



Assessment of Good Manufacturing Practices in Ethiopia Dairy Industry



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Submission: February 12, 2020; **Published:** June 12, 2020

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Abstract

Good Manufacturing Practice is an operational requirement necessary to enable a dairy plant to produce milk and milk products safely. It is the first step to food safety as a series of principles to be fulfilled to ensure that products meet prerequisites for safety and quality. Ethiopia dairy industries collect and process milk into different dairy products however the quality of the products was under question due to different reasons. Therefore, the objective of the study was to identify a good manufacturing practice of milk processing plants in Ethiopia dairy industry. The study was conducted on twenty-one milk processing plants. Data was collected through a semi structured questionnaire from September to October 2018. The result indicated that 89% of milk processing plants have adequate space for equipment, installations, for processing, packing and storage of materials. 90.5% of milk processing plants have adequate light and walls was constructed as suitable for dry wash and paint light color, anti-corrosion materials. 95% of the plants slope was well attached with waste canal. 67% of processing room ceiling had constructed with dust proved materials. 76% milk processing plants have adequate hot and cold water. 76.2% have separate and secure chemicals store. 76.2% of milk processing plant use different method of pest control. 95.24% of the plant's worker was give attention for personal hygiene and follow medical checkup regularly. 85.7% of milk processing plants have hand washing facilities. 52.4% of milk processing plants workers were not release any kind of ornaments or jewelry during processing. 85.7% of milk processing plants have strict regulation that inhibited eating, drinking, smoking and chewing of anything in processing room. Only 19% of milk processing plants had provided continuous training. 85.7% of milk processing plants products have labeling for both manufacturing date and expired date of the products with its composition. 42.9% of milk processing plants had calibrated their equipment's on regular time. Average storage capacity of milk processing plants was 25,619.05 liters per day with a minimum capacity 4000 liters per day and maximum capacity 50,000 liters per day. In conclusion GMP was not applied uniformly in the entire milk processing plants of the country.

Keywords: Good manufacturing practice; Milk processing plant

Introduction

Food producers and processors of all sizes want to produce the safest food possible for their customers and consumers. While not all food producers and processors are legally required to follow specific regulatory requirements due to the type of products they produce, all can and should use some basic Good Manufacturing Practices (GMP), which are the basic sanitary and processing requirements necessary to ensure the production of safe food [1].

Good Manufacturing Practices describe the methods, equipment, facilities, and controls for producing processed food and it usually refer to practices and procedures performed by a food processor which can affect the safety of the food product. It may refer to the people, equipment, process and the environment in the production process [2]. Developing and adopting a system

of GMP for the supply of raw milk to the processing industry, is widely accepted as a fundamental step that must be made to achieve improved raw milk quality and assure the industry is able to meet its potential. This GMP would include not only the steps that must be followed to produce raw milk of a higher quality but also the standard that each step must achieve, the training that will be required to implement the GMP, and the record requirements necessary at each step to allow the whole process to be subject to systems of internal and external audit [3].

GMP is an operational requirement necessary to enable a dairy plant to produce milk and milk products safely. The dairy business has a legal and moral responsibility to produce and prepare milk that will not harm the consumer. There can be a high

cost to the dairy business if it does not implement adequate GMP. It includes many basic operational conditions and procedures that are required to be met by the dairy business. These includes: the correct construction and layout of the food premises, the condition of the external environment of the food premises, the adequate maintenance of equipment and utensils used within the food business, the use of suitable chemicals within and around the food premises including cleaning chemicals, pest control chemicals and machines lubricants, the identification and storage of waste within and by the food business. The cleanliness of the food premises, equipment's, utensils, floors, walls and ceilings [4].

GMP is the first step to food safety as a series of principles to be fulfilled to ensure that products meet prerequisites for safety and quality. It can be one of components of HACCP which is a systematic approach to production that is designed to prevent hazards from occurring. Ethiopia dairy industries collect and process milk into different dairy products. However, the quality of the product was under question. Therefore, the objective of the study was to identify good manufacturing practice of milk processing plants in Ethiopia.

Material and Method

Study area

The current study was conducted in milk processing plants which located in the country and processed raw milk into different milk products. According to [5] about 32 milk processing industries were established in different parts or region of the country. The study areas were Addis Ababa, Amhara, Afar, Oromia and South, regional state.

