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A comparative study of ohmic and conventional pasteurization on camel milk

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***Abstract*---**The present study was about the comparison of effect of ohmic and conventional pasteurization on camel milk. The objectives were to analyze the pasteurization effect of both methods on microbial and nutritional quality of camel milk. Camel milk was pasteurized by both methods, conventional heating as well as ohmic heating by maintaining the temperature of milk at 63°**C** and changing the time of

pasteurization for 3.75, 7.5, 15 and 30 minutes. After pasteurization the milk was tested for microbes by total plate count (TPC) and nutritional profile of milk by different analysis. The pasteurized milk by ohmic heating showed a reduction of bacterial count from 2.35 to 1.83 log CFU/ml of TPC. The pH obtained was 6.54, moisture content was 88.19%, fat content was 3.09%, protein content was 2.43%, lactose content was 3.25% and ash content was 0.85% by pasteurization of camel milk with ohmic heating. The pasteurized milk by conventional heating showed a total plate count value of 2.37 to 1.87 log CFU/ml. The pH obtained was 6.6, moisture content was 87.66%, fat content was 2.99%, protein content was 2.33%, lactose content was 3.16% and ash content was 0.84% with conventional heating of pasteurization. The results of the study indicated that ohmic heating technique has a significant impact on total plate count test, fat %, protein% pH and acidity of pasteurized camel milk. Conventional heat treatments also exhibited significant impact on TPC and nutritional profile but the values obtained with ohmic heating were more than the values obtained from conventional heating. Finally, it is concluded that ohmic pasteurization has the potential of reducing heating time and produce safe and nutrient rich milk by reducing thermal degradation losses of nutrients.

***Keywords*---**Ohmic, Conventional, Camel Milk, Degradation losses, Pasteurization.

Introduction

Milk is a complex white liquid and has a great biological value. It is produced for the purpose of feeding the neonates of species and the mammary glands of female animals have capacity to produce milk. Milk is a potential source of food for humans in addition, it is also used as an ingredient in a variety of foods such as yoghurt, cheese, and butter. Milk has been generated by a wide variety of animal species' bodies throughout the course of history. The vast majority of milk that is produced for human use comes from animals that are kept for the purpose of dairy farming. Consumption of camel milk is restricted to just a few regions around the globe. Milk from dairy animals is not allowed to include colostrum and must be collected within the first two weeks of the cow's pregnancy and no later than five days following the birth of the calf [1]. Milk is composed of between 86 and 88% water, with the remaining 12 to 14% being comprised of a variety of various solids. The %ages of lipids, proteins, lactose, minerals, and vitamins that are found in whole milk are around 3-4%, 3%, 4-5%, 0.7%, and 0.1% respectively [2]. Milk from a variety of animals, such as goats and camels, may be combined with other milks to create a variety of delicious dairy products.

Milk contains both soluble and insoluble forms of the protein that makes up milk. The soluble form comprises whey protein, which is responsible for 20 % of total milk proteins, whereas the insoluble form has casein contents, which account for 80 % of total milk proteins [3]. The importance of milk protein is due to the essential amino acids that it contains [4]. In the human body, the protein included

in milk performs a number of different bioactive effects, including those of an antioxidant, antihypertensive, antifungal, antiviral, antibacterial, and immune-modulatory functions. In addition to these tasks, protein is an essential component in the process of nutritional absorption [5].

Camel milk has a moderately salty flavor and an opaque white color [6]. Camel milk has quantity of fat, lactose, and protein content roughly same as that of bovine milk. Camel milk has no beta-lacto globulin, but having a protein content ranging from 2.3 % to 3.92 % [7]. According to research, camel milk contains a larger whey protein to casein ratios which generates a soft and readily digestible curd in the stomach [8].

In the majority of camel-producing nations, camel milk is pasteurized in the same manner as cow's milk. Common pasteurization procedures include 60°C for 30 minutes, 75°C for 15 seconds, and 63°C for 30 minutes. According to various study results, the characteristics of camel milk change after boiling. Camel milk, for example, produces a huge dry deposit on a stainless-steel plate after pasteurization at 60 to 90°C for 1 to 2 hours [9].

Pathogens such as *E. coli, Micrococcus* sp., *Streptococcus*, and *Staphylococcus* may be discovered in raw milk under adverse circumstances. There is a high incidence of *Campylobacter jejuni* and *Listeria monocytogenes*, which may reach up to 13%. Milk contains organisms such as *Coliform, Psychrotroph,* and spore-forming bacteria such as Salmonella subs., *E. coli*, and *Staphylococcus aureus* [10]. Milk also contains *Lactobacillus subs., L. monocytogenes,* and *Pseudomonas subs* [11]. Milk may spread a variety of severe illnesses, including brucellosis, typhoid, and TB [12]. These potentially hazardous microbes may be eradicated from raw milk by pasteurizing it [13]. The two most essential heating techniques in dairy processing facilities are sterilization and pasteurization. Pasteurization kills vegetative forms of bacteria, while sterilization kills dangerous germs as well as their spores, making the milk safe for human consumption.

Pasteurization temperatures (65 to 70 °C) are adequate to kill all harmful bacteria. Pasteurization is performed at 72°C for 15 seconds during the high temperature short time (HTST) and 63°C for 30 minutes during the low temperature long time (LTLT). When milk is stored at a lower temperature (4 °C), its shelf life is increased. The rate of microbial degradation doubles with every 2°C increase in storage temperature [14].

