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EFFECT OF SOME HEAT TREATMENTS ON THE CHEMICAL COMPOSITION OF RAW MILK

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Abstract

The aim of this research is to study the effect of heat treatments for raw milk and study the chemical, physical and microbial content. This study was conducted for the period from 7/11/2021 to 30/1/ 2022 in the laboratories of the College of Agriculture/ Department of Food Sciences/ Tikrit University.

The treatments included traditional pasteurization, solar pasteurization, electric pasteurization and microwave pasteurization, in order to find out which treatments have the least effect on the physicochemical properties of milk and the most effect on the microbial content in raw milk. Among the most important findings of this study are:-

Moisture decreased significantly after milk pasteurization with traditional pasteurization, solar pasteurization, electric pasteurization and microwave pasteurization, as it recorded 86.31, 86.55, 87.17 and 86.20%, respectively, compared to raw milk, which was at 87.32%. As well as the percentage of fat, as it was the lowest when solar pasteurization.

As for ash, conventional solar pasteurization had the lowest percentage, which was 3.32 and 3.34%, respectively

Keywords :the milk, pasteurization, electric pasteurization, chemical composition

Introduction

Milk is a complete diet, and is the only source of nutrition for small mammals before they are able to digest other types of food, as milk is a balanced food because it contains essential amino acids as well as fats, carbohydrates, minerals, vitamins, enzymes, immunoglobulin and many other factors associated with growth (Kumar et al., 2017).

The use of heat treatments for milk to eliminate pathogenic microorganisms that cause damage in addition to limiting the activity of natural or microbial enzymes in milk. Heat treatments are under different temperatures and times, for example, simple treatments such as slow and fast pasteurization that increase the period of preservation of milk by refrigeration for short periods And ultra-heat treatments that work to preserve milk for long periods without the need for refrigeration(Abdul-Ghani ,2013).

Heat treatment aims to produce safe and healthy milk for consumers, as it causes chemical, physical and sensory changes in its composition that reduce the nutritional value. These changes depend on the intensity of the heat treatment used. The heat treatment also leads to the occurrence of chemical reactions such as the Maillard reaction and the formation of undesirable results that affect the health of the consumer (Oral et al., 2014; Arena et al., 2017).

Various changes occur in milk during heat treatment, and these changes continue even after the milk has been stored. These chemical changes include denaturation of proteins, especially heat-sensitive whey proteins, and changes in the balance of salts and interactions between proteins. These treatments also lead to physical changes such as sedimentation, delayed gel formation, and changes in flavor and color. Milk, and these changes may affect consumers' acceptance of the milk produced (Fox et al., 2015).

Materials and Methods

Milk Source

Fresh and full-fat cow milk samples were taken for the morning meal from one of the private farms in Al-Dour District / Salah Al-Din Governorate. Milk was withdrawn daily every morning after cleaning the udder from dust and dirt, then washed, dried and sterilized, and the milk was collected in clean bottles. The samples were transferred to the laboratory and placed in the refrigerator at a temperature (5)°C under cooling conditions. To avoid increasing the microbial load. To ensure the safety of milk and its freedom from mastitis disease, the White Side Test was used, as in Al-

Rawi , (2003) . It was by mixing 5 drops of milk with one drop of a solution of 1 standard sodium hydroxide NaOH and using a suitable glass rod and on a watch bottle. It was a precipitate or a gel or both as evidence of an injury to the udder.

Make Transactions

1- Traditional pasteurization:The process of pasteurization of raw milk was carried out in a water bath at a temperature of 72 ° C for 15 seconds, and it was filled into sterile glass bottles and kept by refrigeration at (5) ° C for the necessary tests (Steffen et al., 2020).

2- solar pasteurization:The raw milk was pasteurized according to the method of Steffen et al. (2020) at a temperature of 72 °C for a second, and the product was cooled in a cooling unit to (23.5) °C, and the samples were filled in sterilized glass bottles by freezing at (5) °C and the necessary tests were conducted on it.

