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HACCP Case study

Feta cheese

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1. Introduction

A family-owned medium-sized cheese making plant has been asked by local retail customers to provide a HACCP Plan for its main product, Feta cheese.

2. Terms of reference

The HACCP study covers all types of food safety hazards, biological, chemical and physical. It did not include any cleaning and sanitation operations which are covered by the plant Good Manufacturing Practice procedures and Good Hygiene practice.

3. Product description

3.1 General

Feta cheese is the most popular white brine matured cheese in Greece and some other countries around the Mediterranean Sea. It is a traditional Greek PDO cheese (Protected Designation of Origin) and it is produced by pasteurised sheep milk, starter culture, microbial rennet and salt, the curd is cut and strained, put into moulds and matured for a minimum period of two months.

3.2 Ingredients

Milk composition: Sheep milk (feta may contain goat's milk up to 30%), starter culture preparation of lactic acid bacteria, rennet, calcium chloride, salt.

3.3 Process

See Figure 1 – Generic flow diagram of FETA cheese production

3.4 Product specifications

Microbiological. See Table 1.

3.5 Package

Vacuum packed in 200g, 450g, 1kg and 2kg containers. Also in 4,8 and 16kg containers in brine.

3.6 Shelf life

One (1) year

3.7 Nutritional values

Energy: 237 Kcal/100g, Proteins: 16,5%, Fat: 19%

3.8 Intended use

Consumers: General public, ages between 20 and 60 mainly.

3.9 Uses

Feta cheese can accompany all Mediterranean meals. It is also used in cooking.

3.10 Consumer instructions are as follows

Keep refrigerated ≤ 4 °C

Table 1: Microbiological Critical Points				
	n	c	m	M
Listeria monocytogenes	5	0	Absence in 25 g	
Salmonella spp.	5	0	Absence in 1 g	
Staphylococcus aureus (cfu/g)	5	2	≤1x10^2	≤1x10^3
Escherichia coli (cfu/g)	5	2	≤1x10^2	≤1x10^3
Coliforms (cfu/g)	5	2	≤1x10^4	≤1x10^5

n = number of sample units comprising the sample;

m = threshold value for the number of bacteria; the result is considered satisfactory if the number of bacteria in all sample units does not exceed 'm';

M = maximum value for the number of bacteria; the result is considered unsatisfactory if the number of bacteria in one or more sample units is 'M', or more;

c = number of sample units where the bacteria count may be between 'm' and 'M', the sample being considered acceptable if the bacteria count of the other sample units is 'm' or less.

