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MANUFACTURING FUNCTIONAL STIRRED YOGHURT SUPPORTED BY COLOSTRUM

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ABSTRACT

Stirred yogurt fortified with colostrum by using different proportions (10, 20 and 30%). Physical, chemical, microbiographic and sensory properties of product were studied. From the obtained results it was clear that there was an increase in coagulation time and protein content by the addition of colostrum during the manufacture of fortified milk and the highest recorded of T_3 (colostrum 30%) of the control.

The chemical composition of the milk produced indicated increased fat, ash, TS, mineral contents; also there was an increase in viscosity, WHC and antioxidant activity by increasing the added colostrum. On the other hand, samples of the fortified milk revealed a decrease in the rate of mating compared to the control either fresh or during the storage periods. Tissue properties (TPA) are improved by increasing the amount of colostrum added.

There was improvement in nutritional and sensory properties by adding colostrum.

Key words: Stirred yoghurt, colostrum, physic-chemical, antioxidant activity and sensory quality

INTRODUCTION

Milk is a fluid secreted by the female of all mammalian species, the primary function of which is to meet the complete nutritional requirements of the neonate, while also serving several physiological functions. Colostrum is the secretion produced by the mammary gland immediately following parturition. In the case of cows, the duration for which the mammary secretion is classified as colostrum rather than milk varies considerably amongst different reports immediately after parturition *Godhia and Patel* (2013), 2 days *Playford* (2001), 3 to 4 days *Abd El-Fattah et al.* (2012). For the purposes of this review, colostrum, unless otherwise defined, will refer to the early milking's from dairy cows, taken up to 3 days post-partum. Colostrum is the first milk produced by a female mammal.

Colostrum is considered as a vital food for the newborn of all mammals in the first day after birth. Colostrum contains various nutrients including protein, fat, carbohydrate, water, fat-soluble vitamins and minerals as well as many biologically active substances such as immunoglobulins, antimicrobial factors, growth factors and others. The most important bioactive components in colostrum include growth and development of the newborn while antimicrobial factor provide passive immunity and protect against infections during the first weeks of life. The antimicrobial activity of colostrum is due mostly to immunoglobulins, although colostrum also contains other antimicrobial factors, lactoferrin, lysozyme and lactoperoxidase *Gauthier et al.* (2006).

The composition and physical properties of colostrum are highly variable due to a number of factors, including individuality, breed, parity, pre-partum nutrition, length of the dry period of cows and time post-partum *Moody et al.* (1951). In general, colostrum contains less lactose and more fat, protein, peptides, non-protein nitrogen, ash, vitamins and minerals, hormones, growth factors, cytokines and nucleotides than mature milk; except in the case of lactose, the levels of these compounds decrease rapidly during the first 3 days of lactation *Uruakpa et al.* (2002). Colostrum is characterised by its very high concentration of immunoglobulin which is of particular importance to the neonate, whose gut, immediately following parturition, allows the passage of large immunoglobulins, thereby conferring passive immunity *Stelwagen et al.* (2009). It is essential that the newborn calf receives an adequate supply of colostrum as the concentration of immunoglobulins and permeability of the gut decrease rapidly over the first 24 h following parturition *Moore et al.* (2005). In addition, colostrum intake influences metabolism, endocrine systems and the nutritional and stimulates the development and function of the gastrointestinal tract. Most healthy dairy cows produce colostrum far in excess of the calf's requirements but, typically, milk collected during the colostrum period is considered unmarketable and often is excluded from bulk milk collection *Marnila and Korohnen* (2002). The high protein content of colostrum leads to multiple problems in industrial processes, e.g. poor heat stability, which interferes with pasteurization *McMartin et al.* (2006). Also, the high content of antimicrobial components in colostrum may affect the fermentation process. Despite this, colostrum has attracted considerable interest as a functional food ingredient *Korohnen* (1998).

Consumption of dairy products is associated with beneficial health effects beyond their nutritional values. Due to its healthy perception, dairy products have been served as vehicles for functional food ingredients over the last 25 years, such as phytochemical and probiotics. Fermented milk products have positive health images due to the beneficial viable bacteria and yoghurt has been already recorded as healthful product.

Fermented milk products are produced throughout the world. As yoghurt is a popular fermented dairy product of Egypt, manufacture of yoghurt usually involves milk fortification with dairy ingredients to increase nutritional value or produce functional yoghurt due to image they possess and their unique nutritional attributes, in addition for refreshing taste, palatability and therapeutic values. The use of colostrum or any of its ingredients in functional dairy foods in still very limited owing to consumer resistance. Relevant efforts have been developed for the processing of colostrum in order to obtain stable and readily available product. The utilization of colostrum is however restricted mainly due to technical problems. The high protein and minerals content leads to problems in industrial processes, whereas high antimicrobial activity decrease the chances of fermentation *Tripathi and Vashishtha* (2006).

