

## Whey as an indicator for standardizing cow's milk fat percentage for cheese production

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### ABSTRACT

The dairy industry seems to have convinced the food industry that whey is a miracle product. The list of supposed benefits it gives to food is as long as your arm. Some of the benefits may be real.

Whey is the liquid remaining after milk has been curdled and strained. It is a by-product of the manufacture of cheese or casein and has several commercial uses. To produce cheese, rennet or an edible acid is added to heated milk. This makes the milk coagulate or curdle, separating the milk solids (curds) from the liquid whey. Sweet whey is the byproduct of rennet-coagulated cheese and acid whey (also called sour whey) is the byproduct of acid-coagulated cheese. Sweet whey has a pH greater than or equal to 5.6, acid whey has a pH less than or equal to 5.1.

Whey is also a great way to add sweetness to a product without having to list sugar as an ingredient as whey contains up to 75% lactose. And it sounds healthy.

This study is done to research the examinations for the production of mozzarella cheese from **Cow's milk**, after research and analyses of a physical-chemical peculiar feature of whey from coagulum. We have followed the processes from the drying of whey from the coagulum analyzer's physical-chemical peculiar feature. We carried out three experiments. For every experiment, we took three patterns and analyzed the physical-chemical. The calculation was appraised statistically. This paper deals with the research of% of whey fat during the process of milk production from standardized to non-standardized milk. Where% of whey fat should be an economic indicator for standardizing milk for dairy production.

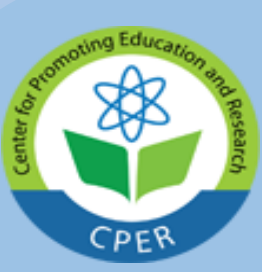
**KEYWORDS:** Milk, cow's, coagulum, whey, cheese

### Introduction

Whey is utilized as a privileged waste among wastewater of the dairy sector. Whey (W) is one of the most significant residues of dairy technology. Generally, it is yellowish, the green-colored liquid remaining as a result of the separation of curd during cheese production and lactose solution containing protein and minerals. Whey interrupts biological processes for traditional wastewater treatment because it has high biological oxygen demand (BOD) (40000-60000 ppm). It leads to very serious environmental pollution problems in the long term to release whey into nature (Kemal Çelik, Whey Every Aspect, 2020).

Whey has been discovered 3000 years ago. It has been utilized getting used for therapeutic purposes. In 1749, in Zurich, Switzerland; a patient whose treatment is impossible to get done and for whom doctors give a very short time to live has traveled to the chalet in Gains and achieved healing disease drinking whey every day. It is not known clearly whether this patient learns therapeutically property of whey by the fact that it has been known as "therapeutically water" by ancient Greek doctors or he has used it at the recommendation of peasants in the region. However, the fact that news about this patient achieving to survive despite the terrific diagnosis of doctor gets around in a short time has led many patients to come to Gains to utilize the miraculous healing feature of Whey. A health center has been founded in this small village in a short time and following that, the health center's more than 160 have been founded in Switzerland, Austria, and Germany. It is known that the centers have functioned in the most active way between the middle of the 18th century and 19th century (Kemal Çelik, Whey Every Aspect, 2020).

Whey, the liquid residue of cheese and casein production, is one of the biggest reservoirs of food protein remaining largely outside human consumption channels. Whey comprises 80-90% of the total volume of milk entering the process and contains about 50% of the nutrients in the original milk: soluble protein, lactose, vitamins and minerals. Whey as a by-product



from the manufacture of hard, semi-hard or soft cheese and rennet casein is known as sweet whey and has pH of 5.9-6.6. Manufacture of mineral-acid precipitated casein yield acid whey with pH 4.3-4.6. With Approximate composition of whey, % of Fat in Cheese whey 0.05%, and in Casein whey 0.04% (Dairy processing HANDBOOK, Lund, 2003 Sweden).

The dairy industry seems to have convinced the food industry that whey is a miracle product. The list of supposed benefits it gives to food is as long as your arm. Some of the benefits may be real.

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Whey is also a great way to add sweetness to a product without having to list sugar as an ingredient as whey contains up to 75% lactose. And it sounds healthy (Gunasekaran Sundaram, M.Memet Ak., Cheese Rheology and Texture, @by CRC Press LLC. 2003).

## 2. Release of Whey during Cheese Production

Caseins known as basic milk protein curdle when fresh milk is left to get boiled at a temperature not low and it is called "curdle" colloquially. A gel structure emerges and is seen if a mixing or shaking is not made in the following period. Whey separation is generally observed when gelled milk is held. This event can get accelerated by heat treatment application a mixing. Then, the structure is divided into two groups as curd whey. It constitutes the basis of cheese making. However, milk has been coagulated for centuries using materials such as rennet enzyme (rennet) obtained from calf stomach. Casein and fat are in concentrate form but other milk components pass to whey within water when milk is processed into cheese.

