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Dairy Plant Processing Capacity and Challenges in Milk Processing Industry of Ethiopia

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Abstract: Ethiopia has a high number of livestock populations and suitable climate for livestock development, a country has been dependent on importing milk and dairy products for long period of time. 95% of the national milk is marketed through informal channels and unprocessed. Only 5% of the milk produced is marketed as liquid milk. Processing capacity and their challenge were not well identified. Objective of the study was to evaluate the current situation and challenge of milk processing industries in Ethiopia. About 32 milk processing industries were established in the country. Out of them the study was conducted in 21 milk processing industries were selected purposely. Data was collected by prepared questioner to identify key problems and opportunities found in dairy industry. Data analysis was processed using the Procedure for Social Science (SPSS) version 23.0 (2016) software. The results are presented in descriptive statistics (frequency, mean, standard deviation and percentage) the mean difference is tested at 0.05 level of significance. Result indicate that Milk processing capacity and Milk processing with ownership type, the value of $p < 0.05$ there is significance difference in milk processing capacity among ownership of the industries.

Key words: Capacity · Challenge · Dairy · Opportunity · Processing

INTRODUCTION

Ethiopia has diversified topographic conditions with altitudes ranging from extremes of 4500 m above sea level in the Semen Mountains to areas 100 m below sea level in the Danakil depression. Within this diversity, climatic conditions vary from arid, tropical, sub-tropical and temperate. Ethiopia has Africa's largest livestock population. Over 60% of its land area is semi-arid lowland, dominated by a livestock economy [1, 2].

Even though Ethiopia has a high number of livestock populations and suitable climate for livestock development, a country has been a dependent on importing milk and dairy products for long period of time. Milk plays a very important role in feeding the rural and urban population of Ethiopia and has high nutritional value. Milk and milk product is produced daily and sold for cash or processed. It is a source of cash in the milk shed areas that enables families to buy other foodstuffs, significantly contributing to the household food security [3]. However, the Ethiopian milk marketing system is not well developed [4-6].

In Ethiopia, 95% of the national milk is marketed through informal channels and unprocessed. System is characterized by no license to operate, low cost of operation, high producer prices as compared with formal market and no regulation of operation [7].

The traditional processing and marketing of dairy products, especially traditional soured butter, dominate the Ethiopian dairy sector. Only 5% of the milk produced is marketed as liquid milk due to under development of infrastructure in rural areas. Hence, the informal (traditional) market has remained dominate in Ethiopia. Production is non-market oriented and most of the milk produced is retained for home consumption [8].

According to FAO [9], Ethiopia's human population will increase to about 149.3 million by the year 2040. On the other hand Teferra [10] reported that the total annual milk supply to Addis Ababa was 65.503 million liters of milk, of those 4.5 and 8.76 million liters of milk supply by Lame dairy and Sebeta Agro-Industry; respectively. Sebeta Agro-industry established the first Ultra heat temperature (UHT) dairy processing facility in the country [8], now family milk industry is establishing

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the second UHT dairy processing facility. The potential market for surplus milk which will have to be processed is found in the 7% urban population. Sixty five percent of this market is formed by Addis Ababa and the surrounding districts. The principal demand will continue to be fluid milk. The current study plant capacity and their challenge to process milk into different milk products was significant and require further identification why Ethiopian milk processing are not work with their capacity. Therefore this study was important to meet the following objectives. The general objective of the study was to evaluate the current situation and challenge of milk processing industries in Ethiopia with specific objective, to identify design capacity and amount of milk processed per day, to differentiated each milk machinery capacity, to estimate the daily amount of milk and milk products processed, to identify main challenges and opportunities in dairy processing industries, in milk industries of the country.

MATERIALS AND METHODS

Study Area: The study was conducted in Dairy industries which located in the country and processed raw milk in to different milk products. According to EMDIDI [11] about 32 milk processing industries were established in different parts or region of the country. The study areas were Addis Ababa Administration, Amhara regional state, Afar regional state, Oromia regional state and South regional state. Addis Ababa Administration and Oromia regional state represent the central part of the country, Amhara regional state represent the north part and some of the central part of the country, Afar regional state represent east north part of the country, South regional state represent the south part of the country.

