

Indigenous Enset (*Ensete Ventricosum*) Fermentation and Starter Culture Preparation Methods in Major Enset Growing Areas of Southern Ethiopia.

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Abstract: In the south west of Ethiopia, enset plant has a major role to play in food security and the ability to drought resistant and multi purpose in their life. One of the products produced from enset fermentation was kocho. Kocho, an acidic starchy food, is prepared by fermenting a mixture of the scraping of the trunk and pulverized stem and corm of ensete (*Ensete ventricosum*). Its preparation methods vary through ethnic groups, geographical locations and languages. Although kocho fermentation procedures differs in different communities, the following feature mature plant selection criteria, the pseudostem and corm of enset plant decorticating scarping, pulverizing and bulla preparation from kocho were commonly shared in both communities of Gammo, Gurage and Kaffa shaka and Gediyo zone where enset was commonly cultivated. Kocho fermentation processes in Gediyo, Kaffa shaka and Gurage zones use traditional starter culture prepared and applied in different ways where as in Gammo zone no starter culture used during fermentation of kocho except that they use some aromatic plants to improve the organoleptic properties of the fermented productes. Furthermore, this review address types of starter culture preparation and processing methods in different enset growing areas.

Keywords: Enset; fermentation; Traditional Starter culture Southern Ethiopia

1. INTRODUCTION

Enset (*Ensete ventricosum*, Musaceae) is an African crop that currently provides the staple food for approx 20 million Ethiopians and ever been domesticated in the southern Ethiopian highlands where sm allholder farmers cultivate hundreds of landraces across diverse climatic and agro-ecological systems as it was reported by (Yemataw *et al.*, 20014). In similar way (Borrell *et al.*, 2019) on his finding suggested that enset serves as a staple food for about 20% of the Ethiopian population, mainly in the south and south-west of the country.

Enset (*Ensete ventricosum* (Welw.) Cheesman) is the major starch staple of the southern where its unique potential attributes enhance the food security. Anthropologists, archaeologists, historians, and other scholars argue that domestication of enset in Ethiopia occurred as early as 10000 years ago (Brandt *et al.*, 1997) . Similarly, (Vavilov, and Rodin, 1997) also reported that indigenous enset farming system that can support the densely populated highlands and the oldest cultivated plant in the regions of the south and south western parts of the country. Its diverse agro-ecological and climatic conditions of southern highlands suitable for production of enset inclding other root and tuber crops which play vital roles in food security and source of income generation (Giorgis *et al* 2001).

Enset has historically been described as a ‘tree against hunger’ due to its important attributes played by the plant mainly as a back bone in supporting the food security of communities that cultivate it. These contributions evidenced during the devastating famines which were occurred in different parts of the country but the influence on enset growing communities was minimized due to enset cultivation as it was reported (Dessalegn., 1995: Brandt *et al.*, 1997). Similar findings was reported by (Garedew., *et al.*, 2017, Zerfu., *et al.*, 2018)) that

enset farming systems contribute a lot for prolonged sustainability of food production through several mechanism such as its potential to tolerate drought & flooding, withstand heavy rain, stored for prolonged time during famine and endure frost damage.

According to (Sahle *et al.*,2018) the other important characteristics which make enset as a food security crop is that it can be harvested at any time during the year, harvested at any growth stage and fermented products can be stored for long periods without losing a significant amount of its nutrients and organoleptic properties. As it was stated by (Country STAT Ethiopia.,2016) enset is a crop that tolerates harsh environmental conditions including prolonged drought periods, flooding, and various types of diseases and become a priority crop in Ethiopia, where it makes a major contribution to the food security of the country. Enset domestication also plays a significant effect most commonly among Sidama, Gedyo, Gurage, Wolayita, Gammo, and Kembata as it was reported by (Atnafu *et al.*,2008) Its persistence to recurrent droughts and high yield potential per unit area of land assures its vital role in ensuring food security. Overall combination of the above factors and its versatile characteristic makes the plant as 'The Tree against Hunger' and gives enset an important role during times of famine which forms the basis of many households' food security [Bekele & Reddy., 2015: Funte, *et al.*, 2009)

Kocho is one of traditionally fermented foods consumed in southwestern part of Ethiopia. It is obtained from Enset (Tiruha *et al.*, 2014)]. The plant has different parts such as pseudostem, pulverized corm and stalk of inflorescence. The edible part of the plant is swollen pseudostem and corm which processed and fermented in different traditional mechanisms designed by knowledge of local people. Kocho is the main food product obtained by fermenting the mixture of the scraped pulp of the pseudo stem, pulverized corm and stalk of inflorescence under soil pit, above the ground using the leaves and Erosa (bamboo basket) into a starch rich food product, *kocho* (Admasu and Struik.,2001).