3- Electric Pasteurization:The process of pasteurization of raw milk was carried out according to the method described by Yang et al. (2020); Hyesoo et al. (2021), where an electric field (20-30 kV/cm) was used in the liquid food processing chamber with a continuous flow system with a flow rate of (100) liters. / hour, as the temperature of the resulting fluids after treatment did not exceed (49) m, the distance between the poles of the high voltage and the discharge was (0.006) m, the number of user pulses p (30000) pulses / sec, the pulse width 30 (PW)S microseconds, and the frequency F (35) KHz, and the resulting samples were packed in sterile glass bottles and kept by cryopreservation at (5) C for the necessary tests.

4-Microwave Pasteurization:The microwave pasteurization process was carried out according to what Al-Halfi et al. (2010) mentioned, where a microwave device was used.

Chemical tests of milk

Moisture was estimated according to Ling's method (2008) with a weight of 3 g of milk and dried using an electric oven at a temperature of 105 ° C until the weight was fixed, and the moisture percentage was calculated as in the following equation:Moisture % = ((drying after drying by sample weight - drying before drying by sample weight)) / ((sample weight)) x 100

While fat was estimated according to Kerber's method mentioned by Min and Ellefson (2010), with a weight of 3 g of milk samples, 10 ml of distilled water were mixed with it in a Kerber tube, 10 ml of concentrated sulfuric acid and 1 ml of amyl alcohol. The tube was shaken well and placed in a centrifuge. Centrifuge on Kerber tubes for 3-5 minutes and then read the fat column as a percentage of milk fat. The protein was

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estimated as reported in Hool et al. (2004), weighing 0.4 g of milk, 5 ml of concentrated sulfuric acid and 1 g of digestion powder (25 g of potassium sulfate, 2 g of blue copper sulfate, and 1 g of selenium oxide) were added to the digestion and the digestion was completed and The digestion process was completed using the Buchi 430 apparatus, the distillation was carried out using the Buchi apparatus, and the percentage of total nitrogen was calculated from the following equation:Total nitrogen % = (0.1 x 0.014 x (V2-V1)) / (sample weight) x 100.The percentage of ash in milk is estimated according to the direct burning method described in A.O. It was introduced into the incineration furnace for five hours at a temperature of 500 - 550 ° C until white ash was obtained and to facilitate the evaporation of water from the sample, a few drops of concentrated acetic acid were added, which leads to the precipitation of proteins and prevents the formation of a layer on the surface that hinders The process of rapid evaporation, then the sample is transferred to the dryer, and the ash percentage was calculated from the following equation:Ash % = ((drying after the scoop with the sample is the weight - drying before the scoop with the sample is the weight)) / ((the sample is the weight)) x 100

Results and Discussion

1-Moisture

It is noted from Figure (1) that the results for the percentage of moisture decreased significantly at the level (0.05) after pasteurization of milk with conventional pasteurization, solar pasteurization, electric pasteurization and microwave pasteurization, as it recorded 86.31, 86.55, 87.17, 86.20%, respectively, compared to raw milk that was at 87.32%.

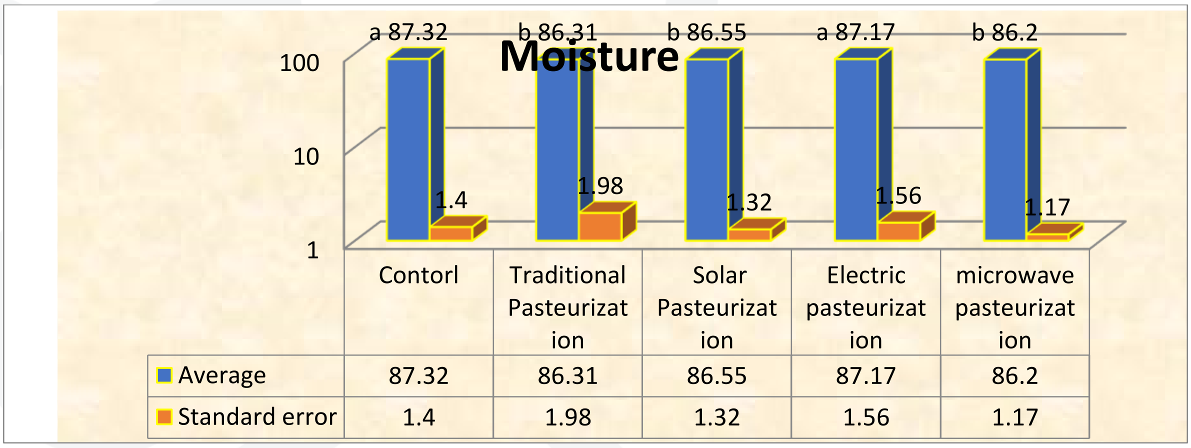

Figure (1) shows the effect of different heat treatments on the moisture content of milk samples.

