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Effect of Microwave Treatment on Chemical Composition and Microbiological Quality of Milk

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ABSTRACT

Nine samples of raw milk; 3 buffalo, 3 cow and 3 mixed (1 buffalo: 1 cow) were exposed to different periods of microwave treatment (0second, 30 seconds, 60 seconds, 90 seconds, 120 seconds, 150 seconds and 180 seconds) to evaluate changes in chemical composition and microbial load in milk samples during microwave treatments. Also, these samples were stored for 7 days at refrigeration temperature to follow up changes in chemical composition and microbiological status during storage. In addition, a comparison between pasteurized and microwaved milk was carried out. Results showed that moisture content was decreased with prolonging microwave periods while fat, protein, ash, specific gravity and acidity were increased. Total bacterial count, lactic acid bacteria, lipolytic bacteria, proteolytic bacteria, Psychrotrophic bacteria, yeasts and molds count were decreased or disappeared with prolonged time of microwave treatment and no coliform bacteria were detected after treatment. At the same time, pasteurized milk was higher in moisture content than in microwaved milk but lower in acidity, protein, ash and fat contents. Total bacterial count, lipolytic, proteolytic and psychrotrophic bacterial counts were higher in pasteurized than microwaved milk samples. No coliform bacteria, yeasts, molds and L.A.B. were detected neither in microwaved milk nor in pasteurized milk.

Keywords: Microwave, Milk, pasteurization, Microbiological evaluation, Coliform bacteria, chemical composition

INTRODUCTION

Thermal treatment is a major processing technology in the dairy industry. The purpose of thermal processing is to extend the shelf life of milk and milk products without compromising milk safety. Various thermal treatments such as pasteurization and sterilization can be selected on the basis of severity of the heat treatment and the intended purpose. Apart from inactivation of pathogens, thermal treatment can also result in some other desirable changes, such as protein coagulation, texture softening, and formation of aromatic components. (Ahmed, and Ramaswamy, 2014).

Gajanan *et al*.,(2015) reported that technological revolution have search for new or improved food processing technologies. Recently, several new food processing technologies, including microwave and radio frequency heating, pulse-electric field treatment, high-pressure processing, ultrasonic applications, irradiation, and oscillating magnetic fields are being investigated to improve, replace, or complement conventional processing technology.

The microwave pasteurization is a promising method as it cause less damage in the foodstuffs than the conventional heat treatment, due to the short treatment and radiation time (Albert *et al*., 2009)

Microwave heating refers to dielectric heating due to polarization effects at a selected frequency band in a nonconductor. Microwave heating in milk occurs due to coupling of electrical energy from an electromagnetic field in a microwave cavity with the food and its subsequent dissipation within mik product. Resulting in a sharp increase in temperature within the product. (Gajanan *et al.,* 2015)

The unconventional antibacterial treatments applied on milk are: sterilization by ionizing radiation, ultrasound treatment, electro pasteurization, the use of microwave etc. Microwaves are nonionizing radiation; with varying electromagnetic waves of radiant energy with frequencies ranging from 300 MHz to 300 GHz. Domestic ovens operate at 2.450 MHz. (Deliu *et al.,* 2013). The same author reported that in food heating operations, microwave heating offers several distinct advantages when compared with conventional heating methods. The advantages include speed of heating, energy saving, precise process control, and faster start-up and shutdown times. Other advantages include higher quality product in terms of taste, texture, and nutritional content.

Since the first reported study on the use of microwave systems for pasteurization of milk, several works on microwave milk treatments, mainly conducted on microbiological aspects, have been reported (Thompson & Thompson, 1990). Although the enhancement of chemical reactions by microwave irradiation is known, few studies have been performed on chemical changes produced during microwave heating of milk.

Hammad (2015) studied the effect of microwave treatment on microbiological load of different types of milk. Microwave treatment of cow's or human milk is effective in reducing bacterial counts (Sigman *et al*., 1989).

Microwave heat treatment of milk for 2.5 min killed 97.7% of bacteria (Demel *et al*., 1990). After storage for 14 days at 8°C the total colony count had doubled and reached more than 10^4 cfu mL^{-1}. Nasri *et al*., (2013) investigated the lethal effect of microwave against *Salmonella enterica serovar typhimurium*.

The aim of this work was to investigate changes in chemical composition and bacteriological quality of milk after microwave treatment for different periods and following these changes during storage at refrigeration temperature. A comparison between heat pasteurized and micro waved milk was also carried out.

MATERIALS AND METHODS

1- Materials:-

Three samples of (buffalo, cow and mixed) milk were collected from some farms in Assuit Governorate and treated with microwave for different periods. Also a sample of pasteurized milk was obtained from the dairy factory in the faculty of Agriculture Assiut University.

2- Methods of analysis:-

Milk samples were subjected to microwave treatments at different periods (0second, 30 seconds, 60 seconds, 90 seconds, 120 seconds, 150 seconds and 180 seconds). Moisture, total nitrogen (TN) and ash contents as

well as titratable acidity of milk were estimated according to A.O.A.C (2000). Total crud protein content was calculated as N×6.38 (Plummer, 1988). The percentage of fat content had been estimated by using Gerber method (B.S.I. 1958). Specific gravity (Sp. Gr.) of milk samples was determined according to Ling (1963).

Total bacterial count, lactic acid bacteria, proteolytic bacteria, coliform bacteria, yeasts and molds count were estimated according to Difco Manual (1998). Psychrotrophic bacteria and lipolytic bacteria were estimated according to Marshall (1992). All analyses were performed in triplicates. Obtained data were programmed in a computer for statistical analysis using SAS (1998) program.

The conventional pasteurization of milk was attained by heating at 72 °C for 40 sec.

RESULTS AND DISCUSSION

1- Buffalo's milk

The changes in chemical composition of buffalo's milk during microwave treatment at different periods and different temperatures are represented in Table (1). The chemical compositions have varied effected by the exposure time after 0 (for control), 30, 60, 90, 120, 150 and 180 seconds, respectively as following:

The acidity of examined milk samples were 0.157, 0.158, 0.162, 0.169, 0.176, 0.18 and 0.183 % with high significant difference (F-test, $p<0.01$) between treatments. Regarding specific gravity (Sp. Gr.) it was 1.030, 1.030, 1.0305, 1.031, 1.032, 1.033 and 1.0345 gm/ cm^3 with no significant difference (F-test) between treatments. Moisture contents were 85.72, 85.28, 84.61, 83.88, 82.66, 81.74 and 81.07 % with no significant difference (F-test) between treatments. On the other hand, ash contents were 0.607, 0.63, 0.698, 0.728, 0.769, 0.828 and 0.869 % with high significant difference (F-test, $p<0.01$) between treatments. Regarding fat contents, it were 7.26, 7.26, 7.3, 7.56, 7.86, 8.26 and 8.63 % with no significant difference (F-test) between treatments. Protein contents also increased with increasing exposer time to microwave, and it were 4.28, 4.37, 4.49, 4.67, 4.79, 5.02 and 5.12 % with high significant difference (F-test, $p<0.01$) between treatments.

