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QUALITY IMPROVEMENT OF DAMIETTA CHEESE USING SOME SPICES EXTRACT

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ABSTRACT

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The experiment was carried out to investigate the effect of some spices extract on the quality of Damietta cheese. The sensory evaluation of cheese supplemented with cumin oil only gave slightly pronounced flavor, compared with control one. The curcumin treated cheese showed faint-yellow color of slight good appearance. The microbiological quality revealed that cumin and N.sativa oils have strong antimicrobial effect against microbial groups than their aqueous extracts. Curcumin was found to be the most effective additives among the aqueous spices extract used. According to the effect of storage periods, there was a significant reduction of microbial groups in treated cheeses. The multiplication rates of microbial groups in control cheeses of 5 % salt were rapid compared with control one of 10 % salt during the storage periods. On contrary, the reduction rates of microbial groups were rapid in treated cheeses of 10 % salt compared with 5 % salt. Also, there was a high significant difference between treated cheeses and control one. Concerning salt concentration, there was a significant difference between both types of cheese (5 & 10 % salt) against all microbial groups, except *S.aureus*. Also, there was a significant difference for all microbial groups between cheeses of 5 % and 10 % salt in all cheese groups, except *S.aureus*. Fungal growth was observed at 21 days of storage over cheese surface and whey of control one of 5 % salt only.

Key words: *Spices extract, Damietta cheese.*

INTRODUCTION

Cheese is a food derived from different types of milk that is produced in a wide range of flavors and textures. There are several types of cheese which are grouped according to different criteria such as length of ageing, texture, manufacturing method, fat content, animal milk, country, etc. Damietta and Kareish cheeses are the most popular soft cheese in Egypt, usually made from salted raw whole or skim milk that are previously heated at 40°C by using rennet extract. Cheese made from raw milk usually carries large number of pathogenic or non-pathogenic microorganisms. In addition, cheese may be subjected to contamination during processing, handling and distribution from different sources by various types of microorganisms (Yousef *et al.*, 2001). Different outbreaks were reported as a result of consumption of different types of cheese (WHO, 2002).

Common herbs or spices may be added to some cheeses as flavoring agents including N.sativa , bitter cumin, red and green peppers, garlic, black pepper, caraway, parsley (Hassanein *et al.*, 2014). Levels of the additives are typically less than 1 % of the curd (Hayaloglu and Farkye, 2011). Spices as natural plant foodstuffs are common dietary adjuncts that contribute to the taste and flavor of food, stabilize the food from microbial deterioration and offer a promising for food safety. It was recorded that spices and their derivatives have inhibitory activity on the growth of bacteria, fungi and their toxins, so, they could be used in food industry to assure the production of microbiologically stable food (Kizil and Sogut, 2003). Therefore, this study was carried out to investigate the effect of some spices extract on sensory attributes and microbiological quality of Damietta cheese supplemented with these spices.

MATERIALS and METHODS

Preparation of spices extract

Bitter Cumin and N.sativa aqueous extracts were prepared according to (Arora and Kaur 1999), where good quality seeds were first cleaned using sterile dist. water to remove any dirt or debris, dried in laminar flow biological safety cabinet, and then ground using sterile electric blender. Water extract was prepared by adding 100 ml of sterile de-ionized dist. water to 20 grams of the powder in sterile wide-mouth screw-capped bottles (200 ml volume), allowed to soak for 24 hours at 5°C, then the mixture was centrifuged at 3000 rpm for 10 minute and the supernatants were filtered. Curcumin aqueous extract was prepared by boiling 10 % curcumin powder solution using sterile dist. water, left for sedimentation and then filtered. (Murad, 1998). Cumin and N. sativa cold pressed oils were purchased from local market.