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4. Process Flow Diagram

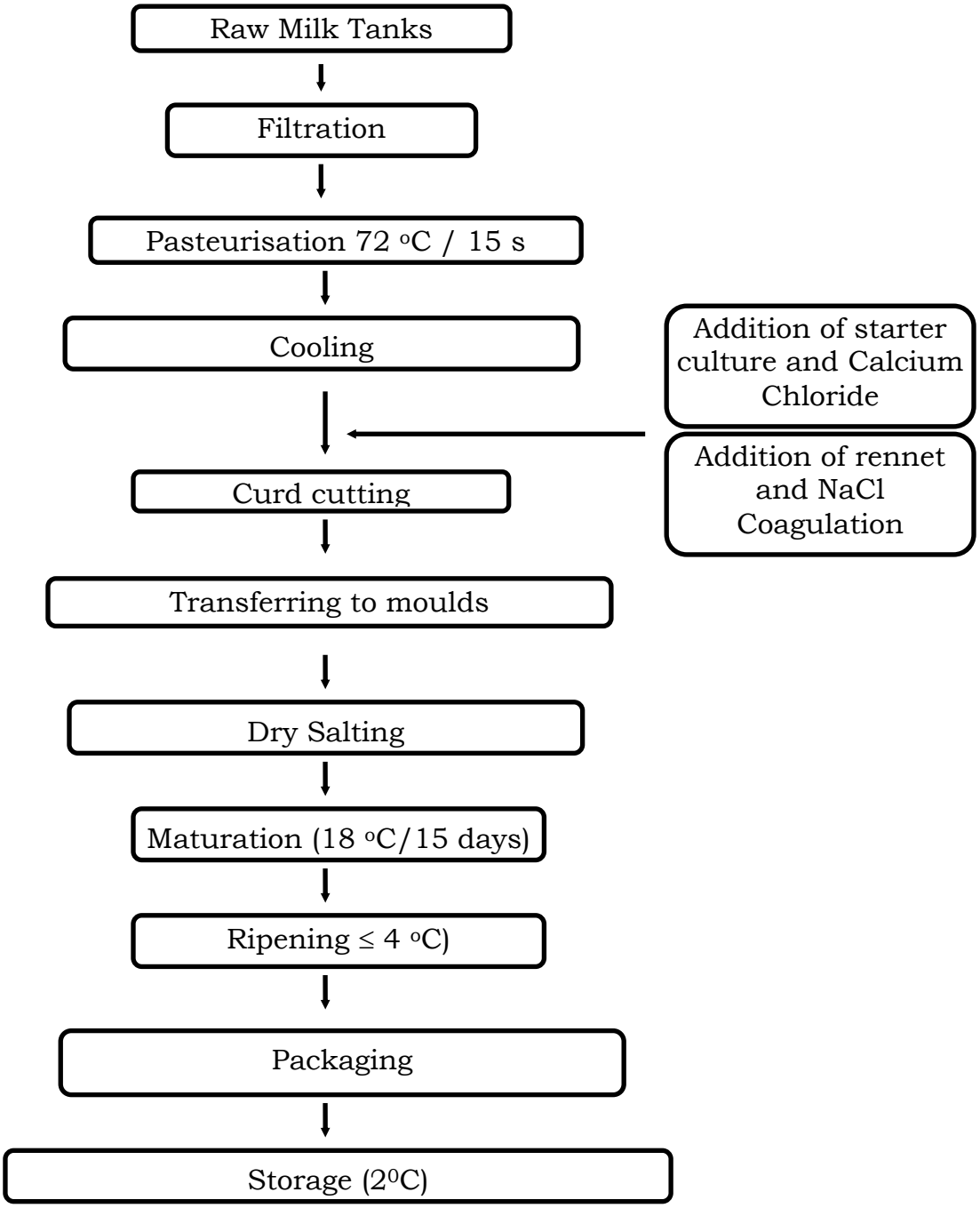

Figure 1. Generic flow diagram of FETA cheese production

4.1. Raw Milk Tanks (CCP)

Raw milk intended for cheese making should not be stored for longer than 24h and always at temperature <4 °C to avoid psychrotroph bacteria growth. It should be tested for: a) antibiotics, b) mycotoxins, c) pesticides, d) microbiological tests e) total acidity and pH f) storage time less than 24 hours at temperature always <4 °C.

Antibiotics should be absent. In EC countries the maximum tolerance limit for Aflatoxin M1 (AFM1) in milk is 50 ng/kg (in dairy products like Feta cheese, it is 250 ng/kg). Raw goat's and sheep's milk intended for the manufacture of heat treated milk-based products must meet the following standard: Plate count at 30 °C (per ml) < 1.500.000. Compliance with the standard must be checked by random sampling, either on collection at the production holding or on acceptance of the raw milk at the treatment or processing establishment.

The Pesticide Maximum Residue Limits (MRLs) for milk are presented below for each pesticide (Table 2). Pesticide residue analysis in raw milk should be carried out according to what is commonly used in each region.