Sample Size: Out of 32 Dairy industries found in the country 21 milk processing industries were selected purposely; 6 milk processing industries from Addis Ababa Administration (Family milk processing industry, 7-D milk processing industry, Nuredin Hasan milk processing industry, Lame dairy milk processing industry, Chuye milk processing industry and Peagwean milk processing industries), 3 milk processing industries from Amhara regional state (Rut and hirut milk processing industry, Evergreen milk processing industry and Emebetnalijochiwa milk processing industry), 1 milk processing industry from Afar regional state (Addis kidan milk processing Factory), 10 milk processing industries from Oromia regional state (Sebeta agro-industry, Modjo milk processing industry, Ada'a milk cooperatives, Lasal milk processing industry, Holland dairy, Etete milk processing industry, Elemitu integrated agro industry, Life agro industry, Lonney milk processing industry and Zagol milk processing industry) and 1 milk processing industries from South regional state (Almitikus milk processing industry).

Method of Data Collection: The data was collected through by prepared a semi structured questionnaire from September to October, 2018 to identify the key challenges faced and opportunities found in dairy collection databases, dairy products storage facilities, milk quality control frames, dairy transport, dairy industry.

Data Analysis: To process and analysis the collected data, Statistical Package for Social Sciences (SPSS) statistical software version 23 [12] was used. Descriptive statistics was used to analysis the survey data collected from dairy industry owners, managers and milk Process experts through semi- structured questionnaire survey in the study areas. (Frequency, mean, standard deviation and percentage) the mean difference is tested at 0.05 level of significance.

RESULTS AND DISCUSSION

Origin and Ownership: Before 1990 there were ten private milk processing plants have entered the milk marketing and processing in Ethiopia and increasing the amount of milk channeled via the formal markets [8]. According to EMDIDI [11], currently in Ethiopia there are 32 milk processing industries was establish in different parts of the country. However, this finding is lower than the result of AACCSA [13], who obtained that there are about 35 active dairy processing industries in the country greater than Yilma, Emannuelle and Ameha [14] over 22 medium- and large-scale dairy processing companies in Ethiopia with nine of them operating in Addis Ababa and the rest in other major regional cities.

In this study twenty one milk processing industries were located in different area of the country was interviewed.

According to the present study about 85% of the milk processing industries were managed by male managers and about 15% of the milk processing industries were managed by female. The results indicated that about 66.7% of milk processing industries were owned by private limited company, about 28.6% of milk processing industries were owned by Share Company and about 4.8%

of milk processing industries were owned by union or cooperatives. About 48%, 28% and14% of milk processing industries were found in Oromia regional state, Addis Ababa region Administration and Amhara region Administration; respectively and the remaining proportion was share equally for Afar and South regional state.

Dairy Processing Plants Design Capacity: According to the present study the average mean capacity of milk processing industries of the country is 30, 119±27, 729 liters per day; the largest milk processing industries had capacity processing milk up to 120, 000 liters per day, while the smallest dairy processing plant can process 4, 000 liters of milk per day (Table 1). Milk processing capacity among ownership type (private, share or union) the value of $p<0.05$ there was significance difference milk processing capacity among ownership of the industries.

Milk Processing: Based on the present study, it is possible to determine how much milk was processed into different milk products, such as pasteurized milk, yogurt, cheese, butter and the likes, per day by the dairy industries indicated in Table 2.

As a result revealed that, 21 dairy industries processed an average mean of 9, 619±16672.5 liters per day; the largest and smallest dairy processing plant were processed 67, 000 liters and 300 liters of milk per day; respectively. The Result agrees with the finding of AACCSA [13] who reported that the daily processing capacity of the largest processor, Lame Dairy, is 60, 000 liters per day, now it operates at a maximum of 40, 000 liters. This indicated that milk processing difference among ownership type (Private, share or union) the value of $P<0.05$ there is significance difference in milk production by ownership type.

Type and Amount of Product: About 83.4% of the total milk produce in the study area was pasteurized milk and 12.69% covered by yogurt. Average production of pasteurized milk in the study area was 8740.48±16239.63 liters per day. ANOVA of pasteurized milk by sex and ownership showed that the mean difference is significant at the 0.05 level. Average production of yogurt in the study area was 1330±2280.46 liters per day. ANOVA of yogurt by sex and ownership resulted the mean difference is significant at the 0.05 level. Average production of Gouda cheese in the study area was 33.81±83.52 kg per day. ANOVA of Gouda cheese by sex revealed the mean difference is significant at the 0.05 level.

