Traditional *Enset (Ensete ventricosum)* Processing Techniques in Some Parts of West Shewa Zone, Ethiopia

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ABSTRACT

Enset, (Ensete ventricosum Welw) Cheesman, plant serves as a staple food for about 20% of Ethiopian population. Processing of enset for food is based on traditional knowledge of the people and varies among different enset growing regions. The objective of the present study was, therefore, to assess and document indigenous knowledge of traditional enset processing method in one of enset growing areas of West Shewa Zone, Ethiopia. The study was conducted using Participatory Research Appraisal (PRA) system. which involved 132 respondents in the high altitude and 126 in the mid-attitude sites. The major processing steps, including, the traditional tools used, selection of mature enset plants, preparation of fermentation pits and clearing of processing spots, pulverization and decortication, bulla extraction, gamma preparation, storage of processed biomass in the pit were described. Matured enset plants were identified by locally established maturity signs, such as, size of the central shoot, appearance of inflorescence and exposure of the corm. Among the respondents, 62.1% of those in the high altitude and 93.6% in the mid altitude areas affirmed that enset plant

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reaches maturity between the age of four and seven years, while the remaining of the respondents claimed that it takes eight or more years to reach maturity. Traditionally, enset fermentation takes place in an earthen pit. October to early December was considered to be the appropriate time for processing. Traditional knowledge of enset processing has been generally owned by women and the processing is normally unthinkable without them, signifying their role in securing food supply for the households. Traditional enset processing is tedious, labour intensive, unhygienic and is done using local tools with a lot of similarities in basic steps of processing among different localities. This age-old processing of enset would require the concerted effort of food microbiologists and food processing technologists to lessen the pressure on women and to avoid spoilage during fermentation in order to produce wholesome products. The important traditional practices of enset processing that have been revealed during the present study could be utilized as an information to improve the traditional processes, thus, eventually contributing to food security.

Key words: *Enset ventricosum,* fermentation, traditional processing, women

Introduction

Enset, (Ensete ventricosum Welw) Cheesman, is known to exist in Asia and Africa (Gebremariam, 1993) but it is cultivated as a food source in Ethiopia (Morpurgo *et al*., 1993). *Enset* food products are used as staple and/or co-staple food for about 20% of the Ethiopian population (Brandt *et al*., 1997), particularly in the southern, southwestern and western parts of the country (Sisay and Birhanu, 2006; Brandt *et al,* 1997; Rahmato, 1993; Pankhurst, 1993).

The corm and pseudostem of *enset* plant are traditionally processed into primary food product, *kocho.* The process is an age-old technique in *enset* growing regions of the country and is still used without any scientific modification. Some of the steps in the traditional *enset* processing techniques differ among regions and even among localities (Tedla and Abebe, 1994; Gebremariam, 1993). Thus accurate understanding of these processes in all *enset* growing regions can help refine, improve, standardize and increase the utilization of the process in order to contribute to food security of the country (Anon, 1992). Traditional *enset* processing in Sidama and Wolayita (Southern Ethiopia) has been reviewed by Tedla and Abebe (1994). However, the processing in other parts of the country, especially in western Ethiopia has not yet been well studied and, therefore, the present study was undertaken to investigate these processes in West Shewa Zone of the country.

Materials and Methods

The study was undertaken in enset growing areas of West Shewa Zone of Oromia Regional State, Ethiopia. It was conducted using Participatory Research Appraisal (PRA) (Belay *et al.* 2008) method by actual follow-up of the process. For the actual follow-up of the study, two localities within the *enset* growing areas of the zone, Wonchi locality (2908 masl) for the high altitude and Awaro locality (2252 masl) for the mid-altitude were selected. In each locality, one cooperative and outstanding farmer who owned mature *enset* plants who was willing to sell his plants and had allowed the use of his yard for the study was selected. At the same time, eight women from high attitude and six from the mid-altitude areas, who were considered by the society to be well experienced and knowledgeable about the process were selected for undertaking the traditional enset processing operation. After selecting a total of fifteen mature enset plants (9 in high altitude, 6 in mid-altitude) the processing activity had continued by following each step and by recording all pertinent information through interviewing the women at each site. Tools used for the processing were characterized and their particular uses were recorded.

