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Production of Ricotta Cheese from Whey

إنتاج جبنة الريكوتا من مصّل الحليب (الشرش)

A dissertation submitted in partial fulfillment for the degree of B.Sc. (Honor) in food science and technology

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October, 2018

الآية

قال تعالى:

وَأَيُّ لَّهُمُ اللَّيْلُ نَسَلَخُ مِنْهُ النَّهَارَ فَإِذَا هُمْ مُظْلِمُونَ * وَالشَّمْسُ تَجْرِي لِمُسْتَقَرٍّ لَهَا ذَلِكَ تَقْدِيرُ الْعَزِيزِ الْعَلِيمِ * وَالْقَمَرَ قَدَرْنَا مَنَازِلَ حَتَّىٰ عَادَ كَالْعُرْجُونِ الْقَدِيمِ

صدق الله العظيم

سورة يس (37-39)

DEDICATION

To our parents

To our families

And our friends

ACKNOWLEDGEMENTS

Firstly, unlimited thank to **ALLAH** who helped and gave us health to complete this research.

We wish to express gratitude and thank to our supervisor **Professor Ahmed El- waad El- faki** for his helped us complete it.

We unlimited thank to teacher randa, eglal and teacher eshraga, also to helped us completed this work.

Also we gratitude health to all staff members of the department of food science and technology.

With deep thank and gratefulness to our family for supporting us to complete this research.

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ABSTRACT

This study was carried out in order to benefit from the whey usually disposed from white cheese production for further production of cheese. Three types of cheese were produced (white cheese 'A' as control from 5liters of milk and the whey produced was used in making two types of cheese: 2.5liters whey+75ml acetic acid 'B' and 2.5liters whey+50ml acetic acid 'C').

Chemical characteristics of cheeses A, B and C showed that moisture was 74.35%,54.45%, 54.26% and protein 14.61%, 13.92% , 13.88%, and fat 24.24%, 21.89%, 21.73% and ash 5.43%, 3.73%, 3.72% and total solids 48.62%, 14.90%, 14.87% , respectively there were significant differences between three types of cheese and sensory evaluation of overall acceptability was 4.16%, 3.00%, 3.08%, respectively there was significant difference and showed acceptability. According to these results whey can be used for production of cheese (ricotta cheese).

المخلص

أجريت هذه الدراسة بغرض الإستفادة من الشرش الذي يتم التخلص منه عادة من إنتاج الجبن الأبيض لإنتاج جبن الريكوتا، تم إنتاج ثلاثة أنواع من الجبن (الجبن الأبيض من 5 لتر من الحليب واستخدم الشرش الناتج في صنع نوعين من الجبن: 2.5 لتر من الشرش +75 مل من حمض الخليك و 2.5 لتر من الشرش +50 مل من حمض الخليك).

أظهرت الخصائص الكيميائية للأجبان A,B,C أن الرطوبة كانت 54.45%,74.35% أظهرت الخصائص الكيميائية للبروتين والدهون 54.26%,13.88%,13.92%,14.61% والرماد 21.73%,5.43%,3.73%,3.72% والمواد الصلبة الجامدة 14.90%,48.62%، وكانت نتائج التقييم الحسي 14.87%، 4.16%,3.00%,3.08% على التوالي، وكان هنالك فرق أظهرت القبول الجيد؛ وفقا لهذه النتائج يمكن إستخدام الشرش لإنتاج الجبن(جبن الريكوتا).

CHAPTER ONE

INTRODUCTION

Milk is a considerable resource of product whose composition varies, four components is dominant in quantitative terms: water, fat, protein and lactose, while the minor components are minerals, enzymes, vitamins, and dissolved gases (Konte, 1999).

Cheese with estimates of date of birth ranging from 8000 to 3000 years BC, historians believe that it was discovered by accident .They suggest that middle easterners, who often used the internal organs of animals in a dried animal stomach for several hours (Herbst,2010).