The variation in kocho fermentation processes in Enset growing areas led to differences in quality, fermentation time, traditional starter culture they use and types of spices for organoleptic properties. The main objective of this review is to point out and give overview of different fermentation procedures practiced in some selected districts of Gammo, Kaffa-shaka, Gurage and Gediyo zones of southern Ethiopia.

2. MATERIALS AND METHODS

2.1 Study Area and Household Survey

A detailed survey and field observations were conducted in four districts of (Gediyo, Gurage, Kaffa shaka and Gammo) in southern Ethiopia. The survey covered four districts based on their enset production, consumption and starter culture availability. People were asked whether they use starters. If they did, they were asked further questions, being the local name of the starter how they prepare, the main ingredients (spices they use during starter preparation, steps in the production, time of fermentation before they use as starter, the amount required to different size of enset during a single fermentation. In addition to the data collected from local communities in the form of interview and personal observation, some research findings also used for this review.

2.2 Processing of Enset (*Ensete ventricosum*) fermentation in different parts of Southern Ethiopia

Enset is processed mainly for consumption in enset growing areas and commonly harvested in different seasons in accordance with scarcity of food but most commonly from November to March, and its processing entirely handled by women's. Findings from (Fekadu *et al.*, 2016) indicated that methods used in enset processing are more or less similar especially in the two steps (scraping of pseudostem and fermenting in a pit particularly in Gammo, Kaffa shaka, Wolyita and Gurage) where as some studies also indicated that in Gediyo and Amaro fermentation is not in the pit but on the surface, covered with enset leaves under cold area.

Kocho preparation and foods derived from the enset requires several complicated procedures in both southern parts of Ethiopia where kocho products were commonly consumed. Its preparation requires various steps starting from its planting to getting purified products which includes new shoots transplantation, cultivation, manuring selection of the mature plant to harvest, site selection at farm yard for fermentation, digging of the fermentation pits and material preparations commonly initiated by head of household male (Olmstead, 1974). In similar way harvesting time, plant selection for harvest and har

vesting season are also controlled by the head of household, thus production consists of a series of consecutive tasks, where some are more gender-specific (Negash, 2001; Pankhurst, 1996). In general women are more involved in leaf sheath transplanting, rhizome processing, *kocho* storage and marketing whereas men are more involved in propagation, transplanting, digging the pits (for fermentation of the harvested enset).

Enset fermentation processes for its products begins from harvesting the mature plant, cutting, digging, lining a pit for fermenting the pulverized corm or root, scrapping (decorticating) the outer sheaths of the stem to remove unnecessary parts from the edible. As of harvesting cutting pseudostem into small size pieces which remove much of the fiber (decorticoed) by chopping and grating the sub sectioned pseudostem on a special wide wooden board and finally collecting the pulpy white juice below at the base of inclined wooden board (Fig.2) and fermenting for duration of (1-6) months depending on different climatic and traditional practices.

The three products during its fermentation are *Kocho*, *bulla* and *amicho* in order of their significance. In some cases the corm (the underground stem) can be cooked and consumed since it is highly rich in carbohydrate and above all its food products have a potential nutritional and health benefit (Forsido *et al.*, 2013). Enset products are traditionally incorporated into cultural events such as births, deaths, weddings, new year celebrations, local representative designations and other cultural practice.

2.2.1. Kocho fermentation processes in Gammo zone.

In Gammo zone of two districts, Dorze and Ditta most commonly cultivated enset varieties are Gena Maze and Ketishe which was chosen by the local community. Farmers use vernacular names for identification of enset, however the names vary considerably based on region, language and ethnic groups (Yemataw *et al.*, 2014). Out of the selected varieties Gena with highest preference due to its quality of *kocho* and *bulla*. *Kocho* fermentation begins with the scrapping the leaf sheaths of the pseudostem with bamboo scrapers and pulverized the corms of the plants with bamboo scrapers by knowledgeable women.

