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Improving the Indigenous Processing of Kocho, an Ethiopian Traditional Fermented Food

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Abstract

The experiment was carried out using factorial combination of two enset varieties, three fermentation time, and two processing methods with tree replication, to investigate the effects of fermentation time, variety and processing methods on physicochemical qualities, chemical composition, microbial quality and sensory acceptance of *kocho.* In this study, *kocho* samples were prepared from Kinnare and Astare enset variety, and processed by modified and traditional Gurage *kocho* processing methods. The modifications were made by adding minimally boiled pulp of chopped pseudo stem in traditional processing methods of *kocho*. All processed *kocho* samples were then fermented for 10, 20 and 30 days. The results revealed that physicochemical qualities, chemical composition, microbial quality and sensory acceptance of *kocho* were affected by fermentation time, enset variety and processing methods.

Kocho samples of Kinnare variety resulted in higher TTA and lower pH than those of Astare variety, which showed 0.55% LA and pH of 4.86. Modified Gurage *kocho* processing method resulted in lower TTA and higher pH value. As fermentation time increased, crude fiber, ash and carbohydrate contents decreased; moisture and crude protein contents increased; however, crude fat content of *kocho* samples did not show significant change. Higher crude protein, crude fat and carbohydrate contents were recorded for *kocho* samples from Kinnare variety, on the other hand, *kocho* samples from Astare variety resulted in higher crude fiber, total ash, and moisture content.

Kocho of Kinnare variety had resulted in higher counts of LAB, yeast and mold, total aerobic bacterial and lower counts of coliform bacteria. *Kocho* samples processed by traditional Gurage processing method resulted in higher yeast and mold counts and coliform counts, while *kocho* samples prepared by modified Gurage processing method resulted in higher LAB, and total aerobic bacterial count. Sensory evaluation showed that *kocho* bread baked from *kocho* of Kinnare variety, prepared by modified Gurage processing, followed by fermentation, was the most liked than *kocho* breads from Astare variety in the study.

Keywords: Indigenous processing; Enset variety; Minimally boiled pulp; Fermentation time

Introduction

Enset is one of the potential indigenous crops for food, and the Enset cultivation system is economically viable, and is one of the few successful indigenous and sustainable agricultural systems [1]. It is sustainable because it has been providing food for humans for generations from the same plot, and maintains the quality of life of the people. It grows in a wide range of environmental conditions. Even though it is grown in many wide areas, the dwellers of the central and southern parts of Ethiopia are the only people that use Enset as a staple and co-staple crop.

Since Enset (*Ensete ventricosum*) products such as *Bulla* and *Kocho* are one of the main energy sources and serve as the staple and co-staple food for many people in Ethiopia, knowledge of the fermentation process is of particular interest for proper utilization of the crop. The fermented *kocho* is often stored in pits that are lined with Enset leaves. The *kocho* must be left in a storage pit for a minimum of a month, but it can be stored for many months and even for several years [2].

The length of fermentation time varies from a few weeks to several months, depending on ambient temperatures of incubation. In the cooler regions, it is kept in a pit for years, and the quality is said to increase with increasing fermentation time. In warmer regions, fermentation is rapid and is therefore, terminated within 3 to 6 months [3]. After the fermentation is completed, a portion is removed from the pit and the liquid is squeezed out of it, resulting into a moist fibrous *kocho*. The major foods obtained from Enset are *kocho*, *bulla* and *amicho*. However, *kocho* is the bulk of the fermented food obtained from the mixture of the decorticated (scraped) leaf sheaths and grated corm (underground stem base). However, there are many constraints on *kocho* which influence quality attributes due to the variation in variety selection, duration of fermentation, and method of processing. This study was, therefore, designed to evaluate the suitability of two varieties, appropriate processing methods, and optimized fermentation time for *kocho* production.

Materials and Methods

Experimental procedure and sample preparation

The study experiment was organized in a factorial design with two Enset varieties (Kinnare and Astare), two processing method (traditional and modified), and three fermentation time with three replication. The samples were obtained fron Gurage Zone, Gunchire woreda, in SNNP, Ethiopia. The two enset variety (Kinnare and Astare) were selected for *kocho* preparation, based on the consumption

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frequencies and local preference of Enset varieties for *kocho* and *bulla* preparation. All analysis was done at the Food Science and Post Harvest Technology, and Pathology Laboratories Haramaya University from May-August 2012.