Upon discovering, they experimented with preserving the curds through salting and pressing. As cheese became known, production methods varied to develop new types of cheese. While the Middle Eastern cheeses were typically a soft and creamy ricotta or crumbly feta, Europeans typically pressed and aged their cheese in caves, eventually developing the gouda, brie and cheddar we know today (Beresford,2004).

Whey is used in many things because of its high nutritional value and has several benefits:

It used to contain a quantity of vitamins and is good to some people how are allergic to lactose, and to reduce of wastes of whey.

Major objective:

To produce cheese from whey.

Specific objectives:

- 1- To formulate white cheese from whey in the laboratory.
- 2- To determine the physicochemical properties of the produced cheese.
- 3- To evaluate the sensory characteristics of the cheese.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of milk

In France, human milk consumption was defined in 1909 by the International Congress of Food by the following formula: "milk is the product of the total, full and uninterrupted milking of a dairy female in good health, also nourished and not overworked. It must be collected properly and not contain colostrums (Adib and Bertrand2009);(Leseur and melik1991). Milk is a whitish food generally produced by the mammary secretory cells of females in a process called lactation; it is one of the defining characteristics of mammals. The milk produced by the glands is contained in the udder. Milk secreted in the first days after parturition is called colostrum (Kebchaoui 2012). The quality of milk is paramount; therefore, it must be properl, and this table shows the composition of milk from different mammals:

Table 2.1: The composition of milk from different mammals in g /100 g y stored and transported in optimal conditions .

Species	Water	Protein	Fat	Lactose	Ash
Cow	87.2	3.5	3.7	4.9	0.72
Sheep	82.7	5.5	6.4	4.7	0.92
Goat	86.5	3.6	4.0	5.1	0.82
Camel	87.7	3.5	3.4	4.7	0.71

Source: Konte (1999).

2.2 Cheese production:

Cheese is the solid part of sweet milk obtained by heating milk and coagulation it by means of rennet or an acid. Rennet is an infusion made from prepared inner membrane of the fourth stomach of the calf. The curd is salted and subjected to pressure. Cheese is made from skim milk, milk plus cream, or cream(Fox, 2017).

Cheese is kept for a longer or shorter time, according to the kind, that fermentation or decomposition may take place. This is called ripening (Fox ,2017).

According to (Cogan,2017), the cheese production include:

2.2.1Curdling:

Today, the same principals are applied cheese producers start with cow, goat or sheep milk. This milk first need to be curdled (separated into liquid whey and solid curds) by converting lactose, or milk sugar, into lactic acid. This is done by adding either an acid such as vinegar or more commonly a starter culture. The starter culture contains one or more types of bacteria, known as lactic acid bacteria which produce lactic acid as they metabolize as the milk becomes more acidic, a protein called casein needs to curdle.

2.2.2Cooking:

For some cheeses, the temperatures is raised to 35-55C°.This creates a harder cheese by taste is also affected, as the heat triggers chemical reactions.

2.2.3 Salting:

Along with acting as a preservative, adding salt to the curds remove more of their whey, change their flavor, and firm their consistency. Salt can be mixed directly into the curds or applied to the outside as a dry salt or as a brine (salt water) wash.

2.2.4 Cheddaring:

To produce cheddar or similar cheeses, the curds are repeatedly stacked and pressed, forcing more whey from them to create a hard cheese.

2.2.5 Stretching:

Stirring and kneading the curds in hot water to form a ball creates the stringy texture found in mozzarella and provolone cheese.

2.2.6 Washing:

Some cheese is washed in warm water; this causes a more mild of flavor, lowering the cheese acidity. After this processing, cheese makers press the cheese into molds which allow liquid to escape as more whey is drained from the curds, where it takes its final shape. This cheese may be sold as it is, often lacking much more flavor than salt and having a rubbery texture, but it typically goes through an aging process next.