Until date, traditional food heating techniques have shown to be successful. Traditional thermal pasteurization and food sterilization processes depend on heat conduction and convection. The fundamental disadvantage of conventional heating methods is non uneven heating of the product. Due to internal food product resistance to heat conduction, heterogeneous heating occurs in several food sectors, resulting in aesthetic quality losses [15]. This extends the time needed for heating. The most important factor in preventing food borne illnesses in any food product is homogenous heat treatment. Another issue with traditional heating techniques is the need for a dirty steam boiler [16]. Food does not interact with hot surfaces, allowing for even and quick product heating[17] . For these reasons shelf life is extended by ohmic heating, which raises pasteurization

temperatures without causing protein denaturation or coagulation. As a result, ohmic heating has the potential to reduce the influence of thermal activity on food quality. For ohmic heating, the electrical food conductivity range needed is 0.01 to 10 S/m [18]. Under the same circumstances, the ohmic technique yields lower D and Z values than the traditional method [19]. The effects of ohmic heating on the processing of soymilk were examined. The findings showed that soymilk preparation took less time and consumed much less energy than conventional heating [20]. The traditional heating technique lengthens the heating duration and reduces quality. Understanding of alternate thermal pasteurization and sterilization procedures that minimize lengthy heating durations and unwanted temperature peaks is growing; ohmic heating is the best of these approaches [17]. The present study was comprised of to determine the best method of pasteurization on milk.

2. Material and Methods

2.2. Procurement of raw materials

Multiple locations all across Faisalabad were scoured for fresh camel samples to bring back for analysis. Camel milk sample was purchased from Airport chowk near laboratory college of Agriculture university Faisalabad. The food microbiology laboratory, which is a component of the Faculty of Food, Nutrition, and Home Sciences at the University of Agriculture Faisalabad (UAF) received these samples for the purpose of analysis. Glass vials that had been previously sanitized were used for the collection of the samples. An ice box was used in order to maintain the samples' high level of freshness. The lactase enzyme, in addition to other chemical components, as well as the necessary glassware, was acquired either from NIFSAT or the local market in Faisalabad. Following a design of different experiments done in this study has shown in fig.1.

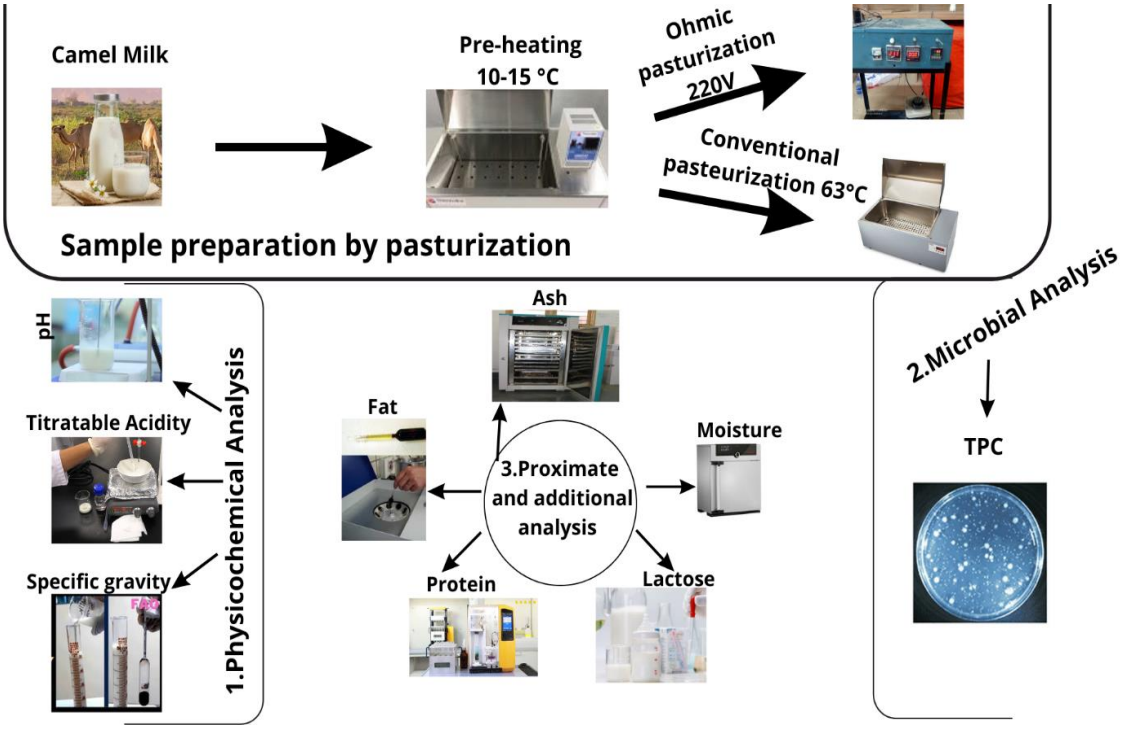

Fig.1. Design of Experiments

2.2. Preparation of the milk sample for analysis

Raw camel milk was preheated in a water bath for 10-15 minutes at 10-30°C (but not more than 50°C). A water bath is made out of a stainless-steel container filled with water and samples, as well as a control panel for heating the sample for long time.