The results for raw milk were in agreement with the findings of Al-Jubouri (2018), who found that the percentage of moisture was (87.35%), while the results were close

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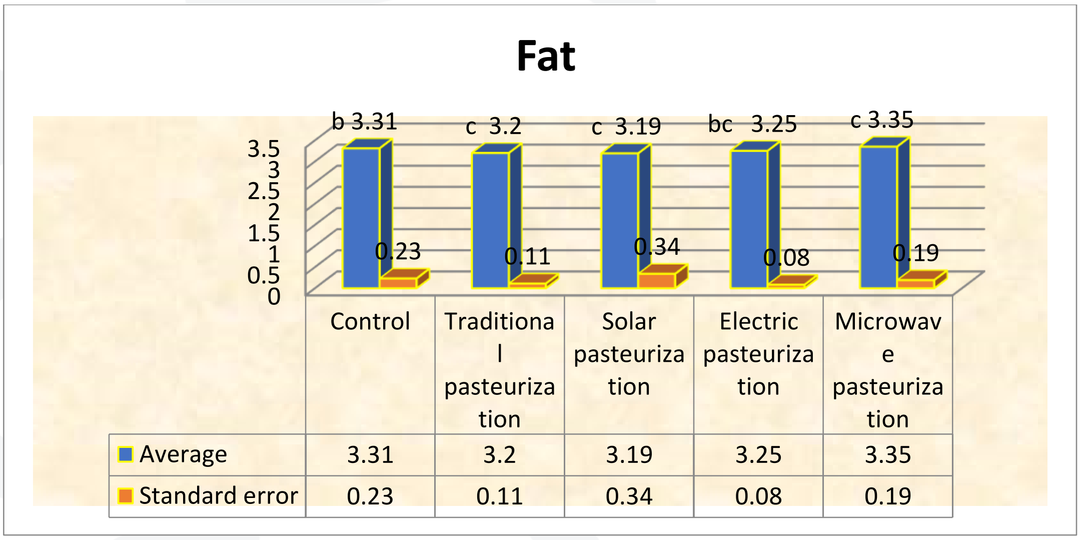
to what was indicated by Al-Jaishi (2018), who found that the percentage of moisture was (87.64%) in raw milk. The results are in agreement with Aldubhany et al. (2014) who stated that the moisture percentages in heat-treated milk decrease by a few percentages during storage and that the decrease in moisture percentages is due to the high percentage of total solids. The decrease in moisture percentages in heat-treated milk models may be due to interactions and correlations Between proteins and Maillard interactions, these interactions continue during storage and lead to the production of large-sized molecules that retain a percentage of moisture (Al-Jubouri, 2022). These results also agree with what Al-Halfi et al. (2010) mentioned, who indicated a decrease in the moisture content of raw milk from 83.53 to 82.76 in solar pasteurized milk, as a result of the difference between the milk temperature and the pasteurization device, which leads to the evaporation of part of the milk water as a result of exposure Milk to pasteurization temperatures when passing through the absorbent plate. The results of electrically pasteurized milk matched with Al-Hilphy et al., (2020), who indicated that the moisture content was (87.1%) during treatment (20) volts / cm. Microwaved cow's milk from 86.83 to 85.22.

2-fat:

Figure (2) shows that there is a difference in the results of the percentage of fat, as it was recorded that there were significant differences between the control sample and traditional pasteurization, while it had a significant decrease at the level (0.05) after solar pasteurization and electrical pasteurization to record 3.19 and 3.25%, respectively, and it obtained Significant increase after microwave pasteurization, as it reached 3.35%.