2.2.7 Ripening:

In its final stage of production, cheese is set out in a controlled environment to age cheese makers manage its temperature, humidity and bacteria population. During the aging process, the starter bacteria again become active as they break the casein protein and milk fat into fatty acids amines and amino acids it is during this process that sweet cheese gains its signature hole appearance, as its bacteria produce carbon dioxide gas

bubbles bacteria are often introduced (either applied directly to additional the cheese or made present in the air) to further manipulate the cheese final taste and consistency. These bacteria work from the outside in first forming a crust on the exterior before gradually affecting the interior of the cheese. Also the cheese maker sometimes creates holes in the cheese, allowing the entrance of oxygen and the simultaneous formation of mold throughout the cheese.

2.3 Whey protein:

Other milk proteins are present in the whey serum and whey proteins are defined as soluble proteins in the whey after precipitation of casein at ph 4.6 and at 20C. Serum protein include afresh protein fraction 80% consisted of lactoglobulin (B-LG),B-lactoalbumin (LA, Da) Bovine serum albumin(BSA) and immunoglobulin. A second non-protein fraction20% is composed of proteose, peptone and nitrogen compounds(Filio,2006).

2.4 Health benefits of whey protein:

According to (Arnarson, 2017):

1-whey is an excellent source of high quality protein (whey protein it is a complete high quality protein, containing all of the essential amino acids, in addition it is very digestible.

2-Whey protein promotes muscle growth.

3-Whey protein may lower blood pressure.

4-Whey protein may help treat type 2 to diabetes.

5-Whey may help reduce inflammation.

6-Whey is beneficial for inflammatory bowel disease.

7-Whey protein may have beneficial effects on blood fats.

8-Whey protein is highly satiating (filling), which may help reduce hunger.

9-Whey can help you lose weight.

2.5 Whey products:

Products include: mozzarella on pizza, quarg in cheesecake, ricotta in ravioli. Third major outlet for cheese is in the production of a broad range of processed cheese products which in turn have a range of applications, especially as spreads sandwich fillers or food ingredients (Filio, 2006).

2.6 Cheese from whey protein:

Whey cheese is cheese made from whey instead of milk. Whey is the clear, yellowish liquid by product of cheese making or of straining other cultured dairy products like yogurt and milk kefir (Filio, 2006).

How is whey cheese made?

The usual method of making whey cheese consist of merely cooking whey until it separates again. The temperature levels for making whey cheese are around 93.3C°.

Whey is made of water, albuminous protein mineral and trace milk sugar. The temperatures used in the milk cheese recipe are usually not high enough to fully separate the albuminous proteins out of the whey, but the secondary, higher temperature cook will yield even more cheese solids. Whey can be cooked over direct heat source and does not require indirect or a water bath heating methods (Fox, 2017).

Ingredients used to make whey cheeses:

Making cheese whey does not usually require rennet or starter cultures .Rather some type of acid (vinegar, citric acid and lemon juice) is used as the coagulant in whey cheese .Sometimes cream is called for in a whey cheese recipe to bring up the yield of the recipe and to develop the creamy texture of the resulting cheese. Hard and soft cheeses can be made from whey, but usually whey cheese will be slightly drier, saltier, and more crumbly than whole milk cheeses. Filter leftover whey to remove any remaining solids before using it for cheese making, to prevent off flavors or strange solids showing up in the finished cheese (Bitello,2013).

2.7 Whey cheese recipes:

According to (Bitello,2013) ,there are many cheeses that can be made out of whey. A few examples are listed below:

- Mycost (brown cheese).
- Traditional ricotta.

2.8 Processing and method:

Comes in many varieties the cheese variety determines the ingredients processing and characteristic of cheese.

The composition of many cheese is defined by standards of identity in the Cheese can be made using pasteurized or raw milk. Cheese made from raw milk imparts different flavors and textures characteristic to the finished cheese. For some cheese varieties, raw milk is given a mild heat treatment (below pasteurization) prior to cheese making to destroy some of the spoilage organisms and provide better conditions for the cheese cultures. Cheese made from raw milk must be aged for at least (60) days , as defined in the (CFR) , section 7 CFR 58.439 , to reduce the possibility

of exposure to disease causing microorganisms (pathogens) that may be present in the milk . For some varieties cheese must be aged longer than sixty day. Cheese can be broadly categorized as acid or rennet cheese, and natural or process cheeses. Acid cheeses are made by adding acid to the milk to cause the proteins coagulate. Fresh cheeses, such as cream cheese or queso fresco, are made by direct acidification. Most types of cheese, such as cheddar or Swiss, use rennet (an enzyme) in addition to the starter cultures to coagulate the milk. The term (natural cheese) is an industry term referring to cheese that is made directly from milk. Process cheese is made using natural cheese plus other ingredients that are cooked together to change the textural and melting properties and increase shelf life (Bitello,2013).