Such results are in agreement with Hattem *et al*., (2011) and Alkaladi *et al*., (2014) that gradual increase occurred in T.S, protein, fat, Sp. Gr. and ash contents with increasing the microwave exposer time. However, results of Iuliana *et al*., (2015) were agreed with our results for Sp. Gr. But disagreed in contents of protein, fat and T.S which were decreased.

Changes in chemical composition of buffalo microwaved milk for 150 and 180 seconds during different storage periods are represented in Table (2).

Table 1. Chemical composition of buffalo milk during microwave treatment at different periods.

Temperature °C	Control	30 s	60 s	90 s	120 s	150 s	180 s	LSD 0.05	LSD 0.01	F-test
Acidity %	17± 2.64^{e}	44.66± 2.30^{d}	73± 8.88^{c}	87.66± 7.02^{b}	96.66± 0.557^{a}	97.66± 0.557^{a}	98.33± 0.557^{a}	7.87	10.93	**
	0.157± 0.0017^{d}	0.158± 0.0025^{d}	0.162± 0.0032^{d}	0.169± 0.003^{c}	0.176± 0.0055^{b}	0.18± 0.0023^{ab}	0.183± 0.0032^{a}	0.0057	0.0079	**
Sp. Gravity gm/cm^3	1.030± 0.0025	1.030± 0.0025	1.0305± 0.0022	1.031± 0.0018	1.032± 0.0016	1.033± 0.0016	1.0345± 0.0021	-	-	NS
Moisture %	85.72± 3.78	85.28± 4.07	84.61± 4.09	83.88± 3.78	82.66± 3.72	81.74± 3.63	81.07± 3.68	-	-	NS
Ash %	0.607± 0.06^{e}	0.63± 0.04^{de}	0.698± 0.002^{cd}	0.728± 0.045^{c}	0.769± 0.05^{bc}	0.828± 0.045^{ab}	0.869± 0.04^{a}	0.079	0.11	**
Fat %	7.26± 0.87	7.26± 0.87	7.3± 0.916	7.56± 0.873	7.86± 0.873	8.26± 0.808	8.63± 0.832	-	-	NS
Protein %	4.28± 0.30^{e}	4.37± 0.155^{e}	4.49± 0.187^{de}	4.67± 0.059^{cd}	4.79± 0.137^{bc}	5.02± 0.109^{ab}	5.12± 0.103^{a}	0.291	0.408	**

In the same column, means with the same letter are not significantly different ($p<0.05$)
N.S.: Non significant *: Significant **: Highly Significant

Table 2. Chemical composition of buffalo microwaved milk to150 and 180s during different storage periods.

	Zero time		1st day		2nd day		3rd day		5th day		7th day		LSD 0.05		LSD 0.01		F-test	
	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150s	180s	150s	180s	150 s	180 s
Acidity %	0.18± 0.002	0.183± 0.003	0.181± 0.002	0.185± 0.004	0.181± 0.003	0.186± 0.002	0.182± 0.002	0.186± 0.001	0.185± 0.002	0.188± 0.001	0.186± 0.003	0.191± 0.002	-	-	-	-	NS	NS
Sp.Gravity gm/cm^3	1.033± 0.001	1.034± 0.002	1.033± 0.001	1.034± 0.002	1.033± 0.001	1.035± 0.001	1.033± 0.001	1.035± 0.002	1.034± 0.002	1.035± 0.002	1.034± 0.002	1.037± 0.002	-	-	-	-	NS	NS
Moisture %	81.74± 3.62	81.07± 3.68	81.70± 3.62	81.10± 3.69	81.68± 3.66	80.97± 3.69	81.52± 3.63	80.81± 3.87	81.23± 3.59	80.78± 3.8	81.12± 3.66	80.27± 3.6	-	-	-	-	NS	NS
Ash %	0.828± 0.045	0.869± 0.04	0.829± 0.045	0.873± 0.037	0.830± 0.036	0.882± 0.04	0.838± 0.037	0.891± 0.048	0.846± 0.04	0.914± 0.042	0.856± 0.03	0.918± 0.057	-	-	-	-	NS	NS
Fat %	8.2± 0.808	8.63± 0.832	8.26± 0.808	8.63± 0.832	8.26± 0.808	8.63± 0.832	8.36± 0.808	8.8± 0.818	8.63± 0.76	8.9± 0.86	8.8± 0.72	9.2± 0.83	-	-	-	-	NS	NS
Protein %	5.02± 0.109^{c}	5.12± 0.103^{c}	5.03± 0.103^{c}	5.12± 0.103^{c}	5.06± 0.137^{c}	5.12± 0.103^{c}	5.12± 0.103^{bc}	5.17± 0.08^{bc}	5.26± 0.085^{ab}	5.41± 0.37^{ab}	5.44± 0.09^{a}	5.65± 0.207^{a}	0.192	0.245	0.273	0.348	**	**

In the same column, means with the same letter are not significantly different ($p<0.05$)
N.S.: Non significant *: Significa **:Highly Significant

The chemical composition was changed During storage period after 1st, 2nd, 3rd, 5th and 7th days of storage, respectively as following : after 150 s treatment, acidity contents were 0.181, 0.181, 0.182, 0.185 and 0.186 % Sp. Gr. were 1.033, 1.0335, 1.0335, 1.0341 and 1.0346 gm/ cm^3 moisture contents were 81.70, 81.68, 81.52, 81.23 and 81.12 %. Regarding ash contents, it reached 0.829, 0.830, 0.838, 0.846 and 0.856 %; Fat contents increased with storage and it were 8.26, 8.26, 8.36, 8.63 and 8.8 %; Protein contents also increased with storage and it reached 5.03, 5.06, 5.12, 5.26 and 5.44 % after the over mentioned storage periods, respectively .

While after 180 s, the acidity value reached 0.185, 0.186, 0.186, 0.188 and 0.191 % with no significant differences (F-test). Sp. Gr. was 1.034, 1.035, 1.0355, 1.0356 and 1.0371 gm/ cm^3 with no significant difference (F-test). Moisture contents reached 81.10, 80.97, 80.81, 80.78 and 80.27 % with no significant difference (F-test). and ash contents 0.873, 0.882, 0.891, 0.914 and 0.918 % with no significant difference (F-test). Fat contents were 8.63, 8.63, 8.8, 8.9 and 9.2 % with no significant difference (F-test). Protein contents also increased with high significant difference (F-test, $p<0.01$), it were 5.12, 5.12, 5.17, 5.41 and 5.65 %5, after 1,2,3,5,7days, respectively.

