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Research Article

On-Farm Evaluation of JICA-Type Milk Churner

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Abstract

Ethiopia's large livestock population and livestock-friendly climate make it a country with enormous potential for dairy development. Through the creation of jobs and revenue, milk and milk products make significant contributions to both the national and home economies. One of the main issues facing the nation's milk industry is postharvest losses. This study was carried out in the Jimma and Bunno Bedalle zones to evaluate the performance of a better plastic milk churner with farmers' participation. Fifty households were chosen from five rural kebeles where the production of butter from milk has a long history. Seven liters of sour milk were used to test both churners, and based on the average outcome, the upgraded churner produced noticeably more butter (55 percent, 56 grams per liter) than the conventional clay pot (39 percent, 37 grams per liter). In addition, it took a lot longer for the conventional butter processing mechanism to churn (an average of 65 minutes) than the upgraded churner (30 minutes). In summary, a better churner was chosen over a local one because it produced more butter, was more efficient at producing butter, and took less time to churn. By including men in the milk chain, using an upgraded churner could also help to lessen gender inequality.

Keywords

Churner, Improved, Milk, Processing, Traditional

1. Introduction

Ethiopia's large livestock population and livestock-friendly climate make it a country with enormous potential for dairy development [2]. Through the creation of jobs and revenue, milk and milk products make significant contributions to both the national and home economies [9]. Accordingly, one of the livestock industries that has the potential to reduce poverty and enhance household nutrition in the nation is the dairy sector [6]. Given the country's enormous potential for milk development, general economic expansion, rising urbanization, and improved regulatory environment, it is anticipated that Ethiopia's milk sector would continue to support both the local and national economies [5].

Nonetheless, one of the main issues facing the nation's milk industry is postharvest losses [11]. About 97% of Ethiopia's milk is produced through this system, and because of inadequate infrastructure, it is challenging to get raw milk to the country's markets or processing facilities [7]. Just 5% make it to the terminal market area; the remainder is converted into various dairy products at the farm gate [10]. Additionally, inadequate handling, contamination, and the lack of advanced technology in the market are linked to post-harvest losses [3]. In addition to increasing milk's shelf life, efficient processing improves the welfare of dairy producers by adding value to products and raising revenue [14].

Traditional tools, equipment, and procedures are mostly used in the study region for the collection and processing of

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milk and milk products [13]. As a result, the nation's traditional milk processing is still carried out in households using naturally fermented milk and antiquated churning tools, namely clay pots and a basic calabash [1]. In terms of time savings and milk fat recovery per unit of milk processed, both the gourd and the earthenware are inefficient [4].

This method of adding value to milk is similarly labor-intensive; the majority of the work is done by women and children as household chores [15]. Most people associate the process of creating butter with labor-intensive tasks like churning, whipping, or prolonged shaking of a jar [8]. Users should have access to more suitable technologies if there is to be any improvement in the existing state of processing animal products [12].

Acknowledging that a better plastic milk churner with ideal churning conditions has been created by the Japan International Cooperation Agency (JICA). In contrast to conventional churners, which produced the same amount of butter in over an hour, it provided a high extraction rate, turning 90–95% of the milk into butter in a matter of minutes. In order to maximize exposure, the study's goal was to assess how well an upgraded plastic milk churner performed in a few chosen Jimma and Bedelle zone locations with farmers' participation.

2. Materials and Methods

2.1. Materials

The materials required to construct the prototype were:

Plastic jar, square pipe, round bar, flat iron, bronze, clay pot, bolt, and nut.

2.2. Methodology

2.2.1. Site and Farmer Selection

This investigation was conducted in the special district's Jimma and Bunno Bedelle zones. Due to their potential dairy products, the districts of Dedo, Seka Cokorsa, and Gera were chosen in the Jimma zone, while the districts of Gachi and Bedelle were chosen in the Bunno Bedelle zone. A purposeful selection of stockholders was made, and they received training on how to use an upgraded milk churner throughout processing as opposed to the local one.

Fifty male and female farmers who can lactate cows in five areas were given access to fifteen upgraded milk churners that were constructed in the workshop of the Jimma Agricultural Engineering Research Centre (JAERC) using readily accessible materials. One portion of the obtained sour milk sample was churned in a conventional milk churner, while the other portion was churned in an upgraded milk churner as part of the evaluation process. The effectiveness of both milk churners in producing butter was then assessed.

2.2.2. Training

Training is one of the most important factors in accelerating the adoption of a certain technology. Before attempting to implement the methods and/or technologies on their farms, farmers and other technology users may be able to learn the fundamentals. Therefore, agricultural experts from extension and mechanization processes trained 50 female farmers and 25 male farmers on the use and advantages of churners.

2.2.3. The Working Principle of the Churner

To create yogurt, milk is first kept in a storage utensil for two to three days, depending on the weather. The sour milk was put into the hopper after the churn was set up in the desired location before the operation began. After that, work and rotating yogurt began. Turbulence caused the formation of sour milk butter granules. Through the middle of the hopper lid, the granule formation is examined. Ultimately, the butter particle floated on the yogurt liquid's surface after being manually gathered from the hopper's surface. Depending on the temperature, humidity, yogurt quality, and amount, the procedure takes 27 to 35 minutes.