2.9 Ingredients:

The main ingredient cheese is milk. Cheese is made using cow, goat, sheep, water buffalo or a blend of these milks. The type of coagulant used depends on the type of cheese desired. For acid cheeses, an acid source such as acetic acid (the acid in vinegar) or glucono delta- lactones (a mild food acid) is used.

For rennet cheeses, calf rennet or, more commonly, rennet produced through microbial bio processing is used. Calcium chloride is sometimes added to the cheese to improve the coagulation properties of the milk. Flavorings may be added depending on the cheese. Some common ingredients include herbs, spices, hot and sweet peppers, horseradish, and port wine (Cogan,2017).

2.10 Bacterial cultures:

Cultures for cheese making are called lactic acid bacteria (LAB) because their primary source of energy is the lactose in milk and their primary

metabolic product is lactic acid. There is a wide variety of bacterial cultures available that provide distinct flavor and textural characteristics to cheeses. For a more detailed description of cheese culture and microbiology (Fox ,2004 ;kosikowski and Mistry 1997, and Law ,1997).

Starter cultures are used early in the cheese making process to assist with coagulation by lowering the PH prior the rennet addition. The metabolism of the starter cultures contribute desirable flavor compounds, and help prevent the growth of spoilage organisms and pathogens. Typical starter bacteria include lactococcus lactic subsp. Lactic or cremories, streptococcus salivarius subsp. Thermophilus, lactobacillus dellbruckisubsp, bulgaricus, and lactobacillus helveticus.

Adjunct cultures are used to provide or enhance the characteristic flavors and textures of cheese. Common adjunct cultures added during manufacture include lactobacillus casein and lactobacillus plantarum for flavor in cheddar cheese, or the use of Propionic bacterium freudenreichi for eye formation in Swiss. Adjunct cultures can also be used as a smear for washing the outside of the formed cheese, such as the use of brevio bacterium linens of gruyere, brick and limburger cheeses. Yeasts and molds are used in some cheeses to provide the characteristic colors and flavors of some cheese varieties (Law,1997).

2.11 Ricotta cheese:

Ricotta cheese is one of the cheeses that are used in the preparation of many dishes, such as lasagna and pizza. They can be prepared at home by separating whey from whole milk, or by purchasing with whey , some cheeses like mozzarella, ricotta also provide ,some minerals ,vitamins as well as energy sources, such as carbohydrates and proteins. Iorio(2009).

2.12 Benefits of ricotta:

There are some types of ricotta free of fat and so it is better health because it contains low calories compared to containing the fat and the inclusion of ricotta cheese on cholesterol, protein and carbohydrates works to protect the heart from diseases and protection from blockage of arteries and strengthens the teeth and reduces the risk cancer. Iorio(2009).

CHAPTER THREE

MATERIAL AND METHODS

3.1 Materials:

3.1.1 Source of milk:

The milk brought from the farm of department of animal production, faculty of agricultural studies, university of Sudan science and technology, in addition to milk from other farms around, in the bahri area.

3.1.2 Source of acetic acid:

Acetic acid brought from local supermarket.

3.1.3 Source of calcium chloride:

Calcium chloride is brought from the Department of Science and Technology (Lab), faculty of agricultural studies, university of Sudan science and technology.

3.1.4 Source of calf rennet:

Rennet enzyme was brought from the local market Khartoum.

