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Study of HACCP Implementation in Milk Processing Plant at Khyber Agro Pvt. Ltd in Jammu & Kashmir

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Abstract

The goal of the study was to set up a HACCP plan for milk processing industry in Pulwama Jammu & Kashmir to abolish and diminish the hazards for safe and sound milk and cheese production and to appraise the degree of conformity to food safety and to investigate the actual intricacy that occurs during the HACCP implementation process. Hazard Analysis and Critical Control Point System (HACCP) has been indicated as an effective and rational means of assuring food safety from principal production to final consumption, it is appreciated as a worldwide systematic and defensive tactic to address biological, chemical and physical hazards through deterrence and anticipation instead of end-product testing and inspection. The study was based on actual conditions in the milk processing plant, the seven principles of HACCP and several existing standard models of HACCP were practically applied using qualitative approach to eliminate the hazards and to guarantee safe dairy products as HACCP can enhance the responsibility and degree of control for hazards for ensuring food security at food industry level. CCPs were identified in the milk and cheese production using the decision tree the most important identified CCPs were pasteurization temperature, working of UV light, cold storage temperature, and metal detector. The prerequisite program was provided to deal with hazards so as to reduce the number of CCPs before the production to simplify the HACCP plan.

Keywords: CCPs; Food safety; HACCP; Milk processing

Introduction

The food processing industry in India is one of the leading industrial sectors in terms of production, consumption, export and growth prospects. Significant sub-sectors in the food processing industries are fruit and vegetable processing, fish processing industries, milk, meat and poultry manufacturing, packaged /convenient food, alcoholic beverages and aerated drink and grain milling and processing industrial sectors. As per national dairy development board of India the annual milk production status in Jammu & Kashmir state in the year 2014-2015 was 1951000 tones. Milk and milk products are highly nutritious but are mostly prone to health risks due to microbial contamination. Availability of standard Hygienic Milk is a subject of matter in many parts of the country counting the Kashmir valley. Unhealthy practices in dairy farm units, at milk reception centers, processing lines and during post processing handling are allied with a potential health risk to consumers due to the presence of pathogens in the milk and due to environmental contamination. The microbial contamination of milk and Milk products should not surpass the quantity that could badly have effect on shelf life and, if it does, it makes the milk insalubrious and hence unhealthy for human consumption [1] Food safety in dairy industry is a technical discipline depicting milk acquirement, processing, handling, storage and marketing of milk and milk products in manner that prevent food borne illness. This is mainly due to unhygienic conditions and inappropriate processing, handling and storage conditions, the human resources in the industry are poorly educated, unlicensed, and inexpert in food hygiene and they work under unsophisticated and unsanitary conditions with little or no knowledge about the reasons and roots of food borne diseases If HACCP is applied to milk marketing it should consider the advancement to milk safety at all phases of the chain. Hazard analysis and critical control point system (HACCP) has been internationally acknowledged and accepted as the system for the effective food safety management [2]. The main hazards in dairy industry are Microbiological as studied by Tranter [3]. There is always an ever increasing consumer demand for safe and high quality foods of protracted life. It is important to develop a food safety policy and plan for the implementation of HACCP because most of dairy foods are sensitive have less shelf life and are prone to foods borne diseases due to destitute handling and manufacturing practices. The purpose of the study was to design a HACCP plan to control hazards and to ensure safe and secure production of milk and milk products the implementation of HACCP system can provide safe food to the consumer and can improve the quality, safety and customer confidence. As the milk and milk products are consumed by all age groups, infants, adolescents, old aged and even by the immune suppressed ones so a necessity of implementing Food safety programs like HACCP should be made mandatory for safety of the one's consuming the milk and milk products. There is a need to endorse and enhance implementation of hazard analysis critical control point system and consumer food safety education efforts at all stages of milk and cheese production and marketing chains (Figure 1).

