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EFFECT OF SOME HEAT TREATMENTS ON THE PHYSICAL 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 physical properties of raw milk. Among the most important findings of this study are:-As for the physical properties, the results showed a decrease in the density only in the electric pasteurization and it was not affected in the rest of the treatments. And the effect of electric pasteurization on increasing the electrical conductivity compared to the other treatments, where it was 4.53.

Keywords: The milk, pasteurization, electric pasteurization, physical composition

INTRODUCTION:

Milk is known as: the liquid that is produced from the mammary glands of ruminants, and it is considered a complex food that is used and consumed all over the world, as well as the basis for the production of all dairy products with its economic importance such as cheese, butter, yoghurt, ice cream and others. Milk has been used since the earliest times as a food for mankind through the consumption of milk of cows, buffaloes, camels, sheep and goats, today the term "milk" is synonymous with cow's milk (Abd-El Aal et al., 2012).

Milk is an important food for humans because of its high nutritional value as well as the importance of benefiting from it. In addition, milk is unstable as it constitutes an ideal growth environment for the activity and growth of microorganisms, including pathogenic and perishable organisms, and to make milk low in health risks to consumers and also to ensure microbiological safety. Milk has many heat treatments and is the most common (Ritota et al., 2017).

The main objective of heat treatment is to produce safe and healthy milk for consumers, but at the same time it caused physical, chemical and sensory changes in its composition that lead to a decrease in 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 create undesirable outcomes that affect consumer health (Oral et al., 2014; Arena et al., 2017).

This research aims at the effect of different heat treatments on the physical properties of raw milk.

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.

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

Milk physical tests :

The acidity of milk samples was estimated by weighing 9 g of milk in a 100 ml beaker, adding 0.5 ml of anti-phenolphthalein to it and then rinsing it with 0.1 NaOH standard solution until it appeared pink and settled for 30 seconds. The acidity was calculated according to the following equation (Tyl & Sadler, 2017):
Total Acidity (TA) % = (0.1 x 0.09 x volume of NaOH) / (sample weight) x 100
The PH is calculated according to the method of Hool et al. (2004), by weight 10 times that of milk, and then the pH is estimated using a PH-meter. Then, the pH value of the sample was estimated using a pH meter. The specific density of milk samples was estimated using a lactometer (Sharma, 2006). The electrical conductivity of the samples was calculated by the method followed by Ganapathy et al., (2019) using the EC meter device from (HANNA) company, and the readings were taken directly in milli-siemens / cm while placing the electrodes in the samples.

RESULTS AND DISCUSSION

1-Acidity :

Figure (1) shows that the acidity ratios in the different treatments did not record any significant differences at the level (0.05) after traditional, solar, electric and microwave pasteurization and the values were 0.14, 0.14, 0.15, 0.14, respectively, while the control sample was significantly higher than the rest of the samples, where it recorded 0.17 .

