

Basics of HACCP—Dairy and Food Industry

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Abstract

This paper is deals with basics of Hazard Analysis and Critical Control Points (HACCP) principles and its application in dairy– food sector. HACCP rules are widely accepted and implemented, protocol for improving the quality and safety of food products. The implementation of HACCP procedures helps the dairy/food industries for providing best quality products via handling the total quality management (TQM) of whole industry.

Keywords: HACCP, total quality management, prerequisite programmes

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INTRODUCTION

Dairying has played a prominent role towards household nutrition security and also in strengthening the rural ensuring supply of quality milk and milk products to people in both urban and rural areas. The inspiration for dairy cooperative movement was the success of the Khaira District Cooperative Milk Producers' Union (Amul) Amul grew rapidly from its initial base of two societies and two hundred litres of milk. We have largest cattle and buffalo population in the world. More than 67 percent of dairy animals are owned by marginal and small farmers, which constitute the core milk-production sector in the country.

We are the leader of the global dairy sector and we are marketing milk and their products in good quality through Cooperative, private dairies. This organized dairy industry, which accounts for about 20 percent of total milk production, comprises two sectors: government and co-operatives.

What is “HACCP”

Food safety has become a common concern worldwide, making public health agencies and governments of several countries look for more efficient ways to monitor production chains (Makiya and Rotunda 2002) [1]. Hazard Analysis and Critical Control Point (HACCP) is an internationally recognized system for reducing the risk of safety hazards in food.

Milestone of “HACCP”

1. The HACCP system was introduced in the United States in 1971 by the Pillsbury Company in collaboration with the National Aeronautics and Space Administration (NASA) and the US Army Natick Research and Development Laboratories [2].
2. In 1972 Pillsbury Company in the United States began the application of its HACCP 102020 concept to the manufacture of its consumer food products
3. In 1990 Globalization Started with Fish & Meat industries, HACCP approval by Indian Government bodies [2].
4. International Standard ISO 22003 (2006) defines food safety management system (FSMS) as the set of interrelated or interacting elements to establish policy and objectives and to achieve those objectives, used to direct and control an organization with regard to food safety correlated with the HACCP concept [4].

PREREQUISITE PROGRAMMES

Before the application of HACCP principles, some “prerequisite programs,” such as good manufacturing practices and cleaning procedures, should be established in order to ensure basic hygiene conditions in the processing plant [6]. Some examples of prerequisite programmes are mentioned below.



Fig. 1: Various Food and Dairy Product which are healthy.

Prerequisite programs are programs that are put in place in the facility to control hazards in the environment, preventing contamination of the product [7]. It is essential to control factors that may or may not be directly related to the manufacturing controls, were as Prerequisite programs support the HACCP Plans (Figure 1).

Good Hygiene Practices (GHP)

1. *Personal cleanliness:* Importance to maintain the quality and safety of any dairy or food products.
2. *Disease Control:* No person who is affected by a communicable disease [8].
3. A high degree of personal cleanliness is necessary to prevent contamination of food products. Hair must be completely covered by a hair net. Street clothes are not allowed in the production areas. Clean uniforms are to be worn Proper hand washing requires the use of warm water and a bacterial soap, thoroughly cleaning entire hands, wrists, between fingers, etc. and dipping in a hand sanitizer [9].

Raw Material Control

1. Correct analytical method should practice to ensure the quality of each raw material
2. Maintain a healthy relationship with the raw material supplier or dealer
3. Maintain up to date records of the quality analysis

Sanitation and Maintenance

1. Scientifically designed plant should be use for production with a proper waste treatment and disposal systems

2. Clean-in-place (CIP) systems should be monitored and recorded (cleaning the interior surface of pipelines, vessels, filters, process equipment and associated things without dismantling).
3. In CIP system, cleaning solutions used include various types of detergents, sanitizers or disinfectant
4. Chemicals list and material safety data sheets should be review up to date.

HACCP PLAN

HACCP Plans is a written document which is based upon the seven principles and prepared for each process or product and identifies possible hazards and controls (Table 1).

Steps of HACCP

HACCP include twelve important steps which are developed by incorporating pre steps with basic seven HACCP principles (Figure 2).

