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Improvement of Some Parameters of White Soft Cheese by Adding Cinnamon and Thyme

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Abstract: This study was designed to show the effect of adding different levels of cinnamon and thyme for 30 days on some quality parameters of white soft cheese processed from buffaloe's milk. The cinnamon had a significant ($p<0.05$) effect on the flavor of the examined samples with all its concentration (0.01%, 0.03% and 0.05%) at 30 days storage. The results indicated that the fat/total solids, protein contents and titratable acidity were significantly ($p<0.05$) affected by storage period and spices type. The concentration of cinnamon 0.03% and 0.05% had a reduction significant ($P<0.05$) effect on Total Colony Count in comparing with thyme at 30 days storage. Coliforms couldn't be detected in cheese samples with cinnamon 0.01%, 0.03% and 0.05% at the end of storage period.

Key words: White soft cheese · Cinnamon · Thyme · Quality parameters · Coliforms

INTRODUCTION

Cheese is a nutrient-dense food made from cows, buffalo, goats, or sheep, by coagulation. The precise nutritional composition of cheese is determined by multifactorial parameters, including the type of milk used (species, breed, stage of lactation and fat content) and the manufacturing procedure [1]. In general, cheese is rich in the fat and casein constituents of milk, which are retained in the curd during manufacture and it contains relatively small amounts of the water soluble constituents (whey proteins lactose and water-soluble vitamins), which partition mainly into the whey. Like most dairy products, cheese is a rich source of minerals, protein, vitamin, fat and carbohydrate [2]. Cinnamon contains essential oils and all other categories like cinnamic acid, cinnamaldehyde and cinnamate. It has got good anti-inflammatory, anti-oxidant, anti-ulcer, anti-microbial, hypoglycemic and hypolipidemic potential, its flavour is due to an aromatic essential oil which makes up 0.5 to 1% of its composition [3].Thyme is a phytogenic feed additive belonging to the Labiatae family known as a source of essential oils. Thymol is the principal component and has gained much attention for its potential antioxidative and antimicrobial actions [4]. The present study aimed to investigate the effect of cinnamon and thyme on some parameters of white soft cheese at different storage periods.

MATERIALS AND METHODS

Buffaloe's milk was obtained from faculty of agriculture, Cairo University farm, Egypt. The examination of gross composition of Buffaloe's milk used in white soft cheese manufacture was done according to AOAC [5]. Microbial rennet was obtained from local market. Commercial edible grade table salt (sodium chloride) produced by El-Nasr company, Alex., Egypt was obtained from the local market. Calcium chloride was obtained from Sigma-Aldrich [6]. The leaves of thyme and cinnamon were obtained from local spices market at Cairo. They were grinded to fine powder before use.

White soft cheese was made from heated 42 Kg buffaloe's milk (65°C for 30 minutes then cooled to 50°C) as described by Mehaia [7]. Calcium chloride, salt and rennet were added at the ratio of 0.1%, 3.0% and 1 tablespoon/liter respectively, stirred well and set for 2 hours. The cheese curd was divided into seven equal portions as follow: cheese curd without additives (as plain). Thyme powder and cinnamon were added at

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ratios of 0.01%, 0.03% and 0.05%. Thyme and cinnamon were each added separetes to the curd cheese after drainage the whey with manual gentelly distribution, cheeses from different treatments were divided into parts packaging and stored into plastic containers, covering with salted whey (3% NaCl). The containers were tightly closed and stored at refrigerator (6±1°C) for 30 days.

Cheese samples were taken when fresh and after 10, 20 and 30 days for sensory evaluation, chemical and microbiological examination. All experiments were performed in triplicates, each analysis in triplicates and average results were recorded. The selected ratios of cinnamon, thyme were used based on the preliminary preference test by panelists.

Samples were carried out according to the scheme of Clark *et al.* [8], a panel test of 3 panelists (each sample) of the staff members of Food Hygiene & Control Department, Faculty of Veterinary Medicine, Cairo University. The cheese samples were evaluated for flavor (40 points), body & Texture (40 points), color & appearance (10 points), salts (5 points) and style (5 points).

Samples of white soft cheese were analyzed for moisture and ash contents as described by Bradley *et al.* [9]. The Gerber method was used for fat determination in cheese as described by ISO [10]. The Titratable Acidity (TA%) of cheese samples were determined as described in AOAC [5]. The Total Protein (TP%) were determined using formol titration method as described by Lanna & Laurenza [11] and Chang & Nielsen [12].