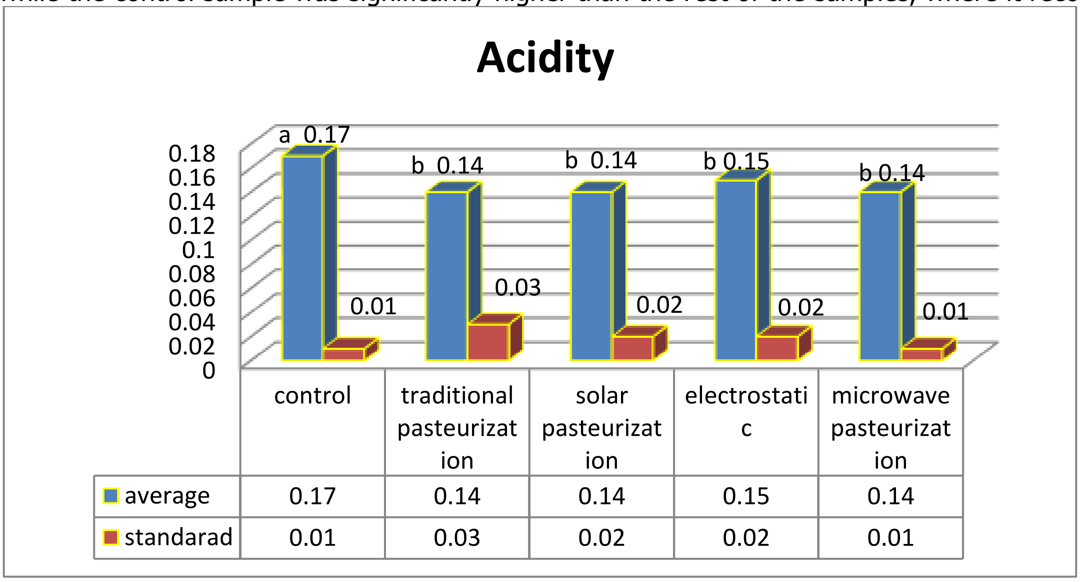
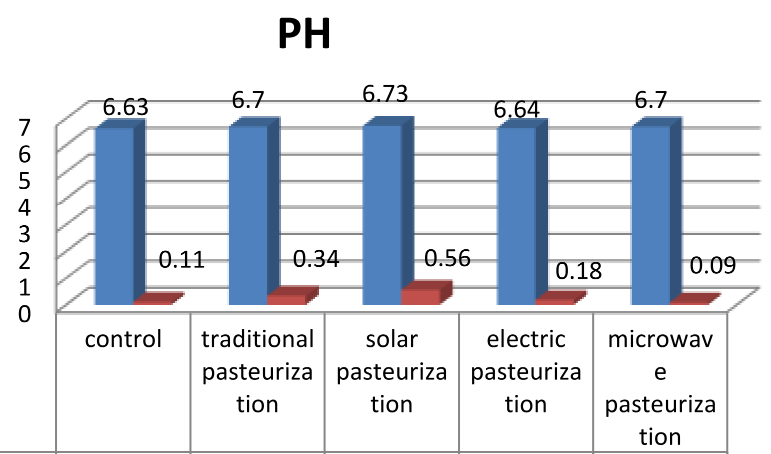


Figure (1) shows the effect of different heat treatments on acidity in milk samples .

The natural acidity percentage of fresh milk ranges between 0.14 - 0.18%, and its main source is milk proteins and some acidic salts that are naturally present in milk and not due to lactic acid, which does not exceed 0.002% (Al-Shabibi et al., 1980). The results of raw milk agreed with The findings of Al-Jaishi (2018), which found that the percentage of acidity was (0.16%). The reason for the low acidity is due to the expulsion of dissolved gases and their loss in milk, especially CO2, which is one of the factors that cause acidity, also converts a percentage of calcium phosphate from the soluble state to the colloidal state, and this was indicated by Muhammad Ali and others (1984).

2-PH:

Figure (2) shows the pH values differed significantly at the level (0.05), as there are no significant differences between traditional pasteurization, solar pasteurization and microwave pasteurization, where the results recorded 6.7, 6.73 and 6.7, respectively, and the control sample did not differ with electric pasteurization and were 6.63 and 6. 64 in a row.



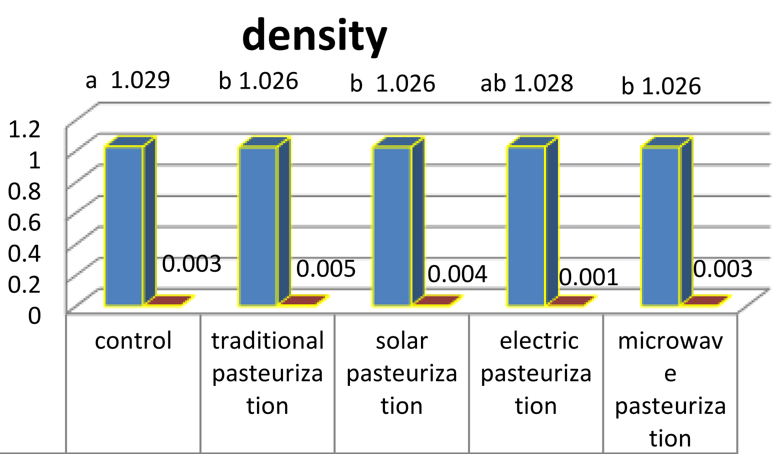
	control	traditional pasteurization	solar pasteurization	electric pasteurization	microwave pasteurization
average	6.63	6.7	6.73	6.64	6.7
standard error	0.11	0.34	0.56	0.18	0.09