1. *Assemble HACCP Team:* There are many areas of expertise that should be represented for a comprehensive analysis of the production / processing / marketing system. Each member of the HACCP team may cover more than one area of expertise according to their technical background and professional experience.
2. *Describe Product:* A full description of the product should be drawn up, including relevant safety information such as:
 - i Composition (e.g. raw materials, ingredients, additives, etc.); physical/chemical structure (including water activity, pH, etc)

- ii Processing (e.g. heating, freezing, drying, etc. and to what extent)
 - iii Microbiological or chemical criteria applicable including microbial/static treatments (cooling, freezing, brining, heat-treatment, etc)
 - iv Packaging (e.g. carton, hermetic/canning, vacuum, modified atmosphere)
 - v Storage and distribution conditions, methods of distribution;
 - vi Required shelf life (e.g. “use by date” or “best before date”);
 - vii Instructions for use.
3. **Identify intended Use:** The HACCP team should define about the normal or expected uses of the products and targeted consumers. The terms should specify about the age groups of customer, health condition of indented users of particular product (Table 2).
 4. **Construct Flow Diagram:** A flow diagram should be drawn showing each step in the operation, from purchase of raw materials to serving food to consumers. Flow diagram is very important step to understand whole processing steps in detail.
 5. **Onsite Confirmation of Flow Diagram:** Steps must be taken to confirm the processing operation against the flow diagram during all stages and hours of operation, and the flow diagram amended where appropriate.
 6. **Conduct a Hazard Analysis:** The purpose of the hazard analysis is to develop a list of hazards which are of such significance that they are reasonably likely to cause injury or illness if not effectively controlled.
 7. **Identify the Critical Control Point (CCP):** A critical control point is defined as a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.
 8. **Establish the Critical Limit(s):** A critical limit is a maximum and/or minimum value to which a biological, chemical or physical parameter must be controlled at a CCP to prevent, eliminate or reduce to an acceptable level the occurrence of a food safety hazard. A critical limit is used to distinguish between safe and unsafe operating conditions at a CCP. Critical limits should not be confused with

operational limits which are established for reasons other than food safety (Table 3).

9. **Establish a System to Monitor Control of the Critical Control Point:** Monitoring is a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification. Monitoring serves three main purposes.
10. **Establish the Corrective Action:** If CCP is not under control, establish the corrective action like changing processing condition such as processing temperature, time, etc. The HACCP system for food safety management is designed to identify health hazards and to establish strategies to prevent, eliminate, or reduce their occurrence. Establish procedure for verification (Table 4).
 Establish procedure for verification to confirm that the HACCP system is working effectively. Verification is defined as those activities, other than monitoring, that determine the validity of the HACCP plan and that the system is operating according to the plan.
11. **Establish Documentation:** There are certain written records or kinds of documentation that are needed in order to verify that the system is working [10].

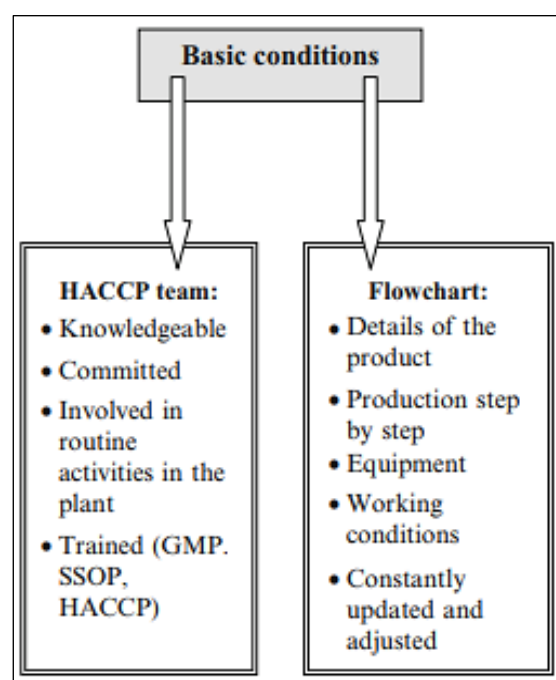


Fig. 2: Basic conditions for HACCP (Cusato et al. 2012).