After that, the preheated milk samples were kept at that temperature for five minutes before being homogenized. When temperatures are over 12°C, the development of Escherichia coli increases to such an extent that there is a possibility of unacceptable contamination of the milk that is being processed even if the milk is only held for 12 hours.

Homogenization was carried out at a temperature of 25-30 °C for 10-15 seconds in a homogenizer. By forcing milk that is under high pressure through a tiny hole, this technique reduces the average diameter of the fat globules to about less than 2micrometer. The first part of the homogenized milk was heated in a water bath using the traditional technique of pasteurization, and the second portion was heated using the ohmic heating approach.

2.2.1. Pasteurization:

Pasteurization at low temperatures for extended periods of time (LTLT) is also known as batch or holding pasteurization. In one, two, or three tanks, the milk

and milk products were heated or cooled in batches depending on the number of tanks. The procedure comprised heating the milk to a temperature that ranged from 62.8 to 65 degrees Celsius, maintaining it at that temperature for thirty minutes, and then quickly cooling it to a temperature that was lower than 10 degrees Celsius. The batch processing procedure consisted of the following steps: filling the vessel, heating it, keeping it at that temperature for a certain amount of time, cooling it, emptying the vessel, and then filling the containers by using the metal wall and hot water steam [21]. After that, the product was either heated or chilled, and then it was gently stirred to facilitate a quick transmission of heat.

Pasteurization at a high temperature for a short period of time, sometimes referred to as HTST or flash pasteurization. The HTST procedure was carried out on a plate heat exchanger made of stainless steel that was located in a laboratory. A peristaltic pump was used to agitate the milk sample before introducing it into the system. At the same time, the heat exchanger was calibrated to maintain temperatures of 72 degrees Celsius, 75 degrees Celsius, or 81 °C for 15 or 25 seconds, respectively [22]. In preparation for further examination, several samples of pasteurized milk were placed in sterilized glass bottles of 350 ml capacity, sealed, and labelled in a laminar flow cabinet before being placed in a refrigerator set to a temperature of 4 degrees Celsius. The physical, chemical, and microbiological properties of each of the samples were evaluated as soon as they were removed from the pasteurization process, as well as after two, three, and four weeks of storage.

The ohmic heating chamber, also known as the ohmic heating cavity, is a rectangle shape tank (Made of glass) that has three sets of electrodes that are tightly fastened along the length sides of the chamber. Silicon paste, which can resist temperatures of around 600 degrees Celsius, was employed as the cementing ingredient in the construction of the tank. When an electric current was sent via the electrodes, the tank was loaded with the sample that needed to be treated, and the tank's contents were heated. A thermometer that was able to resist temperatures of up to 200 °C was used to test the temperature of the sample. A digital multi meter was used in order to measure the electric current and the voltage of the power. The conditions for pasteurization were described as following: temperature of 72 °C for 15 seconds. After the milk samples had been pasteurized, but before they were placed in cold storage, ice water was used to quickly chill down the camel milk samples to a temperature of 4 degrees Celsius. The camel milk was pasteurized using both conventional and ohmic heating cell system according to the following steps.

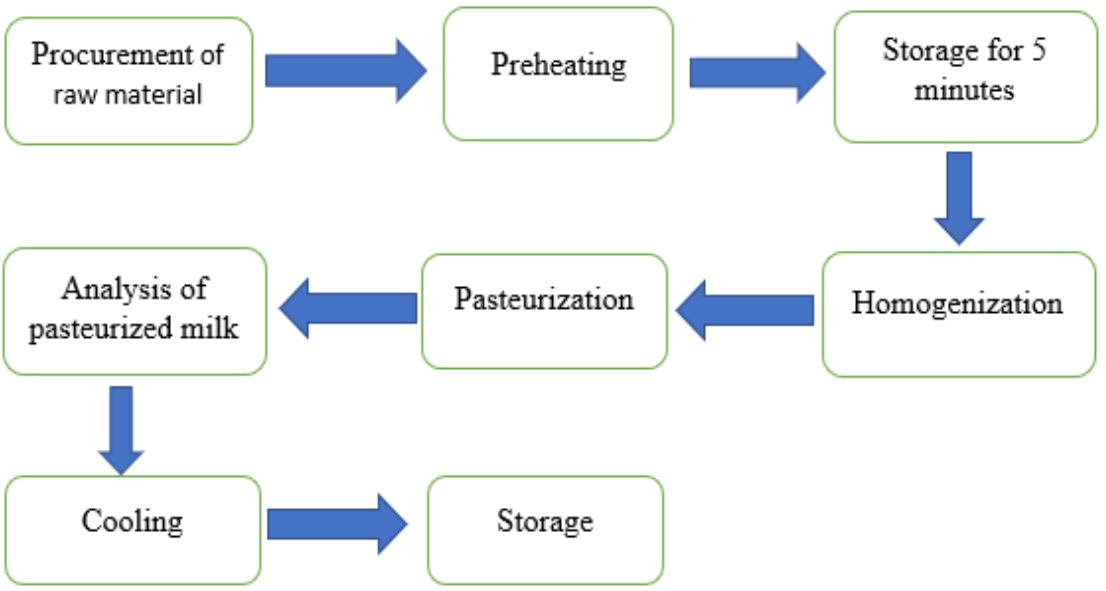

Fig.2. Pasteurization of camel milk

2.3. Analysis of pasteurized milk

2.3.1. Microbiological Analysis

Staphylococcus aureus, Salmonella, and E. coli were the three infectious agents that were investigated in this body of study. In the beginning, we achieved the development of pathogens on selective agar medium that corresponded to the pathogens.