Sample Size

Out of 32 Dairy industries found in the country 21 milk processing industries were selected purposely; six, three, one, ten and one milk processing industries from Addis Ababa, Amhara, Afar, Oromia and South regional state; respectively.

Method of data collection

The data was collected through a semi structured questionnaire from September to October 2018 to identify Good manufacturing practice in Ethiopia dairy industry.

Data analysis

To process and analysis the collected data, Statistical Package for Social Sciences (SPSS statistical software version 23 [6] was used. Descriptive statistics was used to analysis the survey data.

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 [7]. According to [5], currently in Ethiopia there are 32

milk processing industries was established in different parts of the country. However, this finding is lower than the result of [8], who obtained that there are about 35 active dairy processing industries in the country greater than [9] 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.

According to the present study about 66.7%, 28.6% and 4.8% of milk processing industries was owned by private limited company, by Share Company and owned by union or cooperatives. About 47.6%, 28.6% and 14% of milk processing industries were found in Oromia, Addis Ababa (AA) and Amhara region Administration, respectively and the remaining proportion share as equally for Afar and South regional state.

Installed capacity

The capacity was estimated on the basis of a double shift 16-hour shift per day and 360 working days per annum.

Daily installed vs processing capacity per day in liters (Table 1)

Table 1: Daily installed vs processing capacity per day in liters.

Region	Installed Capacity	Actual Processed	Percentage
AA	33416.67	17450	52.22
Amhara	31666.67	3200	10.11
Afar	10000	2000	20
Oromia	30700	8370	27.26
SNNP	20000	2000	10
Average	30119.05	9619.05	31.94

Spacing

According to [10] reported that, milk processing plant shall provide, adequate space for equipment, installations and storage of materials. Similar result was obtained in current study that about 89% of milk processing plants have adequate space for equipment, installations, for processing, packing and storage of materials. Allocation of the space for the specific section and to the specific plant and equipment is a matter of thinking so as to provide sufficient space to each plant and equipment for better functioning at the place for worker. Less space will create congested atmosphere and may cause accident at work in hurry some

Time

whereas unnecessarily providing more space may cause shortage of land in future and will cost more for maintaining cleanliness. So, the space provided for a section should be sufficient for working freely and comfortably, which should be planned well with concept of expansion in future also. The sections like boiler,

electricity and refrigeration should be kept in isolated area to safeguard the plant from accident and damages. (Figure 1)

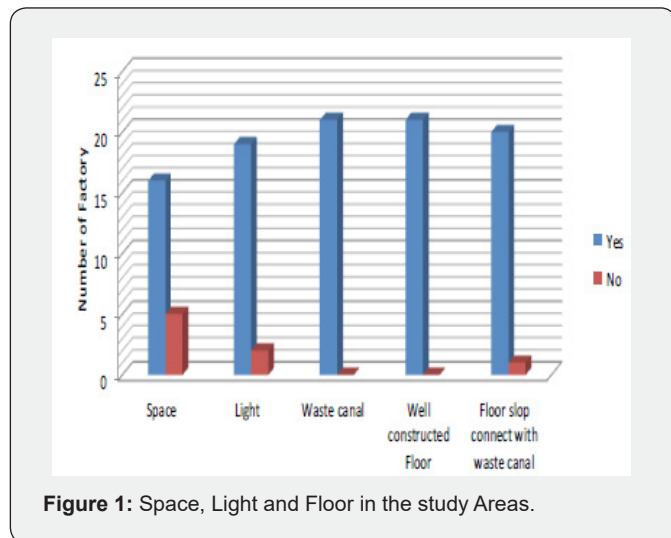


Figure 1: Space, Light and Floor in the study Areas.

Lighting

Plant should have adequate natural lighting or artificial lighting inside. All processing areas should be provided with adequate and appropriate natural or artificial lighting to facilitate all activities including processing, product inspection, visual examination of rooms, cleaning and sanitizing, packaging and maintenance to be carried out in a hygiene manner. Light fixtures and light bulbs suspended over food, ingredients, packaging materials and food contact surfaces should be equipped with coverings to prevent or minimize physical contamination in case of breakage. Adequate lighting shall be provided in hand-washing areas, dressing and locker rooms, and toilet rooms and in all areas where food is examined, processed, or stored and where equipment or utensils are used. The light source shall not cause any change in the color of foodstuffs.