Machinery Type and Capacity: As the survey in the study area indicated that pasteurized machine, cream separator and skim milk packaging machine capacity had significant difference at 0.005 level among ownership type. Machinery capacity of the region show in Table 3. Pasteurizer machine have a capacity to pasteurize in mean average of 33695.24±40358.92 liters of milk per day, cream separator have a capacity to separate cream in mean average of 26203.81±25447.68 liters of milk per day, skim milk packing machine have a capacity to pack skim milk in mean average of 25000±29534.25 liters of milk per day, yogurt packing machine have a capacity to pack yogurt in mean average of 11370.48±13344.38 liters of yogurt per day, butter churner machine have a capacity to churn butter milk in mean average of 1700±6959.17 liters of milk per day.

Product Marketing: The dairy products currently produced in the dairy industry and sold at local market can be categorized into raw milk, pasteurized milk, UHT milk, butter, cottage and other type of cheese, sour milk and yogurt. Pasteurized milk, butter, yogurt and various type of cheese (apart from cottage cheese) are both imported and locally produced. Currently about 24 types of milk and milk products were produced in milk processing industries of Ethiopia. A report by MOA and ILRI [15] indicted that Industrial products include pasteurized milk, skimmed milk, yoghurt, fermented milk, table and cooking butter, cheese, cream and ice cream.

But the most important products are pasteurized milk (250 ml and 500 ml), yogurt (125 ml, 250 ml and 500 ml) and different type of cheese special Provolone, Mozzarella, Gouda and Feta cheese. This result disagree with the finding of MoA and ILRI [15] who obtained that The major marketable dairy product is butter which has a relatively longer shelf life as compared to fresh whole milk. Majority of the milk and milk products produced in milk processing industries were supplied to local market. About 85.7% of milk processing industries in study area were not export milk and milk products whereas fewer industries were export the products to Djibouti, Saudi Arabia and Juba. This result confirms the finding of Yilma [14]. Who revealed that Ethiopia is not known to export dairy products. However, some insignificant quantities of milk and butter are exported to a few countries. Butter is mainly exported to Djibouti and South Africa (targeting the Ethiopians in Diaspora), while milk is solely exported to Somalia from the South Eastern Region of the country.

Table 1: Processing capacity of milk industry in region/location per day (liters)

Location/Region	N	Mean	Standard error
Addis Ababa Region	6	33 416	18265
Amhara Region	3	31667	14240
Afar Region	1	10000	0
Oromia Region	10	30700	6298
South Region	1	2000	0
Total	21	30119	6051

Table 2: Actual milk processing of the region per day (liters)

Location/Region	N	Mean	Standard error
Addis Ababa Region	6	17450	10939
Amhara Region	3	3200	1332
Afar Region	1	2000	0
Oromia Region	10	8370	3853
South Region	1	2000	0
Total	21	9619	3638

Table 3: Milk machinery's capacity (liters) in the dairy industry by region

Location/Region	N	Mean	Standard error
Addis Ababa Region	6	34733	11726
Amhara Region	3	12667	3333
Afar Region	1	16000	0
Oromia Region	10	42920	16857
South Region	1	16000	0
Total	21	33695	8807

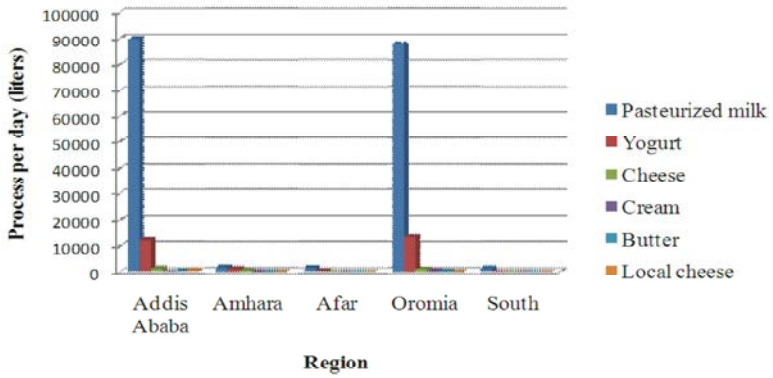

Fig. 1: Products process per day (liters)

Sebeta Agro-Industry has established the UHT dairy processing facility in 2006. Now day Family milk processing industry started those UHT machine and the total UHT producer's number increase to two milk processing industry in the country.

Amount and Reason of Milk Reject: As the present study revealed that, averagely 147.86 + 281.65 liters of milk per day were rejected from milk processing industries due to milk processing machinery defect, plastic pouch defect, milk quality problems (Adulteration) and rejected due to lactic acid formation before arrive milk processing unit. According to SNV [16] the hygienic condition of milk and milk products is very poor. Addition of water to increase the volume of marketable milk and creaming are quite common. Since milk is rejected upon delivery because of poor hygienic condition, producers pay a due emphasis in the production, storage and transportation of milk if their milk has to be accepted.