Yoghurt consumption has increased around the world because of its nutritional value, therapeutic effects, and functional properties *McKinley* (2005). Yoghurt is an increasingly popular cultured dairy product in most countries. This is partly because of an increased awareness of the consumers regarding possible health benefits of yoghurt. Yoghurt is easily digested, has high nutritional value, and is a rich source of carbohydrates, protein, fat, vitamins, calcium, and phosphorus. Because milk protein, fat, and lactose components undergo partial hydrolysis during fermentation, yoghurt is an easily digested product of milk *Sanchez and Gill* (2002).

Due to the bioactive components of colostrum and its effective utilization, the present study was planned to manufacture fortified stirred yoghurt with colostrum and studying the physical-chemical, microbiological, sensorial and functional characteristics of such product. This amalgamation of yoghurt stirred with colostrum has great potential to develop a product, which may gain greater demand and consumer appeal.

MATERIALS AND METHODS

Materials

Cow's colostrum(1.5kg) and cow's milk (10kg) were obtained from the dairy farm at belongs to the Animal Production Research Station, Karrada, Kafr El-Sheikh, Agricultural Research Center, Ministry of Agriculture. Fresh buffalo milk (6.8% fat)(10kg) and buffalo colostrum(1.5kg) used in this study were obtained from the dairy farm labelers to Animal Production Research Station, Mahalta Moses, Kafr El-Sheikh, Agricultural Research Center, Ministry of

Agriculture. Direct Vat Starter (DVS) containing *Lactobacillus delbreuckii* sub sp. *bulgaricus* (YCX11) and *Streptococcus thermophiles* was obtained from Chr. Hansen's laboratories, Denmark.

The samples were mixed with electric stirrer then packed in 100 ml sterilized cups and stored in refrigerator at 4^{O}C. Along with colostrum stirred yoghurt. Control stirred yoghurt was prepared without addition of colostrum beside were 3 treatments as follows.

C: control (fresh standardized mixed buffalos and cow's milk 1:1).

T_1: fresh mixed milk standardized (buffalos and cows 1:1) +10% mixed colostrum (buffalos and cows 1:1).

T_2: fresh mixed milk standardized (buffalos and cows 1:1) +20% mixed colostrum (buffalos and cows 1:1).

T_3: fresh mixed milk standardized (buffalos and cows 1:1) +30% mixed colostrum (buffalos and cows 1:1).

Methods:

Preparation stirred yoghurt:

Yoghurt manufactured according to Tamime and Robinson (2007). Fresh mixed (cows and buffalos milk 1:1) and mixed colostrum (buffalos and cows 1:1) were standardized to 3.5% fat. Standardized yoghurt milk was fortified with 10, 20 and 30 % (w/w) of colostrum heated at 80^{0}C for 10 min. then cooled 42^{0}C 2% yoghurt starter was added. Yoghurt mixes from the different treatments were filled in 100 ml plastic cups and incubated at 42^{o}C until complete coagulation. After coagulation, samples were held at 5±1 ^{0}C for 9 days. Samples were analyzed at fresh, 3, 6 and 9 days of storage. Three replicates were carried out.

Chemical analysis:

The total solids, protein, fat, ash and carbohydrate were determined according to the AOAC (2012). Acidity was determined according to the methodology described by BSI (2010). The pH value was measured using pocket pH meter (IQ Scientific USA, Model IQ 125). The antioxidant activity DPPH Assay (2, 2- Dipheny1-1-picrylhydrazyl) was determined by the method described by Blois (1958). Mineral content Ca, Na, K, Mg, Fe and Zn were determined according to the method of James (1995). IgG, IgM and Lactoferrin were determined according to Fahey and Mackelvey (1965) and Chen and Mao,(2004). However vitamin A and E were determined according to Prentice and Langridge (1992). Specific gravity of milk and colostrum were measured by using lactometer.

Microbiological analysis:

Lactic acid bacteria (LAB) was enumerated on Elliker agar medium, as described by Elliker et al. (1956). Total bacterial counts (TBC) of the produced stirred yoghurt samples were determined as described by IDF (1991). Lipolytic bacteria counts (LBC) were estimated according to Luck (1981). Proteolytic bacteria counts (PBC) were estimated according to Frank et al. (1992). Mould & yeast and coliform group as described by Difco (1985).