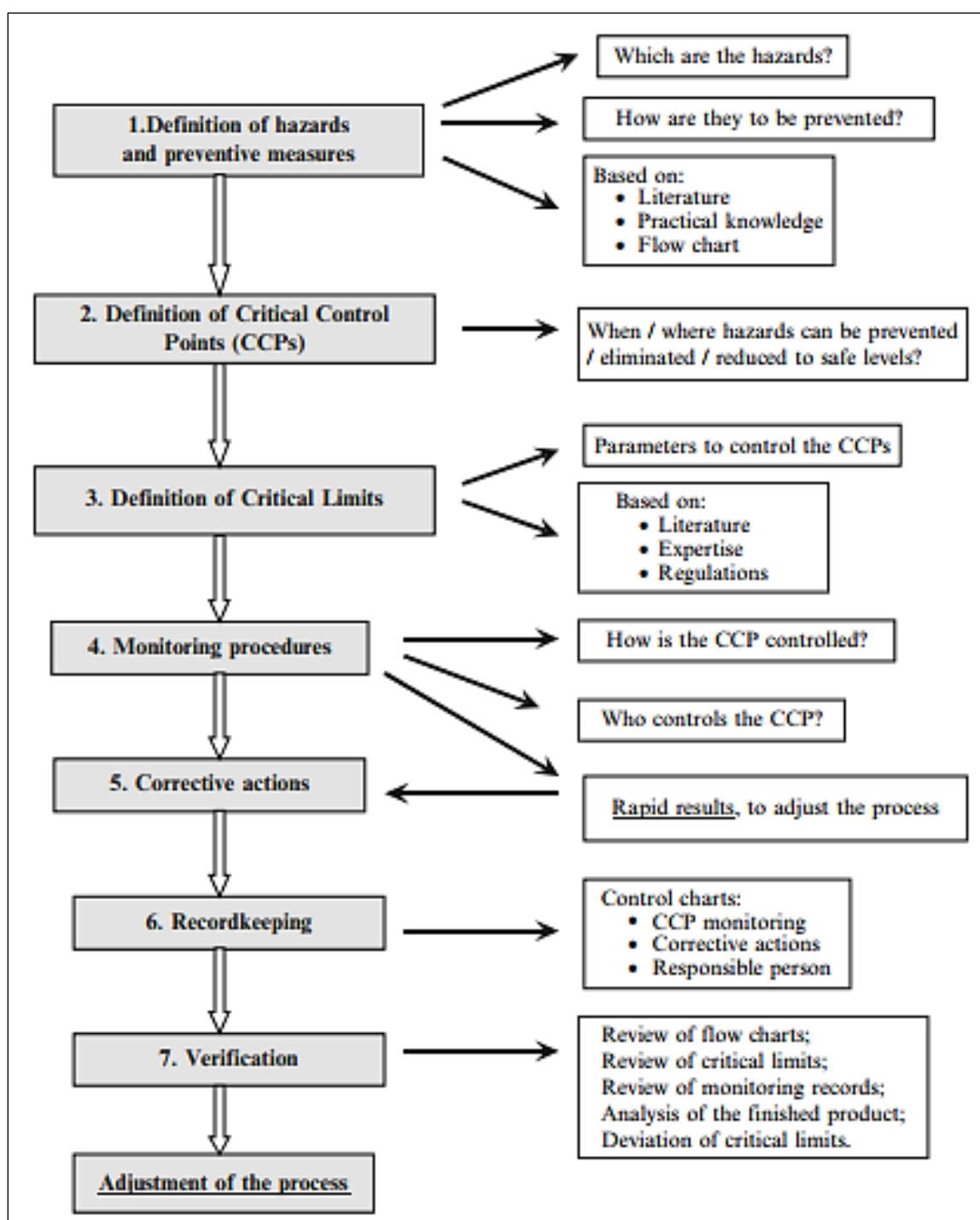


Fig. 3: HACCP Principles and Their Application in the Food Industry (Cusato et al. 2012)

IMPORTANCE OF HACCP APPLICATION IN DAIRY SECTOR

During the last three decades, our nation's milk producers have transformed Indian dairying from stagnation to world leadership. Although the organized sector handles less than 20 percent of the production, it has an installed capacity to process about 33 percent of India's total milk production [11-13].

Quality control methods that are sensitive to the fact that our milk comes from large numbers of small producers. But many researchers like Shapton (1988) [14] would point about HACCP application in dairy sector expanding the variety, improving the quality and maintaining the relative price of India's dairy products so that they can meet competition from around the world (Figure 3).

Table 1: Hazard in Ingredient and Incoming Material Analysis Chart [2]

Ingredient and material	Hazards	Preventative measure
Milk	MCP	store <4°C proper transfer equipments sanitize equipment proper personal hygiene and handling
Rennet	M	qualified product supply, store <4°C
Salt	MP	qualified product supply, store at room temperature proper personal hygiene and handling
Water	MCP	supply quality water
Cans and plastic box	MCP	qualified product supply
M – microbiological, C – chemical, P – physical.		

