016) and Forsido et al. (2013) respectively. In terms of total carbohydrate content, the current finding was superior to the value (64.8%) reported by Tadessa and Masayoshi (2016) for *Naqaqa* enset landrace. The variations could be related to genotype, environmental or harvesting period difference (Alphonse et al., 2018).

**Mineral composition**

As opposed to the hypothesis, no significant difference in calcium content was observed among enset landraces used for traditional medicine and the other landraces. Comparable calcium contents of 99.7 mg $g^{-2}$ from *Neqaqa* and 100 mg $g^{-2}$ from *Nobo* enset landraces were reported by Tadessa and Masayoshi (2016) and Forsido et al. (2013) respectively. On the other hand, Ajebu et al. (2008) reported calcium contents of ten enset landraces ranging from 50-200 mg $g^{-2}$ with an average calcium content of 130 mg $g^{-2}$. The variation could be related to the genotype or growing environment difference (Ajebu et al., 2008; Wekesa et al., 2014). As compared to the current finding, larger magnesium contents (63.2 mg $g^{-2}$) from *Naqaqa* and (60-260 mg $g^{-2}$) from ten different landraces were Tadessa and Masayoshi (2016) and Ajebu et al. (2008) respectively. The variations could be related to genotype or environmental difference (Ajebu et al., 2008; Wekesa et al., 2014).

The highest phosphorus contents were obtained from *Astara* and *Guarye* landraces, which are used in the traditional treatment of bone fracture and breakage. This could be the reason for the selective use of the landraces for the mentioned traditional medicine, as the presence of phosphate is crucial for bone growth and mineralization (Penido and Alon, 2012). The current finding was in line with different findings. Forsido et al. (2013) reported 90 mg $g^{-2}$ from Nobo landrace and Mohammed et al. (2013) reported 110 mg $g^{-2}$ phosphorus content of unspecified enset landrace. Whereas, Ajebu et al. (2008) reported in a range of 80-140 mg $g^{-2}$and average value of 120 mg $g^{-2}$ phosphorus content from ten enset landraces. According to Ajebu et al. (2008), the phosphorus content of corms from Astara landrace was 80 mg $g^{-2}$, which is quite lower than the current finding (127.41 mg $g^{-2}$); the variation could be due to the difference in the growing environment (Wekesa et al., 2014) or it may be related to giving the same vernacular name for different enset landraces (Endale, 1997).

Similar to the current finding, a wider variation in potassium content (860-3050 mg $g^{-2}$) of enset landraces was reported (Ajebu et al., 2008). According to Forsido et al. (2013), the potassium content was reported to be 2180 mg $g^{-2}$. In all cases, it was shown that enset corm is very rich in potassium content. The sodium content was in the same range with the values 4, 23 and 15 mg $g^{-2}$ reported by Ajebu et al. (2008) for ten enset landraces and Forsido et al. (2013) for *Nobo* landrace respectively. On the other hand, smaller value of 5.2 mg $g^{-2}$ for enset corms of *Neqaqa* and 3 mg $g^{-2}$ for unspecified enset landraces were reported by Tadessa and Masayoshi (2016) and Mohammed *et al*. (2013) respectively. These variations reported could be related to the difference in landrace, growing environment or age of sampled plants (Ajebu et al., 2008; Wekesa et al., 2014). The iron content of enset corm was found to be small in general, but it was higher than the value (0.7 mg $g^{-2}$) reported by Yewelsew et al. (2007) in boiled unspecified enset landrace. However, it was smaller than the value (12.3 mg $g^{-2}$) reported by Tadessa and Masayoshi (2016) for *Naqaqa* landrace. This variation could either be due to the genotype or growing environment difference (Ajebu et al., 2008; Wekesa et al., 2014) or boiling of the corm may result in the reduction of iron content (Bethke and Jansky, 2008).

