WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Assessment and Evaluation of Enset Processing Technologies

Tamiru Dibaba*

Ethiopia Agricultural Research Council Secretariat, Addis Ababa, Ethiopia

A B S T R A C T

Enset is the important plant in countries like which high rate of population growth and most hunger where found since this plant is the life safer even in dry condition of the environment. So increasing the productivity and production of such important plant is very necessary. The major bottleneck of increasing productivity and production are the processing method and the diseases. Hence, to overcome such problems especially traditional processing method this is laborious and time consuming, different research institutes, universities and poly technique colleges modify the methods by developing processing machines. The assessment was done in 12 organizations which are done research on enset processing devices. Out of these some of them were have no prototype, some of them were not evaluated the machine and some of them were evaluated and demonstrated the machines. Therefore, the main objective of this assessment is to assess the enset processing technologies and identify the better machine from the existing. According to the result, the Bako Agricultural Engineering Research center integrated machine is the best and the Ambo University integrated machine is the better from the processing machine.

Keywords: *enset, processing, machine, kocho, fermentation*

1. 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. The main food product from it is obtained by fermenting the mixture of the scraped pulp of the pseudo stem, pulverized corm and stalk of inflorescence and is locally known as 'kocho‘

During harvesting the scrapings from the pseudo stem together with pulverized corm are put in a pit for storage, usually together with some natural products (e.g. from older corm or some herbaceous plants) that contain the yeast required to rapidly initiate the fermentation process.

More than twenty percent of Ethiopia’s population used Enset for human food, fiber, animal forage, construction materials, and medicines. It was estimated that a quarter or more than 20 million of Ethiopia’s population depends on Enset as staple and co-staple food source, for fiber, the major foods obtained from enset are kocho, Bulla and Amicho.

The processing of enset is traditionally a role for women, who act as a reservoir of knowledge about the techniques involved, but the tasks involved are labor-intensive and tedious (Hunduma & Ashenafi, 2011). The preparation of enset for processing is a very time consuming and hard work. By social custom, almost all the operations connected with enset processing are the exclusive responsibility of women in the family (Almeida, 2004). In Ethiopia enset are decorticated traditionally using a locally made bamboo scraper against a wooden plank . This traditional method is inefficient, unhygienic, gender based, less productive and time consuming.

To alleviate this problem, there were different researches Institutes, Poly technique Colleges and Universities developed and modified different enset processing machines. But still the problem did not solved due to appropriate machine was identified. Therefore, the main objective of this study is to assess the existing enset processing technologies and to select the better technology for further demonstration and popularization.

2. Material and Method

2.1 Study area

The assessment was done in different Universities, Poly technique colleges and Research Centers. The Universities where the assessment done were Ambo University, Hawasa University, Wolaita Sodo University, Arba Minch University and Wolkite University, the poly technic colleges were Worabe poly technical college, Hosaina poly technical college. And Wolkite poly technical college and finally the Research centers Bako Agricultural Engineering Research Center, Melkasa Agricultural Research Center, Hawasa Selam Vocational Business Group and Wolaita rural technology promotion center. But out of these universities Hawasa University, Wolkite University and Wolaita Sodo University had no completed machine, and also Hawasa Selam Vocational Business Group had no enset processing machines.

2.2 Data collection and analysis

The assessment and evaluation of the enset processing technology were done through interviews and physically visiting the technologies. The evaluation was done in terms of different aspects like machine performance, Eases labor, chemical resistance (corrosion proof, non-degraded, etc) Comfortable to operate (ergonomically), had a faster production rate, Improves hygiene of the work (no contact of human feet with food item), Reduce production loss and current status of technology. Therefore, some of these machines didn't testing its performance by the owners where the others had tested. Hence, to evaluation the machine without performance data were difficult but overviewing the machine physically and got some information including video of the machine during operation. Therefore, the descriptive statistics was used to evaluate the assessed machines to select the better one.

3. Result and Discussion

From assessment of enset processing machine I got four types of machines based on their functions. Such as enset scrapping machine which separate (scrap the leaf sheath) the leaf sheath from fiber, decorticating machine which chopping corm, squeezing machine which separate the liquid part from sold and final the fermentation box/pit which the extracted product collected and stored for fermentation. In general each of the machines were had their own drawback and performance which described as follow.

