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IMPACT OF HEAT TREATMENT ON SOME PROPERTIES OF GOAT MILK YOGHURT.

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ABSTRACT

This study aimed to investigate the impact heat treatment on goat's milk yoghurt. Fresh goat's milk from three breed groups (Damascus, Zaraibi and Baladi) during the lactation period (March to August) were used in making fresh and stored yoghurt using yoghurt culture (YC-380DVS). The first treatment was served as control (A) where it was treated thermally with 90 ^{0}C /5 min, second treatment (B) was treated with 90 ^{0}C /10 min, third treatment (C) was treated with 85^{0}C /30 min. Treatment (A) showed the higher SN (0.36) in fresh and stored yoghurt and also higher TVFA (1.73) in fresh yoghurt. Treatment (B) characterized with higher acidity (0.95 and 0.97) % in fresh and stored yoghurt, respectively. Higher fat content (3.17%) was found in stored yoghurt and higher TVFA (1.73 and 1.83) in fresh and stored yoghurt, respectively. Treatment (C) showed the higher pH value (4.6 and 4.47) in fresh and stored yoghurt, respectively, higher T.S (15.2 and 15.81) was detected in fresh and stored yoghurt, respectively, higher Fat content (3.03%) in fresh yoghurt, higher TN (0.65 and 0.68%) and protein (4.15 and 4.36%) in fresh and stored yoghurt, higher curd tension (CT) value (22.67 and 25.67) in fresh and stored yoghurt, and also the lowest amounts of exudates CSC (3.56, 3.67) in fresh and stored yoghurt, respectively. and curd synersis CS after 10,20,30,60 min (3.60,4.83,5.41,6.22) in fresh yoghurt, and (3.41,4.47,4.54,5.87) in stored yoghurt, respectively.

INTRODUCTION

Yoghurt is one of the most popular fermented milk products in Egypt and throughout the world for its -at least in part- various health claims and therapeutic benefits added to its nutritional impact. Goat milk and its product of yoghurt have three significant importances in human nutrition. (1) feeding more starving and malnourished people in the developing world than from cow milk; (2) treating people afflicted with cow milk allergies and gastro-intestinal disorders, which is a significant segment in among populations of developed countries, and (3) filling the gastronomic needs of connoisseur consumers, which is a growing market share in many developed countries (Haenlein, 2012). On the other hand, goat's milk yoghurt has gained popularity such as weak body and poor texture and problem of goaty of mutton flavour may exist in some areas. (Pazakova *et a.,l* 1999), (Jumah *et al*., 2001) and (Domagala 2008). In the literature a lot of fundamental studies on improving quality of yoghurt from goat's milk. This was carried out by studying impact of some processing variables such as heat treatment of yoghurt milk after complete fermentation on chemical and physical properties of the product. (Abd El-Salam *et al*., 1991), (Sakar 1995), (Lee and Lucey 2004) and (Qian *et al.* 2010). Thus, the aim of the current study was to investigate the impact heat treatment on goat milk yoghurt.

MATERIALS AND METHODS

1. Fresh goat's milk from the three breed groups (Damascus, Zaraibi, and Baladi) at lactation stage (March: August), were used in the present study was collected from private herd at El-Gharbia Governorate.
2- Yoghurt culture (YC-380DVS) consisting of *Streptococcus thermophilus and Lactobacillus delbrueckii sub sp. bulgaricus* was obtained from Chr. Hansen's Lab.,Denmark

Yoghurt samples were analyzed for titratable acidity and moisture content according to (Ling, 1963). Fat content was determined by Gerber's method (B.S.I., 1955). Total nitrogen (TN) and (SN) were measured by semi-micro Kjaldahl procedure as give by (Ling 1963). Total protein content was determined following: protein = TN × 6.38. Total volatile fatty acids (TVFA) were assessed as given by Kosikowski (1978), Determination of curd tension was estimated according to Chandrasekhara *et al.* (1957) as described by Abd El-Salam *et al.* (1991), Determination of curd synersis was carried out as described by Mehanna and Mehanna (1989), Measurement of synersis by centrifugation method was measured according to the method of Harwalkar and Kalab (1983). The attained data were statistically analyzed according to SPSS (1999).

