Effect of Clonal Variation on Quality of Kocho, Traditional Fermented Food from Enset (Ensete Ventricosum), Musaceae

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Abstract  Enset (Ensete ventricosum Welw. Cheesman) is an important multipurpose crop serving for a large part of the Ethiopian population living in the southern and southwestern parts of the country. Survey on indigenous knowledge of farmers on local system of selection and identification of enset varieties was carried out in three localities of Sidama zone, namely: Chafee Jebesa (3 km east of Hawassa), Tulla and Abella 13 and 16 km, respectively, (south of Hawassa) from November 2011 to July 2011. The main objective of the study was to evaluate the sensory characteristics in relation to a nutritional analysis of selected top ten enset varieties. Open – ended and semi-structured purposive questionnaires targeted on best varieties of enset commonly used in the above mentioned localities were used for the survey. The sensory characteristics such as appearance, odor, taste, sourness, dryness and texture of kocho samples prepared from each selected enset variety were evaluated using a sensory panel of judges. Nutritional analysis of the selected varieties was also carried out using Official Methods of Analysis (AOAC, 1984, 1990, 1995). The results of nutritional analysis revealed that there was no significant difference among the selected varieties in terms of their moisture and ash content. The values of moisture content ranged from 59.90 to 63.30% while ash content was between 2.11 to 2.35%. However significant differences have been observed among the selected varieties in terms of their protein (2.93 to 3.51%), fat (0.43 to 1.25%), fiber (3.22 to 4.57%) and carbohydrate (49.21 to 64.15%) content. This is mainly attributed to varietal differences among the selected enset plants. In conclusion, varietal variation can affect proximate composition as well as sensory characteristics of the final product. This investigation can be the starting point for the selection of varieties of better nutritional value to reduce possible dietary insufficient uptake particularly of proteins and calories in the area.

Keywords  Enset, Kocho, Proximate analysis, Sensory characteristics, Varieties

1. Introduction

1.1. Background and Justification

Enset (Ensete ventricosum (Welw.) Cheesman) is a perennial monocarpic, herbaceous plant belonging to the Musaceae family (Ajebu Nurjeta., et al., 2008; Welde-Michael,., et al., 2008). Enset traditionally is ranked first in importance as cultivated staple food crop in the highlands of central, south and southwestern Ethiopia (Berhanu Abegaz Gashe, 1987a; Almaz, 2001; Admasu, 2002). Kocho, the main food product derived from enset, is obtained by fermenting the mixture of the scraped pulp of the pseudostem, pulverized corm and stalks of the inflorescence (Berhanu Abegaz Gashe, 1987a; Pijls et al., 1995; Almaz, 2001). Whereas, bulla is another product of enset made entirely from the internal juice part of the pulp of the pseudostem.

Ensete ventricosum grows at altitudes of about 1500-3100 m above the sea level, an average rainfall of 1100-1500 mm per year and a mean temperature of 16-20°C with relative humidity of 60-80% (Memarua, 1995; Brandt et al., 1997). Some enset plants can be found also at lower altitudes (Admasu, 2002).

According to Mehtzin and Yewelsew (1994), enset grows as a tree, ranging from 4 to 11 meters in height to the tip of the leaves; its pseudostem (stem part) dilates at the base to a circumference of 1.5-3.0 meters. The dilated base provides the main yield (Mogessie, 2006). According to Mogessie (2006), the length of the pseudostem ranges from 2 to 5 meters depending on the clone and the ecological condition of its cultivation. Leaves are borne on the pseudostem almost from the same point and on short petioles (Figure 1), are 5 meters long and 0.75-1.5 meters wide (Brandt et al., 1997).
Mehtzun and Yewelsew, (1994), indicated that, the underground portion (corm) of enset consists of a corm which is 0.70-1.8 meters long with a circumference of 1.5-2.5 meters at maturity.