3.2 Methods:

3.2.1 Experiment 1:

In this experiment 10pound of fresh cow milk brought from the farm of the animal production department and. After that put it on a water bath for a quarter of an hour at 70C° and then descend from the water path. Calcium chloride was added as much at 0.8 g after the temperature reached at 42C°, the rennet enzyme was added 10 ml g and then placed in incubation for one hours and a half. Then it coagulated and the clot was

cut into small parts to extract the greatest amount of whey protein, and then weigh two liters and half of whey in the pot on the fire directly to heat after the temperature above boiling was reduced to add vinegar at 60 ml the result is no coagulated.

The potential for failure is the presence of salt in the whey used to conserve the first cheese.

3.2.2 Experiment 2:

In the second experiment we brought ten pound of fresh cow milk from the farm of the animal production department and then the milk. After that ,put on a water path for a quarter of an hour at 70C° and then descend from the water path Calcium chloride was add as much as 0.8 gram after the temperature reached at 42C° ,the rennet enzyme was add 10 mil gram and then placed in incubation for one hours and a half . Then it coagulated and the clot was cut into small parts to extract the greatest amount of whey protein En then weight a pound and half of whey in the pot on the fire directly to heat after the temperature above boiling, reduced to add vinegar by 60 mg the result is auctioned the coagulated then the coagulate in the whey was placed on a light cloth to clear and remove the resulting whey .but the taste of vinegar is also apparent and its flavor.

3.2.3 Experiment 3:

In the third experiment we brought ten pound of fresh cow milk from the other farm. After that put it on a water path for a quarter of an hour at 70C° and then descend from the water path. Calcium chloride was add as much as 0.8 gram after the temperature reached at 42C° ,the rennet enzyme was added 10 mil gram and then placed in incubation for one

hours and a half. In this result was no coagulation, antibiotics that inhibits the enzyme may work.

3.2.4 Experiment 4:

In this experiment, 10 pounds of fresh cow milk was brought from the farm of the animal production department. After that put on a water bath for a quarter of an hour at 70C° and then descend from the water bath. And then calcium chloride was added about 0.8 g after the temperature reached at 42C°. Ten ml g of rennet enzyme was added, then placed in incubation for one hours and a half. After that it coagulated and the clot was cut into small parts to extract the greatest amount of whey protein, and then take 2 liter of whey, and divided into liter per liter and put one liter in the pot on the fire directly left until boiling occurs and then added 30ml of white vinegar. The result was coagulated, the coagulate was obtained by using cloth clear to remove the whey, remaining whey was 600ml out of 1000 ml. Then take the remaining portion of the whey and take the same steps as the pervious with the difference in the amount of vinegar which was added in 20 ml. The result was coagulation also but the coagulate texture was less solid than the previous one, with remaining whey increasing to 650ml.

The note:

The amount of whey remaining in the initial experiment was 50ml less than the second experiment also the clot in the first is more solid than the second clot it can be said that all the increased amount of vinegar increased proportion of coagulate.

3-2-1-Moisture content

Moisture content was determined according to the association of official's analytical chemists AOAC (1990) as follows: tow grams of each sample were weighted in clean dry and pre-weighted crucible and then placed in oven at 105°C and left over night. The crucible was transferred to desiccators and allowed to cool and then weighted. Further placed in the oven was carried out until constant weight was obtained. Moisture content was calculated using the following formula:

$$MC\% = \frac{(W_2 - W_1) - (W_3 - W_1)}{(W_2 - W_1)} \times 100$$

Where:

MC: moisture content.

W1: weight of empty crucible.

W2: weight of crucible with sample.

W3: weight after drying.

3-2-2-Protein content

Protein content was determined by kjeldhal method according to the AOAC (1990) as following:

1-Digestion: Ten grams of sample was weighed in a crucible and transferred to a digestion flask two tables of kjeldahl catalyst (mercury) and 25ml of concentrated sulphuric acid were added to the sample the flasks were placed on the digestion apparatus, heated firstly at low heat, then heating was continued with increased heat until the mixture was color less. Then the flasks were allowed to cool.