Two varieties (Kinnare and Astare) of Enset were processed into *kocho,* according to Gurage processing method of *kocho* and *bulla* preparation. During harvest, leaves and older leaf sheaths were first removed from the designated plants for *kocho* and *bulla* preparation. The internal leaf sheaths were separated from the pseudostem down to the true stem, which was section between corm and pseudostem. Then, the true stem was separated or stumped from the underground corm. The concave side of the leaf sheath was peeled and cut into pieces of about half meter length (approximate length), and split lengthwise, in order to shorten the leaf sheath to a workable size. Then, the pseudostem was decorticated using a locally made bamboo scraper, while the leaf sheath is held on an incline against a wooden plank. To decorticate the leaf sheath, the women might sit on the ground (often on Enset leaves), and use one leg to hold the leaf sheaths in place. The working area used for decortication was covered with Enset leaves. Then, the corm was grated separately by serrated animal bone after uprooting and removal of any soil from its surface with a locally made knife. After the completion of decorticating and grating, the leaf sheath pulp was spread on fresh Enset leaves covering the ground, after which the grated corm was mixed on the decorticated pulp. Turning, mixing, rinsing, and chopping of the decorticated pulp and starter was continued over a period of time, until the mixture is partially fermented, when it is then referred to as *kocho*. The samples were subjected for analysis after 30 days of fermentation.

The modified method used for *kocho* samples were prepared by modifying the traditional preparation method. Following the same harvesting and processing method as the above traditional method, two varieties of Enset (Kinnare and Astare), *kocho* samples were prepared by adding minimally boiled decorticated Enset pulp that is ready for fermentation. The pulp was boiled at 72°C for 20 minutes. Then it was cooled to 40°C, and added to the decorticated pulp prepared by traditional Gurage processing methods. Finally, *kocho* powder samples were taken from 10, 20 and 30 days fermented *kocho* for experimental analysis, from both traditional and improved preparation methods.

Physico-chemical analysis

Moisture content: Moisture content of the sample was analyzed by oven drying method [4]. A drying dish was dried in an oven at 105°C for 1 hr, and placed in desiccators to cool. The weight of the drying dish (W1) was determined. 2 g of *kocho* samples were weighed in the dry dish (W2) oven dried at 105°C for 2 hr, and after cooling in a desiccators to room temperature, it was again weighed (W3) [5,6].

Chemical analysis

Total crude fiber content: A 2 g sample was transferred to 400 ml beaker. After digestion with 1.25% sulfuric acid and washed with distilled water, and then digested by 1.25% NaOH, the sample was filtered in coarse porosity crucible in apparatus, at a vacuum of about 25 mm. The residue left after refluxing was washed again with 1.25% sulfuric acid near the boiling point. 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:

$$\text{Total crude fiber}(\%) = \left(\frac{M1 - M2}{M3}\right) \times 100$$

Where M_3 is the weight of sample

Total crude fat content: 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:

$$\text{Crude fat, percent by weight} = \left(\frac{W2 - W1}{W}\right) \times 100$$

Where, W1=weight of the extraction flask

W2=weight of the extraction flask plus the dried crude fat (g)

W=weight of the sample

Total crude protein content: Crude protein was analyzed by micro Kjeldahl method. The general procedure included the following steps of digestion: 2 g sample was digested by adding 5 ml of concentrated sulfuric acid, in the presence of potassium sulfate catalyst in a Kjeldahl flask, then neutralization and distillation as the digest was diluted with 30 ml distilled water. 25 ml of NaOH (40%) was added to neutralize the sulfuric acid. Upon addition of NaOH, the ammonium was distilled off and trapped into a boric acid and solution containing methyl blue and methyl red indicators. Finally, titration of the ammonium attached to borate anion was titrated with standardized HCl, and total crude protein of *kocho* was calculated as total nitrogen, according to AOAC [7].

