# DETERMINATION OF MICROBIOLOGICAL CONTAMINATION SOURCES DURING TURKISH WHITE CHEESE PRODUCTION

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# Abstract:

- To determine the microbiological contamination sources during production of white cheese.
- Twenty nine different control points or sample types used for examination.
- Enumeration of Microorganisms.

# Introduction:

- Turkish white cheese is a brined cheese.
- Soft or semi hard texture and a salty, acid taste.
- Previously classified under ‘‘safe foods’’
- Cheese contaminated with pathogenic microorganism, threat to public health.
- Investigation of possible microbiological contamination sources.

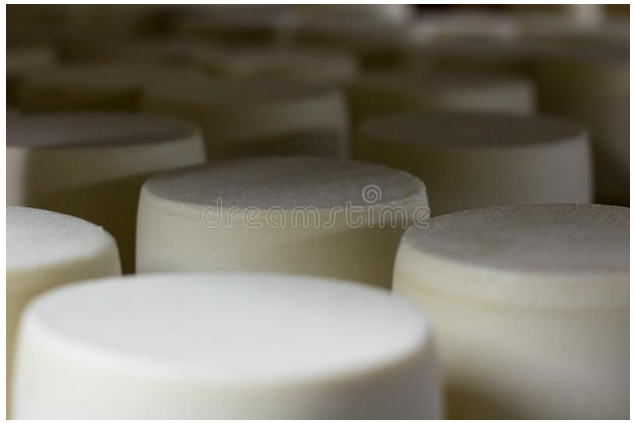


Fig1. White Cheese

# Background:

## CHEESE:

- Cheeses are milk-based foods.
- Soft or hard cheese
- White-brined cheeses: Feta and Feta-type cheeses.
- Goat, sheep or cow milk, or a mixture of milks is used.

# PRODUCTION:

- Milk pasteurization, starter cultures and rennet, milk coagulation and curd formation.
- Curd is drained in molds, cut into pieces, salted.
- Ripened in brine.
- Biochemical, physicochemical, and organoleptic characteristics.

# TRANSMISSION OF BACTERIAL PATHOGENS

- Direct contamination or cross-contamination events.
- Raw milk, Biofilms, air, production surfaces, cheese vat and cloth, curd cutting knife,etc.

Reception of raw milk

↓

Clarification

↓

Standardization of fat ratio

↓

Pasteurization

(at 74 °C for 2 min)

↓

Cooling

(to 32 °C)

↓

Addition of starter culture

(1 % at 32 °C)

↓

Addition of rennet and CaCl2

(0.02 % at 30°C)

↓

Coagulation

(completed in 90 min)

↓

Curd Cutting

(curd size 2 cm3, curds rested for 10 min)

↓

Draining

(35 min)

↓

Pressing and moulding

(curd size 8 cm3, 1 h)

↓

Salting

(in 15–16 % pasteurized brine at 15 °C for 12 h)

↓

Cold Holding

(at 4 °C for 1 day)

↓

Vacuum Packaging

(in polyethylene bags)

↓

Storage and short ripening

(at 4 °C for 2 weeks)