Changes in total microbial counts in fresh and treated samples of buffalo milk for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively were represented in Table (3).

Table 3. Microbiological analysis of fresh and microwave treated samples of buffalo milk.

Bacterial groups	Control	30 s	60 s	90 s	120 s	150 s	180 s
Total count	201.33×10^3	143×10^3	85×10^3	72×10	33.33×10	18.66×10	5.66×10
L.A.B.	138.33×10^3	107×10^3	64.33×10^3	36×10	7.33×10	-	-
Psychrotrophic	21×10^3	13.3×10^3	7.66×10^3	3×10	0.66×10	-	-
Lipolytic	35.66×10^3	22×10^3	7×10^3	5×10	0.66×10	-	-
Proteolytic	11.66×10^3	3×10^3	1.33×10^3	0.33×10	-	-	-
Yeasts	32.33×10^3	25.33×10^3	9×10^3	1.33×10	-	-	-
Moulds	1.66×10^3	1×10^3	0.33×10^3	0.33×10	-	-	-

Total bacterial counts were 201.33×10^3, 143×10^3, 85×10^3, 72×10, 33.33×10, 18.66×10 and 5.66×10 CFU /ml. Lactic acid bacteria (L.A.B) counts were 138.33×10^3, 107×10^3, 64.33×10^3, 36×10, 7.33×10, 0 and 0 CFU/ml. Regarding Psychrotrophic bacteria counts were 21×10^3, 13.3×10^3, 7.66×10^3, 3×10, 0.66×10, 0 and 0 CFU/ml. Concerning lipolytic bacteria counts were 35.66×10^3, 22×10^3, 7×10^3, 5×10, 0.66×10, 0 and 0 CFU/ ml. Proteolytic bacteria counts also decreased during microwaving and were 11.66×10^3, 3×10^3, 1.33×10^3, 0.33×10, 0, 0 and 0 CFU/ ml. Yeasts count were 32.33×10^3, 25.33×10^3, 9×10^3, 1.33×10, 0, 0 and 0 CFU /ml. Molds count were 1.66×10^3, 1×10^3, 0.33×10^3, 0.33×10, 0, 0 and 0 CFU /ml after microwave treatments for 0, 30, 60, 90,120, 150 and 180 seconds. No coliform bacteria were found among all treatments.

These results are in agreement with Hammad (2015), Tremonte *et al*., (2014), Alkaladi *et al*., (2014) and Al-Hilphy and Ali (2013).

Changes in total microbial counts of buffalo microwaved milk during storage after 150s and 180s treatment were represented in Table (4).

Table 4. Changes in total microbial counts of buffalo microwaved milk to150s and 180s during different storage periods.

Bacterial groups	Zero time		1st day		2nd day		3rd day		5th day		7th day	
	150s	180s	150s	180 s	150 s	180 s	150 s	180 s	150s	180s	150 s	180 s
							×10					
Total count	18.6	5.66	18.66	5.66	19.66	8.33	25.66	9.33	27.66	12	28.33	13.66
L.A.B.	-	-	-	-	-	-	-	-	-	-	-	-
Psychrotrophic	-	-	-	-	-	-	-	-	-	-	-	-
Lipolytic	-	-	-	-	1.66	0.66	1.66	0.66	3	2	4	3.33
Proteolytic	-	-	0.33	0.33	0.66	0.66	1	1.66	2	2	2.33	3
Yeasts	-	-	-	-	-	-	-	-	-	-	-	-
Molds	-	-	-	-	-	-	-	-	-	-	-	-

Total bacterial counts were increased during storage after 150s or 180s. AT 150s it were 18.66×10, 19.66×10, 25.66×10, 27.66×10 and 28.33×10 CFU/ml after 1st, 2nd, 3rd, 5th and 7th days of storage, respectively. No lactic acid bacteria, Psychrotrophic bacteria, yeasts and molds were found during storage period, while lipolytic bacteria count showed 0, 1.66×10, 1.66×10, 3×10 and 4×10 CFU /ml. and proteolytic bacteria counts were 0.33×10, 0.66×10, 1×10, 2×10 and 2.33×10 CFU /ml.

While after 180s of storage it were 5.66×10, 8.33×10, 9.33×10, 12×10 and 13.66×10 CFU /ml. No lactic acid bacteria, Psychrotrophic bacteria, yeasts and were molds found during storage period, while lipolytic bacteria count were 0, 0.66×10, 0.66×10, 2×10 and 3.33×10 CFU /ml. proteolytic bacteria counts were 0.33×10, 0.66×10, 1.66×10, 2×10 and 3×10 CFU /ml after 1, 2, 3, 5 and 7 days, respectively

2-Cow's milk:

The changes in chemical composition of cow's milk during microwave treatment at different periods and different temperatures are represented in Table (5).

The chemical composition had varied effecte by the exposure time after 0 (for control), 30, 60, 90, 120, 150 and 180 seconds, (s), respectively as following:

Acidity contents of cow milk during different periods of microwaving were 0.15, 0.15, 0.155, 0.159, 0.166, 0.173 and 0.181 % with highly significant difference (F-test, $p<0.01$). Regarding Sp. Gr. of examined

samples it were 1.027, 1.027, 1.028, 1.0288, 1.029, 1.030 and 1.032 gm/cm^3 with high significant difference (F-test, $p<0.01$).

Moisture contents decreased through the examined periods and it were 87.82, 87.75, 87.44, 86.43, 85.39, 84.6 and 83.13 % with high significant difference (F-test, $p<0.01$). In contrast, ash contents increased during different periods and it reached 0.517, 0.52, 0.544, 0.583, 0.637, 0.722 and 0.76 % with no significant difference (F-test).

Fat contents of examined samples were 4.06, 4.06, 4.16, 4.32, 4.76, 5.1 and 5.46 % for control, 30s, 60s, 90s, 120s, 150s and 180s respectively with no significant difference (F-test). Protein contents also increased gradually during microwave treatments, it was 3.74, 4.01, 4.16, 4.52, 4.99, 5.2 and 5.3 % without any significant difference (F-test).

Table 5. Chemical composition of cow milk during microwave treatment at different periods.