![Enset Plant Diagram](image)

**Figure 1.** The enset plant (adapted from: Brandt et al., 1997)

### 1.2. Varieties of enset

Morphological and genetic variability between the individuals of a population represents the main resource for selection, both natural and artificial. Any crop improvement program relies on the existence of sufficient variability in the crop (or population thereof) to be improved. Biologically, enset so called varieties are clones, i.e., vegetatively reproduced assemblages of individuals (Tesfaye Bezuayehu, 2008). In accordance with the International Code of Nomenclature for Cultivated Plants (ICNCP, 2016), the different varieties can be referred to as Clones or cultivars.

There are large numbers of enset varieties distributed in different regions of Ethiopia (Almaz Negash, *et al.*, 2002). According to Tesfaye Bezuayehu (2008), in the Sidama area, around 103 different enset varieties were recognized by the farmers. The report also showed that 79 of these represented actually grown varieties, whereas the rest were reported only verbally. Some enset clones are known by farmers to have medicinal value for both humans and animals (Brandt *et al.*, 1997).

Enset production involves transplanting of suckers originating from the mother corm in to field (Admasu, 2002). The report by Admasu (2002) showed that seeds are also used to produce seedlings in some parts of southern Ethiopia. Depending on ecology and variety, enset takes nine or more years to produce flowers and set seeds (Tesfaye Bezuayehu, 2008). According to this author, the communities that cultivate and use the crop in Ethiopia recognize and maintain a considerable assemblage of enset varieties. Other Studies indicated that, household wealth is also considered related to the number and diversity of enset varieties where enset is used as staple food (Almaz, 2001).

Enset can improve food security in enset growing areas of Ethiopia and also plays major economic and social roles. This plant is popular as staple food for millions of people in the southern and southwestern parts of the country. In addition, enset is a crop with many other uses, as for human food, for livestock feed, for industrial fiber, as binding material in fences and house-building, for mattresses and seats, as packaging material, and as substitute for plates or umbrellas.

The development of improved enset varieties and their dissemination to more enset growing regions is important particularly in relation to improvement of product quality and sustainability. Hence, research on this aspect is required. Although many studies [a shot gun sequence is available in gene bank (L.-F. Li *et al.*, 2010)] were conducted on this plant, less information is available on the role of locally maintained varieties contributing to the possible improvement of the quality of the final product. Therefore, this study was aimed at identifying the best enset varieties that mainly contribute for good quality of the final product, particularly in reference to the use as human food, to be recommended and selected as candidate varieties for the improvement of agriculture in selected localities of Sidama region.

### 2. Materials and Methods

#### 2.1. Description of the Study Area

The study was carried out in the proximity of Hawassa, capital city of the Southern Nations Nationalities and Peoples Regional State (SNNPRS), Ethiopia. It is located 273 km southern from the capital, Addis Ababa. The altitude of the town is 1697 m above the sea level, with mean annual temperature and rainfall of 20.9°C and 997.6 mm, respectively. The selected study localities in the Sidama Region were: Chafee Jebesa (3 km east of Hawassa), Tulla and Abella 13 and 16 km, respectively, south of Hawassa, where enset is used as staple food.

#### 2.2. Study Subject

Elder farmers and in many cases house wives in each selected locality of Sidama region were the main study subjects in this study to collect ethno-botanical data such as local names for the cultivated varieties, methods of varietal differentiation, sensory acceptability of each variety in the order of their importance, and other uses of different enset
varieties recognized by them. They were also asked to give information on other varieties which are grown in other localities of the Sidama region.

2.3. Study Design and Sample Size Determination

Systematic random sampling was carried out on the enset growing farmers and their housewives since November 2010 to July 2011 in three localities: Chafee Jebesa (3 km east of Hawassa), Tulla and Abella, respectively 13 and 16 km south of Hawassa. The selection was based on the availability and consumption of enset in these localities. All knowledgeable people in each locality were listed first and 30 from each locality were selected based on lottery method for the survey. A survey of the local system for enset varieties naming and selection was carried out using both open – ended and semi-structured purposive questionnaire. The socio-economic factors associated with the naming and selection of varieties for different purposes was also assessed during the survey. The different enset varieties were ranked as 1-10 based on their importance and acceptability in each locality. The first ten ranked varieties were considered as the top ten enset varieties contributing best to the quality of the final product. During processing of the selected clones, for Kocho production, traditional methods practiced by the Sidama women were followed throughout the experiment. In addition, the processors were interviewed in Sidamga (local language) for additional information.