Microbiological substrate plate count agar (PCA) is applied in order to ascertain the total number of aerobic bacteria still capable of life in a given sample [23]. It is not a media that exhibits discrimination. The number of bacteria that was present in liquid samples was measured in colony forming units per milli liter (CFU/mL). In order to get the required concentrations, the samples were diluted. These plates were then gently rotated in order to guarantee that the sample and the molten sterile agar were thoroughly mixed together. The agar was also sterile. The plates were kept in an incubator at either 20 or 30 °C for a total of three days. After incubation, the number of colonies on the plate containing 25-250 colonies was counted. This was done since it was believed that this would provide the most accurate result. To determine the actual number of bacteria, present in the sample, the dilution factor was used for the calculation.

2.3.1.1. Total plate count

The Total Plate Count, often known as TPC, is a technique that may be used to estimate the total number of microorganisms (such as mould, yeast, and bacteria) present in a substance. The dilution phase of the sample continues until it

achieves a 10-5 dilution as the first step in the research process. The total microbial analysis was performed by placing each dilution sample, which was 1 ml in volume, onto a petri dish that contained 15-20 ml of liquid. The sample that was on the petri plate was removed and placed in the freezer. Incubation was the last step, which was accomplished by placing a petri dish in an inverted position inside of the incubator. The temperature of the incubation was maintained at 36 degrees for 24 to 48 hours. After the appropriate amount of dilution, aliquots of 100 milliliters were sterilized and spread evenly over the surface of the plate containing the count agar. Plates were kept in an incubator at 37 °C for a predetermined amount of time (24-48 hours). The colony counter was used for the purpose of determining the total number of healthy colonies [24].

2.4. Physicochemical Analysis

2.4.1. pH

The pH scale, which measures acidity on a scale ranging from 1 to 14, is the most popular and widely used measure of acidity. A pH value of 1 is the most acidic, while a pH value of 14 is the most alkaline, and a neutral pH value is 7. A variation of one pH unit may reflect a difference in concentration that is ten times as great. Consider the fact that pH 4 is ten times more acidic than pH 5. The pH of milk sample set was measured using a digital pH meter (Lino-Lab 720) during the time intervals that were discussed by [25]. The pH 4 and pH 7 buffers were used for the calibration process. Before taking the sample, the glass container that contained the milk was vigorously shaken to mix the contents. A volume of milk of 50 mL was pipetted into a 77100 mL beaker. A pH meter electrode was placed in a sample, and the digital reading that it produced was observed. The experiment was carried out using three separate trials, and the results were averaged together.

2.4.2. Titratable Acidity

The % lactic acid measurement is used to indicate acidity. In light of the fact that 1 milliliter of 0.1 N lactic acid contains 0.009 grams of lactic acid, the number of milliliters of 0.1 N sodium hydroxide that is required to neutralize the lactic acid in the sample, multiplied by 0.009, will give the amount of lactic acid (grams) that is present in the sample. The titration technique was used in order to ascertain the titratable acidity of each and every sample set at the various time intervals that were indicated by [24]. The titration platform was prepared after gentle shaking, and the burette with 0.1 N NaOH was filled to the appropriate level. A few drops of the indicator color phenolphthalein were put in there as well. A dilution of the sample, which was 10 milliliters in volume and 90 milliliters in volume, was prepared in a conical flask, and then it was titrated against 0.1 molar sodium chloride. The experiment was carried out in three separate instances, and each one's results were recorded alongside the average.

$$\% \text{ Lactic acid} = \frac{\text{No. of ml of 0.1 N NaOH solutions required for neutralization x 0.009}}{\text{Weight of sample}} \text{ x } 100$$

2.4.3 Specific gravity

Lactometers are instruments that quickly determine a substance's specific gravity. The technique is based on the law of flotation, which says that when a solid is submerged in a liquid, the solid will float to the surface of the liquid. It is subjected to an upward force that is equivalent to the weight of the liquid that has been displaced by the body and is operating in an upward direction. Samples of milk were heated to 40 degrees Celsius. After 5 minutes, the samples were cooled to 20 degrees Celsius [26]. After the milk samples were put in the cylinder, the lactometer was then inserted into the cylinder while making sure that the lactometer floated softly without coming into contact with the edges of the jar. After you have achieved equilibrium, it is time to take a reading of the milk's temperature and lactometer reading on the scale. The experiment was carried out three times, and the results from each were averaged to arrive at a conclusion.

Calculation

Specific gravity of milk can be calculated by the following formula (for all type of lactometer).

$$\text{Sp. Gr.} = \frac{\text{Corrected lactometer reading}}{1000} + 1$$

LR + CF is the corrected lactometer reading.

Whereas the coefficient of determination (CF) for the Quevennes lactometer is equal to 0.1 times the difference in temperature above 60 degrees Fahrenheit.

2.5. Chemical Analysis

The moisture %age, ash %age, lactose %age, protein %age, and finally the fat %age of camel milk were determined by collecting samples of uniform size and then analyzing them according to the protocols described in [27].