According to the current study 90.5% of milk processing plants in the study area have enough light in processing room that able to generate confidence during processing milk and milk products. The current study revealed the result of [11] the 21% of the factories lighting were adequate to carry out operations and protected whereas about 9.5% of milk processing plants in current study has not enough light in processing room, which was difficult to produce or process safe milk and milk products.

Floor

The floor of processing area made with non-toxic, odorless and impervious materials and shall be even and non-slippery, seamless and easy for cleaning and sterilizing. The floor in the areas with drainage or waste water flowing to the floor in operation, frequently wet work environment or cleaning by washing with water should be also anti-acid and anti-alkali, and should have certain drainage slope and drainage system [12]. Even if almost all the milk processing plants have well-constructed floor which

are smooth, free from cracks and do not shed particulate matter however about 95% of the plants slope was well attached with waste canal, due to inappropriate of floor slope and about 5% of them have problem of drainage. (Figure 2)

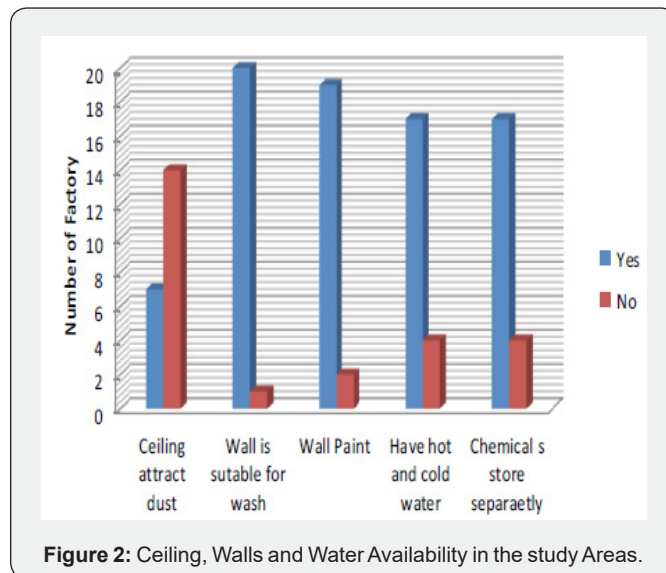


Figure 2: Ceiling, Walls and Water Availability in the study Areas.

Walls

Walls should be constructed with non-toxic, odorless, smooth, water-proof and easy-to-clean light-color anti-corrosion materials. In current study about 90.5% of milk processing plants walls was constructed as suitable for dry wash and paint light color, anti-corrosion materials. According to [13] reported that internal walls should be smooth, flat, and resistant to wear and corrosion, impervious, easily cleanable and white or light colored. The wall corners and pillar corners in the cleaning work area and quasi-cleaning work area should be in sound condition, easy to clean, disinfect and maintain certain radian for the convenience of washing clean and sterilizing [12].

Roof

Interior roof of processing, packing and storing areas should be easily cleaned to prevent dust from accumulating and avoid such circumstances as condensation, fungi-growth or falling. Where the roof of clean work area, quasi clean work area and other arenas of foodstuff exposure is of the structure that can easily become dirty, it is better to install the level and smooth and easy-to-clean ceiling; in case of the reinforced concrete structure, the interior roof should be even and seamless, while the top angle should have a proper radius [12].

Ceilings use to prevent accumulation of dirt, to reduce condensation and mold growth and to facilitate cleaning. According to the result of [11], 43% of ceiling condition were excellent and 50% condition was critical. The current study result indicated that 67% of plants processing room ceiling had constructed with dust proved materials that do not attract dust so

that the products were able to free of dust while the remain milk processing plants ceiling have attracted dust so it need additional maintenance to clean the area.

Water

Water is used in food processing both as an ingredient and for cleaning and sanitation, thus the water quality and safety are great importance [14]. A clean water supply is essential to minimize contamination. Food and Drug Administration [15] addresses essential facilities in processing milk plant as; adequate supply of energy, adequate supply of potable cold and hot water a suitable water treatment system where appropriate, adequate facilities for washing and disinfecting equipment, and adequate staff amenities. About 76% milk processing plants have adequate hot and cold water. The dairy plant should be supply adequate potable water. Potable water and steam should be supplied at volumes, pressure and temperatures necessary for all sanitation and operational activities. Steam should be produced, handled and stored in a manner that is protected from contamination. Water quality test should be performed at planned intervals by recognized laboratories. Documentation of the results of water testing should be recorded. Water lines installations and equipment should be constructed and maintained to prevent back siphon age and back flow.