RESULTS AND DISCUSSION

As shown in Table (1) acidity was increased and pH values decreased with significantly differences ($P<0.05$). Thus, the acidity values were 0.88, 0.95 and 0.81% in fresh yoghurt treatments A, B and C, respectively in fresh yoghurt. The treatment (C) was the lower acidity value (0.81) %, however treatment (B) was of the higher acidity value (0.95) %. On the other hand**,** the acidity values of stored yoghurt were 0.90, 0.97 and 0.83% in A, B and C treatments, respectively. The treatment (C) was the lower acidity value (0.83) %; however the treatment (B) was the highest acidity value (0.97) %**.** Acidity significantly increased and pH decreased ($P<0.05$). Thus, pH values were 4.5, 4.5 and 4.6 in A, B and C treatments, respectively in fresh yoghurt. The treatment (C) was of the highest pH value (4.6) %, while the treatments (B) and (A) were similar of the lowest pH value (4.5). %. On the other hand**,** the pH values of fresh yoghurt were 4.4, 4.37 and 4.47 in A, B and C treatments, respectively in fresh yoghurt. The treatment (C) was of the highest pH value (4.47) %, while the treatment (B) was (4.40) and treatment (A) was of the lowest pH value (4.37).

The earlier results in the literature indicated slight increase in acidity and corresponding decrease in pH may be attributed to changes in milk components due to heat treatment of milk. These included decomposition of lactose to from organic acids and redistribution of Ca, P and Mg between soluble and colloide forms and subsequently increase the acidity and decrease pH. (Tamime and Robinson, 1999 and Elzahar *et al.,* 2007).

As shown in Table (1) the treatment (C) was of the highest T.S content (15.2) %, while the treatment (A) was of the lowest T.S content (13.5)

%. In the fresh yoghurt and the same trend was observed in stored yoghurt .the treatment (C) was of the highest content (15.81) %, but the treatment (A) was of the lowest T.S content (14.72) %. Fat contents of fresh yoghurt of treatment (B) was the highest (3.07) %, while the treatment (A) was the lowest fat content (2.77) %. On the other hand**,** fat content was 2.83, 3.17 and 3.13% in A, B and C treatments, in stored yoghurt. From previous results, where to use the longest time for the heat treatment given opportunities longer to vaporize a large amount of water, raising the proportion of T.S and fat content.

It seems from Table (1) that the values of T.N % in the treatment (C) were the highest value (0.65) %, while the similar values (0.60) were detected in treatments (A) and (B) insignificant differences in T.N among the treatments in fresh yoghurt. The treatment (C) was of the highest value (0.68) %, while the treatment (A) was of the lowest value (0.61) %., however treatment (B) was (0.63) %. insignificant differences in TN among the treatments in storaged yoghurt.

The values of protein content in the treatment (C) was the highest value (4.15) %, while the treatment (B) contained the lowest value (3.81) %., and treatment (A) was moderate (3.83) %, with insignificant differences in protein content ratio among treatments in fresh yoghurt. On the other hand, treatment (C) was of the highest value (4.36) %, while the treatment (A) contained the lowest value (3.89) % and the treatment (B) was (4.04) %. Statistical analysis showed insignificant differences in protein content among the treatments. SN % of fresh yoghurt samples of the treatment (A**)** contained the highest value (0.36), while the treatment (C) was the lowest value (0.32), while the treatment (B) was (0.35) with insignificant differences in SN among the treatments. On the other hand, treatment (A) was the highest value (0.36), while treatment (C) was of the lowest value (0.33), while treatment (B) was (0.35) with insignificant differences in SN among the treatments. The heat treatment resulted in denaturation the whey protein, leading to interaction between *B- lg* and *K- casein* is presumed to be the reason for the formation of a branched casein network during fermentation of yoghurt milk. (Kalab *et al*., 1983, Mottar *et al*., (1989) and Abd El-Salam *et al*., (1991). This was more pronounced with the user treatment (C), which of the longest time. Hence the decrease in proportion of SN.