Methods

The research work on 'Study of HACCP implementation in milk processing plant" was conducted in Khyber Agro farms Private ltd. Lethpora, Pulwama, Jammu and Kashmir during December 2015 to May 2016, the methodology used for this research is mentioned.

Implementation of HACCP in milk and cheese processing plant

The purpose of this study was to design a HACCP system in milk processing plant. This study is based on qualitative approach rather than quantitative approach and based on HACCP checklist and CCP decision tree given by FAO. The HACCP system was implemented on the twelve steps given by codex alimentarious commission mentioned as the following.

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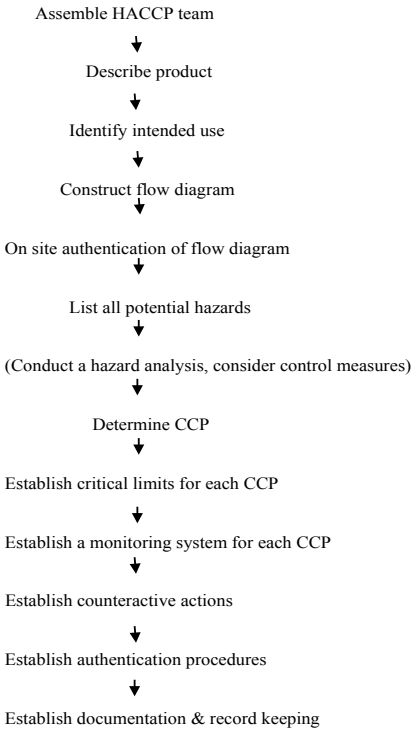

Figure 1: Logical sequence for the application of HACCP.

Assemble the HACCP team: The first task in the application of HACCP in the milk processing plant was to create a team having the knowledge and expertise to develop a HACCP plan. The team formed was multidisciplinary and included plant personals from production/sanitation, quality assurance, microbiologist, engineering and inspection all these experts were internal. Highly effective HACCP teams had well defined role clarity and ensured proper depiction of the team.

Describe the product: The HACCP team made a complete description of the product on the basis of ingredients/processing method /packaging materials/etc. used in the product Preparation to help out in the identification of all probable hazards associated with the product this is shown in Table 1.

Identification of intended use: The intended use of the product refers to its normal use by end-users or consumers, it was identified on the basis of normal use of the product by the consumers, including infants, elderly people immune suppressed ones the products i.e., Processed milk was used by infants as baby foods, health drinks, beverages like tea, coffee, etc., it was obligatory to be placed in ice-cold conditions or boiled, and cheese (coagulated product) used in pizzas, instantly ready to consume foods, customary and convectional foods with shelf life of 1 week and could be consumed with no risk.

Construct a flow diagram: It was easier to identify paths of potential contamination, to suggest method of control so a flow diagram of whole process was made. The function of a flow diagram was to provide a clear, simple outline of the paths involved in the process. The range of the flow diagram covered all the steps in the process which were openly under the charge of the company. The flow diagram of the products was developed for the specific products i.e., milk and cheese on the possible parts of sequence and their processing steps.

On-site confirmation of flow diagram: The HACCP team leader after the formation of a flow diagram had to verify the flow diagram on-site for accuracy and completeness. The HACCP team leader along with the other HACCP team members scrutinized the flow diagram constructed to confirm with the authentic operations it represents on site. The various changes, proceedings, or activities that would entail an on-site confirmation included, shifting of raw material and ingredients through processing pathways and apparatus, redeployment of equipment. New ingredient used or product developed, movement of product from one line to next line or equipment, packaging conditions storage etc.

List all the potential hazards conduct a hazard analysis: Hazard analysis is the most important aspect of HACCP plan to ensure the safety of product during and after processing and to improve the product shelf life and make it safe to consume. Hazard analysis was conducted by the HACCP team on the basis of HACCP checklist (as per FAO) and all the feasible hazards correlated with unprocessed material, ingredients, process operations, post process operation were identified, and marked as Biological (B), Chemical (C), Physical (P). Hazard identification is beneficial to identify potential biological, chemical and physical hazards that may arise during each step of processing.