Physical analysis:

The apparent viscosity was determined according to Petersen et al. (2000). Both synersis and water holding capacity (WHC) were measured according to Arslan and Ozel (2012). The texture profile analysis (TPA) test of stirred yoghurt samples was done as described by Bourne (1978).

Sensory evaluation:

The organoleptic properties were evaluated as given by Tamime and Robinson (1999), while flavour was scored out of 50 point body & texture 40 points and appearance of 10 points. The organoleptic properties were assessed by 10 panelists from the staff of the Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture

Statistical analysis:

Results were evaluated statistically using the software program of the SAS system SAS (1999). Differences between means were determined by Duncan’s multiple range tests at a level of 0.05 probability Steel& Torrie (1980).

RESULTS AND DISCUSSION

Table (1) illustrate the physic-chemical properties of fresh cows, buffaloes, mixed milk, cows colostrum, buffaloes colostrum and mixed colostrum used for preparation of stirred yoghurt including fat, protein, total solids, ash, lactose, acidity, pH, specific gravity, DPPH inhibition, lgG, lgM, lactoferrin, vitamin A, vitamin E, and mineral contents. According to the obtained data it could be conclude that all the components of buffaloes and mixed colostrum were higher than that of milk except the value of lactose which recorded 4.00% and 4.98% for mixed colostrum and mixed milk respectively. These results are in accordance with ***Vineu et al.* (2005)** who reported that colostrum is very rich in minerals, proteins and immunoglobulin but has less lactose compared to the whole milk.

Table (1): Physico- chemical composition of milk and colostrum used in proportioning of stirred yoghurt.

Components	Cow's Milk	Buffaloes milk	Mixed Milk	Cows colostrum	Buffaloes colostrum	Mixed colostrum
Total solids %	11.50	13.04	**12.50**	19.40	24.00	**21.70**
Fat %	3.20	6.80	**3.50**	5.60	8.80	**7.40**
Protein %	3.05	4.35	**3.70**	9.10	10.20	**9.65**
Lactose %	4.45	5.51	**4.98**	3.20	3.80	**4.00**
Ash %	0.69	0.77	**0.73**	0.90	1.20	**1.05**
Acidity %	0.17	0.16	**0.17**	0.23	0.25	**0.24**
pH	6.65	6.63	**6.65**	6.28	6.32	**6.30**
Specific gravity	1.028	1.034	**1.032**	1.042	1.062	**1.052**
DPPH inhibition* %	6.95	7.89	**7.42**	11.90	12.30	**12.20**
IgG mg/ml**	8.40	11.44	**9.92**	28.20	25.00	**26.60**
IgM* mg/ ml**	0.50	2.10	**1.30**	2.90	1.80	**2.35**
Lactoferrin mg/ml	0.12	0.20	**0.16**	0.90	1.20	**1.05**
Vitamin A IU/100ml	98.40	102.00	**100.20**	187.50	188.30	**187.65**
Vitamin E IU/100ml	180.00	190.40	**185.20**	201.55	396.55	**299.05**
Ca mg/100ml	110.00	129.00	**120.20**	261.80	284.80	**273.30**
Na mg/100ml	119.00	133.00	**125.50**	201.40	105.80	**153.60**
K mg/100ml	29.00	42.00	**35.50**	123.00	102.20	**112.60**
Mg mg/100ml	7.900	9.70	**8.80**	26.08	29.20	**28.00**
Zn mg/100ml	1.80	2.80	**2.30**	0.12	0.20	**0.16**
Fe mg/100ml	0.20	0.30	**0.25**	0.80	0.78	**0.79**

*DPPH inhibition: 2, 2-Diphenyl-1-picrylhydrazyl (DPPH) inhibition (%)
**IgG: Immunoglogulin G (IgG)
***IgM: immunoglobulins termed IgM

The coagulation time of the produced yoghurt as affected by adding different ratios of mixed colostrum are given in Table (2). According to the obtained results the coagulation time increased by increasing the colostrum added, as it increased by 11.10, 16.67 and 27.78% for T_1, T_2 and T_3 (10, 20 and 30% mixed colostrum), respectively. Similar results were recorded by Ayar *et al*. (2016) they recorded longer incubation time for yoghurt made with added colostrum means more time for the lactic acid bacterial to metabolize the lactose of the milk.

He increase in incubation time of stirred yoghurt with colostrum is probably the result of a higher buffering capacity of stirred yoghurts with various ratios of colostrum. The effect also may be attributed to the antimicrobial protein namely lactoferrin (1.05 mg/ml). These results are in agreement with El-Alfy *et al*. (2018) and Abd El-Fattah *et al.* (2012).