2.4. Study Methodology

Both survey and experimental study were conducted in this study. Open – ended and semi-structured purposive questionnaires were used for the survey to obtain first hand information from the selected informants as described above. Experimental studies (sensory evaluation and proximate analysis) were carried out using standard techniques as described below.

2.4.1. Enset Sample Collection

A total of 10 enset varieties were collected from one of the selected locality of Sidama zone (Chafee Jebesa). For each variety, three enset plants were used randomly and processed independently following the traditional methods of kocho preparation in duplicate experiment. Then each experiment on each enset variety was carried out by allowing to ferment for one month using plastic buckets. After completion of the fermentation process, samples from each variety were taken for sensory evaluation and nutritional analysis.

2.4.2. Sensory Evaluation of the Final Baked Product (kocho)

Panels of 12 consumer-oriented judges, students and staff members of the University of Hawassa were recruited to evaluate the organoleptic characteristics of baked kocho from each enset variety. Most of them had participated in a laboratory course on sensory evaluation methods and products of enset like kocho, bulla etc. and were familiar to all of them. The panelists evaluated the different organoleptic characteristics such as; appearance, odor, taste, sourness, dryness and texture (mouth feeling) following standard sample presentation, coding, scoring and data collection (Heymann and Lawless, 1999).

Each baked sample was cut into pieces of similar size corresponding to the number of panelists in three replications. Each piece was presented in identical sample trays coded with 3-digit random numbers in a randomized order within and between the pairs. Finally, the panelists ranked each organoleptic characteristics using a 5-point category scale from 1 to 5 [1 = poor; 2 = fair; 3 = good; 4; very good and 5 = excellent as in Heymann and Lawless (1999)] on the scoring sheet.

2.4.3. Proximate Analysis

2.4.3.1. Moisture Content

The moisture content was determined using triplicate samples in crucibles (as the method described by AOAC (1990). Known quantities of the samples were oven dried at 105°C for 1 h and allowed to cool in desiccators. The weight of the dried samples were recorded and calculated as:

\[
\text{Moisture content (\%) } = \frac{(W_1 - W_2) \times 100}{W_1}
\]

Where \( W_1 \) = weight of fresh sample; \( W_2 \) = weight of dried sample.

2.4.3.2 Crude Protein Content

The crude protein content was determined using Micro Kjeldahl method as described by AOAC (1990). 2 g of material were digested by adding 5 ml of concentrated sulfuric acid, in the presence of potassium sulfate catalyst in a Kjeldahl flask. The digested solution was then diluted with 30 ml of distilled water to carry out neutralization. 25 ml of NaOH (40%) was added to the digest in the distillation jacket to neutralize the sulfuric acid. 50 ml of 40% boric acid was measured into two 250 ml conical flasks labeled A and B, respectively, four (4) drops of methyl red indicator was added each. The conical flasks containing the mixture were placed onto the distillation apparatus with the outlet tubes inserted into each conical flask and NH\(_3\) was collected through the condenser. The distillation continued until 25 mL of the distillate were trapped into the boric acid solution and color changes from red to yellow. The distillates were then titrated with 0.02 M HCl and the titre values were recorded. Percentage of crude protein was calculated as total nitrogen.

2.4.3.3. Fat Content

Fat content was determined according to the method described by AOAC (1984). A 3 g dried sample of kocho was extracted with 100 ml petroleum ether, for a minimum period of 4 hrs in the soxhlet extractor. The solvent was then evaporated by heating on a steam bath. The flask containing the extracted fat was dried on steam bath to a constant mass.
The total crude fat was calculated as percentage by weight:

\[
\text{Crude fat, percent by weight} = \frac{(W_2 - W_1)}{W} \times 100
\]

Where, \( W_1 = \) weight of the extraction flask
\( W_2 = \) weight of the extraction flask plus the dried crude fat (g)
\( W = \) weight of the sample.