During *Kocho* preparation, the men dig a hole about 3 meters deep and 2 meters in diameter whose size was determined by the amount and number of enset plants for *kocho* fermentation and its bottom space filled with stones for drainage. Besides pit preparation, a bamboo cylindrical grating material called *Mailliya* (local language) approximately 2 meters long and 1.5 meters in diameter used to grate the sheath lined with inclined wooden board. The squeezed mass of the pseudostem and the mass of grated corm were carefully mixed. The pits were prepared using compacted enset leaves, and large stones according to traditional practices, to maintain anaerobic conditions through underground pits (Karssa and Papini, 2018). No starter or back slopping was applied to aid the fermentations in Gammo zone, as it was used in other localities in order to facilitate its fermentation processes; however some spices used for its organoleptic properties.

At the end of the above procedures, some heavy stones are placed over it to force the water out from the pit through stones lined at the base or above the ground through bamboos as the fermentation proceeds. Every seven days, for approximately 1 month, the women uncover and mix it by rotating the top to the bottom as it becomes gradually floury. An oval cake is formed, dried in the sun, and aged another 20 days covered in similar way before being ready to eat.

In some cases the products ready to ferment was be covered with the leaf sheath and crossa of the enset plant tightly. Once it was wrapped with the leaves and sheath of enset, heavy weight loaded over it on farm yard in cool environment and left for fermentation (Fig.1). To obtain *bulla*, the pulverized pulp squeezed using plastic bags or goth clothes with small size of pores. The mass of the scraped pseudostem and corm was put in to the plastic bags or cloth and squeezed finally obtain *bulla* (Andeta *et al.*, 2018). (Fig. 2).

2.2.2 Fermentation procedures in Kaffa-Shaka zone of three selected districts.

The most commonly cultivated enset variety in kaffa Shaka zone of Chana Tello and Gimbo districts were Novo, Ommo, and Biggo according to their preferences based on product quality and quantity. Out of the three selected varieties the two varieties, Novo and Biggo were selected and processed into *kocho* in accordance to the traditional processing approach of *kocho* preparation similar to Gammo zone.

e. Harvesting, removing leaves and older leaf sheaths from the designated plants for *kocho* preparation. The inner leaf sheaths were separated from the pseudostem down to the real stem, which was part between corm and pseudostem. Then, the underground corm was separated from the real stem.

Fig1. Diagrammatic representation of traditional enset fermentation process in Gammu Zone