Ten gram of cheese sample was aseptically transferred with a sterile pipette to 90 ml of diluent 2% sodium citrate [6] for preparation the cheese homogenate. The primary dilution was shaked for 10 seconds using mechanical agitator to obtain a 1/10 dilution, then 1ml of primary dilution was transferred to 9 ml of sterilized diluents to obtain decimal serial dilutions [13]. The prepared dilutions were subjected to the following microbiological examinations:

Total Colony Count (TCC): According to ISO [14]; One ml of the previously prepared decimal dilutions were inoculated into duplicate plates of Standard Plate Count Agar [15] and incubated at 30°C for 72 hours.

Coliforms Count (CC): According to ISO [16]; One ml from each of the previously prepared decimal dilutions was inoculated into a series of three fermentation tubes containing Lauryl Sulphate Tryptose (LST) broth [15] supplemented with inverted Durham's tubes. Inoculated tubes and the control were incubated at 35°C for 48 hours. One ml of positive LST broth tubes (gas production) were inoculated into Brilliant Green Lactose Bile broth 2% [15] and incubated at 35°C for 48 hours. From the results obtained, MPN/gm was computed.

Statistical Analysis: According to SPSS [17]: The analysis of variance (ANOVA) test was conducted to test the possible significance (P=0.05) among mean values of parameters using Fishers Least Significance Difference (LSD).

RESULTS AND DISCUSSION

The fat, protein, lactose, Total Solids (TS), Solids Not Fat (SNF) and ash contents of buffaloe's milk used in white soft cheese manufacture (Table 1), were in accordance with EOS [18]. The concentration of thyme 0.01% in cheese gained the maximum total scores as compared to cheese samples containing the different spices and plain cheese at 10 days storage. The statistical analysis for total scores showed a significant differences (P<0.05) for treatments at 20 and 30 days storage. The score were affected by the type and concentration of spices powder. The cheese samples containing 0.01% cinnamon gained the highest scores compared to other treatments at day 20, while the samples containing 0.01% and 0.05% cinnamon gained the highest scores compared to other treatments at day 30 (Table 2).

Table (3) shows no significant differences (P>0.05) in the moisture contents of buffaloe's milk cheese from all treatments as compared to plain at zero day. However, this data indicated higher moisture content than specified in the Egyptian standards (not more than 62%; [19]). The moisture contents of cheese from different treatments increased slightly after 10 days of storage and a few decrease thereafter. The observed increase in the moisture after 10 days can be attributed to the low temperature storage, which would increase the water holding capacity of cheese matrix. However the developed acidity, thereafter would counter act this effect inducing curd contraction and decrease in the cheese moisture except with treatment of cinnamon 0.03% and 0.05% at 20 and 30 days storage, which increase with a significant differences (P<0.05). The present results are in agreement with Abd-El-Kader *et al.* [20] and Salama [21].

Table 1: Gross composition of Buffaloe's milk used in white soft cheese manufacture

Parameters	Buffaloe's milk
Fat %	7.50
Protein %	3.90
Lactose %	5.01
Total solids %	17.20
Solids not fat %	9.90
Ash %	0.78
pH value	6.62
Titratable acidity %	0.17

Table 2: Statistical analytical results of the examined cheese samples based on their Sensory Quality Parameters

Treatments	Plain	Thyme 0.01 %	Thyme 0.03 %	Thyme 0.05 %	Cinnamon 0.01 %	Cinnamon 0.03 %	Cinnamon 0.05 %
Items				Storage period (zeroday)			
Flavor (40)	40	40	40	39	40	40	40
Texture (40)	40	40	40	39	40	40	39
Color (10)	10	10	10	10	10	10	10
Salts (5)	5	5	5	5	5	5	5
Style (5)	5	5	5	5	5	5	5
Total (100)	100[a]	100[a]	100[a]	98[a]	100[a]	100[a]	99[a]
				Storage period (10days)			
Flavor (40)	39	40	39	40	40	40	40
Texture (40)	40	40	39	38	38	38	39
Color (10)	9	10	9	9	10	10	10
Salts (5)	4	5	5	5	5	5	5
Style (5)	4	5	5	5	5	5	5
Total (100)	96[a]	100[a]	97[a]	97[a]	98[a]	98[a]	99[a]
				Storage period (20days)			
Flavor (40)	35	35	35	38	39	37	39
Texture (40)	35	35	38	38	38	35	37
Color (10)	8	8	8	9	9	9	9
Salts (5)	3	3	3	3	4	3	3
Style (5)	3	4	3	4	4	4	4
Total (100)	84[a]	85[a]	87[a]	92[b]	94[b]	88[a]	92[b]
				Storage period (30days)			
Flavor (40)	30	30	35	35	38	37	38
Texture (40)	30	33	36	35	36	34	36
Color (10)	6	6	7	7	8	7	8
Salts (5)	3	3	3	3	3	3	3
Style (5)	3	3	3	3	3	3	3
Total (100)	72[a]	75[a]	84[b]	83[b]	88[b]	84[b]	88[b]

Average values with different alphabetical superscripts within row are significantly different at $P<0.05$.