Figure (2) shows the effect of different heat treatments on the pH of milk samples

The acidic function PH is defined as the negative logarithm of the hydrogen ion concentration in the medium, and that hydrogen ions are produced by the ionization of acidic substances. In acidic milk, the results of raw milk were in agreement with the findings of Al-Jubouri (raw milk with the findings of Al-Jubouri (2018), which found that the pH of the milk reached (6.63). The results of the pH of the raw milk were in agreement with Hamad and Baiomy, (2010); Chandan et al. (2016) who indicated that it was (6.60 -6.65). Also, the results of the pH of milk treated by thermal pasteurization agreed with Prodhan et al., (2016); Elhasan et al., (2017) that was (6.74-6.77). The heat of pasteurization leads to the deformation of micelles of whey proteins, which affects their properties in a way that reduces their bonding with the surface of casein micelles, thus raising the pH value after pasteurization (Pestana et al., 2015); Boland and Singh, 2020). The results of the pH of electrically treated milk also agreed with what was found by Aguirre et al. (2011), who found that (20) kV / cm treatment was (6.65), and it also reached (6.62) in (30) kV / cm treatment, and the results matched With McAuley et al., (2016) who found that the pH value by treatment was (35) kV/cm (6.67). The results also agreed with what was found by Al-Halfi et al. (2010) who indicated that the pH of microwave pasteurized milk was higher compared to raw milk, as it increased from 6.60 to 6.70 and reinforced the reason for this to remove CO_2 during heating, which leads to reducing acidity.

3-Density:

Figure (3) shows the effect of treatments on milk density. The results showed that there were significant differences between samples at the level (0.05), where the results recorded a significant decrease between the control samples and the electric pasteurization of 1.029 and 1.028, respectively, as the results of traditional, solar and microwave pasteurization were not recorded in the presence of Significant differences, all of which were 1.026.



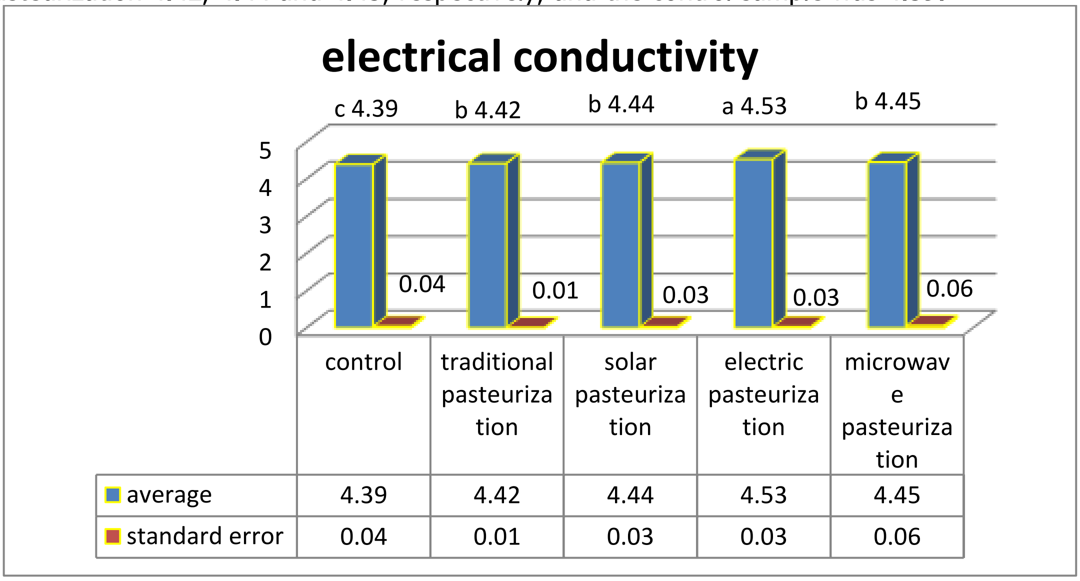
	control	traditional pasteurization	solar pasteurization	electric pasteurization	microwave pasteurization
average	1.029	1.026	1.026	1.028	1.026
standard error	0.003	0.005	0.004	0.001	0.003