Basic production steps required for all types of cheese can be ranged as below;

- **Coagulation process of milk:** Rennet enzyme or acid or both of them are used herein. A gel structure emerges in this period, which is formed by casein proteins that gather in a network structure move away from the structure in this period (Kemal Çelik, Whey Every Aspect, 2020).

Since pretreating milk is a fairly recent practice relative to the history of cheese-making, many consider coagulation as the first and most important step in cheese-making. Coagulation is the step during which milk undergoes a profound physical and rheological change that is gelatin. Milk gel is formed by aggregation of milk protein, the casein. This can be accomplished by:

1. The action of a proteolytic enzyme.
2. Lowering the pH below the isoelectric point of protein (- 4.6).
3. Heatig to about 900 C at a pH of about 5.2 (i.e., higher than the isoelectric point) (Gunasekaran Sundaram, M.Memet Ak., Cheese Rheology and Texture, @by CRC Press LLC. 2003).

- **Separation of whey:** Water and water – soluble components in gel structure move away from the structure in this period.
- **Acid formation:** A certain part of lactose transforms into lactic acid.
- **Salting:** It is performed using NaCl.
- **Ripening:** It is required for desired flavor of cheese and formation of its structure properties (Kemal Çelik, Whey Every Aspect, 2020).

## 3. How to manufacture goat curd to produce mozzarella cheese

Processing steps of the curd's manufacturing:

### 3.1. Preparation of milk

The goat milk is heated up or pasteurized and placed in stainless steel vat, in which the other ingredients are mixed in 72°C/15sec.

The amount of culture or whey used in the processing of goat milk curd is much lower than that used for buffalo milk, which requires stronger acidification. The dose of freeze-dried culture is usually specified by the manufacturer; on the contrary, in case you use the whey culture you must add a suitable amount, generally not exceeding 1%, to get an optimal ripening time of the curd within 4 or 5 hours (Maxhuni, Shukri, 2012, Possibility of obtaining of the cheese: Mozzarella Cheese produced from cows, buffalo, and goats milk).



*Whey in glass.*

### 3.2. Coagulation process

First, you need to heat the milk to 36-38 ° C and then you can add the rennet to it, making sure to mix it thoroughly in the mass. The dose of rennet must be suitable to obtain a compact curd approximately in 1 hr. Generally, with a rennet of title 1:10.000, the proportion may vary from 25 to 35 ml/hl according to the quality of the milk (milk culture castaway 4gr/100l milk (Firma CHR-Ansen-Type of culter FRC-75 Bacteria Mezofile 70% Lactobacillus Bulgaricus 50 U(Junit) 500 l milk and 30% Bac.Thermophylus(Lactococcus)(Streptococcus) Thermophylus), Milk pH=6.4 (Maxhuni, Shukri, 2012, Possibility of obtaining of the cheese: Mozzarella Cheese produced from cows, buffalo and goats milk).

The milk is incubated with a whey starter containing thermophilic bacteria. Then rennet is added to form the curds. The curds are heated in water or whey until they form strings (hence the term "string cheese") and become elastic in texture. The curds are stretched, kneaded until smooth, and then formed into round balls to make fresh mozzarella cheese (Maxhuni, Shukri, 2012, Possibility of obtaining of the cheese: Mozzarella Cheese produced from cows, buffalo and goats milk).

### 3.3. The breakage of the curd

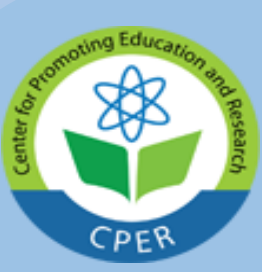
The following steps are the breakage of the curd, which needs to continue until obtaining little lumps of hazelnut size, and then a resting phase of approx. 30 minutes to allow the curd to settle and to consolidate on the bottom of the vat (Xochitl Garcia, 2016, Get Cheesy: Make Curds and Mozzarella).

Curd can be made in both traditional and industrial forms. Traditionally milk is filtered and boiled, the scum is removed and it is cooled to room temperature. A few spoonfuls of a previous batch of curd are added and it is then mixed well and poured into clay pots. These are sealed by wrapping a piece of paper over the pot and allowing it to stand for 12 hours. Traditionally curd (buffalo curd is thicker and tastier and has a higher fat content than cow curd) is made from filtered and boiled buffalo milk. The milk (usually from cows or water buffalo) is warmed and curdled and allowed to rest for an hour before the curds are cut into small pieces and the whey is drained off. The curds are allowed to rest for some hours (Louisa Kamps, "Cheese Curds," NY Times, October 17, 2004).