Table (2): Effect of adding different colostrum percentages on the coagulation time of yoghurt.

Components	**Control***	**Treatments****		
		T_1	**T_2**	**T_3**
Coagulation time (minutes)	180	200	210	230
% Coagulation time increase	0.00	11.10	16.67	27.78

*Control: Fresh standardized mixed milk cows and buffalos.

**T1: Fresh standardized mixed milk cows and buffalos +10% mixed colostrum cows and buffalos.

T2: Fresh standardized mixed milk cows and buffalos +20% mixed colostrum cows and buffalos.

T3: Fresh standardized mixed milk cows and buffalos +30% mixed colostrum cows and buffalos.

Table (3) showed that the protein and fat contents of the stirred yoghurt samples increased slightly with increasing amount of colostrum in fresh and during storage. Similar results were given by Herrero and Requena (2005), also Das *et al. (2013)* reported that increased whey protein content might improve the body structure of dahi due to interaction of whey proteins with casein micelles. The increase of both protein and fat contents could be mainly attributed to some loss of moisture contents through yoghurt making and storage compared to control yoghurt. Stirred yoghurt with colostrum had less lactose values when fresh and during storage and the slight decrease of lactose was proportional to the increase of colostrum rat added. Similar results were obtained by Ayar *et al.* (2016). The obtained results also revealed the increase of both ash and total solids contents of stirred yoghurt with colostrum than the control samples when fresh and storage periods. The increase was also proportional to the increase of colostrum added. This could be due to that colostrum had high total solids as compared to normal milk. Poonia and Dabur (2015) the results are also in agreement with Das *et al.* (2013).

Table (4) showed that the acidity, pH values, carbohydrate and total antioxidant activity of stirred yoghurt with colostrum when fresh and during storage compared to the control, stirred yoghurt with colostrum samples had slightly low treatable acidity when fresh and during storage period as the presence antimicrobial agents decrease the chances of fermentation. Also, due to the presences of bioactive components of colostrum and its effective utilization Tripathi and Vashishtha (2006).

The pH values of all the produced stirred yoghurt took an opposite trend to that of the acidity El-Alfy *et al.* (2018).

Table (3): Changes in total solids, fat, total protein and ash of the stirred yoghurt during storage as affected by added level of colostrum.

Components	Storage (days)	Control*	Treatments**			Mean
			T_1	T_2	T_3	
Total solids %	Fresh	12.80	13.12	14.55	14.90	**13.84[d]**
	3	12.85	13.20	14.60	15.10	**13.94[c]**
	6	12.95	13.25	14.72	15.20	**14.03[b]**
	9	13.02	13.35	14.95	15.35	**14.17[a]**
	Mean	**12.91[d]**	**13.23[c]**	**14.71[b]**	**15.14[a]**	
Fat %	Fresh	3.56	3.92	4.30	4.50	**4.07[d]**
	3	3.60	3.95	4.35	4.68	**4.15[c]**
	6	3.60	4.02	4.42	4.75	**4.20[b]**
	9	3.62	4.10	4.50	4.80	**4.26[a]**
	Mean	**3.60[d]**	**4.00[c]**	**4.39[b]**	**4.68[a]**	
Protein %	Fresh	4.10	4.50	5.40	5.86	**4.97[c]**
	3	4.22	4.64	5.52	5.98	**5.09[b]**
	6	4.26	4.70	5.60	6.02	**5.15[a]**
	9	4.30	4.75	5.63	6.08	**5.19[a]**
	Mean	**4.22[c]**	**4.65[b]**	**5.54[a]**	**5.99[a]**	
Ash %	Fresh	0.75	0.79	0.84	1.02	**0.85[d]**
	3	0.78	0.83	0.90	1.06	**0.89[c]**
	6	0.80	0.85	0.92	1.10	**0.92[b]**
	9	0.81	0.86	0.95	1.12	**0.94[a]**
	Mean	**0.79[d]**	**0.83[c]**	**0.90[b]**	**1.08[a]**	

* See legend to Table (2) for more details.

The results in Table (4) showed the carbohydrate and antioxidant activity of colostrum stirred yoghurt. The obtained results illustrated that the control yoghurt had the highest carbohydrate content for fresh and during storage period. However, the obtained results illustrated that the control yoghurt had the lowest antioxidant activity for fresh and during storage period. Fresh samples recorded 9.75, 12.95, 17.75 and 20.15 DPPH inhibition%, these values gradually decreased along the storage period to be 6.40, 8.50, 13.60 and 16.70 for control, T_1, T_2 and T_3 in the same order at the end storage. Generally, fortification of

Table (4): Changes in Treatable acidity, pH values carbohydrate and total antioxidant activity of yoghurt stirred during storage as affected by added level of colostrum.