3.1 Squeezer

3.1.1 Manual Bulla Squeezers

3.1.1.1 Ambo university Manual Bulla squeezer

This machine is used to separate bulla from scrapped leaf sheath and fermented kocho if necessary. The squeezing was done using bag and hold on by foot traditionally. This machine is operated by putting the scrapped enset into the hopper and press down as shown in the fig.1. The liquid part is flow out in bottom while the solid part is remaining in the hopper. The machine was constructed from galvanized iron for body construction, cast iron pipe for handle and angle iron for stand. In general, the performance of this machine did not test. The machine was well designed.

Figure 1. Ambo University manual kocho squeezer

The main problem of this technology were construction materials are not recommended for food processing even the stand is constructed from low corroded material, and to operate the machine required two person (one person press down while other held the machine to the ground) which is taken additional labor and finally during operation or squeezing the product is inverted by hand to squeeze well and taken out the product by hand as shown in the fig. 2

3.1.1.1.2 Arba Minch University Bulla squeezer

This machine have the same function with the above one but different in design. The operation of this machine is done by pressing the piston and the cylinder has hole which the liquid part is flow out. It was constructed from stainless steel, wood, flat iron and angle iron. The machine had not performance data rather than orally said better. The problem of this machine was similar with the above one and in addition it was not well designed and some of the construction material was rust material which is not recommended

3.1.1.1.3 Bako Agricultural Engineering Research Center Manual bulla squeezer

The machine is easy to transport from place to place and easily to use it. This machine was squeezing only bulla which extract from scrapping leaf sheath but not kocho. The machine was constructed from mesh wire and metal which didn't recommended for food processing machine design. Its performance capacity was 110kg/hr. it was not well designed

3.2 Scrapers

3.2.1 Manual leaf sheath scrapers

3.2.1.1. Ambo University Leaf sheath manual scraper

This machine is used to scrapping the leaf sheath in order to separate fiber from food material. As shown below the system of operating the machine is first fasten the leaf sheath to the lumber on the top after set the machine and scrapping it using splitting bamboo piece. This machine is better than the traditional one in terms of minimizing contaminating the food materials and avoid the health problem occur during hold it by leg. The machine was constructed from lumber and rope for hold the leaf sheath during scrapping with adjustable seat at bottom as shown in the fig 1. The performance of this machine didn't evaluated. The problem of this machine is manually operated which this takes time and tiresome

Figure 3. Ambo University manual enset scraper

3.2.1.2. Bako Agricultural Engineering Research Center Manual leaf sheath scraper

The machine is used to scrapping the leaf sheath in order to separate fiber from food material which is similar with the above fig. the construction materials were lumber, rope, bamboo and the other was metal. The operation is done by woman by seating or standing which means adjustable. Finally the capacity of this machine is about 48.33kg/hr.

3.2.2 Engine driven leaf sheath scrapers

3.2.2 .1 Bako Agricultural Engineering Research Center Engine driven Leaf sheath scraper

This machine is designed to solve the enset scrapping problem which is difficult for women to hold it by one leg and scrapping it. Therefore this machine is improving the quality of product and yield production. The machine was constructed from stainless steel, pvc pipe, angle iron and square pipe as shown below in fig 4. It is driven by 5HP engine motor. The performance result tested by owner were 255kg/hr, 98.97% and 0.03% of decorticating capacity, decorticating efficiency and pulp loss respectively with highest fuel consumption of 16.77ml/kg. The great problems of this machine is the construction material such bolt and nut is rust material and the pvc pipe is easily broken.

Figure 4. Bako Agricultural Engineering Research Center engine driven enset leaf sheath scraper

3.2.2.2 Arba Minch University engine driven leaf sheath scraper

The machine is driven by engine to scraping the leaf sheath of enset which separate fiber from food material. The construction materials of this machine were stainless steel sheet, angle iron bolts and nuts. The performance indicator parameters were not collected. The major problem of this machine was partially the construction material which is rusting.

Figure 5. Arba Minch University leaf sheath scraper

3.3 Decorticating/grating machines.

3.3.1 Single function enset processing engine/ motor operated machines

3.3.1.1 Bako Agricultural Engineering Research Center Engine driven corm grating machine

This machine is used to grating the corm and pseudo stem. The grating capacity of the machine was 1048.3kg/hr, the grating uniformity was 91.63% with 5*5mm sieve, grating efficiency was about 98% and loss 2% and also the fuel consumption was 1.32lit/hr. the machine is easy to transport from place to

place since its weight about 50kg without engine (Merga W. and et al 2021). The main problem of this machine in joint area some parts is rusted and the stand of the machine is also constructed from rust metal.