Total ash content: Ash content of *kocho* was determined, according to AOAC [7] method. Clean drying dish were 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). Then, cooled in desiccators and weighed using analytical balance. Then, 2 gram of *kocho* powder 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 follow:

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

Total carbohydrate content: Total carbohydrate was determined by difference.

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

Where, %M=Moisture content in percent

%P=Crude protein content in percent

%F=Crude Fat content in percent

%Fb=Fiber content in percent

%A=Ash content in percent

Titratable acidity value

The titratable acidity of *kocho* was determined by titrating the sample with a standard base (NaOH) to the phenolphthalein endpoint [8]. A 10 g *kocho* sample was blended with 90 ml distill water, and filltered through 750 mesh size sieve. 10 ml volume of the sample was titrated with 0.1N standard solution of NaOH, after addition of 3 drops of phenolphthalein indicator. As the color of the sample changed to pink, the volume of NaOH consumed until end point reached was used to calculate the titratable acidity, expressed in terms of the predominant organic acid.

pH value

The pH of *kocho* sample was determined from 1/10 dilution of sample by glass electrode attached to digital pH meter at the 10th, 20th and 30th days of fermentation time. 10 g of kocho sample was mixed with 90 ml of distilled water. After calibrating the pH meter at 7.00 with buffer solution, the pH sample was measured.

Microbiological assay

The total microbial population was estimated using the procedure that had been followed by Bracket. *Kocho* samples were taken aseptically from each replication using pre-sterilized pipette, and immediately subjected to serial dilution. Sample (1 ml) was serially diluted in 9 ml of 0.1% peptone water that was kept in the refrigerator. The serial dilution was done in the range of 10-1 to 10-7 series of test tubes. For the estimation of total aerobic bacteria, the sample of 1 ml was taken from the test tube aseptically using discrete pipette, and was plated on plate count agar. Finally, all plates were incubated at 30°C for 2 days. The growth in bacteria was inspected after 2 days, and the colonies were counted using standard colony counter.

For the estimation of total coliform population, the sample of 1 ml was aseptically taken from the test tube using sterilized discrete pipette, and was plated on duplicate Violet Red Bile Agar (VRBA) [9]. Finally, they were placed inverted and incubated at 37°C for 1 day. Afterwards, the growth of coliforms was inspected and the colonies were counted using standard colony counter. For the estimation of yeast and molds, the sample of 1 ml was aseptically taken from the test tube using sterilized discrete pipette, and was plated on Rose-Bengal chloramphenicol agar base (oxoid CM549) [9]. Then, they were placed, inverted and incubated at 25°C for 3 to 5 days. The growth in yeast was inspected after 3 days, and non growth plates were incubated for two days more, to complete the recommended incubation period. For lactic acid bacteria, volumes of 0.1 ml of the appropriate dilutions were spread-plated on pre dried surfaces of MRS agar (de Man, Rogosa and Sharpe Agar), and incubated under anaerobic conditions at 30°C for 48 hrs [10].

Sensory evaluation

Descriptive sensory evaluation was used in the screening of *kocho* bread, based on their sensory quality characteristics. A total of 30 panelists were involved in the sensory evaluation. Sixteen cuts of *kocho* bread samples were presented for panelists to evaluate the taste, color, flavor, and overall acceptability of the samples. During the evaluation period, the panelists attended two sessions. Eight samples were served at each session and then, all panelists were allowed to taste and evaluate the samples for each quality feature using rating scale. All panelists were instructed to make their own individual assessments, according to the evaluation criteria provided for each samples on the basis of taste, color, flavor, and overall acceptability. Finally, the scores of all judges were added and divided by the number of judges to find the final mean score.

Statistical analysis

A factorial combination of the two enset varieties, two processing methods, and three fermentation times with three replications was used in the study. The difference between the treatments was determined by the analysis of variance for factorial experiment, using SAS, and the comparison of the mean was done by LSD tests.

Results and Discussion

Moisture content

During the fermentation of *kocho*, the moisture content was decreased due to excessive leaching during pit fermentation. In contrast, in this study, *kocho* moisture content was slightly increased with increase in fermentation time due to using of equal amount of little quantity water during intermediate mixing, and no leaching effect was observed. The difference in moisture content was probably contributed by difference of initial moisture content of the Enset varieties, and unequal loss of liquid during squeezing process stage.