2.4.3.4. Fiber Content

Crude fiber was determined using the method described by AOAC (1990). A 2 g kocho sample was transferred to 400 ml beaker. It was digested with 1.25% sulfuric acid and washed with distilled water. Then the solution was again digested by 1.25% NaOH, thereafter, the sample was filtered in coarse porosity crucible in apparatus, at a vacuum of about 25 mm Hg. The residue was washed again with 1.25% sulfuric acid. The residue was then dried at 95°C overnight, cooled in desiccators, and weighed (M1). After mashing for 2 hrs at 500°C, it was cooled in desiccators, and weighed again (M2). The total crude fiber was expressed in percentage as:

\[
\text{Total crude fiber (\%) } = \frac{M_1 - M_2}{M_3} \times 100
\]

Where \( M_3 \) is the weight of sample.

2.4.3.5. Ash Content

Ash content was determined using the method described by AOAC (1995). Drying crucibles were oven dried at 120°C in hot air oven and ignited at 550°C for about 3 hours in a muffle furnace (MF 120, nuve, Kabul, Turkey). They were allowed to cool in desiccators and weighed using analytical balance. 2 gram of the sample was put and weighed (M2). The sample was dried at 105°C for 1hr and carbonized by blue flame of Bunsen burner, until the contents turn black. The dish with its contents was transferred to a muffle furnace and ignited at about 550°C, until washing was complete. The residue was weighed (M3). The total ash was expressed as percentage on dry basis as follows:

\[
\text{Total Ash (\%) } = \frac{M_3 - M_1}{M_2 - M_1} \times 100
\]

2.4.3.6. Carbohydrate Content

Total carbohydrate content was determined by difference. The sum of the percentage moisture, ash, crude lipid, crude protein and crude fiber was subtracted from 100% Carbohydrate = 100 - (% moisture + % ash + % protein + % lipids + % fiber).

2.5. Data Management and Analysis

The collected data were double entered into the excel spread sheet and verified prior to analysis using STATA version 8.0. The cleaned and verified data were analyzed using STATA version 8 and SPSS version 15. Data analyses were at 95% confidence interval with marginal error of 5%. Tables and proportions were used for result presentation.

3. Results

3.1. Survey in the Study Area

Sidama farmers use phenotypic differences like leaf color, pseudo stem color, midrib color, pseudo stem length, size, fiber quality, time to maturity etc. to differentiate one variety from the other. In this study, a total of 66 locally recognized enset varieties were assessed during the survey in three selected localities of the Sidama region: Chefe Jebesa, Tulla and Abella. Among all these varieties, ten were selected based on their acceptance by the farmers as those considered of highest quality as food. These were WaniKore, Medicha, Geena, Addo, Dowiramo, Haaho, Sediso, Damala, Birra and Chacho. Most of these varieties are common in the three survey sites. We verified that the names of some enset varieties were used interchangeably in different localities of Sidama region in reference to a single enset variety. E.g. Medicha is known as Genticha in Tulla and in Abella. Previous reports also indicated that, exchange of clones among farmers has not been restricted to single zones or similar environmental conditions or geographical distances. The abundance and distribution of varieties differs from household to household and from locality to locality.

3.2. Descriptive Sensory Analysis

The mean scores given by the panelists to each of the attributes evaluated in different enset varieties are shown in table 1. A comparison of the sensory taste characteristics of the varieties revealed significant differences (P ≤ 0.05) between them for most of the evaluated sensory attributes (appearance, odor, and taste). The variety, WaniKore accounted for the highest scores for the attributes appearance, odor, taste, sourness, dryness and texture compared to the remaining varieties (Table 1). The scores for sourness, dryness and texture did not differ significantly (p ≥ 0.05) among all enset varieties (Table 1).