Figure (3) shows the effect of heat treatments on density values in milk samples

The results for raw milk agreed with what was indicated by Al-Jubouri (2018), who found that the density of milk was (1.030) g / cm3. The results also agreed with what was found by El-Hamdani et al. (2016) that it was in a range of (1.028 - 1.034) g/cm3. The results for the density of milk treated by thermal pasteurization are in agreement with AbdElrahman et al., (2013) who found that it reached (1.026) g/ml, and consistent with Elhasan et al., (2017) who indicated that it was (1.026) g/ml. The results of the density of electrically treated milk also converged with what was found by Aguirre and others, (2011). The inverse proportion between density and temperature in milk is mainly due to the presence of fat and proteins in milk. Where the lack of fat in milk leads to a rise in the density and a decrease in the viscosity when the temperature rises, as it had a direct effect on the measurement of the quantity of density, and that the evaporation that occurs during heating leads to a decrease in moisture and thus leads to a decrease in the density of milk from the standard limit (Al-Shabibi et al., 1980) .

4- Electrical conductivity :

It is noted from Figure (4) that there are significant differences at the level (0.05). The results recorded a significant increase in electric pasteurization of 4.53, while there was a difference in the results of traditional, solar and microwave pasteurization 4.42, 4.44 and 4.45, respectively, and the control sample was 4.39.



	control	traditional pasteurization	solar pasteurization	electric pasteurization	microwave pasteurization
average	4.39	4.42	4.44	4.53	4.45
standard error	0.04	0.01	0.03	0.03	0.06

Figure (4) shows the effect of different heat treatments on the electrical conductivity of milk.

The results for raw milk matched with El-Hamdani et al. (2016) who found that the electrical conductivity was (4.40) mS/cm. The results of heat-massed milk also agreed with Prodhan et al. (2016) who found that it was (4.45) mS/cm. cm . The results for electrically treated milk are in agreement with Aguirre et al., (2011) who found that the electrical conductivity in treatment (20) kV / cm was (4.49) mS/cm, and in the treatment (30) kV / cm. (4.59 mSiemens / cm. Al-Hiphy and Ali, (2014); Goncalves et al., (2017) researchers confirmed that heat treatment with pasteurization leads to a decrease in the viscosity and density of milk, thus increasing the movement of ions in line with the increase in temperature, thus increasing the electrical conductivity of milk The researchers explained Pliquett et al., (2007) andHoward et al., (2011) explaining the reason for the increase in electrical conductivity of electrically treated liquid foods with values that exceed thermal pasteurization due to the higher the voltage and frequency, the higher the ionic movement, which leads to an increase in the electrical conductivity of liquids according to what is known as (Wien effect). As well as the occurrence of a short circuit at high frequencies due to the effect of PEF with a small resistance in the cell membranes that leads to an increase in the conductivity of liquids under the influence of the electrical capacitance (Capacitance of the treatment room, and also the reason for this is the occurrence of anti-charge ionic clouds with the effect of increasing PEF weakens the molecular bonds of fat cells With the effect of entropy, the lipid micelles are recombined in a double-layered membrane overlapping with water molecules, thus forming smaller lipid molecules under an emulsion-like system. High electrical conductivity as a result of water interference, the so-called new charge carriers, and the reason for the increase in conductivity is also attributed to the occurrence of electrical perforation of cells, which leads to fragmentation or the occurrence of pores in the membrane due to the intensity of the PEF field, which helps to release molecules or internal ions to cells such as (potassium ions).) in the liquid environment, which in turn leads to an increase in the electrical conductivity of the liquids.

CONCLUSIONS

The electrical conductivity of milk treated with electro-pasteurization is higher compared to other treatments in terms of physical properties.

SUGGESTIONS:

We recommend the manufacture of different products to show the effect of different thermal treatments on them and to conduct more studies on other treatments other than these treatments and study their impact on the chemical, physical and microbial content.

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