Table (1): Chemical changes in fresh and stored yoghurt made of goat's milk as affected by the different heat treatments applied on yoghurt milk (Average ± SE of 3 replicates).

samples	treatments		
	A	B	C
	Acidity,%		
Fresh yoghurt	0.88±0.01[b]	0.95±0.03[c]	0.81±0.01[a]
Stored yoghurt	0.90±0.01[b]	0.97±0.01[c]	0.83±0.01[a]
	pH		
Fresh yoghurt	4.5±0.06[a]	4.5±0.06[a]	4.6±0.00[a]
Stored yoghurt	4.4±0.06[a]	4.37±0.09[a]	4.47±0.03[a]
	TS%		
Fresh yoghurt	13.50±0.38[a]	14.10±0.25[a]	15.20±0.13[b]
Stored yoghurt	14.72±0.2[a]	15.24±0.03[ab]	15.81±0.2[b]
	Fat%		
Fresh yoghurt	2.77±0.22[a]	3.07±0.15[a]	3.03±0.15[a]
Stored yoghurt	2.83±0.2[a]	3.17±0.2[a]	3.13±0. 2[a]
	TN%		
Fresh yoghurt	0.60±0.01[a]	0.60±0.02[a]	0.65±0.03[a]
Stored yoghurt	0.61±0.01[a]	0.63±0.02[a]	0.68±0.06[a]
	Protein%		
Fresh yoghurt	3.83±0.08[a]	3.81±0.11[a]	4.15±0.2[a]
Stored yoghurt	3.89±0.06[a]	4.04±0.11[a]	4.36±0.4[a]
	SN%		
Fresh yoghurt	0.36±0.07[a]	0.35±0.07[a]	0.32±0.03[a]
Stored yoghurt	0.36±0.07[a]	0.35±0.07[a]	0.33±0.02[a]
	TVFA*		
Fresh yoghurt	1.73±0.07[a]	1.73±0.07[a]	1.67±0.07[a]
Stored yoghurt	1.80±0.07[a]	1.83±0.03[a]	1.73±0.03[a]

Average (a, b) within the same row with different superscripts differed significantly (P<0.05).
***0.01 N-NaoH| 100 g yoghurt.**

Data in Table (1) cleared a small variation in the TVFA content of fresh yoghurt samples the treatment (A) and the treatment (B) had the highest mean value of TVFA content (1.73), while treatment (C) had the lowest mean values of (1.67). On the other hand, the results had increased affected by the storage period, treatment (B) had the highest mean value of TVFA content (1.83), while treatment (C) had the lowest mean values of TVFA content (1.73) and treatment (A) was (1.80) with insignificant among treatments.

Tables (2) reveal data of curd synersis (C.S.C g\10g**)** of fresh and stored yoghurt as affected by heat treatments being applied. Thus the treatment (C) had the lowest values of (C.S.C) (3.56) g\10g. The differences between the samples were insignificant; On the other hand the results had increased affected by the storage period. The treatment (A) and (B) had the highest value of (C.S.C) exudates 4.04 and 4.18 g\10g respectively, while the treatment (C) had the lowest values exudates of (C.S.C) (3.67) g\10g. The differences between the samples were insignificant. However, the centrifugation method is measure of the water holding capacity as a result of high external force. i.e, resistance of the gel to compaction (Lee and Lucey, 2010). The authors as well as (Dannenberg and Kessler, (1988) a,b) attributed such impact to degree of *B-lg* denaturation in heated milk increased water holding capacity and firmness of set yoghurt.