Chemical store

According to [16] mentioned that criteria of safety storage and use of toxic compounds in food industry are, listing of all chemicals used in the plant manufacturers and their instruction should be followed when used with specific storage conditions. In current study about 76.2%, 19% and 4.8% of milk processing plant have separate and secure chemicals store, have not separate and secured chemical store but use chemicals by purchasing based on daily demand and plants were not used chemicals; respectively.

Chemical substances shall be stored separate and in a secure area from foodstuffs, labeled clearly and managed by designated personnel. Cleaners, sanitizers, lubricants, and any non- food chemicals used in the facility must be kept separate from food ingredients and products. They must be properly labeled, stored, and used according to label instructions. Food and food packaging must be removed or covered before cleaning or using chemicals [1].

Pest control

According to [17] reported that criteria of pest control are that the presence of pest is not allowed in any area of the processing plant. In current study about 76.2% of milk processing plant use different method of pest control like U v- insect extinguisher, electric fly killer, fly screen, rodent trap/killer and plastic shatter not allowed pest and 23.8% of plants did not use any kind of pest control method. Protect all entry-points from ingress of pests. Pest control should be carried out by trained personnel and application of pests according to ES 930. At the entrance of

milk processing and storage areas, pest-capture lights shall be set up and screens or other facilities shall be installed at the place connected with outside such as windows to prevent or eliminate the harmful pests. (Figure 3)

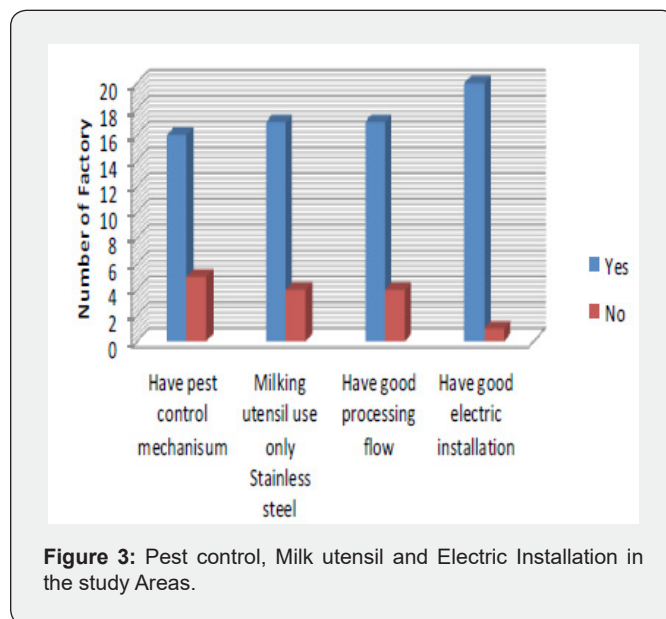


Figure 3: Pest control, Milk utensil and Electric Installation in the study Areas.

Milk utensil handling

About 81% of milk processing plant use only stainless-steel milking utensil and Aluminum can the remaining 19% use plastic material that was not recommended and spoil the product easily.

Electric installation and switch handling

According to the current study 95.2% of milk processing plants have well installed electric line or wire and no connection from any equipment, machine and water line where as its handling was varied about 46.7% of the plants always kept it clean, about 42.9% of the plants not kept clean and the other have no idea or care for handling of electric switch.

Medical care

People known, or suspected, to be suffering from, or to be a carrier of a disease or illness likely to be transmitted through food, should not allowed to enter milk receiving and processing areas. The organization requires the employees to immediately report illness or symptoms of illness to the management. Visitors and pest control contractors should be required to advise management when they are suffering from a communicable disease likely to be transmitted through food. (Figure 4)

For the criteria of control of employee health condition [18-21] reported that no person suffering from any communicable disease is engaged in handling of milk and milk products, and before starting to work, for the first time the employee should produce a medical certificate and the new employee should be trained on the good hygiene practices. (Figure 5)