Determine CCPs: The identification of CCPs is the most important aspect of the HACCP plan the CCPs were detected on the basis of decision tree given by Codex mentioned in the appendices, it requires a logical reasoning approach. The application of decision tree was flexible according to the type of operation i.e., production, processing, storage, and distribution or other.

Establish critical limit for each CCP: For each CCP identified a critical limit was established and specified. A critical limit represented the boundaries that were used to judge whether an operation was producing safe products. Critical limits were set for factors such as temperature, time, product measurements, water activity (ah), humidity level, etc. if these parameters are maintained within boundaries then the safety of the product will be confirmed.

Establish monitoring procedures: Monitoring is the process that the producer depends upon to show that the HACCP plan is being followed. It provides the manufacturer with accurate reports enabling the producer to prove that the conditions of production are in compliance with the HACCP plan Mostly time-temperature treatments (thermograph), pH, moisture level, equipment's and proper processing techniques were monitored by the HACCP team these activities were monitored on weekly and monthly basis. Monitoring procedures performed during operation were recorded in documents for future information and allowed taking action in the event of loss of control or for a process adjustment to be made if there is a tendency towards a loss of control.

Product name	Processed milk	Cheese
Product characteristics	Weight of packet 500 ml, 1litre	500gm
	Water -86.6 %	42.50%
	Fat- 4.5 %	40%
	SNF-8.5%	-
	Protein- 3.4 %	21-23%
	Ash -0.7%	3%
Packaging	LDPE poly packs	Food grade AL. coated PE
Shelf life	7 days	14 days
Labelling instruction	Store in refrigerated condition <4°C	<4ºC
Distribution conditions	<5ºC	<5°C

Table 1: Description of the products.

Establish corrective action: For each CCP identified in the process a specified critical limit was set. When monitoring activities identified a deviation associated to a CCP, corrective actions were completed to bring the process back into control.

Establish verification procedure: Verification refers to the diligence of methods, procedures, checks, and other appraisal, in addition to scrutinizing to determine compliance with the HACCP plan. Authentication ensures that adequate contingency procedure plans are in place when critical limits are exceeded, the verification was done by quality analyst and supervisor of food safety team on daily weekly and monthly basis.

Establish documentation and record keeping: Records are essential for assessment of the adequacy of the HACCP plan and the adherence of the HACCP system to HACCP plan. Records were maintained for the whole HACCP plan and included processing charts, written records, computerized records, records generated by the HACCP system microbial and analytical testing records verification and validation records. These records were well maintained in record books of the industry.

Results and Discussion

In this study the HACCP system for milk and cheese processing was developed step by step on the basis of twelve steps mentioned in the materials and methods as per Code Alimentarious commission (CAC) at Khyber Agro farms. The pre-requisite program was provided to minimize hazards to simplify the HACCP plan. Based on industrial standards and Govt. regulations the hazard identification, critical limits monitoring and validation corrective actions were performed The CCPs were identified by the HACCP team by logically answering questions given in the decision trees. The decision tree technique was put into practice to decide the CCPs as this method is visual easy to understand substitute to numerical charts and statistical probabilities used in other decisions For the hazards identified control measures were recommended and for critical control points identified proper monitoring procedures and corrective actions were put forward.