Figure(2) Describes the effect of heat treatments on the percentage of fat in milk samples

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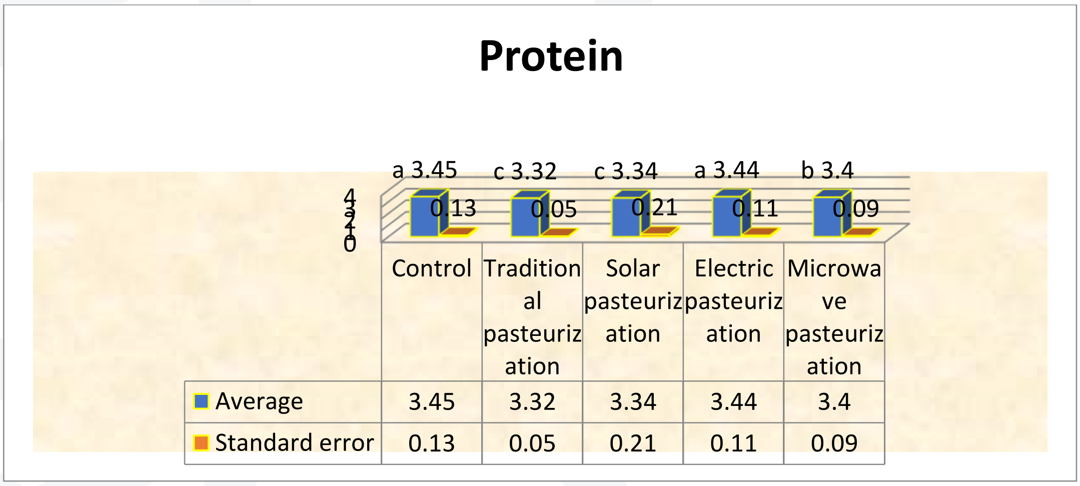
Xu et al. (2020) mentioned that the low percentage of fat in pasteurized milk samples at different temperatures is directly proportional to the temperatures used as a result of the growth and activity of microorganisms, especially cold-loving bacteria and their enzymes, as these bacteria can grow and activity at temperatures close to zero. These results are also in agreement with what Al-Rubaie (2010) mentioned, which indicated a decrease in the percentage of fat from 7.2% to 6.6% in pasteurized milk with a solar method. It led to a decrease in the percentage of fat in the pasteurized milk due to the accumulation of some fat granules and their agglomeration inside the tubular coil in the exchanger of the cooling unit when the milk passed through it and cooled to less than 15 °C, and then part of these granules remained inside the tubes. . The results of electro-pasteurized milk converged with McAuley et al. (2016) who found by treatment (35) kV/cm that the percentage of fat was (3.81%). The reason for the low percentage of fat after electro-treatment is attributed to water interference with large fat granules during the formation of smaller fat granules in milk due to the effect of anti-charge ionic clouds of the electric field and entropy (Pliquett et al., 2007). The results also agreed with what was indicated by Al-Halfi and others (2010), who found a high percentage of fat when using microwaves to 3.8% compared to traditional pasteurization, which was at 3.6%. The stirring process is done well, unlike the microwave, which distributes heat evenly between the parts of the milk.

3-Protein:

Figure (3) shows that there is a discrepancy in the percentage of protein as it recorded significant differences at the level (0.05) between the control sample and microwave pasteurization, as it recorded 3.45 and 3.40%, respectively, and decreased significantly after conventional pasteurization to record 3.32%, and solar and electric pasteurization were recorded.



	Control	Traditional pasteurization	Solar pasteurization	Electric pasteurization	Microwave pasteurization
Average	3.45	3.32	3.34	3.44	3.4
Standard error	0.13	0.05	0.21	0.11	0.09

Figure (3) shows the effect of different heat treatments on the percentage of protein in milk samples.

