

Assessment of Selected Proximate Composition and, Pb and Mn Level of Kocho and Bulla Enset Products Collected From Tepi, Southwestern Ethiopia

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ABSTRACT

This study focused on determination of selected proximate composition such as moisture content, ash content and organic matter as well as concentration of Pb and Mn in Kocho and Bulla samples collected from Tepi Town market. The samples have been purchased from Tepi market and analyzed for specified parameters in Mizan-Tepi University department of Chemistry laboratory. The result showed that moisture ($93 \pm 1\%$) and ($89 \pm 2.35\%$) in Kocho and Bulla respectively, while the ash content ($2 \pm 0.5\%$) and ($1 \pm 0.5\%$) in Kocho and Bulla respectively. On the other hand, heavy metals was found to be Pb 0.05 ± 0.89 in Kocho and 0.07 ± 1.44 in Bulla while Mn 0.05 ± 1.29 and 0.008 ± 0.23 respectively. In conclusion, varietal variation can affect proximate composition as well as the concentration of trace metal of the final product. This assessment can be the starting point for the selection of varieties of better nutritional value to reduce possible dietary insufficient uptake in the area.

Keywords: Enset; Kocho; Bulla; Pb; Mn

INTRODUCTION

Enset is the first important food source crop in Gurage, Kembata, Sidama, Gedio, Hadya, Jemjem and Arero zones. It is a second important crop as co-staple food in Wolaita, Gamo-Gofa, Kafa zones and Yem special wereda. It is planted as the third most important food crop in Wollega, Illubabora and in some parts of Southern region. In the second and third farming systems, cereals and other root crops take the primary and secondary importance [1].

The plant is perhaps the biggest vegetable of all and looks like a banana "tree." The food, however, comes mainly from the lower trunk, filled with starchy pith, which on the largest specimen can be a meter in diameter and three meters tall. A second food comes from underground, where a corm may be almost a meter long and a meter in diameter, packed with starch like some giant potato [2].

Plant products include a carbohydrate-rich food source (kocho, amicho and bulla) as well as fiber for making mats and rope. The edible parts are formed by the pseudo-stem and the underground corm rather than by the fruit. Nutrient value of starchy foods depends mainly on their nutrient content, physico-

chemical properties of their starches and the existence of anti-nutritional activities and toxic substances [3].

Enset food products are used as staple and/or costaple food for about 20% of the Ethiopian population [4], particularly in the southern, southwestern and western parts of the country. The corm and pseudostem of enset plant are traditionally processed into primary food product, kocho and Bulla. The process is an age-old technique in enset growing regions of the country and is still used without any scientific modification. However, the proximate, mineral and anti-nutritive values of enset products in many South western parts of the country, especially in Kafa and Sheka Zones has not yet been well studied and, therefore, the present study will be undertaken to investigate these parameters.

Products of enset

The major food obtained from the Enset plant are kocho, bulla and amicho, all of which are simple to produce once the plant is harvested, and can be stored for long periods without spoilage [5] and the byproducts of Enset plant are Eeko, Yaalimo (Kuuro), Fibers and Leaves are products that provides different benefits for users.

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Received date: December 02, 2021; **Accepted date:** December 16, 2021; **Published date:** December 23, 2021

Citation: Gelata SH (2021) Assessment of Selected Proximate Composition and, Pb and Mn Level of Kocho and Bulla Enset Products Collected From Tepi, Southwestern Ethiopia. J Nutr Food Sci. 11:247.

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Kocho

Kocho is bulky, chewy, fermented starch bread which is made from a mixture of the decorticated leaf sheaths and grated corm. Kocho can be stored for long period of time without spoilage. Kocho depends on the age of the harvested enset plant, the type of clone (variety), and the harvesting season. Moreover, within one plant, the quality is influenced by the part of leaf sheath and corm processed. The preferred type is white in color and is obtained from the innermost leaf sheaths and inner part of the corm, while the lowest grade is blackish and is obtained from the outer leaf sheath and corm.

Bulla

The milky white pulp, known as bulla, is obtained by laboriously scraping it off the inner leaf tissues. The best quality enset food is bulla, obtained mainly from fully matured plants. Bulla is the permissive food product of enset extracted from pseudostem and underground corm. Bulla is an unfermented product which can be dehydrated to powder form and prepared into several recipes. Bulla can be prepared as a pancake, porridge and dumpling.

Benefits of enset product

Food for human: Enset has the potential to provide a local solution, to improve food security and drought resistant. It has a good nutritional value. Enset flour is little more than starch, with minimal fat, protein and vitamins. Enset-based diets thus need heavy supplementation. However, at least one mineral occurs in reasonable quantities. The calcium content is said to be higher than that of other roots and bears. Fermentation increases protein content and slightly raises the levels of essential amino acid [6].