## 4. Whey Protein Components

Whey Protein is a collective term referring to a group of proteins found in milk. Information about the individual proteins found in whey protein can be found below:

- Beta-lactoglobulin
- Alpha-lactalbumin
- Glycomacropeptide (GMP)



- Immunoglobulins
- Bovine Serum Albumin (BSA)
- Lactoferrin
- Lactoperoxidase
- Lysozyme (9.info@wheyoflife.org. 2016).

### 5. Work Material Cow’s Milk

For this study, we have used milk of the following breeds: autochthon cow Busha, Frisyan, Montafon, Simmental, Holstein, in the dairy of the region of Fushë Kosova and Prizren. We carried out three experiments for each milk-kind. For every experiment, we took three patterns of Whey from coagulum and analyzed the physical-chemical. Three experiments were done with 5000 liters of cow’s milk, with raw non-pasteurized and nonstandardized row milk, milk with 3.6% fat.

This study is done to research the examinations for the production of mozzarella cheese, after research and analyses of a physical-chemical peculiar feature of whey from coagulum. We have followed the processes from the drying of whey from the coagulum analyzer's physical-chemical peculiar feature. We carried out three experiments. For every experiment, we took three patterns and analyzed the physical-chemical. The calculation was appraised statistically. This paper deals with the research of % of whey fat during the process of milk production from standardized to non-standardized milk. Where % of whey fat should be an economic indicator for standardizing milk for dairy production.

The calculation was appraised statistically.

#### 5.1. Work methods

For analyzing physical-chemical kinds of milk and whey are used these international standard methods.

1. For the definition of pH value were used the pH-meter ISOLAB pH -111,
2. Soxhelt-Henkels method was used to define sour taste,
3. For Physical-chemicals utilized Lactoscan-D -90,
4. For the definition of Nitrogen (N) were used the Kelda’s method,
5. For the definition of fat percentage % were using the method of Gerber,
6. for the definition of dry matters until drying up of constant mass,
7. Dry quantity of mass without fat has been done in a calculated way,
8. Percentage of fat at dry mass has been done in a calculated way,
9. Water quantity has been done in a calculated way,
10. for the definition of saline’s (NaCl),
11. Ash%, (IDF Standard 17 A, 1972 & Manual of Methods of Analysis of Foods, Milk and milk products, 2005).