*Astara* enset landrace was the best in zinc content of all other landraces. The selective use of this landrace in traditional treatment of bone fracture or breakage, probably related to its richness in Zn content, as scientific findings on the synergetic stimulatory effect of zinc on the healing of bone, was reported by Kaya et al. (2015). Lin *et al*. (2018) also reviewed that zinc plays a major role in regulating every phase of the wound healing process. The highest zinc contents (12.3 and 7.3-22.6 mg $g^{-2}$) of different landraces were reported by Tadessa and Masayoshi (2016) and Ajebu et al. (2008) respectively, while smaller value (1.33 mg $g^{-2}$) by Yewelsew et al. (2007). The variation could be related to the difference in genotype (Ajebu et al., 2008), the environment (Wekesa et al., 2014) or processing form (Bethke and Jansky, 2008).

The copper content was within a range of the findings (0.28-1.17 mg $g^{-2}$) reported by Ajebu *et al*. (2008) on ten enset landraces and it was comparable to the values (0.7 mg $g^{-2}$) from *Naqaqa* and (0.52 mg $g^{-2}$) from *Nobo* landraces reported by Tadessa and Masayoshi (2016) and Forsido et al. (2013) respectively. The current finding in manganese content was quite lower than the values (4.33 and 5.84 mg $g^{-2}$) reported by Mohammed et al. (2013) and Tadessa and Masayoshi (2016) respectively, the variation could be related to genotype or environmental difference (Ajebu et al., 2008; Wekesa et al., 2014).

### Comparison of proximate and mineral composition of enset corm with other root and tuber crops

As compared to other root and tuber crops, enset corm was found to be lower in protein, while comparable in total carbohydrate content as presented in Table 5. Traditional healers usually recommend the inclusion of animal products rich in protein, like milk, yogurt and meat together with enset corm for treating bone breakage; probably they have indigenous knowledge about the protein deficiency of enset products. It was also observed that enset corm showed a better performance in calcium content than most of the root and tuber crops, and the highest of all root and tuber crops compared in phosphorus contents. It was also extremely superior to all root and tuber crops in zinc content, while it showed inferiority in iron content as shown in Table 5. The zinc content of enset corm is even much higher than teff, which is known to have good zinc content (Tadessa and Masayoshi, 2016). In areas where enset serves as a staple food, therefore, strategic supplementation of foods rich in protein, fat and iron is required to alleviate the deficiencies.

### Phytochemical composition

Studies on phytate and tannin contents of on enset products are very scanty. Hiwot (2015) reported a lower phytate content (84.25-112.56 mg $g^{-2}$) of another enset product, *bulla*. Enset corm showed relatively higher phytate content than the value (115.43 mg $g^{-2}$) reported on taro (Gulelat et al., 2013). The highest phytate content may have an implication on human health. Although numerous studies have described the negative effect of phytate on the availability of minerals, a number of dietary components that can counteract its inhibitory effect were reviewed (Schlemmer, 2009). In addition to its calcification inhibitory effect, the author reviewed anticancer and antioxidative activities of phytate.

Recently, interest in food phenolic and tannins has increased greatly due to their antioxidant capacity and their possible beneficial implications in human health. The antimicrobial activities of tannins are well documented (de Sousa et al., 2015; Nouioua et al., 2016). The recommendation to consume *Kibnar* landrace corm at the first stage of bone illness treatment traditionally, is probably due to its highest tannin content, which would be important to protect infection. Haslam (1996) also reported that plants rich in tannins are used in traditional medicine as drugs for the treatment of various organic diseases, including the healing process of wounds, burns and inflammation.

## Conclusion

This study revealed that the three enset landraces (*Astara, Guarye and Kibnar*) used for traditional medicine are significantly different from the other two landraces used for other purposes, in protein, phosphorus, zinc and tannin contents in general; and *Astara* landrace is superior in most of the proximate and mineral contents. As compared to other root and tuber crops, enset showed the highest calcium, phosphorus and zinc content and comparable in protein and carbohydrate composition, while its iron and fat content was quite smaller. The selective use of *Astara, Guarye and Kibnar* landraces, rather than other landraces, for traditional treatment of bone fracture, bone breakage and joint displacement in enset growing society is probably related to their superiority in protein, phosphorus, zinc and tannin contents. As there is only little information on the composition of corms of enset landraces used in traditional medicine, this study can be an important input for future study and management the landraces.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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