The highest values were obtained from *kocho* prepared from Astare variety, while the lowest moisture content was recorded for *kocho* samples prepared from Kinnare. Such a difference could be as a result of genetic differences existing between the varieties [11]. *Kocho* prepared by traditional Gurage method has the highest moisture content, and the lowest moisture content was recorded from improved preparation. The difference in moisture content of *kocho* was attributed to the difference observed in the time taken, especially at squeezing stage. In Gurage traditional processing, the scrapped pulp was slightly squeezed, but in improved processing, the scrapped pulp was squeezed for more extended time to extract the spent liquid for raw material of *bulla* production. The general result showed lower moisture was observed in *kocho* samples that were prepared from Kinnare, than from Astare and pulp squeezing effort. This difference in moisture among *kocho* products processed from Kinnare and Astare were partly due to difference in moisture due to the method of processing and loss of evaporation during fermentation period.

Crude fiber content

As it can be seen from table 1, the crude fiber content of *kocho* samples showed significant difference due to the variety processing method and fermentation time. *Kocho* samples made from Astare variety had more crude fiber content than *kocho* from Kinnare variety, 4.42% and 3.37% crude fiber content, respectively. Similarly, the slightly highest value, 3.96% in crude fiber content were recorded for *kocho* samples processed from traditional method than modified processing methods. This is due to the modified processing method, which digests the fibers found in the content due to the addiction of molten pulp, but processing method did not have a significant difference in crude finer content. As the fermentation time increased, the crude fiber content of *kocho* was decreased, 10, 20, and 30 days of fermentation resulted 2.67%, 2.29% and 1.89% crude fiber, respectively. The decrease in fiber content during fermentation could be attributed to the partial solubilization or degradation of cellulosic and hemi-cellulosic structural materials in the plant (pulp) by microbial enzymes [12] and in this also, fermentation

	MC (% wb)	Crude Fiber (% db)	Ash (% db)	Crude fat (% db)	Crude Protein (% db)	CHO (% db)
Variety						
Astare V1	60.20	4.42	2.33	1.04	3.17	32.75
Kinnare V2	57.15	3.37	2.18	1.27	3.43	35.53
Processing Methods						
Traditional PM1	60.50	3.96	2.24	1.20	3.47	34.00
Improved PM2	63.3	3.75	2.29	1.11	3.26	31.24
Fermentation Time						
10th days FT1	46.78	2.67	3.41	1.60	4.42	44.08
20th days FT2	46.66	2.29	3.39	1.52	4.78	39.63
30th days FT3	44.55	1.89	3.52	1.50	5.09	33.80
Mean	46.03	2.28	3.44	1.54	4.76	39.17
CV	0.89	1.47	0.36	5.21	1.24	0.52

Table 1: The main effect of Enset variety, processing methods and fermentation time on moisture content, crude fiber, ash content, crude fat, crude protein, and carbohydrate content of *kocho* samples prepared for the study.

increases the breakdown of dietary fiber to soluble and digestible form, and which decrease the total indigestible crude fiber content.

Ash content

The ash content difference among variety, processing method, and fermentation time was not highly significant (Table 1). *Kocho* samples prepared from Astare varieties subjected by improved processing method had showed the highest ash content, 2.33% and 2.39%, respectively.

The difference in ash content may be due to genetic or cultivar variation of Enset varieties [13]. Concerning fermentation time, it indicated that fermentation decreased the ash content of enset, and thus, *kocho* has lower ash content than Enset plant [14]. This could due to fermentation, which imparts the solubility of minerals and other organic constituents, which contribute the total ash content in *kocho*. On the other hand, the ash content of *kocho* prepared by two processing methods had almost the same ash content. Therefore, the concentration ash in *kocho* did not significantly affect by the variety, processing method, and the ash content is highly depending on the fermentation time.

Crude fat content

In this study, the crude fat content reached higher value depending on the variety and fermentation period. There was positive correlation between variety and fermentation period on fat content of *kocho* sample. An effect was observed due to fermentation time difference on the *kocho* in crude fat content. When fermentation time elongates, the crude fat content in *kocho* had decreased, 1.60% and 1.52% for 10, 20 and 30 days of fermentation time. This could be due to fermentation, which increase the degradation of fats by lepolytic enzymatic activities and microbial proliferation causing the consumption of nutrients.