Preparation of Damietta cheese (Abou-Donia, 1991):

Cheeses were manufactured in Dairy Technology Unit, Fac. Agriculture, Suez Canal Univ., Ismailia., Egypt. Two quantities (30 litters each) of good quality raw cow's milk obtained from Fac. Vet. Med. Farm, Suez Canal Univ., Ismailia, Egypt, were thoroughly strained using clean, dry and sterile gauze into sterile double-jacketed vats. The milk was heated to 45°C and salted using clean, fine and dry salt to give final concentrations of 5 % and 10 %, where the salt was dissolved in a small part of milk and then mixed with original milk. Rennet extract (Powder) was added in appropriate concentration. Each quantity of milk was thoroughly divided into six parts (each 5 liter), the first part was taken as control (untreated) and the other five parts were treated with chosen concentrate of different spices according to the previous recommended studies which reveal the most antibacterial activity with acceptable flavors. The first part was treated with 3 % bitter cumin aqueous extract (Megahed and Hafez, 2012), the second part with 3 % N. sativa water extract (Alsawaf and Alnaemi, 2011), the third part with 0.3 % curcumin aqueous extract (Hosny *et al.*, 2011), the fourth part with 0.3 % bitter cumin oil (Omar, 2014) and the fifth part with 0.3 % N. sativa cold pressed oil (Alsawaf and Alnaemi, 2012). The treated milks and control one were kept at 45°C for 3 hours until curd formation and then the curd was pressed in a stainless steel mold lined with a clean sterile cloth for 12 hours. The finished curd was preserved in its whey in refrigerator at 5°C±1. Control and treated cheese samples were subjected for sensory and microbiological evaluation at times 0, 7, 14, 21 and 30 days.

Sensory evaluation

Damietta cheese samples were subjected for sensory evaluation (taste & odor and color & appearance). The evaluation was carried out by 10 untrained panelists compromising staff members and post-graduate students in Food Hygiene Department, Fac. Vet. Med., Suez Canal Univ, Egypt, to judge the sensory attributes according to Lawless and Hildegrade (2010). They were informed and trained to understand the used words and sensory scores.

Microbiological evaluation

Tenth-fold serial dilutions were prepared using sterile peptone water (APHA, 2004). Microbial groups were enumerated including total bacterial count (TBC) using standard plate count agar (Merck, Art. Nr., 1621), *Enterobactriacae* count using double layer of violet red bile glucose agar (Merck, Art. Nr., 1406), Enterococci count using Kanamycin Escculin Azide agar (Merck, Art. Nr., 5222) and Yeast and mold count (YMC) using yeast extract chloramphenicol glucose agar (Merck, Art. Nr., 16000) according to APHA (2004). *S.aureus* was enumerated using Baired-Parker agar (CM0275- Oxoid, Hampshire, England) according to Finegold and Martin (1982). Fungal growth was visually observed at 2 days interval on cheese surfaces and whey of both control and treated Damietta cheese.

Statistical analysis

Data were analyzed using the two-ways analysis of variance (ANOVA) according to the general linear model procedures. Logarithmic transformations were applied for all microbiological counts. Mean separations were done through Duncan's Multiple Range Test using the Statistical Analysis System, SAS 9.2, (SAS Institute, Inc., 2009). Results were considered statistically significant at ($P \leq 0.05$).

RESULTS

The results of sensory and microbiological quality of control and treated Damietta cheeses were represented in Tables 1 – 6.

Table 1: The sensory evaluation of control and treated cheeses.