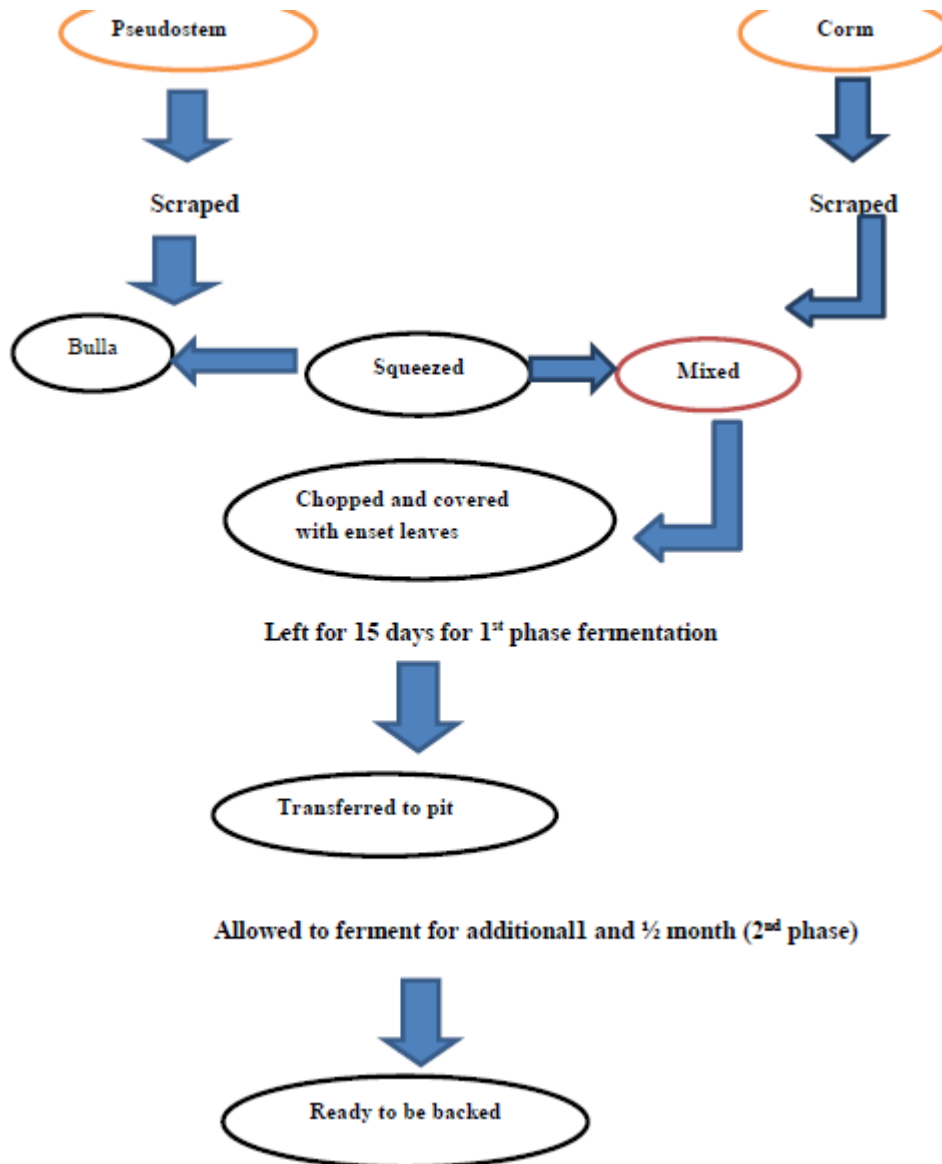


Fig2. Shows preparation of enset for kocho fermentation in farm yard



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The leaf sheath was once peeled and reduced into portions of about half meter size and cut up lengthwise, in order to shorten the leaf sheath to a manageable size. Then, the pseudostem was decorticated by using a domestically made bamboo scraper, whilst the leaf sheath is held on an incline in opposition to a wood plank. The area used for beginning of kocho fermentation was first cleaned and covered with *Ensete ventricosum* (*Musaceae* family) leaves. Then, the corm was grated to small size one by one by flatten wooden board or animals shoulder bone (scapula) after uprooting and making it clean from its surface with a domestically made knife.

After the completion of decortication and grating, the leaf sheath pulp was unfolded on clean *ensete ventricosum* (*Musaceae* family) leaves overlaying the ground, after which the grated corm was mixed with the decorticated pulp. Once the decorticated pulp and grated corm was collected and unfolded on clean *Ensete ventricosum* (*Musaceae* family) leaves overlaying the ground, it was covered with the enset leaves

At 4th day of beginning fermentation traditionally prepared starter culture prepared from the previous leftover chopped part of leaves, corm and pulps fermented for 15-20 days under the hole from which enset was uprooted. The amount of starter culture applied during fermentation varies among the three districts; however, most commonly 22-25L of liquids (from fermenting mash) was used for one fermentation session (according to the local community procedures). Besides application of starter culture, application of some spices from plant byproducts for their organoleptic properties and mixed well. Finally the mixed products covered with the leaves and sheaths with great attention to avoid the entrance of air and its likely spoilage. Left for 4 weeks (1 month) on farm and *kocho* was obtained (Fig 3).

A



B



D



C



Fig 3 (A) Decorticating leaf sheaths against inclined wooden board, (B) The mixture of white chopped sheath and grated corm. (C) The mixture of grated and pulverized corm and pseudostem, (D) The product ready for fermentation.

2.2.3 Enset fermentation procedures in Gurage Zone.

In three districts (Gummer, Cheaha and Isha) around Wolkite where commonly enset plants were used as staple food. The following enset cultivars used for food production and medicinal activities include *bedadit*, *astare*, *lemat*, *nar* and *ye'shera*. These enset varieties were identified based on the color, size, structure of leaves, pseudostems, and other parts of a plant. In addition to the above-mentioned features: growth conditions, resistance to different diseases and drought and their maturity time were considered as selection criteria. (Yemataw *et al.*, 2016) also reported that there were numbers of varieties in Wolkite but their selection criteria was based on their resistance to biotic and abiotic factors.

The appropriate time for harvesting enset for kocho fermentation was most commonly from July to September and December to January. Preference of July to September harvesting time was to replace or transplant the newly growing enset plant on mature plant used for fermentation and to get quality products during dry season (December to January). Studies conducted by (Hunduma, and Ashenafi, 2011; Zerihun and Brihanu, 2015) also supported that high quality and yield of kocho obtained during dry season than rainy season.

A



B



Fig 4. (A) Squeezing processed parts and Liquid bulla in plastic basin (B) Dehydrated and dried bulla.