Enset as an animal feed: all parts of enset are good sources for animal feed. Especially during the dry season the domestic livestock are fed on remnants of enset parts, which are not normally eaten by humans. The leaves of enset can be used to make household goods like sleeping mats and feeding for livestock's [7].

Fiber use: the fiber from enset is used in the weaving of products such as shopping bags, handbags, suitcases, sieves, pouches and mats. The variety, the age of the plant, and the way in which the fiber is extracted and stored all determine its length and quality. Farmers strongly believe that fiber extracted from the male is of a very high quality and strength [7].

Medicinal uses: some enset farmers are believed that enset has medicinal value. Farmers use enset plants as medicines not only for human beings but also for their animals. Enset is a decorative plant that gives grace to the homesteads and is used as a shade for humans and domestic animals. It is also a good windbreak to protect the small grass roofed farmers' houses from strong wind, conserves soil and moisture [6].

Other uses: leafs can be used as an umbrella during rains, for serving oily food, for rapping butter, and spices, for sleeping and sitting. Stores water for small domestic animals like chicken at the bottom part of the loose leaf sheathes [8].

In fact, in Enset plantation areas, native soil has been altered for the better due to the long-term application of manure, natural mulching of leaf and stem residues, the rainfall capture from the plant leaves, and the resulting soil moisture conservation and reduced run-off when compared to bare earth farming. Enset plants, which are traditionally grown in small plantations adjacent to homesteads, can grow to a height of six metres, provide valuable windbreaks and shade from direct sunlight. Because of its large leafy fronds, it is also a good plant to intercrop with coffee, potato and other food crops, which benefit from shady growing conditions [5].

Proximate composition

Enset has been playing an important role as energy and a phytochemical source in human nutrition and animal feeding. This tuberous root is a rich source of carbohydrates, dietary fiber, vitamin A (as β -carotene), vitamin B6, vitamin C. On the other hand moisture content, ash content and organic matter parameters are also classified under proximate composition of the products.

Trace metals

Term "trace metal" refers metals which may be present in food in amount well below 50 mg/kg and which have nutritional significance. It includes sodium, potassium, calcium, phosphorus) and those iron, copper and zinc are found to be necessary in certain quantities in foods; the same elements cause ill effect when consumed at higher level. Hence determination of both major and minor trace level of metal content in food is important for both food safety and nutritional consideration [9].

The mineral contents of enset products vary widely due to numerous factors, such as disease, age of harvested enset, sanitation, soil contamination and others. The general chemical compositions of enset products are high in carbohydrate and low in protein and fat [2].

Minerals are inorganic substances found in the body and function in conjunctions with enzymes, hormones, vitamins and other compounds. They play important roles in nerve transmission, muscle contraction, blood formation and metabolism of macronutrients and energy production. Some minerals can either block or enhance absorption of other nutrients, including other minerals and some vitamins [10].

The present study was conducted to assess selected proximate composition and heavy mineral content of widely available Enset products collected from Tepi market.

METHODOLOGY

Study area

This study was conducted in Tepi South-West Ethiopia. Tepi is located around 611 km south west of Addis Ababa. It is situated at 7.2 degrees North latitude, 34.45 degree east longitude and 1097 meters elevation above sea level.

Sample collection

The samples were randomly purchased from Tepi area and transported to Chemistry laboratory for further analysis. For this purpose, both bulla and kocho samples were purchased and composited to get representative sample. Then it was dried by using sunlight, after that it was ground by using mortar and pestle and then it was stored in plastic bags.

Chemicals and reagents

All analytical grade reagents were used for this study. Aqua-regia was used for sample digestion. The standard solutions of both Pb and Mn have been prepared by diluting their respective 1000 ppm stock solutions to 100ppm. Then, working standards have been prepared by diluting these 100 ppm intermediate solutions to respective working standard. The working standards of Pb with 1 ppm, 2 ppm, 3 ppm and 4 ppm have been prepared while, for Mn 0.5 ppm, 1.5 ppm, 2.5 ppm and 3.5 ppm have been prepared for their AAS analysis. Both metals have been analyzed by FAAS equipped with deuterium arc background corrector and standard air-acetylene flame system using external calibration curve after the parameters optimized for maximum signal intensity of the instrument. The concentration of each mineral was determined from its calibration curve, and concentration was calculated by considering dilution factor and expressed for the dry basis.

The reagents were selected to ensure that the contents of the elements to be determined or of possibly interfering elements were negligible in relation to the lowest element concentration to be determined [11]. Distilled water was used throughout the experiment for sample preparation, dilution and rinsing apparatus prior to analysis.