Concerning processing methods, almost the equal amounts of crude fat contents of *kocho* were recorded from *kocho* processed by traditional and modified methods used in this study, 1.20% and 1.11%, respectively. The higher crude fat content (1.27%) was recorded from *kocho* of kinnare, and the lower crude fat content (1.04%) was recorded from Astare variety *kocho*. The difference in crude fat content among Enset varieties was most probably attributed by varietal variation.

Crude protein content

The crude protein content of *kocho* samples prepared from traditional method of kinnare variety were the highest (3.47% and 3.43%, respectively) of all, while the lowest crude protein content of *kocho* were obtained from modified processed method of astare variety, 3.26% and 3.17%, respectively. This could be associated with the crude protein difference in variety and the addition of pre heated pulp to well increase the solubility of proteins into their smaller units, which results to lower crude protein content in the product.

There was remarkable increase in crude protein content of *kocho* samples as fermentation time increased from 10, 20 and 30 days. The highest crude protein content (5.09%) was obtained at 30 days of fermentation, while the lowest value (4.42%) was recorded at 10 days of fermentation.

On the other hand, in both varieties, as the fermentation time increased, the crude protein content was also slightly increased. The crude protein content of *kocho* increased due to the action of fermenting microorganisms in the synthesis of some amino acids, and improved the quality of the protein, as determined by amino acid profiles. It is also known that fermentation had the general effect of increasing the essential amino acid content of *kocho*. The same trends in increasing of crude protein were observed in barley fermented product [15].

Carbohydrate

As the finding of the study, there was significant difference in carbohydrate content among the varieties, processing methods, and fermentation time. The maximum carbohydrate content (53.53%) for *kocho* samples was obtained from kinnare, while the minimum carbohydrate content (32.75%) was obtained from astare. Similarly, the carbohydrate content had showed significant difference due to the processing method. On the other hand, the highest carbohydrate content (34.00%) was found in *kocho* processed by traditional than minimally modified method (31.24%).

As the fermentation time increased (at 30 days of fermentation time), the carbohydrate content of *kocho* sample decreased. The highest carbohydrate content (44.08%) was recorded at 10 days of fermentation time, and the lowest value (33.80%) was recorded at fermentation time of 30 days. The reduction of carbohydrate content during the fermentation process was possibly due to the breakdown of more complex components by enzymes produced by fermenting microorganisms. And this might be also associated with the reduction of crude fiber content, also advanced the decrease in carbohydrate content. Therefore, decrease in carbohydrate content is related with the addition of fermentation time, resulting to enzymatic degradation and depolimeraization of carbohydrate to their smaller forms. The general trend observed in this study as presented from table 1 was decreasing carbohydrate content due to increasing fermentation time.

Titratable Acidity (TTA)

In this the study, there was significant difference in titratable acidity percent among the varieties, processing methods and fermentation time. The maximum titratable acidity percent among the two Enset varieties was found in *kocho* prepared from Kinnare than stare, 0.61% and 0.55%, respectively.

Similarly, different amounts of titratable acidity percent were recorded from *kocho* prepared by two processing methods during *kocho* fermentation. Highest titratable acidity percent (0.57%) of *kocho* sample was recorded from traditional Gurage processing of *kocho*, while lowest titratable acidity percent (0.50%) was obtained from modified processing methods.

An effect of fermentation time on titratable acidity percent was highly significant during 10, 20, and 30 day's fermentation time, as presented on table 2. The titratable acidity percent was significantly

Variables	pH	TTA (%)
varieties		
Astare V1	4.86	0.55
Kinnare V2	4.78	0.61
Processing methods		
Traditional PM1	4.34	0.57
Modified PM2	4.52	0.50
Fermentation time		
10^{th} days FT1	4.64	0.27
20^{th} days FT2	4.28	0.49
30^{th} days FT3	3.79	0.87

Table 2: Effect of Enset variety, processing methods and fermentation time on pH value and Titratable acidity (%) of *kocho*.

inclined from 10-30 days of fermentation period. Accordingly, the highest (0.87%) titratable acidity percent was found at 30 days of fermentation time, and the lowest (0.27%) titratable acidity percent was obtained for 10 days of fermentation time.

pH value

As the TTA content of *kocho* increased, the pH value was dropped. pH value of *kocho* samples would be affected by Enset varieties, processing methods, and fermentation time. Among Enset varieties, the highest pH value (0.86) of *kocho* samples was founded from Astare,but the lowest pH value(0.78) was founded from kinnare variety. This is inversely related with titratable acidity percent for the same Enset varieties, used for *kocho* preparation.