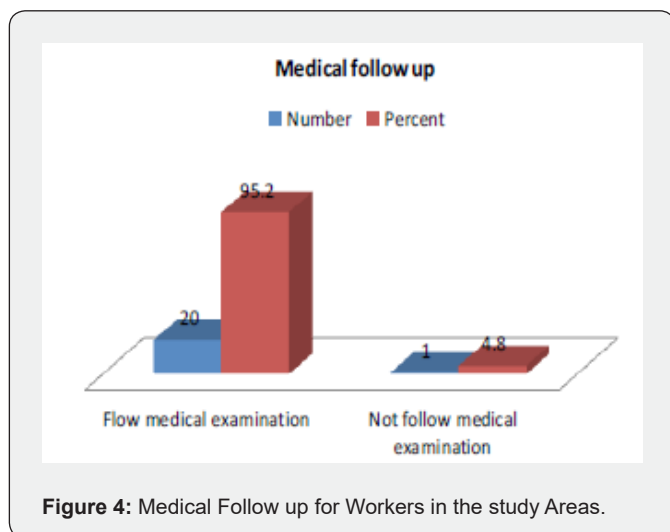


Figure 4: Medical Follow up for Workers in the study Areas.

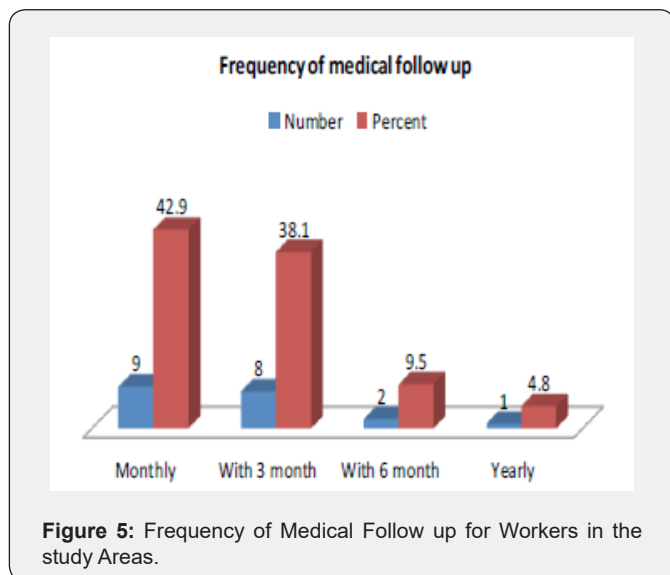


Figure 5: Frequency of Medical Follow up for Workers in the study Areas.

Milk processing and operation personnel shall annually undertake the health check and obtain the health certificate before being put into work. Medical examination of personnel involved in production of milk should be carried out if clinically or epidemiologically indicated; otherwise medical checkup should be done bi-annually. Personnel found to be infected with communicable disease should away from designed areas until medication and reexamination proves completely cured.

According to the current study 95.24% of the plants worker in the study area was follow medical checkup regularly with different frequency and only 4.76% were not follow regularly. About 42.86%, 38.1%, 9.5% and 4.76% check their workers' health with monthly interval, with three months, with six month and yearly interval; respectively. But must be check for those disease which able to transmit from milk to human. Employees experiencing diarrhea, vomiting, open - skin sores, boils, fever or disease must report these symptoms to their supervisor and must not be allowed to work with edible food products.

Uniform

It's critical to reduce the risk of product contamination to a minimum by putting in place a situation program. Develop a program to meet the standards of cleanliness necessary for the product. The fight against contamination is a constant battle and is one that requires the attention of every single employee, every day. To convince staff of the importance of washing their hands after toileting, ask the microbiology department to take fingerprint samples from each operator after they have washed their hands. They can then see how much bacteria are present on their 'clean hands'. Always practice good personal hygiene by washing your hands and wearing the required protective garments, inform your

supervisor if you are ill; you may not allow entering the manufacturing area until you are well again, Minimize contact with product or product contact surfaces and equipment's. Never eat, drink, smoke chew in manufacturing areas. Always follow cleaning and sanitation procedures, report any condition that may cause product contamination and Remove trash and waste materials and store appropriately. (Figure 6)