2-Distillation: To each receiving flask 25ml of boric acid and three drops of bromocresol green+ methyl red indicator were added. The digested samples were transferred from the digestion flask to volumetric flask (100ml) and the volume was completed to 100ml by distilled water. The receiving flask was placed on the distillation rack with the tip of the condenser extended below the surface of the acid. Immediately 5ml of the diluted sample were added from the funnel of the distillation apparatus, then 10ml NaOH (40%) were added gently. The distillation was continued until the volume in the receiving flask was 75ml, and then the flask was removed from the distillatory.

3-Titration: the sample in the receiving flask was titrated against 0.1N HCL. The color was changed from green to purple. The protein content was calculated as follows:

$$N(\%) = \text{ml HCL} * \text{Normality of HCL}(0.1) * 20 * 0.014 / \text{weight of sample} * 100$$

$$\text{Protein (\%)} = N (\%) * 6.38$$

N = Nitrogen content.

3-2-3-Fat content

Fat was determined according to the method of AOAC (1990) using soxhlet apparatus follows:

An empty clean and dry exhaustion flask was weighted. About 2 gram of sample was weighted and placed in clean extraction thimble and covered with cotton wool. The thimble was placed in an extractor. Extraction was carried out for 8 hours with petroleum ether. The heat was regulated to obtain at least 15 siphoning/hour. The residual ether was dried by evaporation. The flask was placed in an oven at 105°C till it dried

completely and then cooled in a desiccator and weighted. The fat content was calculated using the following equation:

$$FC\% = \frac{W2 - W1}{W3} \times 100$$

Where:

FC: fat content.

W1: weight of extraction flask.

W2: weight of extraction flask with fat.

W3: weight of sample.

3-2-4-Total solids content

Total solids content was determined by the forced-draft open method according to Bradley *et al.* (1992). Aluminum dishes were dried for 5 hours at 100°C and stored in clean desiccators until used. Quickly and accurately 3±0.5 gm of sample were weighed into a pre weighed dish on an analytical balance. The dishes with the cover under each were placed on the shelf in the forced-draft oven for 16 hours, removed from the oven and cooled in the desiccators for at least 30 minutes or until they reached room temperature and then weighed. The total solids content was then calculated as follow:

$$\text{Total solids (\%)} = \text{weight after drying/weight of sample} * 100$$

3-2-5-Ash content

Ash content was determined according to the association of official's analytical chemists AOAC (1990) as follows: tow grams of each sample were weighted in clean dry and pre-weighted crucible and then the crucible with its content ignited in a muffle furnace at about 550°C for three hours or more until light gray ash was obtained. The crucible was removed from the furnace to a desiccator to cool and then weighted. The

crucible was reignited in the furnace and allowed to cool until a constant weight was obtained. Ash content was calculated using the following equation:

$$AC\% = \frac{W_2 - W_1}{W_3} \times 100$$

Where:

AC: ash content.

W1: weight of empty crucible.

W2: weight of crucible with ash.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Chemical characteristics of ricotta cheese:

4.1.1 Moisture content:

Table 1 shows that the moisture content of white cheese (control) $74.35 \pm 0.02\%$ was higher than ricotta cheese containing 75ml of acetic acid $54.45 \pm 0.01\%$, while ricotta cheese containing 50ml of acetic acid $54.26 \pm 0.01\%$, less moisture content than the previous two, there was significant difference.

4.1.2 Protein content:

Table 1 shows that the protein content of white cheese (control) $14.61 \pm 0.01\%$ was higher than ricotta cheese containing 75ml of acetic acid $13.92 \pm 0.01\%$, while ricotta cheese containing 50ml of acetic acid $13.88 \pm 0.01\%$, less protein content than the previous two, there was significant difference.

4.1.3 Fat content

Table 1 shows that the fat content of white cheese (control) $24.24 \pm 0.01\%$ was higher than ricotta cheese containing 75ml of acetic acid $21.89 \pm 0.01\%$, while ricotta cheese containing 50ml of acetic acid $21.73 \pm 0.01\%$, less fat content than the previous two, there was significant difference.