3.3. Proximate Composition Analysis

Proximate (nutrient content) analysis in the finding of this study indicated that, there was no significant difference in moisture ash content among the varieties (Table 2). Proximate compositions of protein, fat, fiber, and carbohydrate contents revealed significant differences among the varieties. The highest values of most of the proximate compositions were obtained from kocho sample taken from WaniKore variety, while the lowest values were recorded from kocho sample taken from Chacho variety. Similarly the respondents during survey responded that is WaniKore known for its good quality of the final fermented product.
The survey of this study has shown that there is diversity of enset varieties known by farmers in Sidama. This reveals that there is existence of variation among varieties in terms of their phenotypic as well as genotypic characteristics. Farmers use phenotypic differences like leaf color, pseudo stem color, midrib color, pseudo stem length, size, fiber quality, time to maturity etc. to differentiate one variety from the other. This phenotypic selection results in the increased variation with respect to agro ecological conditions of the three localities might also affect the contents of each variety. In addition, according to Ajebu Nurjeta, et al. (2008), varietal diversity enset affects chemical composition. The highest score was given to the variety wankiroke for most of sensory attributes evaluated. This is most likely attributed to the high content of proximate compositions. The slight variation with respect to agro ecological conditions of the selected enset varieties might affect the nutritional contents of the processed varieties. The slight variation with respect to agro ecological conditions of the three localities might also affect the contents of each variety. In addition, according to Ajebu Nurjeta, et al. (2008), varietal diversity enset affects chemical composition. The highest score was given to the variety wankiroke for most of sensory attributes evaluated. This is most likely attributed to the high content of proximate compositions. The survey also confirmed that the variety wankiroke is ranked first by the consumers in terms of its acceptability. The scores for sourness, dryness and texture did not show significant difference among the selected enset varieties. This is most likely due to the fact that all the selected varieties were processed the same day, and fermented for equal duration of

### Table 1. The mean scores* (± SE) of the sensory attributes of each enset variety

<table>
<thead>
<tr>
<th>Name of varieties</th>
<th>Appearance</th>
<th>Odor</th>
<th>Taste</th>
<th>Sourness</th>
<th>Dryness</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wankiroke</td>
<td>3.71 (0.00)*</td>
<td>3.43 (0.06)*</td>
<td>3.56 (0.19)*</td>
<td>2.14 (0.22)*</td>
<td>2.10 (0.14)*</td>
<td>3.82 (0.17)*</td>
</tr>
<tr>
<td>Medicha</td>
<td>3.42 (0.32)*</td>
<td>3.37 (0.02)*</td>
<td>3.37 (0.11)*</td>
<td>2.42 (0.32)*</td>
<td>2.63 (0.21)*</td>
<td>3.68 (0.12)*</td>
</tr>
<tr>
<td>Geena</td>
<td>3.56 (0.40)*</td>
<td>3.36 (0.07)*</td>
<td>3.03 (0.12)*</td>
<td>2.50 (0.12)*</td>
<td>2.44 (0.11)*</td>
<td>3.56 (0.11)*</td>
</tr>
<tr>
<td>Addo</td>
<td>3.11 (0.01)*</td>
<td>3.19 (0.06)*</td>
<td>2.99 (0.31)*</td>
<td>2.34 (0.01)*</td>
<td>2.31 (0.01)*</td>
<td>3.52 (0.16)*</td>
</tr>
<tr>
<td>Dowiramo</td>
<td>3.33 (0.13)*</td>
<td>3.32 (0.09)*</td>
<td>2.96 (0.23)*</td>
<td>2.25 (0.00)*</td>
<td>2.10 (0.01)*</td>
<td>3.43 (0.04)*</td>
</tr>
<tr>
<td>Haaho</td>
<td>3.17 (0.15)*</td>
<td>3.10 (0.03)*</td>
<td>2.91 (0.01)*</td>
<td>2.94 (0.00)*</td>
<td>2.66 (0.13)*</td>
<td>3.33 (0.11)*</td>
</tr>
<tr>
<td>Sediso</td>
<td>3.32 (0.07)*</td>
<td>2.96 (0.13)*</td>
<td>2.84 (0.15)*</td>
<td>2.60 (0.12)*</td>
<td>2.13 (0.15)*</td>
<td>2.99 (0.02)*</td>
</tr>
<tr>
<td>Damala</td>
<td>2.51 (0.32)*</td>
<td>3.07 (0.01)*</td>
<td>2.43 (0.20)*</td>
<td>2.75 (0.04)*</td>
<td>2.89 (0.04)*</td>
<td>3.09 (0.22)*</td>
</tr>
<tr>
<td>Birra</td>
<td>2.94 (0.27)*</td>
<td>2.81 (0.30)*</td>
<td>2.50 (0.33)*</td>
<td>2.80 (0.11)*</td>
<td>3.10 (0.71)*</td>
<td>2.87 (0.25)*</td>
</tr>
<tr>
<td>Chacho</td>
<td>2.70 (0.21)*</td>
<td>2.83 (0.15)*</td>
<td>2.54 (0.01)*</td>
<td>2.16 (0.03)*</td>
<td>2.82 (0.31)*</td>
<td>2.96 (0.14)*</td>
</tr>
</tbody>
</table>