Temperature °C	Control	30 s	60 s	90 s	120 s	150 s	180 s	LSD 0.05	LSD 0.01	F-test
	17.33± 2.3^{a}	45.33± 1.52^{ab}	73.33± 5.77^{ab}	89.33± 8.32^{b}	91.66± 4.72^{c}	96.66± 1.52^{d}	97.33± 1.15^{e}	7.72	10.72	**
Acidity %	0.15± 0.009^{d}	0.15± 0.009^{d}	0.155± 0.008^{cd}	0.159± 0.007^{cd}	0.166± 0.007^{bc}	0.173± 0.005^{a}	0.181± 0.005^{a}	0.013	0.018	**
Sp. Gravity gm/cm^3	1.027± 0.0005^{e}	1.027± 0.0004^{e}	1.028± 0.0004^{de}	1.0288± 0.0005^{cd}	1.029± 0.0003^{c}	1.030± 0.0005^{b}	1.032± 0.0008a	0.0009	0.001	**
Moisture %	87.82± 0.343^{a}	87.75± 0.4^{a}	87.44± 0.38^{ab}	86.43± 0.859^{bc}	85.39± 1.13^{cd}	84.6± 0.72^{d}	83.13± 0.907^{e}	1.29	1.79	**
Ash %	0.517± 0.107	0.52± 0.105	0.544± 0.132	0.583± 0.143	0.637± 0.141	0.722± 0.156	0.76± 0.165	-	-	NS
Fat %	4.06± 0.901	4.06± 0.901	4.16± 1.00	4.33± 0.85	4.76± 0.85	5.1± 0.818	5.46± 0.85	-	-	NS
Protein %	3.74± 0.305	4.01± 0.624	4.16± 0.721	4.52± 0.578	4.99± 0.929	5.2± 0.83	5.3± 0.91	-	-	NS

In the same column, means with the same letter are not significantly different (p<0.05 N.S.: Non significant
: Significant** *: Highly Significant**

Table (6) show changes in chemical composition of microwaved cow milk during refrigeration storage after 150s and 180s microwaving. The chemical composition was changed During storage period after 1st, 2nd, 3rd, 5th and 7th days of storage respectively as following : after 150 s treatment, Data showed that acidity contents after 150s microwaving were 0.174, 0.177, 0.181, 0.185 and 0.191 % with significant difference (F-test, $p<0.05$). Sp. Gr. results also showed increasing with storage period and it was 1.030, 1.031, 1.031, 1.032 and 1.032 gm/cm^3 without any significant difference (F-test). Vice versa, moisture contents decreased during storage and it were 84.58, 84.44, 84.01, 83.89 and 83.73 %. Regarding ash contents, results show gradual increase during storage and it was 0.719, 0.741, 0.76, 0.801 and 0.826 %. Fat contents were 5.1, 5.1, 5.26, 5.46 and 5.7 %. Protein contents also increased gradually during storage and it was 5.2, 5.2, 5.29, 5.44 and 5.62 % after 1st, 2nd, 3rd, 5th and 7th days of storage respectively (Table, 6).

Table 6. Chemical composition of cow microwaved milk to150 and 180s during differentstorage period.

	Zero time		1st day		2nd day		3rd day		5th day		7th day		LSD 0.05		LSD 0.01		F-test	
	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180s
Acidity %	0.173± 0.005^{c}	0.181± 0.005^{c}	0.174± 0.005^{c}	0.181± 0.005^{c}	0.177± 0.004^{bc}	0.182± 0.004^{bc}	0.181± 0.003^{bc}	0.186± 0.005^{bc}	0.185± 0.004^{ab}	0.19± 0.002^{ab}	0.19± 0.003^{a}	0.195± 0.001^{a}	0.007	0.007	0.01	0.01	*	**
Sp.Gravity gm/cm^3	1.030± 0.0005	1.032± 0.000^{b}	1.030± 0.0005	1.032± 0.000^{b}	1.031± 0.0006	1.032± 0.001^{b}	1.031± 0.0009	1.032± 0.001^{b}	1.032± 0.0008	1.033± 0.001^{ab}	1.03± 0.0007	1.034± 0.001^{a}	-	0.001	-	0.002	NS	*
Moisture %	84.60± 0.722	83.13± 0.907	84.58± 0.755	83.13± 0.931	84.44± 0.678	82.98± 0.927	84.01± 0.529	82.81± 0.772	83.89± 0.431	82.44± 0.578	83.7± 0.53	82.21± 0.617	-	-	-	-	NS	NS
Ash %	0.722± 0.156	0.769± 0.165	0.719± 0.146	0.773± 0.17	0.741± 0.163	0.778± 0.163	0.76± 0.167	0.796± 0.185	0.801± 0.193	0.85± 0.15	0.82± 0.186	0.87± 0.15	-	-	-	-	NS	NS
Fat %	5.1± 0.818	5.46± 0.85	5.1± 0.818	5.46± 0.85	5.1± 0.818	5.5± 0.85	5.26± 0.87	5.6± 0.85	5.46± 0.87	5.7± 0.95	5.7± 0.92	5.93± 1	-	-	-	-	NS	NS
Protein %	5.2± 0.83	5.38± 0.91	5.2± 0.83	5.38± 0.91	5.2± 0.83	5.38± 0.91	5.29± 0.83	5.47± 0.97	5.44± 0.85	5.62± 0.92	5.62±1	5.77± 0.87	-	-	-	-	NS	NS

In the same column, means with the same letter are not significantly different (p<0.05)
N.S.: Non significant *: Significant **: Highly Significant

Data of microwave treatments for 180s showed that, acidity content were 0.181, 0.182, 0.186, 0.19 and 0.195 % with high significant difference (F-test, $p<0.01$). Sp. Gr. results was 1,032, 1.032, 1.032, 1.033 and 1.034 gm/cm^3 with significant difference (F-test, $p<0.05$). Moisture contents decreased during storage and it was 83.13, 82.98, 82.81, 82.44 and 82.21 % without any significant difference (F-test). While ash contents was 0.773, 0.778, 0.796, 0.85 and 0.87 % without any significant difference (F-test).On the other hand fat contents was 5.46, 5.5, 5.6, 5.7 and 5.93 % without any significant difference (F-test). Protein contents also increase and it was 5.38, 5.38, 5.47, 5.62 and 5.77 % without any significant difference (F-test) after the same periods of storage, respectively.

Microbiological analysis of fresh and microwaved cow's milk at different periods and different temperatures represented in Table (7).