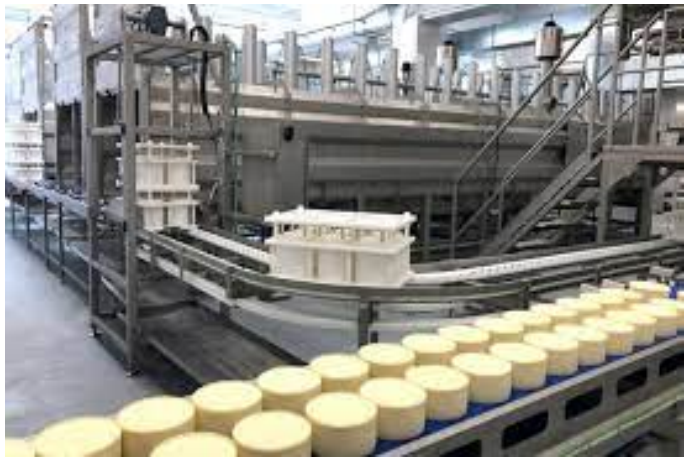

Fig2. Cheese Production setup

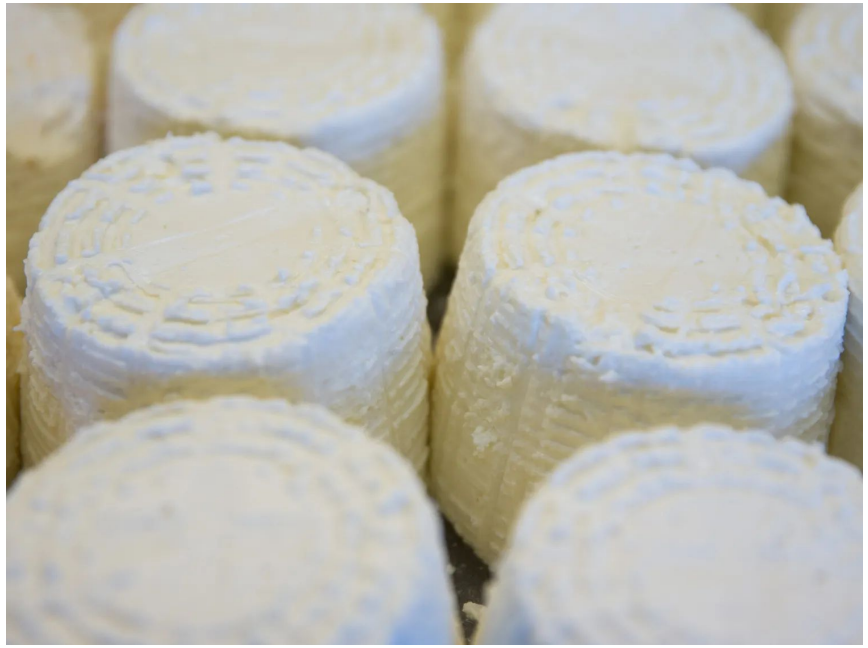

Fig3. White cheese contamination

# Materials and methods:

## SAMPLE COLLECTION

- Taken 10 times in different periods.
- From the production stages.
- Stored at 4 _C and processed within 24 h of collection.

# SAMPLE PREPARATION

- Surface swab samples
- Prewetted swab in 0.1% sterile peptone water.
- Samples from workers hands
- Sterile latex gloves and 20 ml 0.1% sterile peptone water.
- Samples from environmental air
- Agar plates without lids.

# STATISTICAL ANALYSIS

- Statistical software SPSS and MINITAB
- One way analysis of variance (ANOVA)
- Tukey–Kramer multiple comparisons tests
- Regression analyses

# Result and discussion:

- Incoming raw milk was poor.
- Sample 6 and 2 of raw milk harbor E.coli, and coagulase positive staphylococci.
- Statistical analysis to determine the effect of equipment used on the increase of bacterial counts in milk.
- Cheese vat: aerobic mesophilic bacteria, coagulase positive staphylococci.
- Polyethylene separator sheet: aerobic mesophilic bacteria.

- Cheese cloth: Insignificant effect
- Curd cutting knife: aerobic mesophilic bacteria, coagulase positive staphylococci.
- Starter cultures: coagulase positive staphylococci, enterococci and psychrophilic bacteria.
- Brine and upper pressure plate: staphylococci
- Hands of working personnel: contributed to an important increase of staphylococci counts and increased the coliform bacterial counts of vacuum packed cheese.
- Floor and packaging material: psychrophilic bacteria
- Production area air and cold room air: yeasts and molds