Pre-requisites

This first step was fetching in all existing pre-requisite programs under the cover of HACCP program and giving them a widespread route of achieving zero defects within the end product so as to guarantee that are no health concerns within the final product. Some precondition programs created the basis of the HACCP model for ensuring a strong system of checks hostile to possible failures of critical control points. The pre-requisite programs used in the milk processing are the sanitation programs to maintain sanitary condition in the building, premise equipment's, to maintain a clean and hygienic environment, essential for the production of highest quality and safe food products, Good manufacturing practices in the industry to control hazards The Pest Control Program was designed to allow no pests in the plant. This included rodents, insects and birds The Product Recall Program was developed to protect customers from the probable events of product safety malfunction by eradicating all wary products from the distribution channels in the minimum time, once a product recall or withdrawal is defensible and commenced for the product The aim of the Chemical Control Management Program was to reduce the possibility of chemical contamination of ingredients contact surfaces and finished products, as well as shielding the work area and the workforce from revelation to hazardous chemicals.

Possibility of hazard occurrence in milk and cheese processing and suggestive measures to control hazards as per HACCP

Hazards identified in the milk and cheese processing steps and corrective measures suggested are shown in Tables 2 and 3.

To determine the critical control points (CCPs), their critical limits and monitoring frequency

The critical control points in milk and cheese processing steps were determined on the basis of CCP decision tree. The CCPs identified are mentioned in Tables 4 and 5. For each CCP critical limits were identified and monitoring procedures and frequency was decided in case of any failure at CCP corrective actions can be taken which include Temperature control checks, maintaining proper pH, aw control, microbial testing of end product, equipment calibration when failure of CCP occurs owing to improper working of equipment.

Constraints in adopting HACCP by the industry

There are many constraints in implementing HACCP system by an industry which include the Need of awareness and responsiveness of HACCP, No apparent reimbursement, lack of industrial personnel training, lack of management commitment, unevenness of production lines and individuality of each product, lack of Government support in implementation of food safety management programs like HACCP, lack of Technical expertise and inadequate personnel and broad-scale improvement and advancement of the plant required before HACCP could be set in the industry.

Processing steps	Hazard			Control measure
	Microbial	Physical	Chemical	
Receiving of milk	Unhygienic contacts, Salmonella, Staphylococcus	Extraneous matter	Starch	Implementation of GMP OPRP, Effective filtering
Cooling (OPRP)	Unhygienic contacts	Extraneous matter	Not usually	Effective cleaning of cooling tanks, implementation of GMP
R.O treatment	Faecal, coli forms	Heavy metals, calcium Hardness of water	Not usually	Filter changing and effective cleaning membrane filtration,
Standardization	Unhygienic contacts	Extraneous matter	Not usually	Effective cleaning
Pasteurization CCP B1	Unhygienic contacts, Salmonella, Staphylococcus, Staphylococcus	Extraneous matter	Not usually	Implementation of GMP, proper pasteurization
Poly packing (UV)	NON working of UV light	Extraneous matter	Not usually	Monitoring of UV light
Cold storage	Unhygienic contacts	Extraneous matter	Not usually	Effective cleaning, pest control
Crate washing (OPRP)	Unwashed can lead to microbial hazards	Extraneous matter	Not usually	Effective crate washing with tested water
Dispatch	Not usually	Extraneous materials	Not usually	Effective cleaning and maintenance of hygienic conditions

Table 2: Hazard analysis of milk processing steps.

Processing steps	Hazard			Control measure
	Microbial	Physical	Chemical	
Receiving of milk	Unhygienic contacts	Extraneous matter	None	Implementation of GMP
Standardization	Unhygienic contacts	Extraneous matter	None	Implementation of GMP
Pasteurization	Unhygienic contacts improper pasteurization	Not usually	None	Proper pasteurization
Cooling	Unhygienic contacts	None	None	Implementation of GMP
Coagulation by 1% citric acid	Unhygienic contacts	None	Adulterants	Proper verification of citric acid quality from a certified buyer
Draining of whey	Unhygienic contacts	Extraneous matter	Not usually	Proper cleaning and GMP implementation
Milk solids filled in blocks and pressed by weight	Unhygienic contacts	Extraneous matter	Not usually	Implementation of GMP
Cutting into pieces	Not usually	Metal dust	Not usually	Implementation of GMP and use of metal detector
Dipped in chilled water 4°C	Unhygienic contacts	Extraneous matter	Not usually	Implementation of GMP
Draining of water	Unhygienic contacts	Not usually	Not usually	Implementation of GMP
Packed into desired weight and stored at 4°C(OPRP)	Unhygienic contacts	Pests	Not usually	Implementation of GMP, and packing under UV light
Dispatch in chilled conditions (OPRP)	Unhygienic contacts	Extraneous materials	Not usually	Strict Control of sanitary conditions during dispatching to retailers

Table 3: Hazard analysis of cheese processing steps.