The fat/TS% of cheese from different treatments was in accordance with the standard specification (45% to less than 60%) of full fat soft cheese [19] and no significant differences ($P>0.05$) in fat/TS% can be found of the plain cheese at all storage periods. The fat/TS% of cheese from different treatments was almost decreased during storage except the treatment with cinnamon 0.03% and 0.05% and a significant increased ($P<0.05$) in fat/TS% can be found in treatment with cinnamon 0.03% and 0.05% at 30 days storage. Similar results were reported by Abd-El-Kader *et al.* [20], Salama [21] and Fahmy & Hanafy [22].

The changes in proteins content of samples during storage were decreased after 10 days with progressive storage suggesting proteolysis, also these changes coincided with changes in cheese moisture content except the treatment with cinnamon 0.03% and 0.05% at 20 and 30 days storage which significantly increased ($P<0.05$). The addition of spices decreased growth and activity of cheese microflora [21,23,24].

The cheese acidity increased significantly ($P<0.05$) progressively during storage period suggesting protein degradation during storage in all treatments as well as the plain samples except the treatment with cinnamon with all

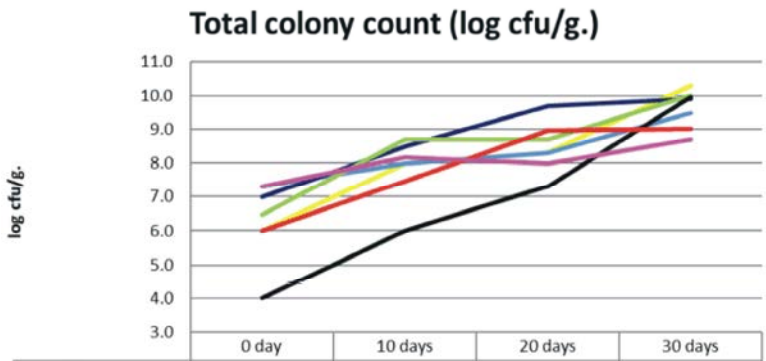
Table 3: Changes in moisture%, fat/TS%, TP%, TA% and ash% of the examined cheese samples as affected by added spices and storage period

Treatments	Fresh (zeroday)	Storage period (days) 10	20	30
		Moisture%		
Plain	61.66[a]	62.33[a]	61.33[a]	60.33[a]
Thyme 0.01%	62.66[a]	63.33[a]	62.33[a]	61.33[a]
Thyme 0.03%	62.33[a]	63.33[a]	60.66[a]	58.66[a]
Thyme 0.05%	62.33[a]	63.66[a]	61.33[a]	60.33[a]
Cinnamon 0.01%	62.33[a]	63.33[a]	61.33[a]	60.00[a]
Cinnamon 0.03%	63.61[a]	65.66[a]	67.33[b]	67.33[b]
Cinnamon 0.05%	63.62[a]	65.66[a]	68.66[b]	68.66[b]
		Fat / TS%		
Plain	51.41[a]	51.98[a]	51.22[a]	51.21[a]
Thyme 0.01%	50.90[a]	50.53[a]	50.47[a]	50.11[a]
Thyme 0.03%	50.13[a]	50.10[a]	50.09[a]	50.05[a]
Thyme 0.05%	48.67[b]	48.21[b]	47.99[b]	47.51[b]
Cinnamon 0.01%	53.54[a]	53.43[a]	53.21[a]	52.66[a]
Cinnamon 0.03%	53.38[a]	53.48[a]	53.70[a]	54.86[b]
Cinnamon 0.05%	53.56[a]	53.89[a]	53.99[a]	55.97[b]
		TP%		
Plain	14.59[a]	13.27[b]	12.00[b]	10.00[b]
Thyme 0.01%	14.08[a]	13.57[a]	13.15[a]	13.00[a]
Thyme 0.03%	14.62[a]	13.99[a]	13.44[a]	13.28[a]
Thyme 0.05%	14.66[a]	14.95[a]	14.86[a]	14.84[a]
Cinnamon 0.01%	14.81[a]	14.90[a]	15.33[a]	15.89[a]
Cinnamon 0.03%	15.01[a]	15.37[a]	16.53[b]	17.94[b]
Cinnamon 0.05%	15.24[a]	15.67[a]	16.88[b]	17.99[b]
		TA%		
Plain	0.23[a]	0.67[b]	0.99[b]	1.25[b]
Thyme 0.01%	0.23[a]	0.55[b]	0.78[b]	0.96[b]
Thyme 0.03%	0.23[a]	0.55[b]	0.69[b]	0.88[b]
Thyme 0.05%	0.23[a]	0.49[b]	0.50[b]	0.79[b]
Cinnamon 0.01%	0.22[a]	0.30[a]	0.37[a]	0.39[a]
Cinnamon 0.03%	0.21[a]	0.29[a]	0.31[a]	0.36[a]
Cinnamon 0.05%	0.21[a]	0.24[a]	0.28[a]	0.33[a]
		Ash%		
Plain	4.50[a]	3.90[a]	4.00[a]	4.79[a]
Thyme 0.01%	4.50[a]	4.00[a]	4.31[a]	4.83[a]
Thyme 0.03%	4.50[a]	4.00[a]	4.61[a]	4.90[a]
Thyme 0.05%	4.53[a]	4.00[a]	4.77[a]	4.98[a]
Cinnamon 0.01%	4.45[a]	4.00[a]	4.31[a]	4.63[a]
Cinnamon 0.03%	4.50[a]	4.00[a]	4.55[a]	4.77[a]
Cinnamon 0.05%	4.51[a]	4.00[a]	4.69[a]	4.92[a]