2.5.1. Calculation of Fat Content

For the purpose of determining the total fat content in the milk samples, the "Gerber" method of routine analysis was used [27]at our research facility. In this particular test, H_2SO_4 is used to raise the specific gravity of milk serum, which in turn creates a more pronounced contrast between milk serum and fat globules and dissolve the SNF. The subsequent application of centrifugal force to this combination and the heat created due to the combining of acid and milk, which caused the fat to melt, cause the free fat globules to rise to the surface of the mixture. When the appropriate amount of centrifugal force is applied, this circumstance facilitates the total separation of fat due to low specific gravity.

The procedure included first adding 10 ml of H_2SO_4 with a density of 1.818 g/ml into the butyro meter, and then carefully pipetting 10.75 ml of milk sample into the butyro meter. Combine the milk and the sulfuric acid in a mixing bowl. After that, 1 milliliter of amyl alcohol at a concentration of 0.811 grams per milliliter

was pipetted into the milk. After closing the butyro meter with the rubber stopper, the liquids were not stirred together. The butyro meter was given a very vigorous shake until all of the liquids were completely combined. After that, the butyro meter was positioned inside of the Gerber centrifuge machine (two tubes in two opposite sides). After the appropriate amount of time had elapsed, which was around 5 minutes, the butyro meter was put into a hot water bath at 65°C for another 5 minutes. At long last, a reading was taken from the scale.

2.5.2. Determination of the level of crude Protein

A piece of equipment known as the Kjeldahl method was used in order to estimate of the crude protein content. The approach is broken down into three distinct processes: digestion, distillation, and titration. In the digestion flask, about 10 milliliters of the digestion sample was added, along with approximately 10-15 milliliters of concentrated hydrogen peroxide and the digestion mixture. The digesting combination contains K_2SO_4 and $CuSO_4$ in the proportion of 8:1. After giving the flask a spin to ensure that all of the components were well combined, it was then set on the heater and left there until the liquid changed colour to a bluish-green and eventually became clear. After the digested mixture was cooled, it was transferred into a volumetric flask with a capacity of one hundred milliliters (mL), and then distilled water was added to bring the total volume to one hundred milliliters (mL). In order to begin distillation, 10 milliliters (mL) of the digested mixture and 10 milliliters (mL) volume of a 0.5 normal solution of NaOH were gradually added to the tube that is known as the distillation tube. After ten minutes, NH_3 was produced, and it was collected in a conical flask as NH_4OH along with twenty milliliters of boric acid solution at a concentration of four %, to which only three or four drops of methyl red indicator were added. When the substance took on a yellowish color, it meant that the distillation process had been completed successfully. After that, the resultant distillate was titrated with a solution of 0.1N hydrochloric acid until it became pink. Estimating the quantity of crude protein required computing the nitrogen content as a %age and then multiplying that figure by 6.25 [27]. The formula for calculating the %age of nitrogen is as follows:

$$\text{Nitrogen \%} = \frac{\text{H2SO4 volume utilized in (ml) x dilution volume x 0.0014}}{\text{Sample weight (g) x sample volume before dilution (ml)}} \text{ x 100}$$

Protein content %age = Nitrogen % x 6.25

2.5.3. Evaluation of the amount of lactose content

A flask was used to combine 10 milliliters of milk with 40 milliliters of water. For the purpose of precipitation, 8 or 9 drops of acetic acid with a concentration of 5 % were also added. In order to filter this, filter paper was used. A container was used to collect the filtrate that is burette, and a solution that was up to one hundred milliliters in volume was created. In a conical flask, combine 5 milliliters of Fehling A (69.3 grams of CuSO4; volume of solution up to IL) and 5 milliliters of Fehling B (100 grams of NaOH and 345 grams of sodium tartrate salt; volume of solution up to 1L). Add 20 mL of water and 1-2 drops of methylene blue

indicator to the mixture. Mix well. After that, the filtrate was analyzed using titration [28].

Lactose % = 0.65 × dry fraction x 100 / volume of filtrate used x the amount of the sample.

2.5.4. The Ash content determination

A muffle furnace was used for the purpose of determining the ash [27]. A sample of 5 grams that was dried and weighed after being put into a crucible. After that, the organic matter was taken away by charring the sample in front of a low flame until it turned into smoke. The smoked sample was put into the oven and heated to 550°C for two to four hours. The sample was removed after the muffle furnace had been switched off for a period of four hours, and then it was placed in the desiccator for the purpose of cooling down before being examined. The following calculation was used to arrive at the final %age of ash content: Ash % is the weight of the sample after ashing multiplied by 100 divided by the weight of the sample before ash contents determination.

The amount of ash in a sample may be calculated as follows:

$$\text{Ash}\% = \frac{C - A}{B - A} \text{ x } 100$$

A grams' worth of the weight of an empty crucible

Crucible's weight in addition to the sample's mass results in a value of B g.

When the ashing process is finished, the weight of the crucible plus the ash equals C grams.

2.5.5. Determination of the Level of Moisture

The apparatus known as oven drying was used in order to determine the moisture %age of milk samples. In order to do this, 5 mL of the substance was weighed after being put in a crucible that had been cleaned and dried; W_1 was the recording of the weight before drying. After that, the crucible containing the sample was put into a drying oven at temperatures ranging from 100 to 105 °C for twenty-four hours, or until a mass that remained constant was achieved. After that, the sample was removed from the oven. The sample was put into a desiccator for half an hour so that it could cool down. W_2 as the weight after it had dried out before being weighed. The %age of moisture was determined by using the formula that is shown further down [27].