Additional information was collected from groups in different enset growing areas of the zone, from women organized to work together in their own yards for comparison and confirmation with the actual follow-up study. A total of 132 and 126 women, including those who participated in the actual study were interviewed in high and mid-altitudes, respectively. Data were analyzed using Microsoft Excel 2007.

Result and Discussion

Traditional equipment used in *enset* processing

1. *Watani*

It is a flat locally prepared wooden board about 2 m long and 25-30 cm wide (Figure 1a). *Watani* is inclined against a standing *enset* plant at about 45-60^{o}. A pseudostem to be decorticated is placed on the slanted *watani* and fixed at the middle by the raised heel of a decorticating woman.

2. *Javga*

It is a wooden equipment prepared locally with two ends of different functions (Figure 1b). One end is serrated and used to pulverize the corm and to macerate the contents of *bolla gamma* during *gamma* preparation. The flat end is about 10 to15 cm wide and 50 to 70 cm long, and is pointed at the apex. This end of *javga* is used to smash the lower piece of the pseudostem and to make *bolla gamma.* The total length of *javga* is about 1m, and is handled between the serrated and the flattened ends.

3. ***Sibisa***

It is a longitudinally split bamboo, about 50 cm in length (Figure 1c), and is used to scrap the fleshy part of enset leaf sheath. *Sibisa* is handled at both ends while scrapping the leaf sheath.