Product	Hazard	Ccp	Critical limit	Monitoring	Corrective action	Verification
Milk	Microbial	CCP B1 Pasteurization temperature	76-80°C for 15 sec	Pasteurized milk& pasteurization Temperature	Sent for re-pasteurization, effective monitoring, study thermographs	Proper temperature control and working of pasteurizer
	Microbial	CCP B2 Working of UV light	Non-Working of UV light	Working of UV light	Re-processing of whole lot and repair of UV light(preventive maintenance)	Microbial load & working of UV tubes during packing
	Microbial,	CCP B3	>4°C	Cold storage temperature and hygiene	Effective temperature control, Cold storage structure to be modified to maintain proper temperature	Cold storage temperature

Table 4: HACCP plan for pasteurized milk.

Product	Hazard	Ccp	Critical limit	Monitoring	Corrective action	Verification
Cheese	Microbial	CCP B1 pasteurization of milk for cheese	76°C -80°C for 15 sec	Pasteurized milk & Pasteurization temperature	Sent for re-pasteurization, effective monitoring, study thermographs	Proper temperature of pasteurization by Lab testing & studying thermographs
	Physical (metal pieces)	CCP P1 Cutting of cheese (metal detector)	Fe material: 0.4mm Non Fe material: 0.5mm SS material: 0.7mm	Metal pieces by Metal detector x-ray scanning, Each time the product is cut into pieces	Check the sliced Cheese for metal contamination & use of certified cheese cutting machines	Proper working of Metal detector Each time the product is cut into pieces by production manager
	Microbial	CCP B2	Cold storage temperature for storing cheese	Cold storage temperature & hygiene Hourly by production manager	Effective temperature control, Cold storage structure to be modified to maintain proper temperature	Cold storage temperature Lab testing Every 4 hrs after corrective action by Production manager

Table 5: HACCP plan for cheese processing.

Conclusion and Recommendations

Conclusion

From the research study it can be concluded that that application of HACCP system can improve the quality of pasteurized Milk and cheese by control of critical points The pre-requisites programs (GMPs) and the operational pre-conditional programs that form the sturdy pillars of a stout and sturdy HACCP plan must be made mandatory to ensure good quality and hygiene in the plant as well as product the direct application of HACCP is difficult in industries that are not producing food products. But for industries that are associated with the food production industry the implementation of HACCP provides familiar value. The lessening of identified CCP number is necessary since it will ensure the safety of food products for consumption and safety of the consumer, and will decrease the overall cost for monitoring hence increase in the net outcome of the company Further studies are needed to verify and validate the HACCP system in milk processing plant.

Recommendations

Proper education and training of the management bodies, workers, employees and handlers allied with milk and cheese manufacturing in the plant is the basic necessity required. Application of HACCP system throughout the chain of pasteurized milk and Cheese process should be encouraged to ensure better

control and safe food. Enhancement of storage and marketing conditions of dairy products are required. To shun the spoilage of sensitive products like cheese and milk, the manufacturer should apply the CIP (clean in place) and COP(clean out place) after every production process, guidance curriculum of GMP and HACCP should be designed and deliberately conducted by training centers and institutes for entrepreneurs of dairy industry to smoothen the process of adoption of these food safety programs and formulate special program for building up the food safety awareness to consumers and to make it mandatory for dairy producers to adopt food quality and food safety management programs.

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