Total bacterial counts were 152.33×10^3, 106.66×10^3, 69.33×10^3, 79.66×10, 53.33×10, 17.66×10 and 4.66×10 CFU /ml. while lactic acid bacteria counts were 91.66×10^3, 69×10^3, 33.33×10^3, 26.66×10, 5×10, 0 and 0.0 CFU /ml Psychrotrophic bacteria counts were 50×10^3, 37×10^3, 18×10^3, 12.66×10, 1.66×10, 0 and 0 CFU /ml. Lipolytic bacteria counts were 10.33×10^3, 5.33×10^3, 1.66×10^3, 0.0, 0.0, 0.0 and 0.0. Yeasts count were 29×10^3, 25.33×10^3, 11.33×10^3, 0.0, 0.0, 0.0 and 0.0 CFU /ml while molds count were 1×10^3, 1×10^3, 0.33×10^3, 0.0, 0.0, 0.0 and 0.0 CFU /ml for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively. No proteolytic bacteria or coliform bacteria were found among treatments.

Average microbiological counts of microwaved cow's milk during storage after 150s and 180s treatment represented in Table (8).

Table 7. Microbiological analysis of fresh and treated samples of cow milk.

	Control	30 s	60 s	90 s	120 s	150 s	180 s
Total count	152.33×10^3	106.66×10^3	69.33×10^3	79.66×10	53.33×10	17.66×10	4.66×10
L.A.B.	91.66×10^3	69×10^3	33.33×10^3	26.66×10	5×10	-	-
Psychrotrophic	50×10^3	37×10^3	18×10^3	12.66×10	1.66×10	-	-
Lipolytic	10.33×10^3	5.33×10^3	1.66×10^3	-	-	-	-
Proteolytic	-	-	-	-	-	-	-
Yeasts	29×10^3	25.33×10^3	11.33×10^3	-	-	-	-
Molds	1×10^3	1×10^3	0.33×10^3	-	-	-	-

Table 8. Changes in total microbial counts of cow microwaved milk to150 180s during different storage periods.

	Zero time		1st day		2nd day		3rd day		5th day		7th day	
	150s	180s	150 s	180s	150 s	180s	150 s	180 s	150 s	180 s	150 s	180 s
							×10					
Total count	17.66	4.66	21.33	5.33	24.33	8.66	26.66	10.33	31.66	15.66	36.66	20.66
L.A.B.	-	-	-	-	-	-	-	-	-	-	-	-
Psychrotrophic	-	-	-	-	-	-	1.66	0.33	2.66	1.33	3.33	2.33
Lipolytic	-	-	1.66	1	4.33	2	6	2.66	8	4.33	10	5
Proteolytic	-	-	0.66	0.33	1.33	1	2.33	2	4	2.66	5.66	4.66
Yeasts	-	-	-	-	-	-	-	-	-	-	-	-
Moulds	-	-	-	-	-	-	-	-	-	-	-	-

After 150s, total bacterial counts were 21.33×10, 24.33×10, 26.66×10, 31.66×10 and 36.66×10 CFU /ml. Psychrotrophic bacteria counts were 0, 0, 1.66×10, 2.66×10 and 3.33×10 CFU /ml. Lipolytic bacteria counts were 1.66×10, 4.33×10, 6×10, 8×10 and 10×10 CFU /ml. Regarding proteolytic bacterial counts it were 0.66×10, 1.33×10, 2.33×10, 4×10 and 5.66×10 CFU /ml at 1st, 2nd, 3rd, 5th and 7th days of storage, respectively. No lactic acid bacteria, yeasts and molds were found during storage periods.

After 180s. Total bacterial counts were 5.33×10, 8.66×10, 10.33×10, 15.66×10 and 20.66×10 CFU /ml at the same respect. Psychrotrophic bacteria counts were 0, 0, 0.33×10, 1.33×10 and 2.33×10 CFU /ml. Lipolytic bacteria counts were 1×10, 2×10, 2.66×10, 4.33×10 and, 5×10 CFU /ml. while proteolytic bacterial counts were 0.33×10, 1×10, 2×10, 2.66×10 and 4.66×10 CFU /ml. No lactic acid bacteria, yeasts and molds were found during storage periods.

Several studies on microwave heating of milk have been carried out. The majority of these microwave-based studies have been used to investigate the possibility of shelf-life enhancement of pasteurized milk, application of microwave energy to inactivate milk pathogens, assess the influence on the milk nutrients or the non-uniform temperature distribution during the microwave treatment (Koutchma *et al.,* 1998).

3- Mixed milk:

Results in Table (9) represented changes in chemical composition of mixed milk (1 buffalo: 1 cow) during microwave treatment at different temperature and different period for 0 (for control), 30s, 60s, 90s, 120s 150s and 180s, respectively.

Acidity contents were 0.161, 0.161, 0.164, 0.17, 0.171, 0.176 and 0.181 %, with high significant difference (F-test, $p<0.01$). At the same respect, Sp. Gr. values were 1.028, 1.028, 1.029, 1.0293, 1.03, 1.031 and 1.032 gm/cm^3 without any significant differences among treatments (F-test). Concerning moisture contents it were 87.41, 87.21, 86.81, 86.32, 85.13, 84.29 and 83.47 % with high significant difference (F-test, $p<0.01$). Vice versa ash contents were increased during microwaving and it were 0.669, 0.672, 0.679, 0.711, 0.762, 0.84 and 0.901 % after 1, 2, 3, 5 and 7 days, respectively with high significant differences (F-test, $p<0.01$).

Results showed that fat contents were increased during microwaving and reached to 4.9, 4.9, 4.96, 5.23, 5.53, 5.8 and 6.1 % with significant differences (F-test, $p<0.05$), at the same respect protein contents also increased during microwaving and it were 3.98, 4.01, 4.19, 4.37, 4.52, 4.7 and 4.93 % without any significant differences (F-test) after microwave treatments for 0. 30, 60, 90, 120, 150 and 180 seconds, respectively.

Changes in chemical composition of mixed milk after 150s and 180s during storage for 1st, 2nd, 3rd, 5th and 7th days, respectively were represented in Table (10). It could be observed that acidity contents were (0.176, 0.181), (0.179, 0.182), (0.181, 0.183), (0.185, 0.187) and (0.188, 0.19) % after 150s and 180s of storage without any significant differences (F-test). At the same respect Sp. Gr. values were (1.031, 1.032), (1.031, 1.032), (1.031, 1.0335), (1.0325, 1.034) and (1.033, 1.034) gm/cm^3 without any significant differences (F-test).

Table 9. Chemical composition of mixed milk during microwave treatment at different periods.