Average values with different alphabetical superscripts within row are significantly different at $P<0.05$.

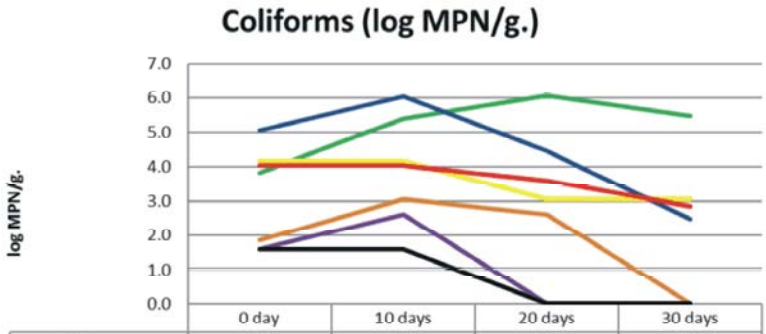
its concentrations non significantly increased ($P>0.05$). These results are in accordance with previous studies of Mehanna & Hefnaway [25] and Ahmed & Abd El–Razig [26]. The development of acidity can be attributed to the growth and activity of cheese microflora, while the development of acidity was slower in cheeses containing added spices especially that containing 0.05% cinnamon, which showed the lowest developed acidity due to the added spices reduce the growth and activity of cheese microflora. The present results are in agreement with Abou-Dawood [27], Abd-Alla *et al.* [28] and Hussein [29].

It is clear from the results obtained that ash contents of cheese greatly associated with moisture contents. At the beginning of the storage period there were no clear



	0 day	10 days	20 days	30 days
plain	6.0	8.0	8.3	10.3
Thyme 0.01%	7.3	8.0	8.3	9.5
Thyme 0.03%	7.0	8.5	9.7	9.9
Thyme 0.05%	6.5	8.7	8.7	10.0
Cinnamon 0.01%	4.0	6.0	7.3	10.0
Cinnamon 0.03%	6.0	7.5	9.0	9.0
Cinnamon 0.05%	7.3	8.2	8.0	8.7

Fig. 1: Statistical analytical results of Total Colony Count (log cfu/g) in the examined samples



	0 day	10 days	20 days	30 days
plain	3.8	5.4	6.1	5.5
Thyme 0.01%	5.0	6.0	4.4	2.5
Thyme 0.03%	4.2	4.2	3.0	3.0
Thyme 0.05%	4.0	4.0	3.6	2.8
Cinnamon 0.01%	1.6	2.6	0.0	0.0
Cinnamon 0.03%	1.8	3.0	2.6	0.0
Cinnamon 0.05%	1.6	1.6	0.0	0.0

Fig. 2: Statistical analytical results of Coliforms Count (logMPN/g) in the examined samples

differences between treatments, while ash contents of all samples were slightly decreased at 10 days, then increased till the end of storage period; there were no interaction between treatments and period affected non significantly ($P>0.05$).

Total Colony Count (TCC) is a prime consideration in examination of food. It gives numerical figure about the general hygienic quality of food. It reflects the sanitary measures adopted during production, handling and storage [30].