Components	Storage (days)	Control	Treatments*			Mean
			T_1	T_2	T_3	
Treatable acidity %	**Fresh**	0.70	0.68	0.70	0.71	**0.70^{d}**
	3	0.85	0.83	0.78	0.76	**0.81^{c}**
	6	0.89	0.85	0.81	0.80	**0.84^{b}**
	9	0.96	0.93	0.89	0.87	**0.91^{a}**
	Mean	**0.85^{a}**	**0.82^{b}**	**0.80^{c}**	**0.79^{d}**	
pH values%	**Fresh**	4.46	4.47	4.46	4.47	**4.47^{a}**
	3	4.26	4.29	4.38	4.40	**4.33^{b}**
	6	4.21	4.26	4.34	4.35	**4.29^{c}**
	9	4.14	4.20	4.29	4.33	**4.24^{d}**
	Mean	**4.27^{d}**	**4.31^{c}**	**4.37^{b}**	**4.39^{a}**	
Carbohydrate %	**Fresh**	4.62	3.96	3.75	3.70	**4.01^{a}**
	3	4.50	3.90	3.70	3.65	**3.94^{b}**
	6	4.45	3.82	3.66	3.60	**3.89^{c}**
	9	4.40	3.80	3.60	3.55	**3.84^{d}**
	Mean	**4.49^{a}**	**3.87^{b}**	**3.68^{c}**	**3.63^{d}**	
Antioxidant activity DPPH (%)	**Fresh**	9.75	12.95	17.75	20.15	**15.15^{a}**
	3	8.80	11.50	16.25	19.20	**13.94^{b}**
	6	7.55	10.30	15.20	18.05	**12.78^{c}**
	9	6.40	8.50	13.60	16.70	**11.30^{d}**
	Mean	**8.13^{d}**	**10.81^{c}**	**15.70^{b}**	**16.53^{a}**	

* See legend to Table (2) for more details.

yoghurt with colostrum increased the antioxidant activity and this increase in parallel to the percentage of added colostrum Hashish *et al.* (2014).

Table (5) showed that the minerals contents (mg/100gm) of stirred yoghurt with colostrum when fresh and during storage at 5^{0}C. The results of mineral analysis revealed that the Ca, Na, Fe, Mg, K and Zn contents of stirred yoghurt with colostrum had higher values when fresh compared to control yoghurt samples and this was proportional to the amount of colostrum added. This also due to the higher contents of colostrum for minerals. The last mentioned mineral contents were also increased along the storage period with

Table (5): Minerals contents (mg/100gm) of yoghurt stirred during storage as affected by added level of colostrum.

Components	Storage (days)	Control	Treatments*			Mean
			T_1	T_2	T_3	
Ca	**Fresh**	125.60	160.00	180.20	210.30	**169.03^d**
	3	126.90	162.10	181.50	211.00	**170.38^c**
	6	128.10	162.70	182.10	211.60	**171.13^b**
	9	131.20	163.50	183.00	213.10	**172.70^a**
	Mean	**127.95^d**	**162.08^c**	**181.70^b**	**211.50^a**	
Na	**Fresh**	37.50	39.60	42.00	45.30	**41.10^d**
	3	38.70	41.10	43.25	45.95	**42.25^c**
	6	39.15	42.60	44.20	46.80	**43.19^b**
	9	40.10	43.20	45.10	47.30	**43.93^a**
	Mean	**38.86^d**	**41.63^c**	**43.64^b**	**46.34^a**	
Fe	**Fresh**	0.31	0.38	0.60	0.70	**0.50^d**
	3	0.33	0.42	0.64	0.75	**0.54^c**
	6	0.36	0.45	0.69	0.78	**0.57^b**
	9	0.39	0.46	0.72	0.81	**0.60^a**
	Mean	**0.35^d**	**0.43^c**	**0.66^b**	**0.76^a**	
Mg	**Fresh**	10.60	12.30	13.20	14.50	**12.65^d**
	3	10.76	12.55	13.60	14.75	**12.92^c**
	6	10.85	12.80	13.70	14.90	**13.06^b**
	9	10.90	12.84	13.76	14.98	**13.12^a**
	Mean	**10.78^d**	**12.62^c**	**13.57^b**	**14.78^a**	
K	**Fresh**	72.30	75.35	78.90	82.50	**77.26^d**
	3	72.95	76.90	80.20	84.10	**78.54^c**
	6	73.20	78.05	81.20	86.10	**79.64^b**
	9	73.50	78.80	81.50	86.30	**80.03^a**
	Mean	**72.99^d**	**77.28^c**	**80.45^b**	**84.75^a**	
Zn	**Fresh**	2.40	3.20	4.35	5.70	**3.91^d**
	3	2.55	3.62	4.60	5.84	**4.15^c**
	6	2.70	3.70	4.85	5.90	**4.29^b**
	9	2.74	3.75	4.98	5.92	**4.35^a**
	Mean	**2.60^d**	**3.57^c**	**4.70^b**	**5.84^a**	