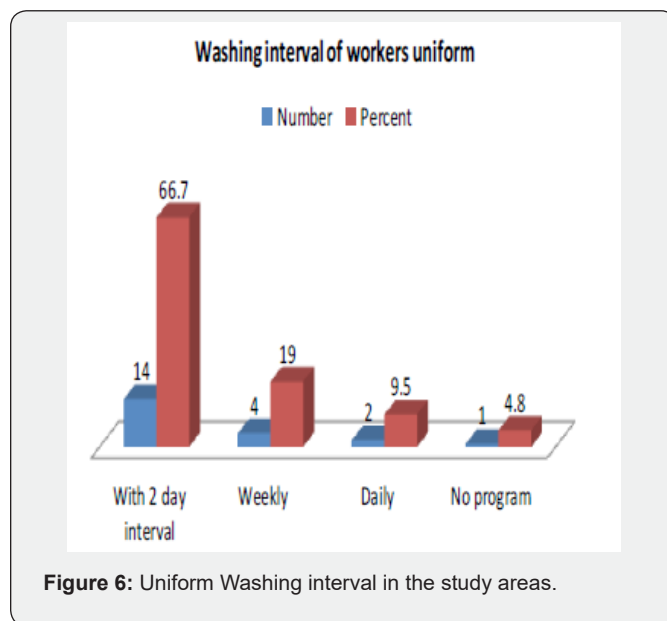


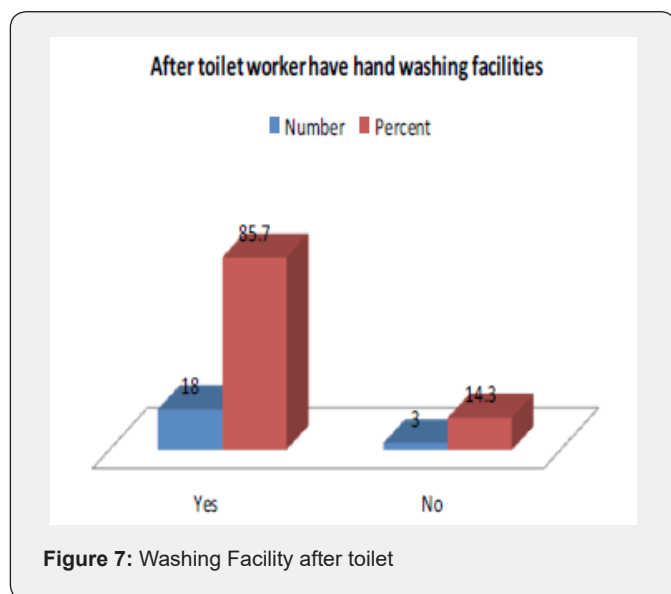
Figure 6: Uniform Washing interval in the study areas.

According to the current study 95.2% of milk processing plants worker give attention for personal hygiene. About 66.7% of the milk processing plants workers washes their uniform within two-day intervals, 19% with week interval, 9.5% wash daily and 4.8% of milk processing plants workers have no program but wash as it is necessary.

Washing facility after toilet

Washing rooms, change rooms and lunchrooms should be designed and maintained in good repair to prevent or minimize contamination of food and others. The washrooms should be equipped with adequate lighting to facilitate sanitary procedures. Hand washing signs, written in local language should also be

present at all hand wash stations with pictorial and written guidance. Furthermore, signs should be posted at all entry ways into the production facility which stated “clean hands before entering this area” in local language. Hand washing stations should have hot and cold potable water, soap (with taps, antimicrobial liquid soap), a hygiene drying apparatus and a cleanable waste receptacle and only for hand not for other purpose. All hygiene facilities do not open directly into production, packing or storage areas. Separate changing facilities should be in place for men and women and should be inspected to be clean, orderly and well maintained. (Figure 7)



According to the current study 85.7% of milk processing plants in the study area have hand washing facilities and 14.3% of milk processing plants have not fully equipped facility. Toilet doors have self-closing mechanisms and their proper functionality should be monitored regularly. While in current study area no one plants have self- closed toilet.

Jewelry/Ornament release

Fingernails short, clean, unvarnished; jewelry should be removed; cuts on exposed skin be covered. In the current study about 52.4% of milk processing plants workers were not release any kind of ornaments or jewelry during processing, about 19% of milk processing plants were release all ornaments except promising ring, about 14.3% of milk processing workers were release only hand watch and neck chain, about 9.5% of milk

processing plants workers release all ornaments what they have and about 4.5% of milk processing plants workers were release their ornaments conditional or as it was necessary. (Figure 8)