Figure (1) shows that the TCC of plain cheese significantly increased ($P<0.05$) through the storage period. Cinnamon concentration of 0.03% and 0.05% had the highest reverse significant ($P<0.05$) effect on TCC and thyme had non-significant ($P>0.05$) effect at 30 day. This suggests that the added cinnamon had antimicrobial effect on cheese microflora.

These results are in agreement with that of Abou-Dawood [27], Abd-Alla *et al.* [28] and Hussein [29]. Statistical analysis showed a significant differences ($P<0.05$) in TCC as affected by addition of cinnamon and storage period.

Coliforms Count (CC) is the traditional indicator of possible fecal contamination, microbial quality, wholesomeness and reflect the hygienic standards adopted in the food operation. One of the essential

Table 4: Correlation of spices concentration with sensory quality parameters and Coliforms Count of the examined samples

	Sensory quality parameters				Coliforms Count			
	Storage period (days)							
Spices concentration	0	10	20	30	0	10	20	30
Thyme 0.01%	+1**	+0.163**	+ 0.003**	+ 0.007**	+0.332**	+0.212**	- 0.127**	- 0.156**
Thyme 0.03%	+1**	+0.217**	+ 0.207**	+ 0.622*	+0.002**	- 0.136**	- 0.237**	- 0.005**
Thyme 0.05%	- 0.128**	+0.217**	+ 0.422*	+ 0.642*	+0.001**	- 0.121**	- 0.009**	- 0.006**
Cinnamon 0.01%	+1**	+0.135**	+ 0.532*	+ 0.403*	- 0.534*	- 0.677*	- 0.852*	- 0.821*
Cinnamon 0.03%	+1**	+0.135**	+ 0.134**	+ 0.622*	- 0.522*	- 0.631*	- 0.731*	- 0.821*
Cinnamon 0.05%	- 0.121**	+0.002**	+ 0.422*	+ 0.403*	- 0.534*	- 0.755*	- 0.852*	- 0.821*

Values equal to Correlation Coefficient (r).

* Significant difference, *p value* < 0.05.

** Non-significant difference, *p value* >0.05

quality characteristics of food is its sanitary quality, i.e that is produced, processed and handled under strict sanitary conditions. Lack of good sanitary practices may result in loss of quality, spoilage or in some cases create a health hazard [31].

Statistical analysis revealed a significant differences (P<0.05) in CC (Fig. 2) as affected by added spices and storage period. The count of Coliforms gradually increased till 10 days of storage, then decreased at the end of storage period probably due to the developed acidity which was not suitable for Coliforms growth. The count of Coliforms in all treatments lower than plain at 20 & 30 days storage and not detected in samples with cinnamon 0.01%, 0.03% and 0.05% at the end of storage period.

From the collectively achieved data between sensory quality parameters and microbiological examination of cheese samples, the 0.01%, 0.05%, 0.01% and 0.05% of cinnamon were given the best results at zero, 10, 20 and 30 days storage respectively.

Data illustrated in Table (4) reveal that a significant direct correlation between thyme 0.05%, cinnamon 0.01%, 0.05% and sensory quality parameters of the examined samples with correlation coefficient (r) of 0.422, 0.532 and 0.422 respectively (p<0.05) at 20 days storage. Also a significant direct correlation between thyme 0.03%, 0.05%, cinnamon 0.01%, 0.03%, 0.05% and sensory quality parameters with correlation coefficient (r) of 0.622, 0.642, 0.403, 0.622 and 0.403 respectively (p <0.05) at 30 days storage. This correlation revealed that the significant improvement of the sensory quality of examined cheese samples was associated with adding of thyme 0.05%, cinnamon 0.01%, 0.05% at day 20 & thyme 0.03%, 0.05% and cinnamon 0.01%, 0.03%, 0.05% at the end of storage period.

A significant reverse correlation between cinnamon 0.01%, 0.03%, 0.05% and Coliforms Count of the examined samples with correlation coefficient (r) of 0.677, 0.631, 0.755 & 0.852, 0.731, 0.852 & 0.821, 0.821 and 0.821 (p<0.05) at 10, 20 and 30 days storage respectively. This correlation revealed that a significant decrease the Coliforms Count of examined samples was associated with adding of cinnamon 0.01%, 0.03% and 0.05% at days 10, 20 and 30 (Table 4).

CONCLUSION

The use of cinnamon powder at concentration of 0.03% and 0.05% has a significant improving effect on the quality of white soft cheese processed from Buffaloe's milk during storage periods.

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