* See legend to Table (2) for more details.

the same pattern in fresh samples, and this attributed to the decrease of moisture contents during the storage period El- Alfy *et al.* (2011).

Table (6) showed the physical properties of produced stirred yoghurt with colostrum during storage at 5^0C. The results of viscosity indicated higher values for stirred yogurt with colostrum than the control, and this increase of viscosity also ran paralleled to the percentage of added colostrum in fresh samples and along the storage period at 5^0C.

Table (6): Some physical properties of yoghurt stirred during storage as affected by added level of colostrum.

Components	Storage (days)	Control	Treatments*			Mean
			T_1	T_2	T_3	
Viscosity Cp	**Fresh**	335	350	645	795	**531[d]**
	3	385	460	715	830	**598[c]**
	6	460	560	795	895	**678[b]**
	9	520	640	830	920	**728[a]**
	Mean	**425[d]**	**503[c]**	**746[b]**	**860[a]**	
Synersis %	**Fresh**	16.20	13.60	10.20	9.75	**12.44[d]**
	3	20.10	15.80	11.10	10.30	**14.33[c]**
	6	22.80	16.50	12.50	11.60	**15.85[b]**
	9	28.50	18.30	14.60	12.15	**18.39[a]**
	Mean	**21.90[a]**	**16.05[b]**	**12.10[c]**	**10.95[d]**	
WHC %**	**Fresh**	86.50	89.30	91.20	93.20	**90.05[a]**
	3	84.10	86.90	90.10	91.80	**88.23[b]**
	6	80.20	85.60	89.50	90.30	**86.40[c]**
	9	78.00	83.40	78.60	89.10	**82.28[d]**
	Mean	**82.20[d]**	**86.30[c]**	**87.35[b]**	**91.10[a]**	

* See legend to Table (2) for more details.
**WHC: water holding capacity.

This could be due to presence of α-lactoglobulin which plays a major role as a gelatinizing agent due to presence of free sulphydry groups. Increased whey proteins in colostrum might have improved the rheological characteristics of stirred yoghurt with colostrum as these parameters are associated with the forces involved in the internal bonds of the produced products *Das and Seth* (2017). *Ayar et al.* (2016) reported that high protein and fat contents of colostrum can be the main reason of viscosity change in general, viscosity increases with increasing solids of liquid foods.

As compared to the control stirred yoghurt with colostrum recorded a slower synersis and higher WHC values than the control either when fresh or during the storage periods. These results are in agreement with *Das and Seth* (2017), they reported that decrease of synersis might be related to increase of protein concentrations which increase water holding due to formation of protein matrix.

Table (7) reveals the texture profile analysis (hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness) of produced stirred yoghurt with colostrum when fresh and during storage at 5^0C to 9 days. The obtained results showed increasing hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness in all treatments than the control when fresh, the increase in the texture characteristics were in paralleled to the amount of colostrum added. This could be due to that addition of colostrum resulted in increasing of total solids and protein concentration, especially whey proteins which might have resulted in a firmer body and improve the body structure due to interaction of whey protein with casein micelles.

During storage it could be noticed the increase of hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness all over the storage period to be 4.32, 4.22, 0.4, 2.80, 1.36 and 3.24 respectively for T3 at the end of the storage up to 9 days. Similar results are given by *Das et al.* (2013). Also, *Das and Seth* (2017) reported that addition of bovine colostrum whey powder at ration of 2% to curd had increased amount of protein which resulted in a significant increase of hardness. On the other hand both adhesiveness and springiness were slightly decreased by advancing the storage. These results are in agreement with *Das et al. (*2013) and *Mailam* (2015).

Table (8) showed that the total bacterial, lactic acid bacterial, lipolytic bacterial and proteolytic bacterial counts of stirred yoghurt were affected slightly by the addition of colostrum and storage period.

According to the obtained results, microbial counts including total bacterial count, lactic acid bacterial count, proteolytic and lipolytic counts showed a slight decrease counts in stirred yoghurt with colostrum compared to the control when fresh and the end of storage (9 days).