Materials

Mortar and pestle were used to crush the sample into the powder, Electronic balance (F2204G) was used to measure the mass of the samples, and Bunsen burner was used to carbonize the samples. Muffle furnace (F30420C) was used to ash the samples and the digital bio base oven, was used to determine the moisture content of the sample. AAS (BUCK Scientific MODEL 210VGP) was used to measure the absorbance of the sample, besides different laboratory materials such as; Fume Hood (FH1800(X)), tongs, funnels, filter paper, flask, stove, measuring cylinder, beaker were also used.

Proximate composition analysis

Moisture content: The moisture content of the samples has been analyzed by oven drying method. 2 g samples have been dried in an oven at 105°C for 24 hr, and placed in desiccators to cool. Then, the moisture content was calculated as follows:

$$\text{Moisture (\%)} = \frac{M1 - M2}{M1} \times 100$$

Where, M1=mass (g) of samples and crucible after drying in oven

M2=mass (g) of samples and crucible before in oven

M3=mass (g) of sample before drying in oven

Total ash content: Ash content of the samples, were determined according to [12] method. Clean drying nickel crucibles were dried at 120°C in hot air oven and ignited at 550°C for 3 hrs in a muffle furnace. Then, 2 g of the samples were put in muffle furnace and ignited at 550°C, for 4 hrs. The residues were weighed. The total ash content was calculated as follow:

$$\text{Ash Content (\%)} = \frac{(M2 - M3)}{(M2 - M1)} \times 100$$

Where, M1=mass of the dried crucible, M2=mass of the crucible and the sample before ashing, M3=mass of the crucible and ash

Pre-conditions for determination of trace metals

Digestion of samples: The digestion optimization has been conducted to get clear and colorless solution to be injected to AAS. For this purpose the time, volume of reagents and mass of the samples have been optimized. Accordingly, different optimizations have been optimized.

Accordingly, different optimizations have been conducted and clear colorless solution was obtained by after digestion of 1 g of each samples by 14 mL of aqua-regia (HCl: HNO₃) at 250°C for 3 hrs. The optimum procedure was selected depending on minimum reagent volume consumption; digestion time and obtaining clear solution.

A reagent blank containing the same reagents subjected to the same digestion procedure was prepared for correcting effect of the blank. The reagent blank was run for each digested samples. Finally, the solutions have been filtered and diluted to 25 mL and then stored in refrigerator below 4°C.

Working standard solution preparation: Determination of the concentration of Mn and Pb metals were carried out by Atomic Absorption Spectrophotometer. The standard solutions of both metals have been prepared by diluting their respective 1000 ppm stock solutions to 100 ppm.

Then, working standards have been prepared by diluting these 100 ppm intermediate solutions to respective working standard. The working standards of Mn with 1 ppm, 2 ppm, 3 ppm and 4 ppm have been prepared while, for Pb 0.5 ppm, 1.5 ppm, 2.5 ppm and 3.5 ppm have been prepared for their AAS analysis.

Statistical data analysis

The data obtained from the analysis of all parameters were analyzed by using excel software.

RESULTS AND DISCUSSION

Parameters analyzed

Table 1: analyzed parameters.

Samples	Moisture content (%)	Ash content (%)
Kocho	93 ± 1	2 ± 0.5
Bulla	89 ± 2.35	1 ± 0.5

The moisture content of kocho and bulla in this study were found to be 93 ± 1 and 89 ± 2.35 respectively. These moisture content results are higher when compared with the moisture contents value (85.92%) obtained and reported [13] for unspecified enset landrace, the variation could be due to varietal, age, harvesting period or environmental difference [14]. This high moisture content because of the kocho and bulla collected from Tepi Town market and this area is one of the areas in Ethiopian known by getting high rainfall [15,16]. The ash content of kocho and bulla that were collected from Tepi market were 2 ± 0.5 and 1 ± 0.5 respectively [17]. These ash content were less than to the value (3.2%) reported [4] for Naqaqa enset landrace [18,19]. And also, this finding was lower than the value (5.2%) reported for the Nobo enset landrace, the variation could be due to genotype, growing environment or harvesting period differences [20,21]. The value of organic matter obtained in this study were (0.04 ± 0.01) and (0.02 ± 0.01) in kocho and bulla respectively [22]. These organic matter values agreed with the value (2-3%) or (0.02-0.03) obtained and reported [23,24].

Optimization of sample digestion

Table 2: Digestion optimization.

Trial	Weight of sample (g)	Volume of HCl (ml)	Volume of HNO ₃ (ml)	Total volume of aquaregia (ml)	Digestion temp (0c)	Digestion time (min)	Result
1	1	3	1	6	20	160	Yellowish solution with suspended matter
2	1	3	1	14	250	18	Clear colorless solution with no suspended matter
3	1	3	1	10	300	200	Yellow solution without suspended solid

For each kocho and bulla samples different digestion procedures using the mixture HCl and HNO₃ were conducted by varying volume of the mixture, digestion temperature and digestion time [25,26].

Heavy metals analysis by atomic absorption spectrometer

Table 3: AAS Optimization condition.