Table 2: Hazard Analysis Chart [2]

Process step	Hazards	Preventative measure
Milk	MCP	proper equipment setting, sanitize all the transfer equipment
Pasteurisation	MCP	72°C, 15 s proper pasteuriser setting, sanitize all the equipment
Rennet	MCP	sanitize the container used for diluting rennet, proper personal hygiene and handling
Trays filling	MCP	sanitize the trays filling and the thermometer, proper personal hygiene and handling, pest control
Coagulation	MP	40°C, 60 min, proper personal hygiene and handling
Cutting	MCP	correct knife size for optimum curd size, sanitize the cutting tools and the cutter's hands and arms, proper personal hygiene and handling
Salting	MCP	2.5-4.5% salt, moisture content is optimum at 60-65%, sanitize the salt container and the stirring tools, supply quality water, proper personal hygiene and handling
Storage and distribution:	MP	temperature of storage is ≤45°F. Distributed using refrigerated (≤45°F), proper building setting, proper storage condition setting, pest control

Table 3: HACCP Control Chart [2]

Process step	Hazards	Preventative measure	Critical limits	Monitoring procedure	Monitoring frequency	Corrective action
Milk reception (CCP1)	microbiological chemical and physical contamination	rennet supply qualified packaging material supply	no unqualified material be used	apply supply quality assurance	each supply	change supplier operator training
Pasteurization (CCP2)	survival of pathogens such as <i>E. coli</i> , <i>Staphylococcus aureus</i> , <i>Bacillus cereus</i> , etc.	pasteuriser checks: – check the heat plate – check the temperature controller – check the flow diversion	temperature set at 72°C, 15 s	check thermometer and time check equipment is properly running supervisor managing and record keeping	each batch routinely each batch	adjust the temperature and time by setting the equipment well call the engineer to repair
Salting (CCP3)	microbiological contamination	correct level of salt correct mixing during salting	salt% = 5.0%	records and testing	each batch	incorrectly salted curd must not be allowed to progress
Rennet (CCP4)	microbiological contamination physical contamination	proper additional rate agitate properly	rennet: 100 ml/100 kg concentrate agitator set at medium	check the additional rate of the rennet and pH check the rate of the agitator record keeping	each batch each batch	applying more testing on pH adjust agitate rate operator training
Trays filling (CCP5)	microbiological contamination	proper temperature setting	temperature set at 32°C	check thermometer record keeping	each batch each batch	adjust the heater to change temperature
Coagulation (CCP6)	microbiological contamination physical contamination	proper time setting and recording take the stirring tools out of the tank	temperature set at 40–45°C time is set at 30–60 min tools prevent coagulation	check the temperature/time and the stirring tools record keeping	each batch each batch	reject product operator training
Cutting (CCP7)	microbiological contamination	proper time and temperature setting		check the temperature/time record keeping	each batch each batch	adjust the heater to change temperature operator training

Table 4: Comparison of White Cheese Analysis Before and After HACCP [2].

Test	Before HACCP	After HACCP
Sensory evaluation		
Taste	accepted	accepted
Color	natural	natural
Flavor	accepted	accepted
I. Chemical analysis		
pH	4.41	4.22
Acidity, %	0.76	0.67
SNF, %	22.1	23.6
TS, %	39.0	39.2
Fat, %	16.9	15.6
Fat/TS, %	41.02	43.38
Moisture, %	62.2	60.8
II. Microbiological analysis		
TVCs	6.95	6.14
Mold and yeast	105	63
Coliforms	43	23
<i>Staphylococci</i>	$2 \cdot 10^2$	-ve
<i>Salmonella</i> spp.	-ve	-ve

ES – Egyptian standarization, SNF – solid not fat, TS – total solids, TVCs – total viable count (Log FU/ml).

CONCLUSION

HACCP is a worldwide-recognized systematic and preventive management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished food product [5]. Customer expectations for quality products and services have prompted organizations to adopt the principles of total quality management that can be simply achievable by implementing HACCP approach to any food sector including dairy industry. HACCP techniques enhance our process management capacity and it's improves product quality[15-16]. But as far as Indian dairy sector, HACCP approaches have problems in practical because the major portion of dairy sector is being lying as unauthorized [17].

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