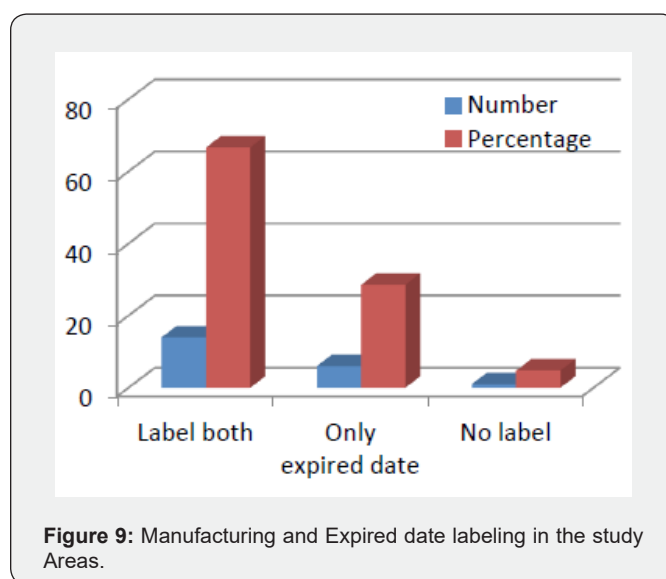
Regulation of eating, drinking, smoking and chewing: Smoking, eating, drinking only in designated areas. About 85.7% of milk processing plants have strict regulation that inhibited eating,

drinking, smoking and chewing of anything in processing room and 14.3% have no strict regulation that inhibited those events. So, that there is separate room or cafeteria for those use or facility. In the study area a prohibited area was not clearly labelled.

Training: According to [19,21] reported that all handlers must have participated in a training program in personal hygiene, GMP, cleaning and disinfection procedures before starting to work in the plant those who handle strong chemicals must be instructed in safe handling techniques. CAC [18] mentioned that the number and type of training sessions, courses for personnel, and interviews with personnel must be monitored and recorded. Ongoing and targeted training on issues ranging from allergen control, cleaning and sanitation procedures, incoming ingredient receipt protocol, and monitoring for employees, management, as well as suppliers [20]. To meet GMP requirements it's essential to have the right people to do the right job. Training should be provided for all employees. This includes basic training on the theory and practice relative to their role. All personnel appropriately trained prior to work and supervised. All new personnel shall receive induction training covering the company hygiene rules before starting work.

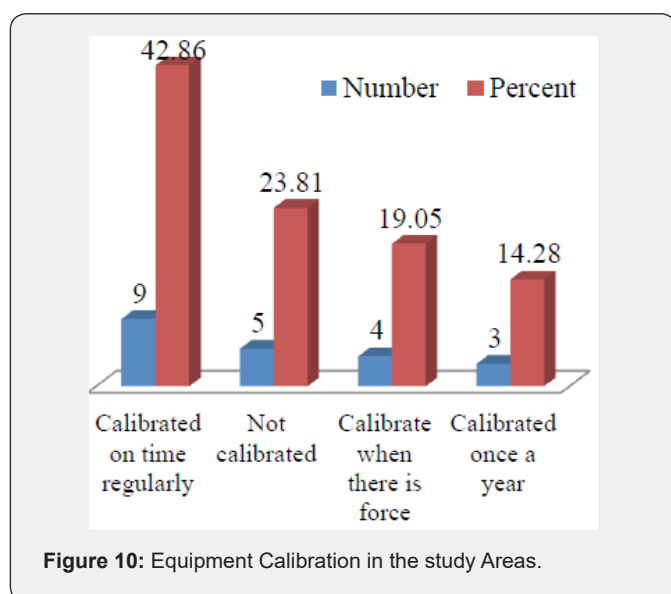
According to the current study 52.4% of milk processing plants had provided continuous training occasionally, about 19% had provided continuous training, about 19% had not provided training at all, about 4.8% had took training when there were new products developed and about 4.8% had took training provided always on job.

Manufacture and Expired date labeling: About 66.7% of milk processing plants were received packaging materials by approving the right materials and store in right place. About 28.6% of milk processing plants were received packaging materials without approving the right materials and about 4.8% of milk processing plants were received packaging materials and approved partial. (Figure 9)



According to the current study 85.7% of milk processing plants products have labeling for both manufacturing date and expired date of the products with its composition. About 9.5% of milk processing plants have labeling only for expired date and 4.8% of milk processing plants have no labeling for both manufacturing and expired date.