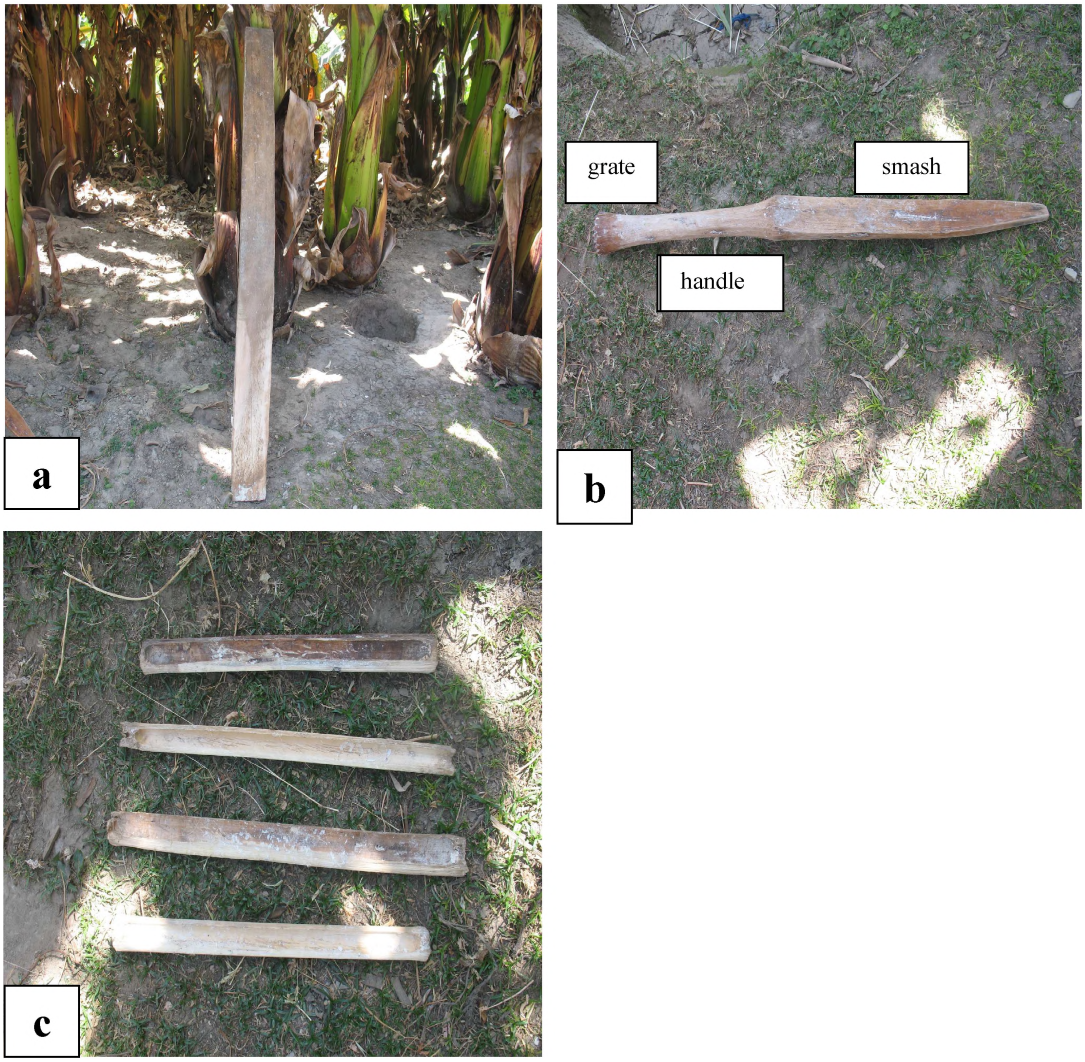

Fig. 1. Enset processing equipment: a) *watani*; b) *javga;* c) *sibisa*

The period for *enset* processing

Enset processing mainly takes place from October to early December and occasionally from May to mid June. According to all respondents, *enset* can be processed throughout the year as long as fresh *enset* leaves are available for use at some critical steps during the processing. *Enset* growers in the high altitude area process *enset* almost throughout the year since *enset* plants retain sufficient number of leaves for the whole year. However, rainy season is not preferred for processing as the area becomes muddy and occasionally flooded. However, under extreme situation, like food shortage in the household, processing is practiced during rainy season as well by preparing fermentation pits on an elevated ground, carefully covering the opening of the pit and constructing drainage furrow around it to avoid flood water from entering.

Traditional processing procedures

Identification of mature *enset* plant, preparation of fermentation pit and the processing area, pulverization and decortication, *bulla* extraction, preparation of fermentation enhancer *(gamma),* fermentation of the pulverized mass in the pit, and continuous stirring and check-up of the fermenting mass were identified as major steps of enset processing in some parts of West Shewa zone.

1. Identification of mature *enset* plants

The study showed that, 62.1% of the interviewed women in the high attitude and 93.6% of those in the mid-altitude sites revealed that *enset* plants reached maturity between the age of four and seven years and sometimes even more (Table 1).

Table 1. Farmers' response on harvest maturity period of *enset* plant

	High altitude		Mid- altitude		Average	
Questions	No. of respondents	Percent of respondents	No. of respondents	Percent of respondents	respondents	No. of Percent of respondents
Time to enset harvest maturity						
< 3 years						
4 -5 years	9	6.8	45	35.7	27	21. 25
6 -7 years	73	55.3	73	57.9	73	56.6
> 8 years	50	37.8	8	6.3	29	22.05
Total number of respondents (n)	132		126		129	
Maximum period between appearance of maturity signs and harvesting						
< 1 year						
< 8 months	128	97.0	87	69.0	108	83
< 6 months	4	3.0	39	31.0	21	17
< 4 months	-		-			
Total number of respondents (n)	132		126		129	

According to respondents, the duration of *enset* maturity depends on soil fertility, amount and pattern of rainfall and agricultural practices, such as weeding, pest control, etc. Similarly, Huffnagel (1961) showed that in addition to the above mentioned factors, type of cultivar, and altitude, also determines the length of time for maturity. Experienced women at both locations identified matured *enset* plants by maturity indicators (Table 2). These include seizure of the central folded leaf shoot “utute” to emerge (Figure 2a) followed by appearance of inflorescence *“shaha”* (Figure 2b). The presence of *utute* indicated young immature plant while the appearance of s*haha* confirmed the maturity of the plant for immediate processing. In addition partial exposure of the corm to the surface (Figure 2c) also indicated maturity. Similarly, previous study in West Shewa zone showed that farmers used the appearance of inflorescence and an exposed corm as maturity signs (Bacha and Taboge, 2003). Another study in Masha Woreda (Southern Ethiopia) indicated drying leaves and outer leaf sheaths and appearance of inflorescence as signs of maturity (Tadesse *et al,* 2003).