Figure 1. *Traditional milk churner and improved milk churner.*

2.2.4. Performance Test of the Churner

A preliminary test run was conducted to see whether or not the churner was functionally satisfactory. Small plastic bags, a plastic container, a 0.1 g accuracy weight scale, sour milk or yogurt, and timer devices were prepared for the trials. In terms of carrying out the necessary task effectively, the prototype churner exhibited good stability. Following this, several test factors were noted, such as the quantity of soy or fermented milk utilized, the soy's purity, the churning time, the churning time, the churning time, and the butter production.

2.2.5. Data Analysis

Data was subjected to descriptive statistical analysis of the mean of butter yield and Churning time by using the Microsoft Excel application.

3. Results and Discussion

Parts of a manual butter churn were assembled and transported for performance testing after manufacturing. Therefore, the test findings listed below are based on the data collected and the technology's performance outcome. The milk churner was evaluated using sour milk. The upgraded churners that were given out have a 10-liter capacity. However, no more than seven liters of sour milk were utilized in the milk churner's evaluation. The evaluation's findings based on the collected data are displayed in the following table. Temperature, churn speed, and the acidity of the sour milk all have a significant impact on how efficiently butter is made.

Table 1. *The mean of butter yield (gm/lit) and churning time (min).*

Parameters were considered during the test	**Performance result of a manually operated butter churn**					
	Jimma zone				**Bedalle zone**	
	Dedo		**Seka**	**Gera**	**Bedalle**	**Gachi**
Ambient temperature (℃)	25.00		24.00	23.00	24.00	24.50
Relative humidity (%)	48.00		51.00	54.00	55.00	50.00
Amount of soar churned (lit)	7.00		7.00	7.00	7.00	7.00
Churning time (min)	Impr. churn	27.00	29.00	32.00	35.00	30.00
	Trd. churn	61.00	65.00	64.00	70.00	66.00
Butter yield (gm)	Impr. churn	365.68	384.16	396.55	413.28	385.07
	Trd. churn	253.40	273.00	281.12	292.60	277.76
Butter yield (gm/lit)	Impr. churn	52.24	54.88	56.65	59.04	55.01
	Trd. churn	36.20	39.00	40.16	41.8	39.68

Where: - Impr. Churn is an improved milk churner and Trd. churn is a traditional milk churner.

The observed results showed that the quality of the milk, churning temperature, humidity, and human power all affected the butter yields from performance tests. The tests yielded the maximum butter yield of 59.04 g/lit and the lowest butter yield of 52.24 g/lit, 41.8 g/lit, and 36.20 g/lit, respectively, for improved and conventional. This indicates that one kilogram of butter requires seven liters of yogurt. The findings of the performance test also show that a manually operated enhanced milk churn takes between 27 and 35 minutes to churn butter, while a typical milk churn takes between 61 and 70 minutes.

The amount of milk to be churned, the churning power, the churning temperature, and the humidity all determine how long the churning process takes. Too high a temperature reduces the amount of butter produced because a significant amount of fat stays in the buttermilk, resulting in spongy, and low-quality butter. Conversely, if the temperature is too low, it takes longer to split the butter into globules, which results in an excessively long churning period. Additionally, the churn's performance was affected by the quantity of material that needed to be churned.

Farmers' Response and Feedback

When the technology was demonstrated, the women were overjoyed. They acknowledged that it might help them cope with the stress of continuing to churn. They pondered whether they could get the churner for less money. The woman in the district sits with her legs folded, shakes, and carefully spins the pot on her lap or based on soft materials. Women stated

that they always look for the most comfortable technology to conduct the churning because this position of holding the pot on their laps or between their legs on a cushion and then shaking it is said to induce knee and elbow pains. In a similar vein, the fact that the guys could control the churning themselves enthused them about the technology. After all, the churner was a device that changed gender roles by circumventing the cultural norm that churning in a gourd was only done by women. They did, however, make several remarks in a focus group-style discussion that require more thought.

4. Conclusion and Recommendation

4.1. Conclusion

On the farm, a JICA-style milk churner was displayed, and its functionality was assessed. The churner can be easily maintained, serviced, and operated. The recovered butter was not contaminated by the materials chosen for manufacturing. Humans are in charge of the churner. The tests yielded the maximum butter yield of 59.04 g/lit and the lowest butter yield of 52.24 g/lit, 41.80 gm/lit, and 36.20 g/lit, respectively, for enhanced and conventional.

Traditional milk churns require between 61 and 70 minutes to churn butter, while manually operated upgraded milk churns take between 27 and 35 minutes. Since the machine is very economical and time-efficient, it can be used for small and medium-sized milk production to promote the production of butter in villages. One milk churner can be bought and used by a group of ladies.

4.2. Recommendation

It is recommended to train local artisans to manufacture, repair, and maintain the milk churner. It was recommended to consider linkage among stakeholders for the multiplication and promotion of the technology.

Abbreviations

Churn	Churner
Gm	Gram
Impr	Improved
JICA	Japan International Cooperation Agency
Lit	Liter
Trd	Traditional

Conflicts of Interest

The authors declare no conflicts of interest.

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