Moisture content %age= weight before drying – weight after drying x 100/ weight of sample

2.6. Statistical Analysis

For Statistical Purposes Statistix-8.1 software was used in order to collect data from a wide variety of parameters [29]. For the purpose of determining the degree of significance among the different varieties, an approach based on a two-factorial totally randomized design with analysis of variance was used. In order to accurately calculate the standard error and the mean value, each trial was performed three times in succession.

Table 1.

TREATMENT PLAN**Treatment**	**Temperature (°C)**	**Time (Minutes)**
T_0	63 °C	30 min
T_1	63 °C	15 min
T_2	63 °C	7.5 min
T_3	63 °C	3.75 min

3. Results and Discussion

Estimating the effects of ohmic and conventional pasteurization on the physical, chemical, microbiological, and sensory characteristics of camel milk was one of the goals of the present study. The whole of the work was divided into three pieces. In the first part, we spoke about the morphological, physiological, and biochemical characteristics of camel milk, as well as the roles of both ohmic and conventional forms of heating. In the second portion, we covered the research that was done on the various methods of heat treatment that may be used on camel milk. The third phase of the research consisted of formulating pasteurized camel milk based on the treatment plan, and then analyzing the quality characteristics of milk. While this was going on, the stability profiles of pasteurized milk by both methods were compared.

3.1. Microbial Analysis

3.1.1. Total Plate Count

In order to determine the presence of aerobic and mesophilic bacteria in milk samples and to evaluate the level of hygienic quality that each sample has, this method is used. It is caused by any and all pathogens as well as non-pathogens [30]. It gives a quantitative estimate of the concentration of microorganisms such as bacteria, yeast or mould spores in a sample. The count represents the number of colonies forming units (CFU) per g (or per ml) of the sample. The statistical analysis revealed that there was a highly significant difference ($P< 0.01$) in the total plate count depending on the length of time the milk was pasteurized.

According to table 4.1b the results show that both techniques applied have the potential to reduce microbes in pasteurized milk but ohmic heating achieved slightly greater results by varying the time of pasteurization by taking the treatment T_0 as control sample. The mean comparison value for ohmic heating method for TPC was measured to be 2.35 log CFU/mL while for conventional heating method this value obtained as 2.37 log CFU/mL. Heating milk at lower temperature and for longer time affects the physicochemical and nutritional properties of milk. In ohmic heating method microbial reduction is due to heating and electroporation effect of electric current as well [31] explained the effect of electric current on the electric charge of membrane. The electric potential effects the charge distribution across the membrane, which causes electroporation of membrane.

Table 2.
Combined Means of Analysis

Method of Pasteurization	**Ohmic heating**	**Conventional heating**
1. Means of Microbial Analysis		
Total Plate Count	2.35±0.11[b]	2.37±0.18[a]
2. Means of Physicochemical Analysis		
pH	6.54 ± 0.31[b]	6.6 ± 0.26[a]
Titratable Acidity	0.18 ± 0.10[a]	0.17 ± 0.12[b]
Specific Gravity	1.026 ± 0.11[b]	1.027 ± 0.14[a]
3. Means of Proximate Analysis		
Moisture	88.19 ± 0.56[a]	87.66 ± 0.49[b]
Crude Fat	3.09 ± 0.57[a]	2.99 ± 0.6[b]
Crude Protein	2.43 ± 0.58[a]	2.33 ± 0.67[b]
Lactose Contents	3.25 ± 0.34[a]	3.16 ± 0.45[b]
Ash Contents	0.85 ± 0.32[a]	0.84 ± 0.27 [a]