Temperature °C	Control	30 s	60 s	90 s	120 s	150 s	180 s	LSD 0.05	LSD 0.01	F-test
	16.66± 1.15^{f}	46± 1^{e}	68.33± 1.52^{d}	90.33± 3.05^{c}	96± 1^{b}	97.33± 0.57^{ab}	98.66± 0.57^{a}	2.61	3.63	**
Acidity %	0.161± 0.009	0.161± 0.009	0.164± 0.008	0.17± 0.007	0.171± 0.008	0.176± 0.007	0.181± 0.006	-	-	NS
Sp. Gravity gm/cm^3	1.028± 0.001	1.028± 0.001	1.029± 0.001	1.0293± 0.002	1.03± 0.002	1.031± 0.002	1.032± 0.002	-	-	NS
Moisture %	87.41± 0.98^{a}	87.21± 0.91^{a}	86.81± 0.823^{a}	86.32± 1.14^{ab}	85.13± 0.44^{bc}	84.29± 0.38^{cd}	83.47± 0.75^{d}	1.43	1.99	**
Ash %	0.669± 0.059^{c}	0.672± 0.059^{c}	0.679± 0.064^{c}	0.711± 0.053^{c}	0.762± 0.054^{bc}	0.84± 0.045^{ab}	0.901± 0.034^{a}	0.094	0.13	**
Fat %	4.9± 0.39^{c}	4.9± 0.39^{c}	4.96± 0.45^{c}	5.23± 0.416^{bc}	5.53± 0.416^{abc}	5.8± 0.36^{ab}	6.1± 0.36^{a}	0.703	0.976	*
Protein %	3.98± 0.369	4.01± 0.406	4.19± 0.495	4.37± 0.58	4.52± 0.544	4.7± 0.62	4.93± 0.72	-	-	NS

In the same column, means with the same letter are not significantly different (p<0.05)
N.S.: Non significant *: Significant **: Highly Significant

Table 10. Chemical composition of mixed microwaved milk to150 and 180 seconds during different storage period .

	Zero time		1st day		2nd day		3rd day		5th day		7th day		LSD 0.05		LSD 0.01		F-test	
	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180 s	150 s	180s	150 s	180s	150s	180 s
Acidity %	0.176± 0.007	0.181± 0.006	0.176± 0.007	0.181± 0.005	0.179± 0.006	0.182± 0.004	0.181± 0.007	0.183± 0.005	0.185± 0.007	0.187± 0.004	0.188± 0.008	0.19± 0.004	-	-	-	-	NS	NS
Sp.Gravity gm/cm^3	1.031± 0.002	1.032± 0.002	1.031± 0.002	1.032± 0.002	1.031± 0.002	1.032± 0.001	1.031± 0.002	1.033± 0.001	1.032± 0.002	1.034± 0.001	1.033± 0.002	1.034± 0.001	-	-	-	-	NS	NS
Moisture %	84.29± 0.386^{a}	83.47± 0.75	84.28± 0.397^{a}	83.47± 0.75	84.1± 0.397^{a}	83.3± 0.72	83.92± 0.346^{a}	83.21± 0.76	83.6± 0.51^{ab}	82.82± 0.67	83.12± 0.32^{b}	82.4± 0.53	0.707	-	0.99	-	*	NS
Ash %	0.839± 0.04	0.901± 0.03	0.839± 0.04	0.901± 0.03	0.854± 0.05	0.927± 0.039	0.873± 0.054	0.943± 0.04	0.9± 0.062	0.977± 0.049	0.926± 0.08	1.001± 0.04	-	-	-	-	NS	NS
Fat %	5.8± 0.36	6.1± 0.36	5.8± 0.36	6.1± 0.36	5.8± 0.36	6.1± 0.36	5.9± 0.36	6.23± 0.32	6.13± 0.41	6.46± 0.28	6.4± 0.45	6.66± 0.28	-	-	-	-	NS	NS
Protein %	4.7± 0.612	4.93± 0.721	4.7± 0.612	4.93± 0.721	4.7± 0.612	4.93± 0.721	4.81± 0.64	5.05± 0.71	4.93± 0.659	5.17± 0.84	5.11± 0.57	5.32± 0.74	-	-	-	-	NS	NS

In the same column, means with the same letter are not significantly different (p<0.05)
N.S.: Non significant *: Significant **: Highly Significant

Moisture contents decreased gradually during storage and it were (after 150s) 84.28, 84.1, 83.92, 83.6 and 83.12 % with significant differences (F-test, p<0.05) and it were (after 180s) 83.27, 83.3, 83.21, 82.82 and 82.4 % without any significant differences (F-test). Ash contents were 0.839, 0.854, 0.873, 0.9 and 0.926 % after 150s without any significant differences (F-test). On the other hand after 180s it was 0.901, 0.927, 0.943, 0.977 and 1.001 % at the same respect without any significant differences (F-test).

Fat contents after 150s and 180s were (5.8, 6.1), (5.8, 6.1), (5.9, 6.23), (6.13, 6.46) and (6.4, 6.66) % without any significant differences (F-test). Protein contents after 150s and 180s were (4.7, 4.93), (4.7, 4.93), (4.81, 5.05), (4.93, 5.17) and (5.11, 5.32) % at the same respect without any significant differences (F-test).

Regarding microbial analysis, Table (11) showed changes in microbial counts in fresh and treated mixed milk after different temperatures and different periods of microwaving.

Total bacterial counts were 228.66×10^3, 165.66×10^3, 102.33×10^3, 90.66×10, 53.33×10, 22.33×10 and 4.66×10 CFU /ml for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively. L.A.B counts decreased during microwaving and it were 172×10^3, 146×10^3, 86×10^3, 71.33×10, 16.33×10, 0.0 and 0.0 CFU /ml at the same respect. Psychrotrophic bacteria counts were 95.66×10^3, 70×10^3, 23.33×10^3, 32×10, 0.66×10, 0.0 and 0.0 CFU /ml for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively. Lipolytic bacteria counts were 24.33×10^3, 10.33×10^3, 3.66×10^3, 10.33×10, 0.33×10, 0.0 and 0.0 CFU /ml while proteolytic bacteria counts were 3.33×10^3, 0.66×10^3, 0.0, 0.0, 0.0, 0.0 and 0.0 CFU /ml for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively. Yeasts count were 21.66×10^3, 13.33×10^3, 6×10^3, 1.33×10, 0.0, 0.0 and 0.0 CFU /ml for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively. On the other hand molds count were 2.66×10^3, 2.33×10^3, 1.33×10^3, 0.33×10, 0.0, 0.0 and 0.0 CFU /ml for control, 30s, 60s, 90s, 120s, 150s and 180s, respectively.. No coliform bacteria were found among treatments.