* Values are means ± SE of triplicate determinations.

### Table 2. Mean Values (± SE) of proximate composition of selected enset varieties (dry weight basis)

<table>
<thead>
<tr>
<th>Name of varieties</th>
<th>Moisture (%)</th>
<th>Protein (%)</th>
<th>Fat (%)</th>
<th>Fiber (%)</th>
<th>Ash (%)</th>
<th>Carbohydrate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wankiroke</td>
<td>60.82 (0.17)*</td>
<td>3.51 (0.00)*</td>
<td>1.08 (0.01)a</td>
<td>3.22 (0.02)*</td>
<td>2.34 (0.02)*</td>
<td>54.30 (0.04)*</td>
</tr>
<tr>
<td>Medicha</td>
<td>61.46 (0.03)*</td>
<td>3.46 (0.02)*</td>
<td>0.79 (0.21)b</td>
<td>3.31 (0.05)*</td>
<td>2.23 (0.11)*</td>
<td>49.21 (0.12)*</td>
</tr>
<tr>
<td>Geena</td>
<td>60.53 (0.26)*</td>
<td>3.43 (0.05)*</td>
<td>1.10 (0.02)a</td>
<td>3.83 (0.11)*</td>
<td>2.33 (0.03)*</td>
<td>53.50 (0.19)*</td>
</tr>
<tr>
<td>Addo</td>
<td>60.26 (0.30)*</td>
<td>3.48 (0.02)*</td>
<td>0.67 (0.05)b</td>
<td>3.75 (0.31)*</td>
<td>2.19 (0.10)*</td>
<td>57.20 (0.71)*</td>
</tr>
<tr>
<td>Dowiramo</td>
<td>62.41 (0.22)*</td>
<td>3.48 (0.04)*</td>
<td>1.25 (0.00)a</td>
<td>3.62 (0.08)*</td>
<td>2.35 (0.35)*</td>
<td>51.61 (0.00)*</td>
</tr>
<tr>
<td>Haaho</td>
<td>60.00 (0.13)*</td>
<td>3.13 (0.01)c</td>
<td>0.91 (0.12)ab</td>
<td>4.51 (0.10)*</td>
<td>2.15 (0.18)*</td>
<td>64.15 (0.11)*</td>
</tr>
<tr>
<td>Sediso</td>
<td>63.30 (0.11)*</td>
<td>3.15 (0.08)bc</td>
<td>0.46 (0.07)c</td>
<td>4.35 (0.20)*</td>
<td>2.11 (0.15)*</td>
<td>57.17 (0.05)*</td>
</tr>
<tr>
<td>Damala</td>
<td>60.52 (0.48)*</td>
<td>2.93 (0.03)*</td>
<td>0.44 (0.04)c</td>
<td>3.48 (0.13)*</td>
<td>2.26 (0.12)*</td>
<td>62.20 (0.33)*</td>
</tr>
<tr>
<td>Birra</td>
<td>59.90 (0.74)*</td>
<td>3.37 (0.05)*</td>
<td>0.46 (0.04)c</td>
<td>4.43 (0.30)*</td>
<td>2.18 (0.11)*</td>
<td>58.64 (0.04)*</td>
</tr>
<tr>
<td>Chacho</td>
<td>61.06 (0.50)*</td>
<td>2.98 (0.13)bc</td>
<td>0.43 (0.13)bc</td>
<td>4.57 (0.01)*</td>
<td>2.17 (0.20)*</td>
<td>59.18 (0.04)*</td>
</tr>
</tbody>
</table>