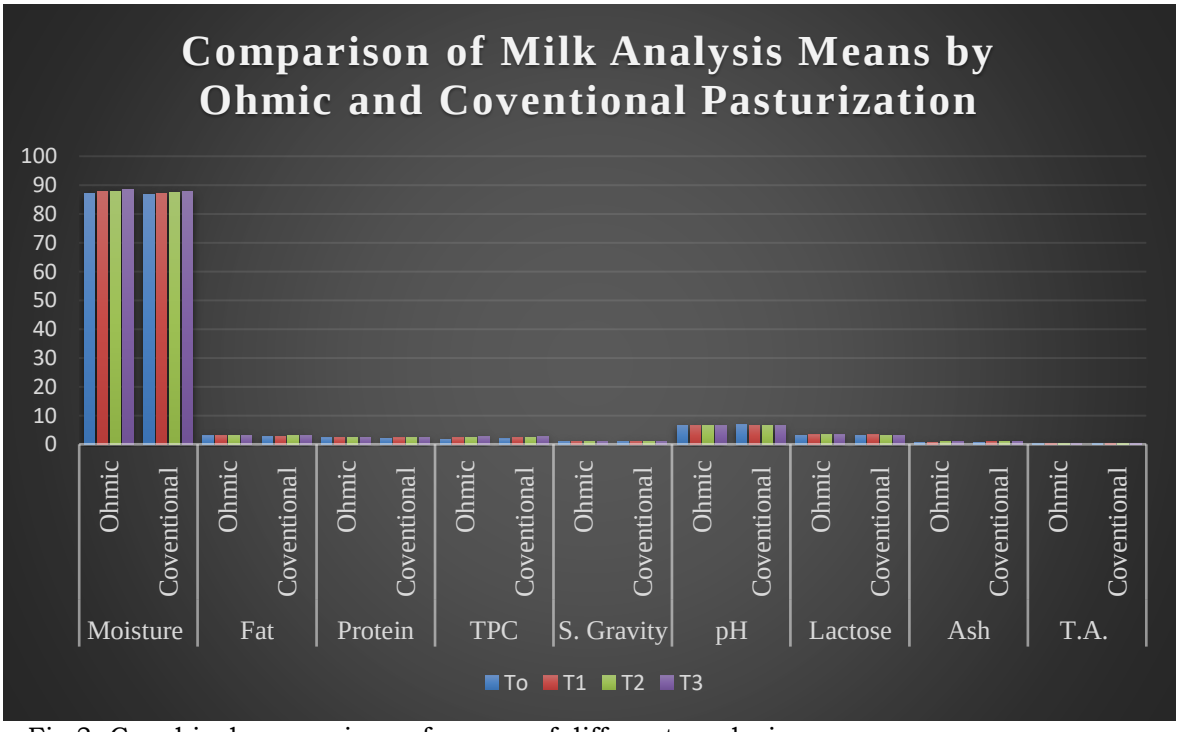

Fig.3. Graphical comparison of means of different analysis

3.2. Physicochemical Analysis

3.2.1. pH

Milk is a perishable food product and the pH of perishable products decreases as the storage time increases and decrease in pH is due to the production of acidity [32]. The findings of the analyses made it abundantly evident that the pH of the camel milk sample, regardless of the treatment used was within the range of 6.46-6.72 on all of the various scales. Sample of camel milk did not vary substantially from one another with regard to differences in time of pasteurization of milk; nevertheless, there was a significant difference between the two methods of pasteurization according to (Fig.3). The pH of conventional heat-treated milk indicates that the conventional treatment had significant impact on hydrogen ion concentration of the milk by taking T_0 as the control sample at 63 Celsius temperature and different staying times. The mean comparison value for ohmic heating method for pH was found to be 6.54 while for conventional heating method this value obtained as 6.60. In results of Ohmic treated milk pH has significant relation between the means of treatments which indicate ohmic heat treatment have no impact on milk pH. The given results are similar to the results of [33] according to these results it is indicated that milk pH was not changed by Ohmic Heating treatment. Two different stay time applications do not affect the milk pH. Research results indicate that there is no significant change in milk pH after and before the application of Ohmic Heating treatment.

3.2.2. Titratable Acidity Measurement

The statistical analysis show that the dependent variable titratable acidity was significantly affected by variations in the time of pasteurization of milk samples while keeping the temperatures constant at which the methods were performed. While this was going on, the interaction impact of the two treatment variables was also found to be significant. In contrast, a significant rise in titratable acidity was found across a variety of treatment combinations from T_0 through T_3 as shown in (Fig.3.). According to the findings of this investigation, the total acidity values of the milk samples were affected significantly by the application of both heating techniques. The mean comparison value for ohmic heating method for acidity was found to be 0.18 g/L while for conventional heating method this value obtained as 0.17 g/L. The results of the current investigation are consistent with those found by [34]. They aimed to investigate the impact that a high temperature had on the biochemical and physiological characteristics of a variety of milk samples that had been kept for five days. Because the process of sterilizing milk led to an increase in total acidity, the results also show that the sterilization of milk at a temperature of 115°C for 15 minutes increased the value of acidity after 5 days of storage. This is because the process of sterilizing milk led to an increase in total acidity. Total acidity and pH are closely related to each other. pH and titratable acidity are inversely proportional to each other so if one value increases the other value decreases as discussed by [35].

3.2.3. Specific gravity

It was shown that there is a significant change in the specific gravity of milk that has been pasteurized. After comparing the specific gravity of milk after being subjected to a variety of treatments, the researchers came to the conclusion that there was significant rise in its specific gravity. The mean comparison value for ohmic heating method for specific gravity was found to be 1.026 while for conventional heating method this value obtained as 1.027. Its value depends upon the protein and fat contents in milk. As moisture remove from milk and TSS of milk increases, specific gravity of milk also increases. The results of this study are confirmed by the study of [36] who studied the physicochemical meters of milk obtained from different sources.

3.3. Chemical Inspection and Analysis

The proximate analysis of any given food item is a crucial indication of both its overall quality and the amount of nutrients it contains. In this study, the composition of camel milk was examined in terms of ash, moisture, crude protein and crude fat. This was discovered via scientific research.

3.3.1. Moisture

The ratio of a food's liquid to its solid components is the best way to describe the food's moisture content. It is an essential component in the manufacturing process as well as the maintenance of food. The level of moisture in food may have an effect on its overall quality. The shelf life of a food item is directly proportional to its total amount of moisture. The more stable the food is, the lower the

moisture content should be. Foods that have a high moisture content of between 60 and 90 % are considered to be perishable. The results of the study (Table 2.) indicated a significant difference between the treatment variables. A decrease in moisture content was noticed as we increased the time of pasteurization between the treatment variables from T_3 to T_0. Moreover, a significant difference (Fig. 3.) was noticed between the two techniques of pasteurization that were applied and T_0 was taken as the control. The mean comparison value for ohmic heating method for moisture content was found to be 88.19% while for conventional heating method this value obtained as 87.66%. The moisture content was found more with ohmic heating treatment. The results of this investigation came to similar conclusions as those found by [37].