Figure 6. Bako Agricultural Engineering Research Center engine driven enset decorticator

3.3.1.2 Arba Minch University Enset corm milling

This machine was constructed from stainless steel and angle iron as stand of the machine. Even if the machine was demonstrated in some area but there is no performance indicating data collected. The main problem of this, machine were the stand constructed from rust metal which may contaminate the product and the power source is electrical motor. The majority of the enset producing farmers did not get electricity.

Figure 7. Arba Minch University enset decorticator

3.3.2 Integrated enset processing engine operated machines

3.3.2.2 Ambo University Improved engine driven integrated machine

This technology is designed to decorticate pseudo stem and corm, pulverize the corm and scrap leaf sheath. The machine was well designed and safe for operation. The construction materials were stainless steel, flat iron, deformed bar and angle iron. Some of the performance indicator parameters like pseudo stem decorticating capacity, leaf sheath scrapping capacity, corm pulverizing capacity, pulp yield and losses were measured to evaluate the machine performance. As the owner of the machine said that the tested result were 315kg/hr, 381kg/hr, 978kg/hr, 79% and losses (6% pulverizing loss,, 4% pseudo stem decorticating loss and 6% leaf sheath loss) respectively. The main problems of this machine were some parts constructed from rust metal which contaminate the product and paint antirust is not recommended for food contact parts as shown below in fig.8.

Figure 8. Ambo University engine driven integrated machine

3.3.2.3 Bako Agricultural Engineering Researh Center Integrated enset processing machine

The machine was constructed from stainless steel and angle iron for stand as shown in fig 10. This machine were tested and the performance indicator parameters measured. According to the test result, the grating capacity, decorticating capacity, un-decorticating sheath decorticating efficiency were, 1658kg/hr, 490kg/hr, 9.67% and 90.55% respectively with fuel consumption of up to 1.1li/hr .the major problem of this machine is safety problem in inlet and feeding inlet which scattering of product out of the machine during operation.

Figure 9. Bako Agricultural Engineering Research Center engine driven integrated machine

3.3.2.4 Wolkite Poly Technic College Enset processing machine

This machine is used to scraping and decorticating enset using electrical motor as power source. The construction materials of this machine were stainless steel sheet, bolts and nuts, galvanized sheet, auger and angle iron. This machine didn't evaluated and no had performance tested result. The main problems of this machine were its materials of construction which was rusted when visited and the food product was changed its color due contaminated by rusted part. The other problem is the weight of the machine which is difficult to move from place to place and safety problem in inlet.

Figure 10. . Wolkite Poly Technic College enset processing machine

3.3.2.5 Worabe Poly Technic College engine driven Enset processing machines

The machine is used to done both function scraping and decorticating by using engine or electrical motor as power source. The machine was constructed from angle iron, square pipe, iron sheet, iron shaft, galvanized sheet water pipe and others. The machine was not integrated rather than connected by one shaft which connected scraper part with decorticator. The two parts were completely separated except they have common shaft. The problem of this machine was its construction material. The machine is not functional and not well designed.

4. Conclusion and recommendation

4.1 Conclusion

The assessment of enset processing technologies was done at 12 sites and the assessment was done based on the physical contact the owner of the technologies and interviewing about the technologies. The interviews were gathering the information like performance of technologies if tested before, videos, working principle of the machine, design of the machine, construction materials and etc. finally, from the information and physical visited technologies, I conclude as follow:

- All technologies I visited were better than traditional way enset processing since they reduce the women drudgery
- The one which developed by Bako Agricultural Engineering Research Center which called it Integrated enset processing machine was better than all relatively from processing machine

4.2 Recommendation

As assessment of enset processing technologies result indicated that there are different efforts by different organization. But most of them were put on shelf not try to improve or not demonstrated at farmer level. There are good effort at Arba Minch University, Ambo University and Bako Agricultural Engineering Research Center.in general from observation and evaluation of technologies, I recommended that:

- All processing technologies had drawback even if better than traditional method. Further improvement of technologies is required to solve the problems of processing
- It is better to multiply and disseminate Integrated enset processing machine which developed by Bako Agricultural Engineering Research Center.

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