Values are means ± SE of triplicate determinations.

4. Discussion
time and baked and presented to the panelists at the same time. Therefore, a significant difference of the sensory attributes: sourness, dryness and texture could not be expected.

The results of proximate analysis (Table 2) indicated that, there was no significant variation among varieties on moisture content of kocho samples taken from each selected variety. This is possibly due to equal amount of initial moisture content, since all the selected varieties are processed at the same time with a similar method of processing and allowed to ferment for the same duration of time. The ash content, which is a subset of the mineral elements in the sample did not also differ significantly among the samples taken from each selected enset variety. This is attributed to similar fermentation time. Since fermentation influences the solubility of mineral elements and of the organic constituents, it directly contributes to the ash composition and quantity of kocho. This is in agreement with studies made on different varieties of cassava (Eleazu, 2012; Kenneth, 2013; Carola et al., 2007; Sarkiyayi and Agar, 2010).

The protein content of kocho samples taken from each variety, varied significantly. This could be possibly due to varietal differences among the selected enset plants. This is in agreement with studies carried out on cassava varieties by Carola et al., (2007). In addition to varietal differences, Apea-Bah et al., (2011) also reported that age of the plant significantly affected (p<0.05) crude protein content i.e. the younger plants contain more crude protein than the older ones. This report indicated that this may be due to differing rates of nitrogen metabolism in the growing plants resulting in differing amount in crude protein content at the time of harvest.

Crude fat content of each sample has also shown significant variation among the selected enset varieties. This could be attributed to genetic diversity among the selected enset varieties. Generally, enset plat has lower fat content as compared to other proximate analysis studied in this experiment. In previous studies (Akpabio et al., 2012) a lower amount of fat content has been reported in a similar plant (cassava). Some of the samples also showed variation on crude fiber content. The observed differences may be related to genetic differences among the selected enset varieties. The samples taken of each variety showed high values of carbohydrate content. This confirmed that enset products are a good source of energy for human as well as animal food. The variation in the carbohydrate content might be attributed to varietal differences. This could confirm the works of other researchers who carried out proximate analysis of other tubers like cassava in comparison to enset (Sarkiyayi and Agar, 2010; Akpabio et al., 2012; Chukwuneke et al., 2013, Kenneth, 2013).

5. Conclusions and Recommendations

This study has shown that noteworthy variation at the level of cultivated varieties of enset can affect some sensory characteristics such as appearance, odor and taste as well as proximate compositions such as protein, fat, fiber and carbohydrate content of the derived kocho prepared from each selected enset variety. It may be concluded that selection of appropriate varieties could contribute to the overall quality of food products prepared from enset plants. The low protein content of all varieties suggests dietary supplementation with foods with higher protein content. Additional research is also necessary, to distinguish between the effect of genetic variation and that of other factors, such as climate, altitude, soil composition and water availability. An important aim is to select the best enset varieties to conserve them as germplam for feasible production of enset products also in the future. In addition, further focus is needed to collect and evaluate the sensory and nutritional analysis of other enset varieties. This will help to ensure food security as well as development of better enset varieties to improve the nutritional content of the final products.

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