Concerning processing methods, the maximum pH value (0.57) was recorded for *kocho* samples from modified processing method, and the minimum value (0.50) was obtained from *kocho* samples from traditional processing methods. This is also inversely related with titratable acidity percent for the same processing methods used for *kocho* preparation.

Finally, the effect of fermentation time was significant on pH value of *kocho* samples. As increasing fermentation time increase, the pH value of *kocho* samples declined. Therefore, the highest pH value was (4.62) founded at 10 days and the lowest pH value (3.79) was founded at 30 days of fermentation time. This is inversely related with titratable acidity percent for the same fermentation time used for *kocho* preparation.

From the above table, at 10 days of fermentation time, lowest counts of total BC (log 15.02/g) was recorded and the highest counts of total BC (log 15.93 cfu/g) was reached at 30 days of fermentation time *kocho*. Ashenafi [16] explained that *kocho* and *bulla* had high counts of aerobic mesophilic bacteria and yeasts as increasing fermentation time increase.

On the other hand, variations on count of total aerobic bacteria were observed in *kocho* prepared from different Enset varieties. Higher total bacterial count reached log 8.66 cfu/g in *kocho* of Kinnare variety. The lower total bacterial count (log 8.64 cfu/g) was recorded from Astarte variety *kocho*. The difference in total bacterial count between varieties was due to slow time in fermentation process, difference in production of organic acids, dominantly lactic acid, and pH drop of fermenting mass. Therefore, fermentation starts earlier in kinnare variety than in Astare variety, or Astare variety had more delay time of fermentation and low count of aerobic bacteria.

As the fermentation time increased from 10 to 30 days, counts of coliform in *kocho* was significantly decreased, as counts of coliform in *kocho* sample from log 7.26 cfu/g at 10 days of fermentation time to log 3.70 cfu/g at 30 days of fermentation time. This clearly showed that counts of coliform in *kocho* decreased as the fermentation time increased. Similarly, coliform counts in *kocho* from different Enset varieties had showed variation. The highest count of coliforms (log 2.77 cfu/g) was recorded from *kocho* of astare variety and the lowest count of coliforms (log 2.71 cfu/g) was recorded from kinnare *kocho*. The difference in counts of coliform of *kocho* between varieties of Enset was possibly due to variation in organic acid production and early lowered in pH value.

In addition to this, *kocho* prepared by different processing methods had showed variation on counts of coliform (Table 3). The highest (log 2.36 cfu/g) and lowest count of coliforms (log 1.01 cfu/g) in *kocho* was recorded from *kocho* prepared by gurage traditional and modified

Variable	Total aerobic bacteria (cfu/g)	Coliform (cfu/g)	LAB (cfu/g)	Yeast & Mold (cfu/g)
Varieties				
Astare V1	8.64	2.77	8.00	4.13
Kinnare V2	8.66	2.71	8.05	4.38
Processing methods				
Traditional PM1	11.15	2.36	7.52	3.89
Modified PM2	6.11	1.01	7.60	2.23
Fermentation time				
10th day FT1	15.02	7.26	15.11	3.98
20th day FT2	15.38	6.51	15.23	2.55
30th day FT3	15.93	3.70	16.11	2.60

Table 3: Effect of Enset variety, processing methods and fermentation time on microbial quality of *kocho* samples.

processing method of *kocho,* respectively. The use of minimally preheated pulp during *kocho* preparation can contribute to low count of coliform due to thermal effect and high production of TTA and lowerd pH.