This may be due to the drop of pH below the optimum level affected the intracellular pH of the LAB which inhibit the enzyme activity, ion transport an nutrient uptake and so that retard the growth and then the count of the LAB Ayar *et al.* (2016).

On the other hand, coliform bacterial, mould and yeast were not detected either when fresh or during the storage periods up to 9 days in all treatments which may be due to the severity of heat treatments of milk and the preventive action of lactic acid bacteria and their metabolites on the growth of coliforms.

Table (7): Texture profile properties of yoghurt stirred during storage as affected by added level of colostrum.

Components	Storage (days)	Control	Treatments*			Mean
			T_1	T_2	T_3	
Hardness (N)	**Fresh**	1.98	2.55	3.54	4.10	**3.04^{d}**
	3	2.12	2.70	3.70	4.15	**3.17^{c}**
	6	2.35	2.80	4.00	4.25	**3.35^{b}**
	9	2.40	2.83	4.10	4.32	**3.41^{a}**
	Mean	**2.21^{d}**	**2.72^{c}**	**3.84^{b}**	**4.21^{a}**	
Adhesiveness (mJ)	**Fresh**	3.10	3.80	4.30	4.50	**3.93^{a}**
	3	2.80	3.65	4.22	4.38	**3.76^{b}**
	6	2.60	3.55	4.10	4.32	**3.64^{c}**
	9	2.52	3.48	4.02	4.22	**3.56^{d}**
	Mean	**2.76^{d}**	**3.62^{c}**	**4.16^{b}**	**4.36^{a}**	
Cohesiveness (Ratio)	**Fresh**	0.20	0.22	0.30	0.35	**0.27^{c}**
	3	0.22	0.24	0.31	0.37	**0.28^{c}**
	6	0.24	0.26	0.34	0.38	**0.31^{b}**
	9	0.25	0.28	0.36	0.40	**0.32^{a}**
	Mean	**0.23^{d}**	**0.25^{c}**	**0.33^{b}**	**0.38^{a}**	
Springiness (mm)	**Fresh**	2.48	2.70	2.92	3.08	**2.80^{a}**
	3	2.42	2.56	2.80	3.00	**2.70^{b}**
	6	2.30	2.48	2.65	2.90	**2.58^{c}**
	9	2.14	2.32	2.52	2.80	**2.45^{d}**
	Mean	**2.34^{d}**	**2.52^{c}**	**2.72^{b}**	**2.95^{a}**	
Gumminess (N)	**Fresh**	0.70	0.82	0.98	1.15	**0.91^{d}**
	3	0.78	0.90	1.06	1.22	**0.99^{c}**
	6	0.84	0.98	1.12	1.30	**1.04^{b}**
	9	0.89	1.02	1.16	1.36	**1.11^{a}**
	Mean	**0.80^{d}**	**0.93^{c}**	**1.08^{b}**	**1.26^{a}**	
Chewiness (mJ)	**Fresh**	2.12	2.38	2.54	2.80	**2.46^{c}**
	3	2.24	2.60	2.80	3.02	**2.67^{b}**
	6	2.36	2.80	2.96	3.20	**2.83^{a}**
	9	2.40	2.84	3.00	3.24	**2.87^{a}**
	Mean	**2.28^{d}**	**2.66^{c}**	**2.83^{b}**	**3.07^{a}**	

* See legend to Table (2) for more details.

Table (8): Microbiological analysis (log cfu/ml) of stirred yoghurt during storage as affected by added level of colostrum.

Components	Storage (days)	Control	Treatments*		
			T_1	T_2	T_3
Total bacterial count	**Fresh**	6.80	6.72	6.65	6.60
	3	6.92	6.80	6.73	6.71
	6	6.95	6.85	6.76	6.75
	9	6.82	6.75	6.70	6.68
Lactic acid bacterial	**Fresh**	5.55	5.46	5.35	5.25
	3	5.60	5.52	5.41	5.32
	6	5.66	5.59	5.54	5.40
	9	5.70	5.62	5.56	5.48
Lipolytic bacterial	**Fresh**	4.52	4.46	4.30	4.10
	3	4.58	4.50	4.35	4.15
	6	4.61	4.52	4.38	4.22
	9	4.50	4.40	4.29	4.12
Proteolytic bacterial	**Fresh**	4.60	4.50	4.30	4.20
	3	4.65	4.52	4.36	4.24
	6	4.68	4.56	4.40	4.34
	9	4.58	4.45	4.35	4.25
Coliform bacterial		**ND****	**ND**	**ND**	**ND**
Mould and yeast		**ND**	**ND**	**ND**	**ND**

* See legend to Table (2) for more details.
** ND: not detected.