Table (2): Rheological properties changes in fresh and stored yoghurt made of goat's milk as affected by the different heat treatments applied on yoghurt milk (Average ± SE of 3 replicates).

samples	treatments		
	A	B	C
	Centrifugal forces(C.S.C) *		
Fresh yoghurt	4.11±0.1[a]	4.11±0.1[a]	3.56±0.3[a]
Stored yoghurt	4.04±0.5[a]	4.18±0.06[a]	3.67±0.3[a]
	Curd tension (CT) **		
Fresh yoghurt	17.00±1.53[a]	20.33±2.33[a]	22.67±3.71[a]
Stored yoghurt	20.00±1.2[a]	24.33±3.5[a]	25.67±3.5[a]
	Curd synersis (CS)after 10 minutes***		
Fresh yoghurt	4.61±0.13[b]	4.00±0.21[a]	3.60±0.07[a]
Stored yoghurt	4.16±0.18[b]	3.93±0.07[ab]	3.41±0.17[a]
	Curd synersis (CS)after 20 minutes		
Fresh yoghurt	5.44±0.19[b]	5.06±0.01[ab]	4.83±0.16[a]
Stored yoghurt	4.91±0.2[b]	4.65±0.32[a]	4.47±0.23[a]
	Curd synersis (CS)after 30 minutes		
Fresh yoghurt	6.01±0.16[b]	5.56±0.12[ab]	5.41±0.17[a]
Stored yoghurt	5.66±0.18[a]	5.47±0.17[a]	4.54±0.74[a]
	Curd synersis (CS)after 60 minutes		
Fresh yoghurt	7.16±0.12[b]	6.64±0.15[a]	6.22±0.16[a]
Stored yoghurt	6.79±0.1[b]	6.18±0.33[ab]	5.87±0.25[a]

Average (a, b) within the same row with different superscripts differed significantly (P<0.05).
***at 4000rpm (3405.6 G) for 10 min.**
***Curd synersis (CS g/15gm)**
****Curd tension (CT, g)**
*****Curd synersis (C.S.C) at centrifugal force.**

Table (2) shows that curd tension (CT) of the fresh yoghurt was insignificant differed as affected by heat treatment after complete fermentation. Fresh yoghurt samples which treated with the heat treatment (C) had the highest value of CT (22.67), while samples which treated with the heat treatment (A) had the lowest mean values of (CT) 17.00 with insignificant differences among treatments. On the other hand, results had increased as affected by the storage period. The treatment (C) had the highest value of CT (25.67), while samples which treated with the heat treatment (A) had the lowest mean values of CT (20), while yoghurt stored samples which treated with the heat treatment (B) was value of CT (24.33). In case of the fresh yoghurt, the heat treatments (A), (B) and (C) after 10 min. of synersis time were 4.61, 4.0 and 3.6, g/15g, respectively, the amounts of exudates after 20 min. of synersis time were 5.44, 5.06 and 4.83, g/15g, respectively. The amounts of exudates after 30 min. of synersis time were 6.01, 5.56 and 5.41, g/15g, respectively and the amounts of exudates after 60 min. of synersis time were 7.16, 6.64 and 5.22, g/15g, respectively. In case of the stored yoghurt, the heat treatment (A), (B) and the heat treatment (C) the amounts of exudates after 10 min. of synersis time were 4.16, 3.93 and 3.41 g/15g respectively, the amounts of exudates after 20 min. of synersis time were 4.91, 5.65 and 4.47 g/15g respectively, the amounts of exudates after

30 min. of synersis time were 5.66, 5.47 and 4.54, g/15g, respectively and the amounts of exudates after 60 min. of synersis time were 6.79, 6.18 and 5.87 g/15g, respectively. Regarding impact of heat treatments on the curd tension (CT) and curd synersis (CS), it seems from the recorded results that heating temperature and long time of heat significantly improved CT. This agrees Abd. El-Salam *et al.,* (1991) who reported that the relation between the heat denaturation of *B*- lactoglobulin and CT of yoghurt. The improved CT of heated milk is attributed to the formation of a large number of bonds per unit volume so that milk serum is better immobilized in smaller pores. In the final we recommended with treated goat's milk with heat treatment 85^0C /30 min when making goat milk yoghurt.