Equipment calibration: Instruments used for measuring, regulating, or recording temperatures, humidity, pH, water activity, or other conditions that control or prevent the growth of undesirable microorganisms in food shall be accurate and adequately maintained, and adequate in number for their designated uses. (Figure 10)



All equipment adequately cleanable, and shall be properly maintained; milk-contact surfaces shall be corrosion-free; seams on food-contact surfaces shall be smoothly bonded or maintained so as to minimize accumulation of food particles, dirt, minimize the opportunity for growth of microorganisms; About 42.9% of milk processing plants had calibrated their equipment's on regular time, about 23.8% of milk processing plants were not calibrated equipment, about 19% of milk processing plants calibrated equipment when regulatory body force them to calibrate and about 14.3% of milk processing plants were calibrate their equipment once in a year.

Products storage room capacity: According to CAC [14] storage and transportation as, storage rooms should be kept clean. Freezer and cold storage shall provide with thermometer, temperature, measuring device. Product storage managed based on first in first out principle and checks for micro-biological contamination. Average storage capacity of milk processing plants was 25,619.05 liters per day with a minimum capacity 4000 liters per day and maximum capacity 50,000 liters per day.

Separate storage areas should be arranged according to different natures of raw materials, semi-finished products, finished products and packaging materials and, when necessary, cooling (cold) stores should be arranged. To store goods of different nature in one warehouse, it is necessary to apply proper isolation with distinct symbols.

Conclusion and Recommendation

Conclusion: Twenty-one dairy processing plants found in the country were assessed for application of good manufacturing practices. It is the pre-request for HACCP program. All milk processing plants must apply in appropriate manure. The following conclusions were drowned from this effort. In this study we conclude that GMP was less applied in precise mode and not applied consistently in all milk processing plants.

- Only 42.9% of milk processing plants calibrate machine and equipment in regular time bases.
- Chemical should be store separately and in secure area. Whereas only 76.2% of milk processing plants store chemicals in separate area. Similarly, only 76.2% control pest.
- Only 52.4% of milk processing plants workers release jewelry during milk processing.
- Only 19% of milk processing plants provide continuous training for workers and have no equal attention for training.
- Even if milk processing plants have good percentage of lighting coverage, the remain percentage of milk processing plants was in difficult condition to process milk and milk products. Beside to this 33% of milk processing plants ceiling had dust attractive.
- All milk processing plants should have potable hot and cold water. While in the current study only 76% of milk processing plants have both hot and cold water.
- Workers medical checkup has been done in different interval. So, it should be uniform and been taken every six months.
- In general, GMP was not applied consistently in milk processing plants of the country. Due to this milk processing plants have different products quality.

Recommendation

- All milk processing plants should be applied a good manufacturing practice and be committed to the development and implementation of GMPS.
- Milking machine and equipment should be calibrated at its regular calibration period.
- Chemicals use for milk processing should be store separately from raw and final milk products in secured area.
- Workers in milk processing plants should release any

kind of ornaments or jewelry during processing since milk is easily perishable products it may be contaminated with workers ornaments.

- All milk processing plants should be provided with adequate light in processing room, packaging, store, toilet etc. to prevent any contamination of milk and milk products.

- Potable water and steam should be supplied at volumes, pressure and temperatures necessary for all sanitation and operational activities. Water quality test should be performed at planned intervals by recognized laboratories and documentation of the results of water testing should be recorded.

- Water line installations and equipment should be constructed and maintained to prevent back siphonage and back flow.

- Medical checkup should be done bi-annually.

- Toilet rooms shall be in the plant and shall not open directly into any room in which milk and/or milk products are processed. The doors have self-closing mechanisms and their proper functionality should be monitored regularly. Toilet rooms shall be completely enclosed and shall have tight-fitting, self-closing doors. All windows must be effectively screened.

- Dressing rooms, toilet rooms and fixtures shall be kept in a clean condition, in good repair and shall be well ventilated and well lighted. Sewage and other liquid wastes shall be disposed of in a sanitary manner.

Acknowledgments

This paper was prepared with the support of Ethiopia Meat and Dairy industry Development institute. The authors sincerely thank the staff at department of milk and milk processing directors and management. Also, thanks go to all milk processing industries of Ethiopia in providing full information that contribute upper hand for the success of the paper.

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DOI: 10.19080/NFSIJ.2020.10.555778

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