#### 5.2. Experimental results

##### 5.2.1. Physic chemical Average percentage of fat in Whey coagulum from standardized milk (3.2%) cow’s milk

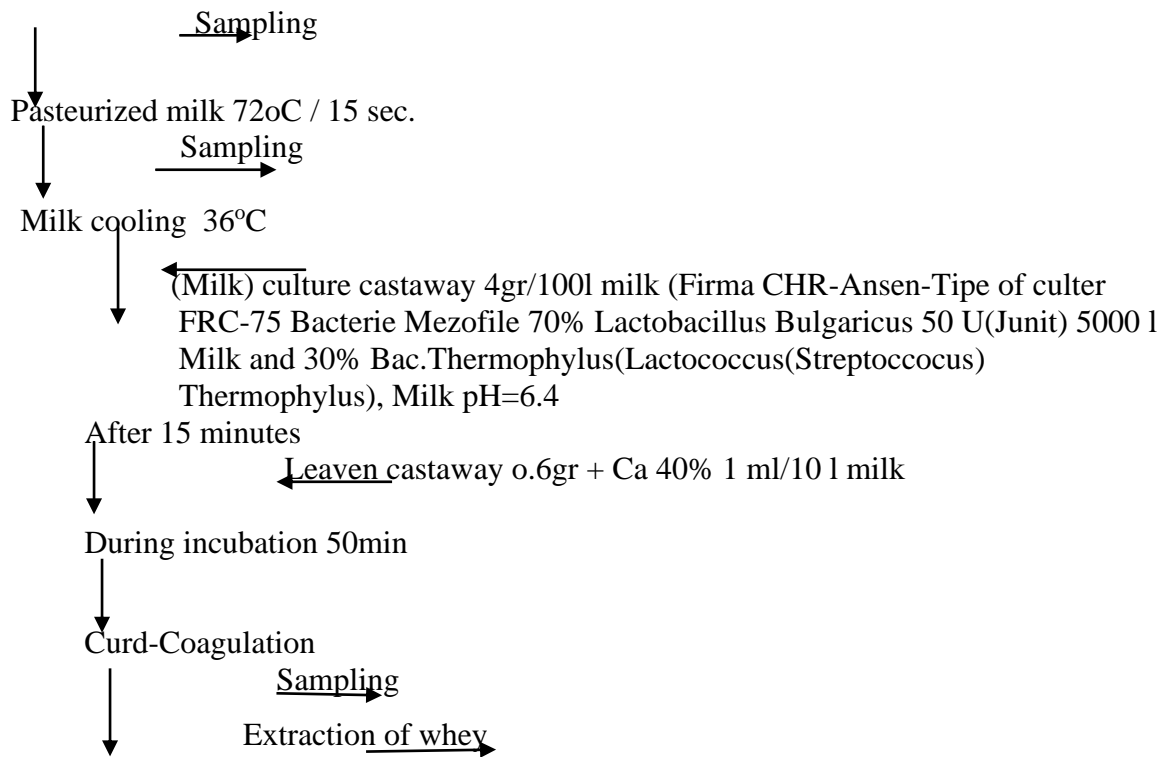
Table.1

Parametres	
pH	5.6
Aciditet °SH	6.9
Temp. Sample	28
<b>Fat %</b>	<b>0.39</b>
SNF % (Solids – not – fat = proteins, lactose, minerals, acids, enzymes, vitamins)	6.8
Density	1.02217
Protein%	0.74
Lactose%	4.9
Water %	93.20
Solids %	0.47
Freezing Point	- 0.215

**5.2.2. Physic chemical Average percentage of fat in Whey coagulum from nonstandardized (3.6%) cow's milk**  
**Table.2**

Parameters	%
pH	6.25
Acidities °SH	5.2
Temp. Sample	26
<b>Fat %</b>	<b>0.84</b>
SNF % (Solids – not – fat = proteins, lactose, minerals, acids, enzymes, vitamins)	7.17
Density	1.02408
Protein%	2.77
Lactose%	3.52
Water %	92.29
Solids %	0.58
Freezing Point	- 0.324
Conductometria - mS/cm	6.03

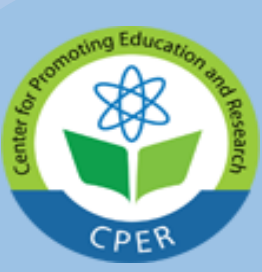
**Processing diagram of the production of mozzarella cheese from cow's milk, using the Traditional method Fresh milk**



Grain exsiccation of coagulum 15min, at t° 42 °C (Maxhuni, Shukri, 2012, Possibility of obtaining of the cheese).



Cheese with whey



## 6. Results and Discussion

- Three experiments were done with 5,000 liters of cow's milk, with raw non-pasteurized and nonstandardized row milk, milk with 3, 6% fat.
- Based on exploratory data for the production of Mozzarella cheese from un-standardized milk of cows, we can conclude that: Fresh milk must be in the standard with the number of microorganisms and with fat.
- Is a very important percentage of fat in whey as the indicator of yield for the curd to production the cheese mozzarella?
- For the maturity of the curd coagulant, the pH of whey must be 5, 9-6, 6. For the maturity of the curd coagulant, the pH must have the value 5, 0.
- Fat percentage differentiation between the non-standardized (3.6%) and standardized (3, 2%) of cow's milk is 0, 4%.
- But, fat percentage differentiation in between the non-standardized (0, 39 %) and standardized (0, 84 %) of cow's milk in whey is: 0.36%.
- The SNF-(Solids-not-fat = proteins, lactose, minerals) in cow's whey from standardized milk is 6.8%, but from nonstandardized milk is higher 7.17%.
- The protein in cow's whey from standardized milk is 0,74%, but from nonstandardized milk is higher 2, 77%.
- The Lactose in cow's whey from standardized milk is 4, 9%, but from nonstandardized milk is higher 3, 52%.
- The Solids in cow's whey from standardized milk is 0, 47%, but from nonstandardized milk is higher 0, 58%.

## 7. Conclusion

- Percentage loss of fat in whey of un-standardized cow's milk during the production process of mozzarella is 0, 4% / 1 kg cheese.
- Meanwhile, the percentage of fat in whey depends on standardized kind of milk.
- Though the results of this particular examination are quite good, we would recommend a temperature rise of 2oC, from 85 0C to 87 0C for a 2-3 minutes period of the pasteurization in order to fully ensure the pasteurization of the curd coagulum.
- This wills Throe that: any percentage of milk fat than the 3, 2% used for the production of cheese, will exceed the whey! Not as a result of the discovery of any new method to acquire the percentage of fat than milk whey not with us last.
- Well, so far not discovered any new method, which had to absorb the whole percentage of fat from fresh milk for cheese production.

## 8. Recommended

- To this should be made standardization of milk anyway, for the manufacture of cheese.
- Because: In economic terms cheesecake every enterprise, there will be economic losses without the use of standardized milk.

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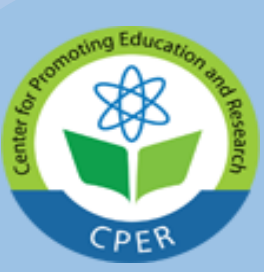
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