Table 2: MRLs	
Acephate	0.02 mg/kg
Carbosulfan	0.03 mg/kg
Famoxadone	0.03 mg/kg
Lindane	0.01 mg/kg
Methamidophos	0.02 mg/kg
Methoxyfenozide	0.01 mg/kg
Pirimiphos-methyl	0.01 mg/kg

4.2 Filtration (CCP)

Physical hazard, the presence of foreign materials. Mechanical filtration through stainless steel mesh with tangential flow of the milk, or a filter cloth in smaller plants is used to remove particulate contaminants. Daily cleaning and visual inspection of the integrity of the filter is necessary.

4.3 Pasteurisation 72°C / 15min (CCP)

Pasteurisation is the most important step of the manufacturing process regarding microbiological safety.

- Temperature and time control is very important, alkaline phosphatase test and occasional microbiological test for coliforms. Pasteurized milk must show a negative reaction to the phosphatase test and a positive reaction to the peroxidase test.
- The pasteurisation vessel should be checked daily before use using the Swab test, and after cleaning it.
- Occasional microbiological test of the final rinse water for the presence of coliforms.

4.4 Cooling at 37°C

Frequent microbiological test of the vessels is needed using the Swab test. If jacketed vessel is used, then temperature can be adjusted to 32±1 °C at this step. Else the temperature will keep dropping and will reach the desirable by the next step.

4.5 Addition of starter culture and calcium chloride 0.5%

Commercial starter culture preparation of thermophile and mesophile lactic acid bacteria (*Lactobacillus bulgaricus, Streptococcus thermophilus, Lactococcus lactis*) 3-

3.5% v/v is added to the pasteurised milk and it is incubated at 32-34 °C until the pH drops to 4.7. The prepared culture must be used within 24h.

4.6 Addition of rennet and NaCl 0.01% / Coagulation for 1 h

During the coagulation process step Good Manufacturing Practice must be applied, mainly cleaning and sterilisation of the coagulation vessels and checking that the temperature stays at 32±1 °C. Microbial cross contamination must be controlled.

4.7 Curd Cutting

The curd is cut and after 10 minutes the strained curd is transferred into the moulds.

4.8 Transferring to moulds

Good Manufacturing Practice must be applied, mainly cleaning and sterilisation.

4.9 Dry Salting

Dry salt is added to the cheese. It influences cheese ripening, controls microbial growth and activity, controls enzymes activity and causes syneresis of the curd and thus reduction of moisture. Physical hazard: Visual inspection for foreign materials.

4.10 Maturation at 18°C / 15 days (CCP)

The pH value plays important roles in cheese making. It has a major impact on texture and microorganism control. Feta should be cooled after pH has reached at least 4,6. Feta cheese matures for at least two months in two steps. a) First at 17 - 18 °C for one day followed by 5 - 15 days in 6% NaCl at the same temperature (final pH = 4,6 - 4,7) and b) Second, at 4 °C in 8% NaCl until the two-month time period is reached. At the first step, general hygiene and temperature control is essential since temperature higher than 21 °C can be hazardous due to growth of *E. coli* which may be present.

4.11 Maturation in refrigerator 4ºC / 45 days (CCP)

Maturation continues at 4 °C in 8% NaCl until the two-month time period is reached. The temperature should be constantly monitored. A combination of factors such as salt content, pH, water activity and the storage temperature interact to render feta cheese microbiologically safe from pathogenic bacteria which may be present as a result of cross contamination (*B. melitensis, E. coli, Y. enterocolitica, A. hydrophila*).