Changes in total microbial counts of treated samples after 150s and 180s during storage represented in Table (12). After 150s, total bacterial counts were 23.66×10, 28.33×10, 33.33×10, 40×10 and 45.33×10 CFU /ml. Psychrotrophic bacteria counts were 2.33×10, 3.33×10, 4.33×10, 7.33×10 and 8×10 CFU /ml. Meanwhile, lipolytic bacteria counts were 0.0, 0.66×10, 1.33×10, 2.66×10 and 3.33×10 CFU /ml.

While after 180s Total bacterial counts were 5.66×10, 8.33×10, 11.33×10, 15.66×10 and 20×10 CFU /ml. proteolytic bacteria counts were 0, 0.33×10, 0.33×10, 1.33×10 and 2.33×10 CFU /ml during storage for 1st, 2nd, 3rd, 5th and 7th days, respectively. No L.A.B., Psychrotrophic bacteria, yeasts and molds were found during storage period.

Table 11. Microbiological analysis of fresh and treated samples of mixed milk.

Bacterial groups	Control	30 s	60 s	90 s	120 s	150 s	180 s
Total count	228.66×10^3	165.66×10^3	102.33×10^3	90.66×10	53.33×10	22.33×10	4.66×10
L.A.B.	172×10^3	146×10^3	86×10^3	71.33×10	16.33×10	-	-
Psychrotrophic	95.66×10^3	70×10^3	23.33×10^3	32×10	0.66×10	-	-
Lipolytic	24.33×10^3	10.33×10^3	3.66×10^3	10.33×10	0.33×10	-	-
Proteolytic	3.33×10^3	0.66×10^3	-	-	-	-	
Yeasts	21.66×10^3	13.33×10^3	6×10^3	1.33×10	-	-	-
Moulds	2.66×10^3	2.33×10^3	1.33×10^3	0.33×10	-	-	-

Table 12. Changes in microbial analysis of mixed microwaved milk to150s and 180s during different storage periods.

	Zero time		1st day		2nd day		3rd day		5th day		7th day	
	150s	180s	150 s	180s	150 s	180s	150 s	180 s	150 s	180 s	150 s	180s
							×10					
Total count	22.33	4.66	23.66	5.66	28.33	8.33	33.33	11.33	40	15.66	45.33	20
L.A.B.	-	-	-	-	-	-	-	-	-	-	-	-
Psychrotrophic	-	-	2.33	-	3.33	-	4.33	-	7.33	-	8×10	-
Lipolytic	-	-	-	-	0.66	0.33	1.33	1	2.66	2	3.33	3
Proteolytic	-	-	-	-	0.33	0.33	0.66	0.33	1.66	1.33	2.66	2.33
Yeasts	-	-	-	-	-	-	-	-	-	-	-	-
Moulds	-	-	-	-	-	-	-	-	-	-	-	-

Comparison between microwave and pasteurization treatments:

Table (13) represented differences in chemical composition between microwaved and pasteurized milk at the same temperature. Acidity contents were high in microwaved milk (0.189 %) than pasteurized milk (0.162%) with high significant difference (F-test, $p<0.01$). No significant differences (F-test) in Sp. Gr. between the two treatments (1.0305 gm/cm^3). Moisture contents were 86.273 and 88.135 % for microwaved and pasteurized milk, respectively with significant differences (F-test, $p<0.05$). At the same respect, ash contents were 0.753 and 0.674 % with high significant differences (F-test, $p<0.01$). A significant difference (F-test, $p<0.05$) was observed between the two treatments in fat contents (3.5 and 3 %). On the other hand protein contents were 4.37 and 3.79 % with significant difference (F-test, $p<0.05$). Such results are in agreement with Alkaladi *et al*., (2014) who found that acidity, fat, protein, ash and T.S. contents are high in microwaved milk than in pasteurised one.

Table 13. The average chemical composition of milk treated with microwave versus pasteurized milk.

	Microwaved milk	Pasteurized milk	LSD 0.05	LSD 0.01	F-test
Acidity %	0.189± 0.0009[a]	0.162± 0.001[b]	0.002	0.003	**
Sp. Gravity gm/cm^3	1.0305± 0.0003	1.0305± 0.0004	-	-	NS
Moisture %	86.273± 0.168[b]	88.135± 0.825[a]	1.349	2.238	*
Ash %	0.753± 0.012[a]	0.674± 0.027[b]	0.048	0.080	**
Fat %	3.5±0.2[a]	3.0±0.2[b]	0.45	0.75	*
Protein %	4.37±0.27[a]	3.79±0.045[b]	0.438	0.727	*

In the same column, means with the same letter are not significantly different ($p<0.05$)
N.S.: Non significant *: Significant: Highly Significant**

Microbial analysis of microwaved and pasteurized milk are represented in Table (14). Results showed that microbial counts in microwaved milk were less than that in pasteurized milk. it was 19×10, 0.0, 3×10, 0.0, 0.0, 0.0 and 0.0 CFU /ml in microwaved milk for total bacterial, L.A.B., Psychrotrophic, lipolytic, proteolytic counts, yeasts and moldscount, respectively while it was 87×10, 0.0, 15×10, 3×10, 3×10, 0.0 and 0.0 CFU/ml in pasteurized milk at the same respect. These results are in agreement with Alkaladi *et al*., (2014). Also Wernery *et al.,* (2005) showed that pasteurization of camel milk had very little effects on its constituent (fat and protein) with slight increase in ash content.

Table 14. The microbiological analysis of milk treated with microwave versus pasteurized milk.

	Microwaved milk	Pasteurized milk
Total bacterial count	19×10	87×10
L.A.B.	-	-
Psychrotrophic bacteria	3×10	15×10
Lipolytic bacteria	-	3×10
Proteolytic bacteria	-	3×10
Yeasts	-	-
Molds	-	-

The inactivation of Streptococcus faecalis, Yersinia enterocolitica, Campylobacter jejuni, and Listeria monocytogenes in milk by microwave energy has been reported by (Choi *et al.,* 1993 a, b)

REFERENCES

A.O.A.C (2000). Association of official Analytical Chemists. Official Methods of Analysis Association of Official Agriculture Chemists. 17th ed., Wisconsin: Georgea BantaCo. Inc.

Ahmed J, and Ramaswamy H (2014). Handbook of food preservation In: Rehman S (ed). Microwave Pasteurization and Sterilization of Foods, 2nd edn. CRC, London 2014pp 691-713.

Albert , Zs. M´andoki, Zs. Csap´o-Kiss and J. Csap´o(2009).The effect of microwave pasteurization on the composition of milk Acta Univ. Sapientiae, Alimentaria, 2, 2 (2009) 153–165.