Table 2. Pair wise ranking of signs identified by farmers as indicators of *enset* harvest maturity

Maturity signs	(A)	(U)	(S)	(E)	Frequency	Rank
Age of the plant (A)	0	U	S	E	0	4
Seizure of *Utute* (U)		0	S	U	2	2
Appearance of *Shaha* (S)			0	S	3	1
Exposed junction of pseudostem and corm (E)				0	1	3

According to all respondents of both study sites, when the inflorescence over matures and gets older (Figure 2d), the nutritive value of the fermented product decreases as the plant becomes more fibrous. Previous work also indicated that *enset* plant harvested too young or too old had reduced starch content (Urga, *et al.,* 1993; Zewdie, 1993). Most of the respondents in the high and mid altitude indicated that the plant must be processed for *kocho* no later than eight months, after the appearance of maturity signs (Table 1).

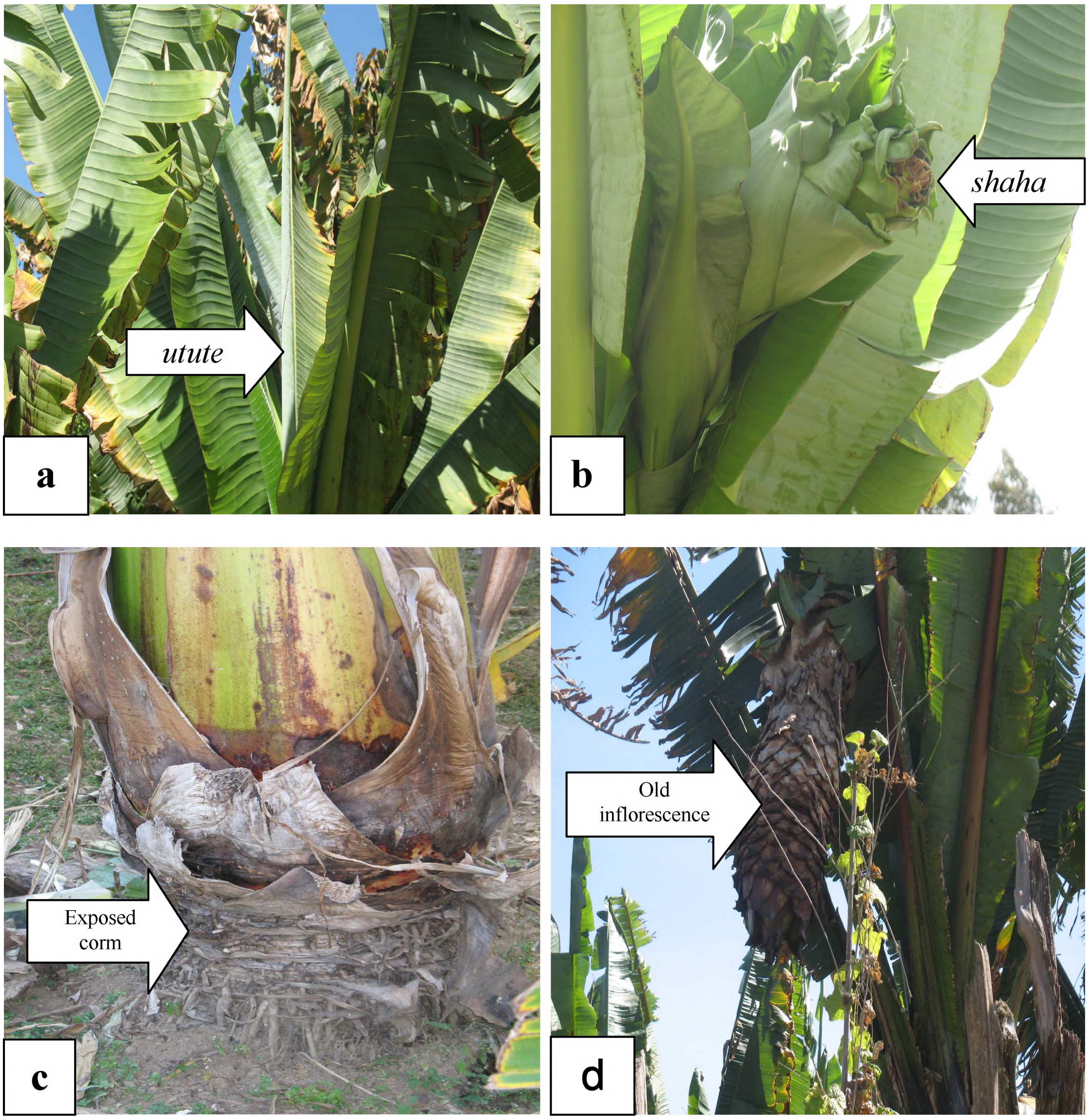

Fig. 2. Indicators of enset harvest maturity: a) a young immature enset with folded leaf *(utute)a* b) a young emerging inflorescence of enset iddicator of harvest maturity; c) a mature enset with port of corm exposed above ground; d) an old infloreocence of enset ind icaring over maturity