| Microorganism | Total aerobic mesophilic bacteria | | Coliforms | | Enterococci | | Entero-bacteriaceae | | Staphylococci | | Yeasts and molds | | Psychrophilic bacteria | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| *Samples* | | | | | | | | | | | | | | |
| Raw milk[a] | 8.43 A[c] | 0.39 | 7.16 A | 0.84 | 6.20 A | 0.61 | 6.56 A | 0.91 | 5.82 A | 0.55 | 4.65 A | 0.29 | 6.04 A | 0.71 |
| Pasteurized milk | 3.16 D | 0.32 | <1.0 E | 0.00 | <2.0 D | 0.00 | <1.0 C | 0.00 | <2.0 D | 0.00 | <2.0 F | 0.00 | <2.0 D | 0.00 |
| Milk in cheese vat | 3.60 D | 2.00 | 1.45 DE | 1.37 | 1.78 C | 0.96 | 0.96 C | 1.29 | 1.74 C | 0.96 | 0.46 EF | 0.96 | 3.74 BC | 1.06 |
| Curd[b] | 6.89 BC | 1.26 | 1.77 CD | 1.18 | 1.48 C | 1.30 | 1.01 C | 1.03 | 1.37 C | 1.79 | 0.49 EF | 1.04 | 4.58 B | 0.81 |
| Moulded cheese before salting | 7.47 AB | 1.08 | 3.06 BC | 1.62 | 3.58 B | 0.84 | 2.50 B | 1.39 | 3.33 B | 0.69 | 2.16 CD | 1.34 | 4.05 BC | 0.49 |
| Moulded cheese after salting | 6.86 BC | 1.61 | 3.63 B | 0.98 | 3.62 B | 0.87 | 3.20 B | 0.68 | 3.40 B | 0.76 | 1.98 CDE | 1.77 | 3.23 C | 0.77 |
| Cheese at cold holding | 6.14 C | 0.84 | 3.55 B | 0.21 | 4.40 B | 0.75 | 3.12 B | 0.22 | 3.91 B | 0.42 | 2.87 BC | 1.53 | 4.33 BC | 0.41 |
| Vacuum packaged cheese | 6.17 C | 0.73 | 3.45 B | 0.70 | 3.78 B | 1.06 | 2.84 B | 0.72 | 3.64 B | 0.60 | 4.15 AB | 0.52 | 4.98 AB | 0.34 |

[a] Log cfu/ml.
[b] Log cfu/g.
[c] A–F: Differences between the processing stages demonstrated with different capital letters in the same column are significant ($p < 0.05$).

**Table 1**

**Results of the microbiological analyses of the samples (n =10) collected during the production of Turkish white cheese**