Metal	Wave length(nm)	slit width(nm)	Energy	Method	Current	Fuel-Oxidant ratio
Pb	283.2	0.70	2.887	Air/Acetylene Abs	2 mA	3:4
Mn	279.5	0.70	3.134	Air/Acetylene Abs	3 Ma	3:4

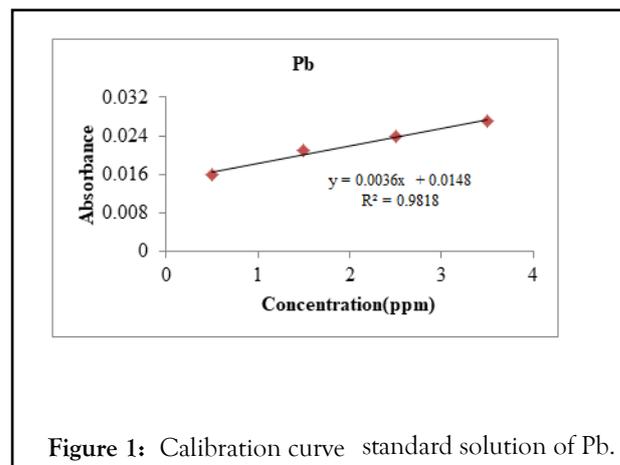


Figure 1: Calibration curve standard solution of Pb.

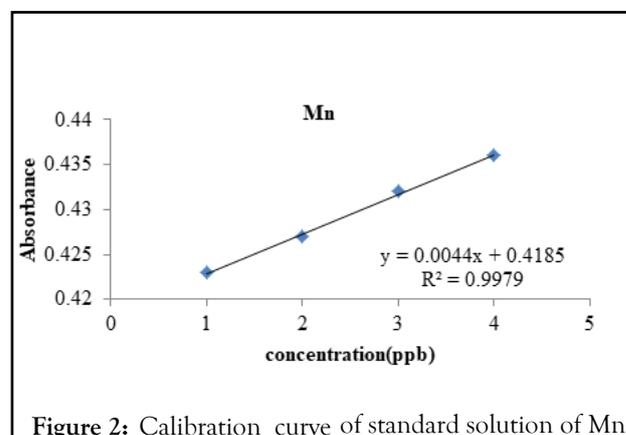


Figure 2: Calibration curve of standard solution of Mn.

Both metals have been analyzed by FAAS equipped with deuterium arc background corrector and standard [27,28], air-

acetylene flame system using external calibration curve after the parameters optimized for maximum signal intensity of the instrument [29]. The concentration of each mineral was determined from its calibration curve, and concentration was calculated by considering dilution factor and expressed for the dry basis [30,31].

Table 4: Metals concentration.

Samples	Pb(mg/gm)	Mn (mg/gm)
Kocho	0.05 ± 0.89	0.05 ± 1.29
Bulla	0.07 ± 1.44	0.008 ± 0.23
WHO/FAO Standards in food	0.1 mg/kg	0.2-0.4 mg/l

The Lead (Pb) Concentration of Kocho and Bulla in currently study were 0.05 ± 0.89 and 0.07 ± 1.44 respectively [32,33]. The result obtained less the value ranging between 3.7-7.2 and 2-16.3 respectively for Kocho and Bulla reported [34,35]. The Manganese (Mn) concentration of kocho and bulla in the samples were collected from Tepi market were 0.05 ± 1.29 and 0.008 ± 0.23 respectively [36,37]. The current finding in manganese content was lower than the values (4.33 and 5.84), the variation could be related to genotype or environmental difference. When the values obtained were compared with WHO/FAO standards it is agreed and lowers than that value in both kocho and bulla [38,39].

CONCLUSION

The sample of kocho and bulla were collected and analyzed for proximate analysis such as moisture content, ash content, and also analyzed for trace metal analysis such as Pb and Mn. The result obtained for all parameters agree with different international standards and the results obtained by other researchers. In addition to this the results of the analysis showed that Kocho and Bulla contains appropriate concentration of trace metals which are Pb and Mn. Their concentration was higher in Kocho when compared with Bulla. This is due to kocho is not purified as bulla, it contains high concentration and also kocho is fermented product from the corm and pseudostem but, bulla is dehydrated product of the juice from the decortication of the pseudostem and grating of corm.

- The results obtained by the current study shown that the kocho and bulla collected from Tepi market contain appreciable amount of nutritional values.
- In addition to this, we also recommend for the Pb and Mn concentration obtained in this study is agreed with WHO Standards, the Tepi population should use it to consume in day per intake as a nutritional, without any fear of healthy.
- We recommend also other researchers should work on enset for further study. We recommend finally in tepi area there is suitable condition for growing of enset so the society should have to increase the crop productivity of enset in order to ensure the supply of nutrition.

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