After selection of a mature plant, leaves and dried leaf sheaths were removed from the surrounding part of the plant and were cleared for further processing. In the mid-altitude area the outer leaf sheaths can not be processed but were uncoiled and removed from the plant. In contrast, in the high altitude, such leaf sheaths were uncoiled and left attached at the crown of the plant for further use during preparation of fermentation enhancer *(gamma).* In both areas, the inner leaf sheaths were removed one by one until very soft and white leaf sheaths were exposed. In the high altitude the pseudostem was cut into three pieces. The lower piece was detached from the corm at the crown leaving the corm underground. In the mid altitude sites, on the otherhand, the plant was totally uprooted and then cut into three pieces; the lower piece was left attached with the uprooted corm. In both sites, leaf sheaths of the top and the middle pieces of the pseudostem, locally called *qalcha,* were uncoiled one by one and splitted longitudinally to fit the width of *watani* (Figure 1a). They were further cut cross-sectionally to a length of about a meter for easy handling during scraping. The inner skin of the leaf sheath was removed carefully to expose the inner fleshy tissues. All the parts ready for processing were transported to processing sites.

3. Preparation of fermentation pit and processing area

In the high altitude area, the fermentation pit was prepared on a well shaded site within the enset farm on the same day when the process of decortications and pulverization takes place. However, in mid altitude areas the pit was prepared about two weeks after the decortications and pulverization process, while the tightly packed pulverized was kept at ambient conditions at the site. Then leaves from harvested plants which were left under the sun becoming flaccid and flexible, were used to line the inner part of the pit. Processing site was prepared by arranging the leaves in layers. In the high altitude, however, the pit and the processing site were prepared side by side, and decortication and pulverization were undertaken near the openning of the pit. Depth and diameter of the pit varied depending upon the amount of the pulverized mass which in turn was based on the need of the household.

4. Pulverization and decortication

At both study sites, the selected women scraped the fleshy ventral side of the leaf sheath by using the *sibisa* (Figure 1c). A woman secured the leaf sheath against a vertically inclined *watani* at half way of its length with her heel from a sitting position (Figure 3a) to prevent the leaf sheath from slipping down during scraping of the lower half. Scraping of the soft material yield fibers as a bi-product. The upper half of the leaf sheath was then turned upside down, for scraping. Scraping from sitting position is very common in the country, though Tedla and Abebe (1994) had reported scraping from a standing position in Wolayita (Southern Ethiopia).

The lower piece of the pseudostem was smashed (Figure 3b) using the flattened and pointed end of javga (Figure 1b). Whenever smashing was thought to be ineffective because some *enset* varieties were tough towards the base, gratting was done with the serrated end of *javga* (Figure 1b). In the mid-altitude area where the lower piece was uprooted along with the corm, pulverization was necessary. It was through pulverization process of the lower piece of the pseudostem and the corm that *Amicho* was produced. *Amicho* is one of the primary food products of enset consumed after splitting and boiling of the corm especially in the high altitude.