As revealed from the above table, effect of fermentation time on the yeast and mold count of *kocho* was remarkably significant. The highest counts of yeast and mold reached log 3.98 cfu/g at 10 days of fermentation time of *kocho,* and lowest count of yeast and mold reached log 2.60 cfu/g at fermentation time of 30 days. This reduction in yeast mold might be anaerobic condition of *kocho* fermentation, followed by a decrease in Ph, and increases in TTA, possibly contributed. The traditional processing method also showed high yeast mold count than pre heat modified method. This could be due to heat effect on reduction of yeast mold. Similarly, *kocho* obtained from kinnare variety had maximum yeast and mold log 4.38 cfu/g and the minimum yeast and mold log 4.13 cfu/g was found from *kocho* samples prepared from astare variety.

Concerning Lactic acid Bacteria count, the highest counts of LAB (log 16.11 cfu/g) were recorded at 30 days of fermentation time, and the lowest counts of LAB (log 15.11 cfu/g) were obtained at 10 days of fermentation time. The result indicated that when the fermentation time increased, the counts of LAB also increased due to the ability of LAB growing at low pH of *kocho,* when counts of other fermenting microbes decreased. However, LAB counts of *kocho* prepared from different Enset varieties and processing methods did not indicated variation in counts.

The data from this experiment indicate that there was relationship between the kocho quality parameters and sensory evaluation results. The prepared *kocho* ketchups had good flavor characteristics, flavor, texture, and fairly overall acceptability. The highest color acceptance mean score (7.91) was obtained from *kocho* bread baked from 30 days fermented *kocho*. The lowest color acceptance score (6.35) was given to *kocho* bread baked from 20 days fermented *kocho*. As the fermentation time of *kocho* increased, its bread color acceptance also increased. The fermenting microorganisms decompose some of complex carbohydrates, pigments from the cellular structure of *kocho* pulp, by producing active enzymes. *Kocho* breads baked from kinnare variety had high score than *kocho* bread baked from astare variety. Similarly, processing method showed clear difference in color acceptance and the highest score was found from *kocho* breads baked under traditional method that pre heat modified methods (Table 4).

Concerning the flavor, as the fermentation time of *kocho* increased, its bread flavor level also increased. On the other hand, The highest

Variables	Color	Texture	Flavor	Over all acceptance
Variety				
AstareV1	6.12	6.27	2.23	4.55
KinnareV2	7.05	7.05	2.04	5.33
Processing Methods				
Traditional M1	5.95	3.21	2.82	4.44
Modified PM2	4.83	5.41	2.48	5.17
Fermentation Time				
10^{th} days FT1	5.56	8.42	1.55	4.30
20^{th} days FT2	6.35	8.94	1.90	4.94
30^{th} days FT3	7.91	9.91	2.07	5.78

Table 4: Effect of enset variety, processing methods and fermentation time on sensory attributes of *kocho* samples (Mean score).

flavor level mean score (2.07) was obtained from *kocho* bread baked from 30 days fermented *kocho*, while the lowest flavor (1.55) was given to *kocho* bread baked from 10 days fermented *kocho*. *Kocho* breads prepared from astare varieties subjectd with traditional processing methods showed high flavor score than kinnare varieties subjected with modified processing method.

Finally, as the fermentation time of *kocho* increased, both texture property and overall acceptability increased. Moreover, *kocho* brads from kinnare Variety showed good texture profile and overall acceptability. In line with this, *kocho* breads prepared from modified method showed better texture and over all acceptability.

Conclusion

In conclusion, extending of fermentation time, difference in processing methods and different Enset variety had resulted differences in chemical composition, physic-chemical characteristics, microbial proliferation and sensory attributes of *kocho*. *Kocho* fermented for 30 days, prepared from Astare variety and processed by modified processing method, resulted in best quality in physic-chemical quality, chemical composition, microbial quality and sensory acceptance. Using of pre heat processing method improved the quality of *kocho* and reduced delay time in fermentation process. Therefore, fermentation played a significant role in *kocho* preparation by enrichment of the product through development of flavors, aromas, and textures, by slightly enhancing protein content and preserving the product through production of natural preservative. Generally, the selection of appropriate varieties improved processing methods and recommended fermentation time were good practice for the processing of tradition food products, such as *kocho* an Ethiopian traditional fermented food.

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