Similar results were reported by Das and Seth (2017), they reported that mould & yeast and coliform were not found in control, as well as, in colostrum whey powder fortified curd samples.

Table (9) indicates that the sensory properties of stirred yoghurt were affected by the addition of colostrum and storage period. Stirred yoghurt containing 10 and 20% colostrum had higher scores for flavour, body & texture and appearance than that control. At the end of storage (9 days) all samples decreased to be (45+36.20+9) 90.20, (48+37+9.10) 94.10, (48.20+37.10+9.20) 94.50 and (44+35+8.70) 87.70respectively. Much lower values were observed during 9 days of storage, this due to the increase of acidity development. These results are in accordance with those of El-Alfy *et al.* (2018).

Table (9): Organoleptic scores of stirred yoghurt during storage as affected by added level of colostrum.

Components	Storage (days)	Control	Treatments*			Mean
			T_1	T_2	T_3	
Flavour (50)	**Fresh**	46.00	47.50	48.00	45.00	**46.63^b**
	3	46.00	48.00	48.50	44.50	**46.75^b**
	6	46.50	48.50	48.50	44.50	**47.01^a**
	9	45.00	48.00	48.20	44.00	**46.08^c**
	Mean	**45.88^b**	**48.00^a**	**48.08^a**	**44.50^c**	
Body and texture (40)	**Fresh**	36.00	36.50	37.50	35.00	**36.25^c**
	3	36.00	37.00	37.50	35.50	**36.50^b**
	6	36.50	37.40	37.60	35.80	**36.83^a**
	9	36.20	37.00	37.10	35.00	**36.33^c**
	Mean	**36.18^c**	**36.98^b**	**37.43^a**	**35.33^d**	
Appearance (10)	**Fresh**	8.50	9.00	9.00	8.50	**8.75^d**
	3	8.90	9.00	9.20	8.80	**8.98^c**
	6	9.20	9.40	9.60	9.00	**9.30^a**
	9	9.00	9.10	9.20	8.70	**9.00^b**
	Mean	**8.90^c**	**9.13^b**	**9.25^a**	**8.75^d**	

* See legend to Table (2) for more details.

Conclusively, the obtained results suggest that, yoghurt can be successfully mad using colostrum for improving the nutritional and sensorial qualities and physico-chemical characteristics of yoghurt. Also, the produced stirred yoghurt with colostrum had antioxidant activity better than the control yoghurt throughout cold storage at 5^{o}C up to 9 days. The fresh and stored for 9 days product high values for all sensory attributes, better firmness. Colostrum can be used in the manufacture stirred yoghurt with 10 or 20%.

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تصنيع زبادى وظيفى مقلب مدعم باللبأ (السرسوب)

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تم صناعة الزبادى الوظيفى المقلب و المدعم بنسب مختلفة من اللبأ الخليط (الجاموسى + البقرى 1:1) و دراسة الخصائص الفيزيائية و الكيميائية و الميكروبيولوجية و الحسية للزبادى الناتج. و من النتائج المتحصل عليها لوحظ زيادة فى زمن التجبن بزيادة نسب الاضافة من اللبأ. و كان أعلى زمن للتجبن للمعاملة الثالثة المضاف اليها اللبأ بنسبة 30%. لوحظ ايضا زيادة فى نسب الجوامد الكلية و البروتين و الدهن و الرماد و المعادن عن الكنترول. أيضا كان هناك زيادة فى اللزوجة الظاهرية و معدل احتفاظ الخثرة بالماء للزبادى المدعم باللبأ و كذلك زيادة للمواد المضادة للأكسدة بزيادة نسب اللبأ المضافة. من ناحية أخرى وجد أن الزبادى المدعم باللبأ كان معدل انفصال الشرش به أقل من الكنترول و هو طازج و أثناء التخزين و تحسنت أيضا خصائص القوام. كما لوحظ تحسن ملحوظ فى الخصائص الحسية نتيجة اضافة اللبأ و زيادة محتوى العناصر المعدنية للزبادى المدعم باللبأ.
التوصية: توصى الدراسة باضافة اللبأ (السرسوب) الى اللبن المعد لصناعة الزبادى المقلب بنسب 10 أو 20% و ذلك لزيادة المواد المضادة للاكسدة و تحسين خواص القوام و الخواص الحسية للزبادى و كذالك زيادة محتوى الزبادى الناتج من العناصر المعدنية.