Enset processing in Gurage zone was entirely women's task like in Gammo and Kafficho, and the common procedures like scraping of pseudostem and fermenting in a pit or above the ground using bamboo tree baskets are similar to other communities where starch deposits in these parts are then extracted through fermentation to obtain *kocho* as it was reported by (Fekadu.,2018).

According to (Brihanu and Gizaw, 2018) bulla preparation in three communities basically similar. It was obtained from the processed parts squeezed through fine cloth and perforated plastic bags and the resulting liquid is collected in plastic basin (Fig .4), then rest for certain period decanted the liquid finally dehydrated to form Bulla.

3. INDIGENOUS STARTER CULTURE PREPARATION FOR KOCHO FERMENTATION IN DIFFERENT PARTS OF SOUTHERN ETHIOPIA.

3.1 Traditional Starter culture Development in Kaffa-Shaka Zone

Indigenous starter culture preparation for *kocho* fermentation was carried out by the woman in advance the starter or fermentation infusion called *Gamicho*. It was prepared from previously left over rhizome and leaves chopped and stored under the hole from which the plant was taken out (fig.5). During its preparation different spices was added to the starter culture with highly prized secrets to have varying tastes that is characteristic to the family. The starter is wrapped in enset leaves, stirred and warmed in the sun every 5 days, and allowed to ferment 15-20 days depending upon the air temperature.

A



B



Fig.5 (A) Preparation of starter in the hole from which corm was taken up (B) Prepared starter starter culture.

3.2 Traditional Starter culture Development in Gediyo Zone

In case of Gediyo community, the corms of mature enset plants were the main raw material for starter culture preparations. Those parts not expected to be included in fermentation carefully removed from t

he corm with knife and make it ready for fermentation. The corms were wrapped with fresh enset leaves on farmyard and left at ambient temperature for about 5-8 days. At the end of 8th days it was exposing to sun for 5-10 hours and again wrapped with fresh enset leaves and allowed 3-5 days fermentation. After comprehensive fermentation of starter culture and ready to use, it was silenced, evenly distributed and carefully mixed with fresh chopped pulpy sheath and corm pseudostem and left for fermentation. The survey results from the zones Gediyo showed that in some localities, the corm of the mature enset plant used for preparation of the starters called Gamama which is sliced into four to six parts based on the amount to be fermented (Brihanu and Gizaw, 2015). Then the slices are rubbed with decayed pseudostem.

3.3 Traditional Starter culture Development in Gammo and Gurage Zone

The information obtained from interview and personal observations revealed that farmers in Gammo zones use no traditional starter culture except some spices to improve the odor of kocho (fermented product of enset during fermentation). For all districts within the selected study areas, the preparation process of the starter are generally the same. However, the preparation and application of the starters differ between zones. The traditional starter is commonly prepared by pulverizing the central parts of the corm, followed by adding different ingredients to the corm like the decayed pseudostem sheath of the previously used enset plant, the fresh chopped pith of the pseudostem, some spices plant extracts (aromatic plants), chopped mature ripen fruits of banana, onion and moringa leaf powder are the major ingredients added and left for 15 to 17 days to ferment as it was stated (Dibaba, *et al.*, 2018).

Liquid starter culture was used in Gurage zone, rather than using solid starter culture. Traditional starter culture is, an aliquot squeezed from of fermented enset applied to aid a new enset fermentation which was similar to traditional injera fermentation by using 'backslopping'. In some areas of Gurage zone, people use the traditional starter prepared similarly as the Gediyo zone but it was prepared from the inner portion of the corm which was mixed with the decorticated pulp and left to ferment for weeks which is contrary to the starter development in other zones as it was forwarded by (Nurfeta, *et al.*, 2009).

The overall survey results indicate that traditional starter culture development in southern Ethiopia is typically prepared according to knowledge of local communities and still maintained through the knowledge transfer concerning process of making the starters.

4. CONCLUSION AND RECOMMENDATION

To improve food security, economic use of the available food is very important. Indigenous knowledge of enset fermentation processing plays a vital role contributing to maintain food security. Different enset varieties, maturation time, fermentation time, processes and method of indigenous starter culture preparation may account for differences in composition of products of kocho and bulla. There was no evidenced technological advancement in enset fermentation to improve its overall acceptability. Therefore, if the indigenous knowledge supported with technological particularly on different fermentation procedures and mechanism of traditional starter culture preparation, it will help to maintain the quality of enset fermentation and quality of the products. Thus advancing the traditional knowledge on overall improvement of kocho fermentation might significantly contribute to its utility food security.

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