Cheese groups	5 % common salt					10 % common salt				
	Storage periods					Storage periods				
	Zero day	7 day	14 day	21 day	30 day	Zero day	7 day	14 day	21 day	30 day
Control cheese										
Flavor (taste & odor)	7.0±0.01	7.0±0.01	6.9±0.01	F.G.	F.G.	7.1±0.01	7.1±0.01	7.3±0.01	7.3±0.01	7.4±0.01
Color & appearance	8.0±0.01	8.0±0.01	7.6±0.01	F.G.	F.G.	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01
Cumin extract										
Flavor (taste & odor)	7.0±0.01	7.0±0.01	7.1±0.01	7.2±0.01	7.2±0.01	7.1±0.01	7.1±0.01	7.2±0.01	7.2±0.01	7.3±0.01
Color & appearance	8.0±0.01	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01
Cumin oil										
Flavor (taste & odor)	5.0±0.01	4.9±0.01	4.9±.0.01	4.9±0.01	4.9±0.01	5.0±0.01	4.9±0.01	4.9±0.01	4.9±0.01	4.9±0.01
Color & appearance	8.0±0.01	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01
N.sativa extract										
Flavor (taste & odor)	7.0±0.01	7.0±0.01	7.1±0.01	7.2±0.01	7.2±0.01	7.1±0.01	7.1±0.01	7.2±0.01	7.3±0.01	7.4±0.01
Color & appearance	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01
N.sativa oil										
Flavor (taste & odor)	7.0±0.01	7.0±0.01	7.1±0.01	7.2±0.01	7.2±0.01	7.1±0.01	7.1±0.01	7.0±0.01	7.3±0.01	7.3±0.01
Color & appearance	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01	8.0±0.01	8.0±0.01	8.1±0.01	8.1±0.01	8.1±0.01
Curcumin extract										
Flavor (taste & odor)	7.0±0.01	7.0±0.01	7.1±0.01	7.2±0.01	7.2±0.01	7.1±0.01	7.1±0.01	7.2±0.01	7.3±0.01	7.4±0.01
Color & appearance	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01	6.2±0.01

Scores using 9 point hedonic scale (9=excellent, 8=very good, 7=good, 6=slight good, 5 = fair, 4=slight bad, 3=bad, 2=very bad, 1=extremely bad)
F.G. = Fungal growth

Table 2: The effect of spices on Logarithmic total bacterial count in Damietta cheese with special reference to its effect 1) among groups; 2) storage periods; 3) salt conc.; 4) salt conc. and storage periods and 5) salt conc. and groups.

1. Cheese groups	5 % common salt					10 % common salt					Total group
	Zero d	7 d	14 d	21 d	30 d	Zero d	7 d	14 d	21 d	30 d	
Control	6.90308	6.97313	7.86332	7.94448	8.96379	6.79885	6.82276	6.89139	7.10848	7.32607	7.39253706^{a}
Cumin extract	6.89763	6.73308	5.59106	4.32221	4.24139	6.83885	5.66275	4.60443	4.10848	4.00607	6.30329531^{b}
Cumin oil	6.78533	6.51851	5.99563	5.74036	4.50515	6.50514	5.38021	4.07918	3.83251	3.95904	5.33010844^{c}
N.sativa extract	6.91907	6.57506	6.30309	5.83885	5.83251	6.07918	6.07432	5.11763	4.61278	4.59106	5.93345744^{bc}
N.sativa oil	6.83885	6.26848	6.14509	5.86332	4.00000	6.36172	6.33251	5.13978	3.79934	3.36172	5.44508417^{bc}
Curcumin extract	6.89209	6.83885	5.75587	4.90848	4.79934	6.32223	5.85126	4.47712	4.32221	3.68124	5.38487035^{c}
											p-value = 0.001
2. Storage periods	Zero day		7 day		14 day		21 day		30 day		**p-value = 0.001**
	6.68183710^{a}		6.43766242^{a}		6.00588201^{ab}		5.58346202^{bc}		5.11561705^{c}		
3. Salt conc.	5 % salt					10 % salt					**p-value = 0.013**
	6.26757270^{a}					5.66221155^{b}					
4. Salt conc. *storage periods	5 % zero	5 % * 7 d	5 % *14 d	5 %*21d	5 % 30 d	10 * zero	10 %*7d	10 % *14d	10 %*21d	10 %*30 d	**p-value = 0.011**
	6.87268^{a}	6.846187^{a}	6.49234^{b}	5.76962^{c}	5.35702^{d}	6.49099^{b}	6.02913^{b}	5.51942^{c}	5.39730^{cd}	4.87420^{e}	
5. Cheese groups * salt concentration											
	Control		Cumin extract		Cumin oil		N.sativa extract		N.sativa oil		Curcumin extract
5 % salt	7.72956^{a}		5.55107^{cd}		5.90899^{bcd}		6.47372^{abc}		6.10315^{bcd}		5.83892^{bcd}
10 % salt	7.05551^{ab}		7.05551^{ab}		4.75122^{d}		5.39319^{cd}		4.78701^{d}		4.93081^{d}
	p-value = 0.023										

Log counts with different superscripts showed highly significant differences at ($P \leq 0.01$).
The original counts can be obtained by the antilogarithm (Base 10) of these results.