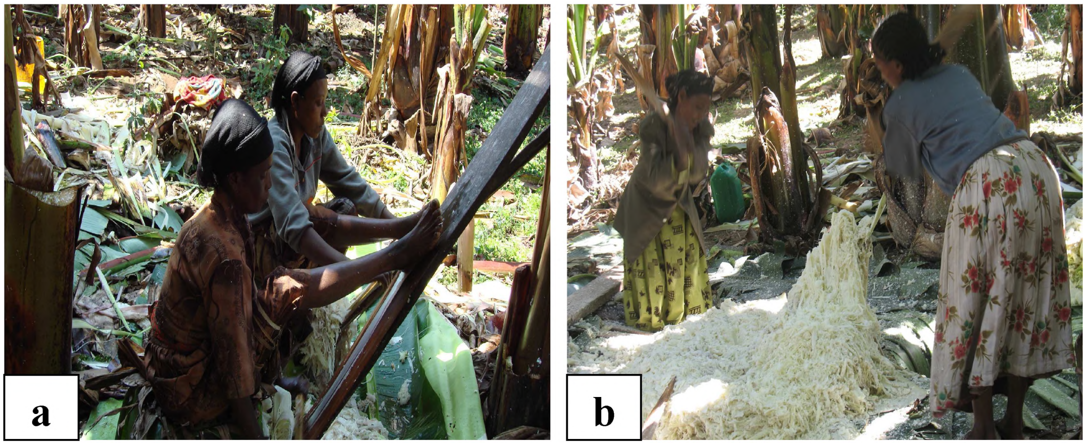

Fig. 3. Processing enset for fermentation: a) women decorticating the leaf sheath of enset; b) women smashing the lower piece of enset pseudostem

In the high altitude locations, after complete smashing and decortication of the pseudostem, the whole pulverized mass was tightly packed into the pit lined with *enset* leaves and loaded with heavy material such as logs or rocks to create airtight conditions and facilitate the fermentation process (Ashenafi, 2006; Gashe, 1987). But, under mid-altitude condition the scraped mass was tightly wrapped with fresh *enset* leaves, loaded with heavy material, and left for about two weeks at the processing site. Then, it was placed in the pit and loaded with heavier material in the same way as in the high altitude. A previous study conducted around Sebeta town, some 30 km south of Addis Ababa, had shown that only three days of temporary storage to be sufficient before the mass was put into a pit (Gashe, 1987). According to all respondents in the mid-altitude area, the temporary storage was required to initiate fermentation.

5. *Bulla* extraction

Bulla is the permissive food product of enset extracted from freshly decorticated pseudostem mass. *Bulla* extraction is commonly practiced only in high altitude environment. The decorticated mass was placed in a perforated sack and squeezed by feet to extract *bulla.* The extract was drained down into a pit lined with a plastic sheet. Alternatively, some processors in the study area had squeezed the mass using a plastic sieve in a bucket to collect the extract possibly to improve the sanitary conditions. The filtrate was allowed to stand for about four to five hours or more resulting in a thick paste with some water on the surface. The water was decanted and used to mix the constituents of the *gamma.* According to all respondents, *bulla* is an unfermented product which can be dehydrated to powder form and prepared into several recipes. Although *bulla* was consumed as unfermented product in the study sites, *Urga et al. (1997)* indicated that it might as well be fermented.

6. *Gamma* preparation

In the high altitude condition a home-made fermentation enhancer called *gamma* was prepared at the first day of the processing. The central part of the corm, while in the ground, was pulverized by the serrated end of *javga* and the mass was collected into a cavity opened at the center of the corm, locally known as *bolla gamma.* The *gamma* was prepared by adding different ingredients, collectively called *qoricha gamma,* to the pulverized corm mass. *Qoricha gamma* was prepared and sold by a knowledgeable elderly widow who kept the process secret. Traditionally, it is believed that, *qoricha gamma,* prepared by a married woman would fail as an enhancer and the fermenting mass could be spoiled. According to 6% of the respondent women, *qoricha gamma* was composed of different herbs, fig tree leaves, aromatic plants, and rotten and blackened *enset* leaf sheath. In addition, the pith from the center of the pseudostem was chopped and added to the corm mass. The supernatant from *bulla* preparation was also added and mixed with the ingredients in the cavity, *bolla gamma.* All the ingredients in the *bolla gamma* were macerated using the serrated end of *javga.* The *gamma* was tightly wrapped with enset leaves and leaf sheaths which were left attached at the crown for final package. A heavy load was placed on the packed *gamma* and was left to ferment for about a month. The fermented *gamma* was added to the mass which has been fermenting in the pit for about a month. According to all respondents, in the high altitude area, the *gamma* was used to further enhance the fermentation of the whole mass to result in the primary food product, *kocho.*