| Microorganism | Total aerobic mesophilic bacteria | | Coliforms | | Enterococci | | Entero-bacteriaceae | | Staphylococci | | Yeasts and molds | | Psychrophilic bacteria | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| *Samples* | | | | | | | | | | | | | | |
| Rennet[a] | 3.48 | 0.79 | 1.30 | 1.25 | 1.18 | 1.52 | 0.60 | 1.26 | 0.55 | 1.17 | 0.40 | 0.84 | 2.39 | 1.50 |
| $CaCl_2$ | 2.86 | 1.68 | <1.0 | 0 | 0.60 | 1.26 | <1.0 | 0 | 0.40 | 0.84 | 0.40 | 0.84 | 1.58 | 1.40 |
| Starter culture | 6.93 | 1.04 | 0.55 | 0.71 | 1.27 | 1.68 | 0.20 | 0.42 | 0.92 | 1.20 | 0.92 | 1.18 | 1.11 | 1.44 |
| Brine | 4.67 | 1.05 | 1.85 | 1.03 | 1.09 | 1.42 | 1.33 | 0.90 | 2.64 | 1.54 | 1.39 | 1.42 | 3.56 | 1.89 |
| Cheese vat[b] | 2.69 | 1.46 | 0.20 | 0.42 | 0.55 | 1.17 | <1.0 | 0 | 0.62 | 1.31 | 0.80 | 1.03 | 0.67 | 1.41 |
| Cheese cloth | 1.34 | 1.73 | <1.0 | 0.00 | 0.62 | 1.32 | <1.0 | 0 | <2.0 | 0.00 | <2.0 | 0 | 0.46 | 0.97 |
| Polyethylene separator sheet | 3.24 | 1.73 | 1.06 | 1.42 | 0.68 | 1.45 | 1.07 | 0.57 | 0.46 | 0.97 | 0.52 | 1.09 | 2.74 | 1.99 |
| Milk stirrer | 2.63 | 1.66 | 0.56 | 1.19 | <2.0 | 0 | <1.0 | 0 | <2.0 | 0 | 0.46 | 0.97 | 2.80 | 1.71 |
| Curd cutting knife | 3.37 | 1.96 | 0.91 | 1.17 | 1.11 | 1.47 | 0.71 | 0.98 | 0.53 | 1.13 | <2.0 | 0 | 2.94 | 1.64 |
| Side pressure plate | 2.91 | 1.56 | <1.0 | 0 | 0.68 | 1.45 | <1.0 | 0 | 0.46 | 0.97 | 0.40 | 0.84 | 1.89 | 1.70 |
| Upper pressure plate | 3.16 | 0.58 | <1.0 | 0 | 0.40 | 0.84 | <1.0 | 0 | 1.09 | 1.50 | 0.86 | 1.11 | 2.45 | 1.31 |
| Moulded cheese cutting knife | 5.24 | 0.77 | 1.14 | 1.20 | 2.55 | 1.48 | 0.87 | 1.14 | 3.68 | 2.06 | 3.61 | 0.74 | 3.89 | 0.49 |
| Cheese tray | 3.62 | 1.05 | 1.06 | 1.39 | 2.03 | 1.75 | 0.91 | 1.23 | 3.38 | 0.82 | 1.97 | 1.79 | 2.17 | 2.10 |
| Packaging material | 0.80 | 1.03 | <1.0 | 0 | <2.0 | 0 | <1.0 | 0 | <2.0 | 0 | <2.0 | 0 | 1.41 | 1.23 |
| Floor | 4.82 | 0.34 | 3.29 | 0.45 | 2.31 | 2.03 | 1.93 | 1.04 | 2.50 | 1.33 | 2.88 | 1.57 | 3.87 | 0.64 |
| Wall | 2.07 | 1.24 | <1.0 | 0 | 1.05 | 1.36 | 0.49 | 1.04 | 1.01 | 1.31 | 0.80 | 1.03 | 1.38 | 1.79 |
| Worker hand 1 | 4.59 | 0.71 | 0.20 | 0.42 | 1.77 | 1.65 | <1.0 | 0 | 2.25 | 1.31 | 0.67 | 1.42 | 2.22 | 1.51 |
| Worker hand 2 | 5.04 | 0.40 | <1.0 | 0 | 1.26 | 1.64 | <1.0 | 0 | 2.66 | 1.53 | 0.55 | 1.17 | 3.52 | 0.47 |

[a] Log cfu/ml.
[b] Log cfu/$cm^2$.

**Table 2**

**Results of the microbiological analyses of the samples (n = 10) collected from starter culture, rennet, CaCl2, brine, equipment, packaging material, environmental and workers_ hands during Turkish white cheese production**

# Conclusion:

- Application of improved hygienic conditions in cleaning and disinfection of equipment.
- Training and routine auditing of personnel for GHP.
- Determined approach from the management about these applications is vital.
- Construction of a positive filtered air system.

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# Appendix:

- **ANOVA test:**
  - A way to find out if survey or experiment results are significant.
- **One Way ANOVA:**
  - Compare two means from two independent (unrelated) groups using the F-distribution.
- **Tukey's multiple comparison test:**
  - Determine which means amongst a set of means differ from the rest.

## SPSS:

- Statistical Package for the Social Sciences.
- data analysis for descriptive statistics, numeral outcome predictions, and identifying groups.

## Minitab:

- analyze and interpret data .
- Identifying trends and patterns.

# Thank You