Type of Inputs and Source: Major types of inputs use for milk processing industries are raw milk, plastic pouch, yogurt cups, rennet and cultures (for yogurt and cheese making). Dairy industries obtained raw milk directly from producers and indirectly from collectors, retailers and milk suppliers. About 47.6% of the culture source was out of

Table 4: Production design capacity and production of milk per day (liters) by region

Milk processing	Factory region	Production capacity	Production of milk per day
Addis Ababa	Mean	33416.67	17450.00
	N	6	6
	Std. Deviation	44739.710	26794.309
Amahara region	Mean	31666.67	3200.00
	N	3	3
	Std. Deviation	24664.414	2306.513
Afar region	Mean	10000.00	2000.00
	N	1	1
	Std. Deviation		
Oromia region	Mean	30700.00	8370.00
	N	10	10
	Std. Deviation	19916.771	12183.326
South Region	Mean	20000.00	2000.00
	N	1	1
	Std. Deviation		
Total	Mean	30119.05	9619.05
	N	21	21
	Std. Deviation	27729.003	16672.541

Table 5: Production design capacity and production of milk per day (liters) by sex owner

Sex of owner		Production design capacity	Production of milk per day
Male	Mean	32972.22	10872.22
	N	18	18
	Std. Deviation	28920.007	17749.194
Female	Mean	13000.00	2100.00
	N	3	3
	Std. Deviation	8185.353	1734.935
Total	Mean	30119.05	9619.05
	N	21	21
	Std. Deviation	27729.003	16672.541

Table 6 Average milk rejected per day (liters) in region

Milk processing factory region	Mean	N	Std. Deviation
Addis Ababa	149.17	6	170.071
Amahara region	166.67	3	208.167
Afar region	.00	1	.
Oromia region	169.00	10	381.734
South Region	20.00	1	.
Total	147.86	21	281.649

Average milk rejected per day (liters) by sex owner

Sex of owner	Mean	N	Std. Deviation
Male	161.39	18	302.615
Female	66.67	3	57.735
Total	147.86	21	281.649

the country, about 28.6% of culture source was from licensed local market and about 9.5% of milk processing industries obtain culture from both sources.

Laboratory Facility: The establishment of an independent laboratory for milk and milk product quality control enables to perform range of tests at milk production, collection and processing centers. The present system in Ethiopia for testing of raw milk and dairy products does not stimulate the production of good quality, biologically pure milk with high technological quality that meets the national/international standards [7].

In present study most of milk processing industries does not equipped with necessary equipment, especial there is lack of microbiological quality taste laboratory equipment's as a result there are no proper means for collecting and processing of information concerning the milk and milk products quality for marketing. Laboratories which offer a complete range of milk and milk product analysis, which determine the hygienic, chemical and microbiological quality of raw milk and dairy products all along the value chain remain the major requirement and concern for the development of dairy sector in the country.

Challenge and Opportunity

Challenges: The current study indicates that about 95.24% of the challenges in milk processing industries of the country were milk supply through informal market. Similar, study by SNV [7] indicated that 95% of the country national milk is marketed through informal channels and unprocessed, as the result informal milk marketing dominated in the country. This informal market system have negative impact on milk processing industries not delivery quality milk and create negative competition between milk processing industries in collecting quality milk. Have also impact on milk processing industry enforced to produce under their design capacity.

About 81.62% of the challenges in milk processing industries were shortage of milk in quality and quantity due to milk producer and collector have lack of awareness on quality milk producing, collecting and quality control. These challenges have also impact on milk processing industry enforced to produce under their design capacity.

About 63.48% milk processing industries have lack of cold truck vehicles to collect milk from milk producer or collection center and final products to market or consumers. They collect milk on Isuzu truck, animal back and individual back.

About 54.43% milk processing industries have lack of quality and quantity packaging material, due to inadequate number of milk packaging material producing factory in the country and even the existing packaging material producing factory produce under their capacity even they produce not quality packaging materials and not deliver on time.

The other challenge was interruption of electric power and irregular current flow of electric power. About 36.29% of milk processing industries have electric power interruption that unable to run the machine and have irregular current flow that able to distract some parts of the machine. These challenges have great effect in milk producing and marketing. Many milk products defect occur due to electric power.