Al-Hilphy, A. R. S. and Ali, H. (2013). Milk flash pasteurization by the microwave andstudy its chemical, microbiological and thermo physical characteristics.J. Food Process Technol.,4(7):1-5.

Alkaladi, A., Mohamed Afifi, M. and Kamal, R. (2014). Application of microwave as an alternative home pasteurization method for camel milk; microbiological, physiochemical and biochemical study. Bothalia J. 44 (4):301-311.

B.S.I (1955). British Standard Institute. Gerber method for determination of fat in milk and milk products. B.S. 696, London.

Choi, HK., Marth, EH. and Vasavada, PC., (1993 b) Use of microwave energy to inactivate

Choi, K., Marth, EH. and Vasavada, PC., (1993 a). Use of microwave energy to inactivate Listeria monocytogenes in milk. Milchwissenschaft 48, 200–203,

Deliu, I., Giosanu, D. and stănescu, C. (2013). The microwaves effects on liquid foods. Scientific Bulletin. Series F. Biotechnologies, Vol. XVII, 208-211.

Demel, S., Steiner, I., Washtittl, J. and Kroyer, G. (1990). Chemische und mikrobiologische Untersuchungen an mikrowellenbehandelter Milch. Z. Erniihrungswiss., 29, 299-303.

Dickinson and Company Sparks, Maryland 21152, USA.

Difco Manual, (1998). Difco Manual, 11th ed., Difco Laboratories, Division of Becton

Effects of microwaving human milk: changes in IgA content and bacterial count. J. Am. Diet. Ass., 89, 69&2.

Gajanan Dhobale, Istiyak Chauhan, J. P. Prajapati1 and H. G. Patel (2015). Microwave Heat treatment for Milk Processing National Seminar on "Indian Dairy Industry –Opportunities and Challenges. 189-193

Hammad, A. H. (2015). Effect of high domestic microwave radiations at sub-lethal temperature on the bacterial content of raw milk. Alexandria J. Veterinary Sci., 47, 47-52.

Hattem, H. E., Manal, A. N., Hanaa, S. S. and Elham, H. A. (2011). A study on the effect of thermal treatments on composition and some properties of camel milk. J. Brew. Distill, 2, 51-55.

Iuliana, C., Rodica, C., Sorina, R. and Oana, M. (2015). Impact of microwaves on the physico-chemical characteristics of cow milk. Romanian Reports in Physics, 67(2): 423–430.

Koutchma, T., LeBail, A. and Ramaswamy, HS., (1998.) Modeling of process lethality incontinuous-flow microwave heating-cooling system, in Proc. Int. Microwave Power Institute, Chicago, 74–77,

Ling, E.R. (1963). A text book of dairy chemistry. Vol. II, 3rd ed., Chapman and Hall, Ltd. London.

Marshall, R.T. (1992). Standard methods for the examination of dairy products, 16th ed. American Public Health Association, Washington, DC., USA.

Nasri, K., Daghfous, D. and Landoulsi, A. (2013). Effects of microwave (2.45 GHz) irradiation on some biological characters of Salmonella typhimurium. Comptes Rendus Biologies, 336, 194-202.

Plummer, D. T. (1988). An Introduction to Practical Biochemistry. 3rd Ed. New Delhi: Tata McGraw-Hill Publishing Company Ltd. pp. 160–161.

SAS (1998). Statistical Analysis System User, Guide: Basis. SAS Inst. Inc Cary. NC.

Sigman, Madeleine, Burke, K. I., Swarner, O. W. and Shavlik. G. W. (1989).

Thompson, J. S. and Thompson, A. (1990). In home pasteurization of raw goat's milk by microwave treatment. Int. J. Food Microbial., 10, 59-64.

Tremonte, P., Tipaldi, L., Succi, M., Pannella, G., Falasca, L., Capilongo, V., Coppola, R. and Sorrentino, E. (2014). Raw milk from vending machines: Effects of boiling, microwave treatment, and refrigeration on microbiological quality. J. Dairy Sci., 97, 3314–3320.

Wernery, U., Johnson, B. and Abrahm, A. (2005). The effect of short-term heat treatment on vitamin C concentration in camel milk. Milchwissenschaft, 60, 266-267.

Yersinia enterocolitica and Campylobacter jejuni in milk. Milchwissenschaft 48,134–136,

تأثير المعاملة بالميكروويف على التركيب الكيميائى والجوده الميكروبيولوجيه للبن

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تم فحص 9 عينات لبن خام (3 جاموسي, 3 بقري, 3 خليط بنسبة 1 جاموسي: 1 بقري) حيث تم تعريض العينات لفترات مختلفة في الميكروويف (صفر, 30 ثانية, 60 ثانية, 90 ثانية, 120 ثانية, 150 ثانية, 180 ثانية) لتقدير التغيرات في التركيب الكيميائي و الحمولة الميكروبيولوجية اثناء فترات مختلفة من المعاملة بالميكروويف. ايضا تم تخزين العينات لمدة 7 ايام على درجة حرارة الثلاجة بعد معاملتها بالميكروويف لمدة 150، 180 ثانية لمتابعة التغيرات الكيميائية و الميكروبيولوجية اثناء التخزين. بالاضافة لذلك تم عمل مقارنة بين اللبن المبستر واللبن المعامل بالميكروويف عند نفس درجة الحرارة التي تمت عليها البسترة. وقد اظهرت النتائج انخفاض محتوى العينات من الرطوبة اثناء فترات الميكروويف المختلفة بينما ارتفع محتواها من الدهن, البروتين, الرماد, الكثافة و الحموضة.كذلك انخفضت أو اختفت تماما الاعداد الكلية للبكتريا , بكتريا حمض اللاكتيك , البكتريا المقاومه للبرودة البكتريا المحللة للدهن, البكتريا المحللة للبروتين, الخمائر و الفطريات تبعا لشدة المعاملة. و لم يثبت تواجد بكتريا القولون بعد اجراء كل المعاملات. عند مقارنة اللبن المبستر باللبن المعامل بالميكروويف وجد ان اللبن المبستر مرتفع في نسبة الرطوبة عن اللبن المعامل بالميكروويف بينما نجد اللبن المبستر منخفض في محتواه من البروتين و الدهن و الرماد و الحموضة. كذلك انخفض محتوى اللبن المعامل بالميكروويف عن اللبن المبستر في الاعداد الكلية للبكتريا و البكتريا المقاومه للبرودة والبكتيريا المحلله للدهن والبكتيريا المحلله للبروتين ولم يثبت تواجد بكتريا القولون , بكتريا حمض اللاكتيك , الخمائر, الفطريات في اللبن المبستر او فى اللبن المعامل بالميكروويف.