3.3.2. Crude Fat

The sum total of the fat and oil included in a food is referred to as the crude fat content. In addition to being a macronutrient, fat is also an essential source of energy. In the adipose tissues of the body, it is kept as a triglyceride form of storage. The flavor of the meal is enhanced by the addition of fat since one gramme of fat has 9 kcal of energy. Consuming more than one's body needs may contribute to cardiovascular disease as well as obesity. The treatments of pasteurization do not have a substantial impact on the fatty acid composition of camel milk samples. The results indicated that ohmic heating has a non-significant impact on the fat value of milk. That is why more fat was detected in milk that was ohmically heat treated.

Research shows that fat globules breakage may occur when temperature and time of pasteurization is increased. Following results are relatively similar to the studies of [38] who described the fat content of raw and heat-treated milk. On an issue somewhat dissimilar to this, research was carried out [39]. They came to this conclusion after noting that the Ultra High Temperature (UHT) processing of milk might diminish the nutritional quality and function of milk lipids, although pasteurization does not impact milk lipids.

3.3.3. Crude protein

Amino acids are the building blocks of proteins. It is essential for the maintenance of structural integrity, the repair of damaged tissue, and the healing of wounds. In addition, it controls the body's operations and is a source of energy. Approximately 4 kilocalories of energy may be derived from 1 gram of protein. Ammonia, urea, and uric acid are the waste products that are produced when protein is broken down, and the body is unable to store them. Protein is the nutrient of choice for bodybuilders since it aids in muscle growth. Patients who are dealing with renal illness should avoid diets that are heavy in protein. Protein is the primary nutrient in milk, and its composition is unaffected by the process of pasteurization. According to the (Table 2.), the results of the study showed a significant variation between the two heating techniques that were applied and T_0 was taken as the control. The mean comparison value for ohmic heating method for protein content was found to be 2.43% while for conventional heating method this value obtained as 2.33%. The higher protein content was measured in the samples that were treated with ohmic heating. The ohmic heating preserved the

protein content to a larger extent in all the four treatments applied. The results of the study of [40] which led to these conclusions, were quite similar. He studied the effect of heating on the protein contents of milk in conventional and ohmic respectively. Milk protein at high temperature starts denaturing, especially beta lactoglobulin that comprises the 50% of milk whey protein. This denatured protein binds with casein micelles through Sulphur Bridge.

3.3.4. Lactose content

Lactose is the primary form of sugar (carbohydrate) that is found in milk and goods made from milk. Lactose is made up of the simple sugar glucose and galactose, both of which are used by the human body as a source of energy. A digestive enzyme known as lactase is responsible for the breakdown of lactose into the sugar's glucose and galactose. Lactose, often known as carbs, is unaffected by the process of pasteurization. Lactose is the most vital vitamin found in milk. According to the (Table 2.) the results of the study showed that there was a significant difference between the two heating techniques that were applied for pasteurization of milk samples. The mean comparison value for ohmic heating method for lactose content was found to be 3.25% while for conventional heating method this value obtained as 3.16%. The study also indicates that there was non-significant change in the lactose content between the means of all treatment variables applied by changing the time of milk pasteurization (Fig.3.). The results were comparable to those obtained by [41]. They reported that the lactose content in milk samples pasteurized at different temperatures was marginally higher than that of the control. However, a decline in lactose content was found in sterilized milk, which is supported and observed that more lactulose (lactose byproduct) is produced in heat-treated milk, resulting in lowering the lactose content in milk samples when heat treated at higher temperatures.

3.3.5. Ash

Ash is the component of food that comes from inorganic sources. The ash content may be used to determine the total quantity of minerals that are present in the substance. These minerals include sodium, potassium, calcium, magnesium, phosphorus, zinc, Sulphur, iron, aluminum, iodine, and manganese. The mineral content of food samples is proportional to the amount of ash present. They are essential in order to guarantee the normal operation of a variety of physiological processes. Ash contents are not affected by any operation on milk as these are inorganic contents which remain constant [42]. According to the (Table 2.) the results of the study reveal that there was a non-significant difference between the means of both ohmic heating as well conventional heating techniques. The mean comparison value for ohmic heating method for ash content was found to be 0.85% while for conventional heating method this value obtained as 0.84%. Moreover, a non-significant difference was also found in between the means of treatment variables that were applied by changing the time of pasteurization as shown in the (Fig.3.). The results of the study show that more ash content was found in samples that were treated with the ohmic heating method. There was a slight decrease in the ash contents of milk samples from T_3 to T_0. These results were in accordance with the findings of [43].

4. Conclusion

Milk requires hygienic handling and special treatments to preserves its nutritional value and to prolong its shelf life after milking. Conventional pasteurization methods using thermal treatments are reported to destroy some essential milk nutrients along with milk spoiling microbe. The present study was a comparative study of milk pasteurization methods, ohmic heating and conventional pasteurization method by applying thermal heat. The efficiency of these methods was analyzed on the basis of physicochemical (pH, specific gravity, titrate-able acidity, lactose, protein and fat contents) and microbial (Total plate count tests) parameters of milk. It is concluded that ohmic heating technique is a reliable, cheaper, and easier way of pasteurizing milk and also it has reduced the microbes to a greater extent. It is an energy efficient and time saving pasteurization technique which may have potential application in near future in dairy industries.

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