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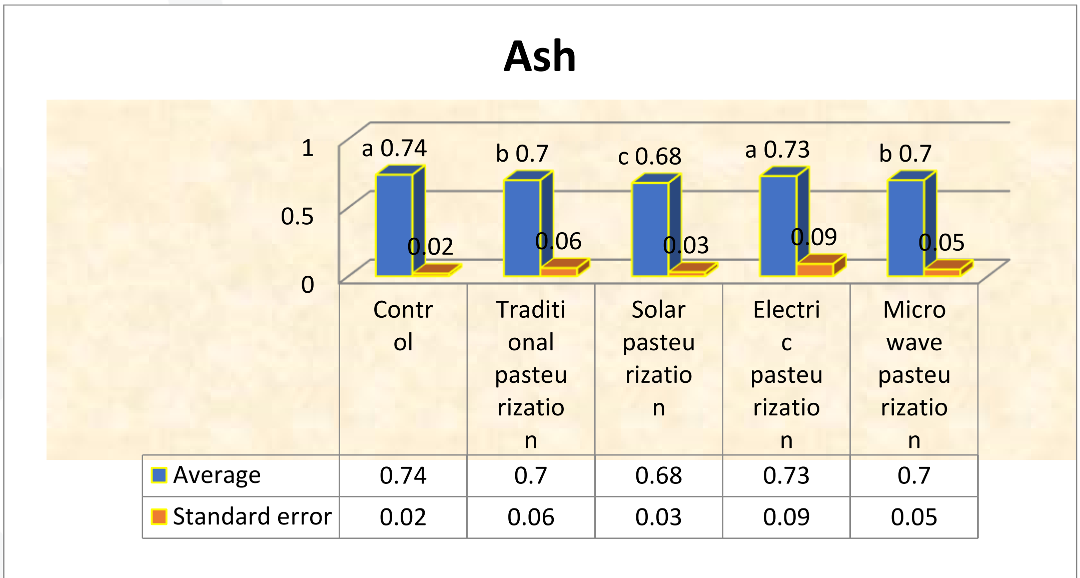
The results of raw milk agreed with what was found by Al-Jubouri (2018), who found that the percentage of protein amounted to (3.40%), while the results converged with what was found by Al-Jishi (2018), who found that the percentage of protein amounted to (3.34%). The results for thermally pasteurized milk matched with AL-Hilphy and Ali, (2014), who found that the percentage of protein was 3.34 %) for solarly pasteurized milk, and they also showed that the effect of solar pasteurization on protein deformation is less harmful compared to the Conventional Pasteurization This is due to the efficient and homogeneous distribution of energy absorbed within the tubes of the solar collector. The results for electrically pasteurized milk converged with Shamsi, (2008), who indicated that the percentage of protein was (3.32%) with treatment (40) kV / cm, but Yang et al. (2020) found a higher percentage of protein with treatment (16) kV / cm. cm with a value of (3.39%). The results also agreed with what was reached by Al-Halfi et al. (2010), who found that a decrease in the percentage of protein occurs when using a microwave device.

4- Ash

It is noted from Figure (4) for the percentage of ash that there are significant differences at the level (0.05), as the results did not record significant differences between the control sample and electric pasteurization, as they were at 0.74 and 0.73%, respectively, and also no significant differences were recorded between traditional pasteurization and pasteurization In the microwave, both were 0.70, and the lowest value was recorded at 0.68 for solar pasteurization.



	Control	Traditional pasteurization	Solar pasteurization	Electric pasteurization	Micro wave pasteurization
Average	0.74	0.7	0.68	0.73	0.7
Standard error	0.02	0.06	0.03	0.09	0.05

Figure (4) shows the effect of different heat treatments on the percentage of ash in milk samples.

The results for raw milk agreed with what was found by Al-Jaishi (2018), which found that the percentage of ash was (0.73%). The results also converged with what was found by Asefa and Teshome (2019), who found that the percentage of ash in raw milk was (0.71%). . The results for thermally pasteurized milk are in agreement with what was mentioned by Bhattarai and Singha, (2010), who indicated that the percentage of ash was (0.64%) after the heat treatment. Al-Hilphy et al. (2012) showed that the ash percentage decreased to (0.69%) after pasteurization and the reason for this is that the treated heat leads to burning jackets and evaporation of CO2 and carbonates and their volatilization. While Al-Hilphy et al., (2020) found that the percentage of ash was affected in a limited way after The electrical treatment on (20) volts / cm to be the rate of (0.68%), and this is similar to what was mentioned by Kayalavzhi and others (2021) in that the percentage of ash was affected little after treatment with the electric field at 50 kV / cm

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