In the highlands, it was believed that the pulverized mass in the pit would not ferment unless *gamma* is added to it or else the process would take longer time than the usual five month period and the probability of *kocho* spoilage becomes considerably high. This might be due to low microbial activity in the high altitudes because of low temperature. Thus, it requires an addition of active microbial population that could enhance the fermentation of the mass in the pit. However, in the mid altitude, *enset* fermentation was mostly done without the *gamma*. Preparation of a fermentation enhancer is also well known elsewhere in the southern parts of the country though the ingredients and preparation methods may differ (Zewdie, 1993; Sandford and Kassa, 1993). Even though microbial population of enset fermentation has been investigated (Ashenafi, 2006; Urga *et al.,* 1997; Nigatu and Gashe, 1993; Gashe, 1987; Girma and Gashe, 1985), there is no data on microbial population of such fermentation enhancer. Microbial analysis of *gamma* may shade some light on the importance of its preparation in *kocho* fermentation.

7. Regular mixing and check-up of the fermenting mass

In both study sites, the fermenting mass needed regular mixing at some time interval and check-up for any undesirable signs. In the high altitude, the mass was sampled by hand at the top layer (15 to 20 cm) on the 11^{th} day after the onset of fermentation. Thereafter, on the 30^{th} day, the whole mass was taken out of the pit, *gamma* was added and mixed thoroughly. The old leaf lining of the pit was replaced with fresh leaves and the mass was put back into the pit. The same process, except addition of *gamma* was repeated on the 52^{nd} day and the mass was put back into the pit and left to ferment for about five months. According to all the respondent women, frequent mixing was done when signs of spoilage such as undesirable odor appears.

In mid-altitude, the mass was sampled by hand on day 5 and 10 after the mass has been left to ferment at the processing area, prior to preparation of the pit. The whole mass was thoroughly mixed at about day 15 and put into a newly dug pit. At this step, a handful or two of *kocho,* a fermented *enset* product bought from local market, was added to the mass to speed up the fermentation process. However, this was optional and depends on the urgent need of the household. Re-mixing and changing of pit-lining leaves is done every 15 days to avoid spoilage at the mid-altitude.

According to all respondents of both study localities, the fermenting mass could be consumed within two months depending on food shortage in a family. They have also indicated that the quality of the fermented product is improved as fermentation time increased which is in agreement with the general consensus that longer fermentation results in better quality *kocho.*

Traditional *enset* processing was generally performed by a group of women. As traditional enset processing was tedious, and consumes a lot of time and energy, the women always worked in group of six or more, locally known as *dado.* The group worked for each member in turn rotationally.

Conclusion

According to this study and previous reports (Tedla and Abebe, 1994; Sandford and Kassa, 1993; Zewdie, 1993) traditional knowledge of enset processing are generally owned by women. It was also observed that, with the present situation, the processing is unthinkable without the involvement of women and their traditional knowledge, signifying the great role women play in securing food in a household. Though some basic steps of traditional *enset* processing were similar at both study sites, differences were observed in *bulla* extraction, *gamma* and *amicho* preparation, where the processes were not practiced at all in the mid-altitude condition. *Enset* processors in the mid-altitude optionally used fermented *kocho* as a fermentation enhancer whereas those in the high altitude always used *gamma* to enhance fermentation. The duration of fermentation was shorter in the mid-altitude than in the highland. This was reported to be attributed to rapid proliferation of microorganisms due to warmer temperature of the fermenting mass in the mid-altitude (Hunduma and Ashenafi, 2010). Other differences in microbial dynamics and changes in some physico-chemical parameters during fermentation were documented by Hunduma and Ashenafi (2010).

Traditional *enset* processing in the present study sites differed from earlier reports (Urga *et al,* 1997; Tedla and Abebe, 1994; Zewdie, 1993; Sandford and Kassa, 1993) in maturity signs, methods of decortication, and in ingredients for the preparation of *gamma.* As enset farmers in different regions use different maturity signs, recommendation of appropriate maturity indicators which really coincide with time of high nutrient content is important. Generally, enset processing is tedious, labour-intensive, unhygienic and an age-old practice which requires the concerted effort of food microbiologists and food processing technologists to mitigate the burden on women and to avoid spoilage during fermentation in order to produce a wholesome product. The result of this and other studies can be used as baseline information to improve, standardize and scale-up the process for industrial production of one of the most important and dominant staple foods of Ethiopia, thus guaranteeing food security in the country.

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