About 45.38% of the challenge was due to Lack of existing original milk processing machine spare parts producing factories and 31.76% due to lack of trained man power on machine maintenance or repair. Shortage of well-trained man power on milk and milk products processing. Lack of well-equipped laboratory facilities especially in microbiology laboratory. About 40.41% of the challenge was happen due to milk consuming habit of the country, milk is not consuming at fasting season especially in Christian religions due to this milk and milk products have low demand during this time. As reported by Care Ethiopia [17], the major challenges observed in milk and milk products marketing are: High seasonality of milk and milk products production and supply to market, easy spoilage of milk, lack of milk collecting facilities, lack of marketing and milk quality skills by women, there is poor feeder rural, poor quality control systems at milk collecting centers.

Opportunity: The countries have high livestock population and suitable climate for livestock production. The sector has great milk potential and at existing situation the resource is not touched as its potentials. Government of the country gives strong attention in milk production and processing and has good working condition. Government has provided technical support, provide consultancy service and provide professional training on milk processing, quality control, products input and diversification.

A number of non-governmental organizations are involved in the sector. The expansion of urbanization and increase population number increase the demand for milk and milk products. The expansion of loan provider financial institution. Currently constructing railway Addis Ababa to Djibouti has great opportunity to generate market for milk and milk products. And the expansion of different industry growing is another opportunity

CONCLUSION

Currently in Ethiopia there are 32 dairy plants were established in different parts of the country. According to the current study about 85% and 15% of dairy plants were managed by male and female managers; respectively. About 66.7%, 28.6% and 4.8% of dairy plants were owned by private, by share company and by union or cooperatives; respectively. About 48%, 28%, 14%, 5%

and 5% of dairy plants were originated in Oromia, Addis Ababa, Amhara, Afar and South regional state; respectively.

According to the current study the average mean capacity of dairy plants of the country was 30, 119 liters per day. Milk processing capacity with ownership type $p < 0.05$ there was significance difference. Whereas averages mean actual milk processing was 9, 619 liters per day. Milk processing difference with ownership type had $P < 0.05$ there is significance difference. Currently, out of dairy plant capacity only 31.8% was processed per day.

Currently about 24 types of milk and milk products were produced in milk processing industries of Ethiopia, however not all milk products are produces in all milk processing industries. Major products are pasteurized milk, yogurt and different kind of cheese (Provolone, Mozzarella, Gouda and Feta). About 83.4% of the total milk produce was pasteurized milk and about 12.69% was yogurt. Analysis of variance of pasteurized milk and yogurt by sex and ownership indicate that the mean difference is significant at the 0.05 level. Analysis of variance indicated that machinery type and capacity of pasteurized machine, cream separator and skim milk packaging machine had significant difference at 0.05 level of significant with ownership type.

Majority of the products were sold in local market. About 85.7% of dairy plant were not export milk and milk products whereas fewer industries were export the products to Djibouti, Saudi Arabia and Juba.

Averagely about 147.86 liters of milk were rejected from each dairy plant per day because of machinery and plastic pouch defect also poor quality milk supply (Adulteration).

Dairy plants obtained raw milk directly from producers and collectors. About 47.6%, 28.6% and 9.5% of inputs source were out of the country, from licensed local market and from both sources; respectively.

The establishment of an independent laboratory for milk and milk product quality control enables to perform range of tests at milk production, collection and processing centers. The present system in Ethiopia for testing of raw milk and dairy products does not stimulate the production of good quality, biologically pure milk with high technological quality that meets the national/international standards. Most of dairy plants does not operational with necessary equipment, particularly there is lack of microbiological laboratory equipment's as a result there are no proper means for collecting and processing of information concerning the milk and milk products quality for marketing. Laboratories which offer a complete range of milk and milk product analysis, which determine the hygienic, chemical and microbiological quality of raw milk and dairy products all along the value chain remain the major requirement and concern for the development of dairy sector in the country.

Recommendation:

- Capacitating the processors through training to improve the quality of dairy and dairy products.
- Make policy and Develop laws to prevent unlicensed milk and milk product traders.
- Encourage and support the dairy processor through machine maintenance and operations
- Create a strong linkage and awareness along the dairy value china to kept the quality of milk
- Encourage financial institute to support the processors on milk machine spare part purchase and substitution.
- Making quality based payment policy.
- Improve electric power interruptions and solve power cut problems through sustainable
- Conduct regular assessment to enhance the dairy industries.

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