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Table 3: Identification of CCPs							
No	**Process Step**	**Potential hazards and possible causes**	**Control measures**	* **Q 1**	* **Q 2**	* **Q 3**	**CCP Y/N**
1	Raw Milk Tanks	B C	Sampling according to a programme established for a certain collection area	Y	N	-	Y
2	Filtration	P	Inspection and cleaning	Y	N	-	Y
3	Pasteurisation at 72^{0}C for 15 sec	B	Control cleaning process Check pasteurisation diagram Apply phosphate test The control laboratory applies a sampling programme of the cooperative farms based on risk assessment.	Y	N	-	Y
4	Cooling at 37°C	B	Frequent use of swap test	Y	Y	N	N
5	Addition of starter culture	B	Ensure continuous activity (avoid contamination from bacteriophages)	Y	N	-	Y
6	Addition of rennet and NaCl		Avoid cross contamination	N	-	-	N
7	Curd Cutting		-	N	-	-	N
8	Transferring to moulds		Apply GMP and GHP	N	-	-	N
9	Dry Salting	P	Visual inspection	N	-	-	N
10	Maturation at 16°C/15days, RH=85%	B	Retain RH at max 85%, higher values of RH may favour the growth of moulds which produce mycotoxins and continuous temperature control	Y	N	-	Y
11	Storage <4^{0}C	B	Organoleptic control, Microbial control	Y	N	-	Y

B: Biological, C: Chemical, P: Physical

* Questions of the Decision Tree

Q1 Is there a hazard associated with this raw material?

Yes: Go to Q2 / *No*: Proceed to next raw material

Q2 Are you or the consumer going to process this hazard out of the product in a subsequent step?

Yes: Go to Q3 / *No*: CCP. Sensitive raw material, high level of control required

Q3 Is there a cross-contamination risk to the facility or to other products which will no be controlled?

Yes: CCP. Sensitive raw material, high level of control required. / *No*: Proceed to next raw material

Table 4: Controlling of CCPs				
Process Step	**Hazard**	**Monitoring**	**Frequency**	**Critical points**
Raw Milk Tanks	B	Control Milk acidity Aerobic mesophilic count Temperature	According to a programme established for a certain collection area*	pH 6.2-6.65 max 500,000 cfu/g <4°C
	C	Antimicrobial substances		absence
Filtration	P	Any extraneous material	Every day	absence
Pasteurisation	B	Temperature	Every batch	75°C for 15min
Addition of starter culture	B	Temperature pH	Every batch	32-34 °C 4.7
Maturation 18°C/15days	B	pH Temperature	Continuously Continuously	4,2<pH<4,6 17-18 °C<T<21 °C
Storage 4°C/45days	B	Temperature	Every batch	≤ 4°C

B: Biological, C: Chemical, P: Physical

*Mixing of different batches of raw milk should be avoided, in order to avoid cross contamination

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References

1. Anifantakis, E. M. (1991). Greek cheeses. National Committee of Greece, Athens, Greece
2. Azar M.T., Rofehgari-Nejad L. (2009). The Implementation of HACCP (Hazard Analysis Critical Control Point) to UF-FETA Cheese Production Lines. Research *J. of Biological Sciences* **4**: 388-394.
3. Codex Alimentarius, FAO/WHO Food Standards. Pesticide Residues in Food, Maximum Residue Limits; Extraneous Maximum Residue Limits http://www.codexalimentarius.net/mrls/pestdes/jsp/pest_q-e.jsp
4. Commission Regulation 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in food stuffs. Official J. European Union L. **364**: 5-24.
5. Council Directive 92/46/EEC of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat treated milk and milk-based products. Official J. European Union L. **268**: 1-40.
6. FAO, Rome 2004. Worldwide regulations for mycotoxins in food and feed in 2003.
7. http://www.fao.org/docrep/007/y5499e/y5499e0f.htm#TopOfPage
8. Mauropoulos, A.A., Arvanitoyannis, I.S. (1999). Implementation of hazard analysis critical control point to Feta and Manouri cheese production lines. *Food Control* **10**: 213-219
9. Mortimore, S., Wallace, C. (1998). In: HACCP - A practical approach, second edition, An Aspen Publlication, ISBN 0412754401
10. Papageorgiou K.D. (2003). HACCP in Feta production. Aristotelian University of Thessaloniki, Faculty of Veterinary Medicine.
11. Perdikaris, A. (2003). ISO 9000 and HACCP. A Ministry of Rural Development and Food publication, (In Greek). http://www.minagric.gr/greek/agro_pol/Perdikaris/ISO9000_HACCP.pdf