4.1.4 Ash content

Table 1 shows that the ash content of white cheese (control) $5.42 \pm 0.01\%$ was higher than ricotta cheese containing 50ml of acetic acid $3.73 \pm 0.01\%$,

while ricotta cheese containing 75ml of acetic acid $3.72 \pm 0.01\%$, less protein content than the previous two, there was significant difference.

4.1.5 Total solids content

Table 1 shows that the total solids content of white cheese (control) $48.62 \pm 0.02\%$ was higher than two types of ricotta cheeses containing 75ml and 50 ml of acetic acid their values were $14.90 \pm 0.01\%$ and $14.87 \pm 0.01\%$, respectively there was significant difference.

Table 4.1: Chemicals characteristics of ricotta cheese

Sample	Moisture	Protein	Fat	Ash	Total solids
White cheese(control)	74.35 ±0.02 ^a	14.61 ±0.01 ^a	24.24 ±0.01 ^a	5.43 ±0.02 ^a	48.63 ±0.02 ^a
Ricotta 75ml acetic acid	54.45 ±0.01 ^b	13.92 ± 0.02 ^c	21.89 ±0.02 ^c	3.73 ±0.02 ^b	14.87 ±0.02 ^b
Ricotta 50ml acetic acid	54.26 ±0.01 ^c	13.88 ±0.02 ^b	21.73 ±0.01 ^b	3.72 ±0.02 ^b	14.90 ±0.01 ^b

4.2 Sensory evaluation of ricotta cheese:

4.2.1 Color

Table 2 shows that ricotta cheese containing 75ml of acetic acid and 50ml of acetic acid and white cheese (control) there values were $3.17\pm 0.093\%$ and $3.17\pm 0.72\%$ and $3.83\pm 0.093\%$, respectively no significant difference between them.

4.2.2 Flavor

Table 2 shows that ricotta cheese containing 75ml of acetic acid and 50ml of acetic acid and white cheese (control) values were $2.58\pm 1.16\%$ and $2.66\pm 1.07\%$ and $3.41\pm 1.16\%$, respectively no significant difference between them.

4.2.3 Taste

Table 2 shows that ricotta cheese containing 75ml of acetic acid and 50ml of acetic acid and white cheese (control) values were $2.91\pm 1.24\%$ and $2.66\pm 1.15\%$ and $3.75\pm 1.28\%$, respectively no significant difference between them.

4.2.4 Texture

Table 2 shows that ricotta cheese containing 75ml of acetic acid and 50ml of acetic acid and white cheese (control) values were $2.66\pm 1.15\%$ and $2.91\pm 1.24\%$ and $3.75\pm 1.28\%$, respectively no significant difference between them.

4.2.5 Overall acceptability

Table 2 shows that ricotta cheese containing 75ml of acetic acid and 50ml of acetic acid and white cheese (control) values were significant difference between two ricotta cheese and white cheese.

Table 4.2: Sensory evaluation of ricotta cheese:

Sample	Color	Flavor	Taste	Texture	Over acceptability
White cheese(control)	3.83 ±0.93 ^a	3.41 ±1.16 ^a	3.75 ±1.28 ^a	4.08 ±0.79 ^a	4.16 ±0.83 ^a
Ricotta 75ml acetic acid	3.17 ±0.72 ^a	2.66 ±1.07 ^a	2.91 ±1.24 ^a	3.00 ±2.91 ^a	3.00 ±0.73 ^b
Ricotta 50ml acetic acid	3.17 ±0.93 ^a	2.58 ±1.16 ^a	2.66 ±1.15 ^a	2.91 ±1.08 ^a	3.08 ±0.99 ^b

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION :

The result of this study showed that ricotta cheese produced from whey was rich in ash , protins and fat ; and it is acceptable as cheese .

5.2 Recommendations:

1. Ricotta cheese can be produced from whey .
2. To reduce environment contamination by disposal of whey
3. Ricotta cheese is considered cheap from economic point of view
4. Further studies are recommended using different concentration of acetic acid

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