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تـأثير المعـاملات الحراريـة المختلفـة على بعض خـواص الزبـادى المصنـع مـن لـبن الماعز

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هدفت الدراسة الحالية الى دراسة تأثير المعاملات الحرارية المختلفة على بعض خواص الزبـادى المصـنع مـن لـبن المـاعز لتحسين جـودة الزبـادى باسـتخدام سـلالات مختلفـة للـبن المـاعز (الدمشـقى- الزرايبـى والبلـدى) خـلال موسـم الادرار بدايـة مـن شـهرمارس حتـى أغسـطس وذلـك باستخدام درجـات حـرارة مختلفـة لبسترة اللبن هـى : المعاملـة (أ) 90 درجـة مئويـة لمـدة 5 دقـائق (كنترول). المعاملة(ب) 95 درجة مئوية لمدة 10 دقائق و المعاملـة (ج)85 درجـة مئويـة لمـدة 30 دقيقة.

أوضحت النتائج المتحصل عليها أن:

1- حصـلت المعاملـة الأولـى (أ) علـى أعلـى نسـبة فـى النيتـروجين الـذائب (0.36 %) فـى العينـات الطازجة وبعد التخزين (7أيام) وكذللك فى نسبة الأحماض الدهنية الطيارة(1.73) فى العينات الطازجة.

2- حصـلت المعاملـة الثانيـة (ب) علـى أعلـى نسـبة فـى الحموضـة (0.95 و0.97)% فـى العينـات الطازجة وبعد التخزين (7أيام) بالترتيب.وكذلك حققتأعلى نسبة دهن (3.17%) فى العينـات المخزنة وكذللك فى نسبة الأحماض الدهنية الطيارة(1.73 و1.83) فى العينات الطازجة وبعد التخزين.

3- حققت المعاملة الثالثة (ج) على أعلى درجة فى رقم الحموضة (4.6 و 4.47) وكذلك فـى نسبة المـادة الصـلبة (15.2 و15.81)% فـى العينـات الطازجـة وبعـد التخـزين (7أيـام) بالترتيب.وكـذلك حققت علـى نسبة دهن (3.03%) فـى العينـات الطازجـة وكـذلك فـى نسـبة النيتروجين الكلـى (0.65 و0.68)% وأيضـا حققت المعاملـة الثالثـة (ج) أعلـى نسبة بـروتين (4.15 و4.36) فى العينات الطازجة وبعد التخزين.

أيضـا أظهـرت النتـائج النهائيـة أن المعاملـة (ج) أظهـرت تحسن ملموسوانخفاض فـى معدل انفصـال الشرش بعد مرور 10و 20 و 30 و60 دقيقة حيث كانت (3.60 و4.83 و5.41 و6.22) و(3.41 و 4.47 و 4.54 و 5.87) فـى العينـات الطازجـة والمخزنـة بالترتيـب ومعـدل انفصـال الشـرش تحـت ضـغط الطـرد المركـزى حيـث كانـت (3.56 و 3.67) بالترتيـب فـى العينات الطازجة والمخزنة وكذلك أعلى قيمة لقوة شد الخثرة حيث كانت (22.67 و 25.67) بالترتيب فى العينات الطازجة والمخزنة.

4- من النتائج السابقة يمكننا أن نوصى باستخدام درجة حرارة 85 درجة مئوية لمدة 30 دقيقة عند بسترة لبن الماعزفى صناعة الزبادى لما أظهرته النتائج من تحسن واضح فى النتائج عن باقى المعاملات.

قام بتحكيم البحث

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