Table 3: The effect of spices on Logarithmic total *Enterobacteriaceae* count in Damietta cheese with special reference to its effect 1) among groups; 2) storage periods; 3) salt conc.; 4) salt conc. and storage periods, and 5) salt conc. and groups.

1. Cheese groups	5 % common salt					10 % common salt					Total group
	Zero d	7 d	14 d	21 d	30 d	Zero d	7 d	14 d	21 d	30 d	
Control	4.49136	4.59106	5.47712	5.53147	5.77815	4.43136	4.51954	4.56239	4.76332	4.7834	4.72092^{a}
Cumin extract	4.59106	4.47712	4.43136	4.37712	3.36172	4.66275	4.74818	4.38021	3.72607	3.46239	4.34180^{abc}
Cumin oil	4.61278	4.57978	4.31278	3.74818	3.77815	4.57978	4.54406	3.90848	2.78532	2.66646	3.97828^{cd}
N.sativa extract	4.59106	4.46239	4.39239	4.34509	3.82406	4.62324	4.25527	4.32221	3.98677	3.83250	4.42550^{ab}
N.sativa oil	4.95424	4.95424	4.90309	3.74036	3.57978	4.60000	3.81954	3.78532	2.55630	2.25527	3.84975^{d}
Curcumin extract	4.54406	4.47712	4.16848	3.82941	3.65904	4.37875	4.24242	3.86275	3.65733	2.69019	4.17095^{bcd}
											p-value = 0.002

2. Storage periods	Zero day	7 day	14 day	21 day	30 day	**p-value = 0.001**
	4.52582^{a}	4.50589^{a}	4.47555^{a}	4.01223^{b}	3.71984^{b}	

3. Salt conc.	5 % salt	10 % salt	**p-value = 0.001**
	4.59280^{a}	3.90293^{b}	

4. Salt conc. *storage periods	5 % zero	5 % * 7 d	5 % *14 d	5 %*21d	5 % 30 d	10 * zero	10 %*7d	10 % *14d	10 %*21d	10 %*30 d	**p-value = 0.034**
	4.63076^{ab}	4.59028^{ab}	4.86420^{a}	4.54527^{ab}	4.33348^{ab}	4.42088^{ab}	4.42150^{ab}	4.08690^{b}	3.47918^{c}	3.10621^{c}	

5. Cheese groups * salt concentration

	Control	Cumin extract	Cumin oil	N.sativa extract	N.sativa oil	Curcum extract
5 % salt	5.17383^{a}	4.46767^{abcd}	4.26633^{bcd}	4.64700^{ab}	4.42634^{abcd}	4.57562^{abc}
10 % salt	4.26801^{bcd}	3.21592^{b}	3.29022^{de}	3.20400^{cd}	3.27316^{e}	3.76629^{cde}
			p-value = 0.046			

Log counts with different superscripts showed significant differences at ($P \leq 0.05$).
The original counts can be obtained by the antilogarithm (Base 10) of these results.

Table 4: The effect of spices on Logarithmic total Enterococci count in Damietta cheese with special reference to its effect 1) among groups; 2) storage periods; 3) salt conc.; 4) salt conc. and storage periods and 5) salt conc. and groups.

1. Cheese groups	5 % common salt					10 % common salt					Total group
	Zero d	7 d	14 d	21 d	30 d	Zero d	7 d	14 d	21 d	30 d	
Control	4.77815	4.81954	4.90848	5.41497	5.81497	4.79209	4.80848	4.87506	4.9218	4.97136	4.35823^{a}
Cumin extract	4.89209	4.83885	4.77815	4.68124	3.98677	4.83884	4.85630	4.58649	3.95904	2.92941	4.43472^{a}
Cumin oil	4.93952	4.25424	3.92427	3.25424	2.98677	4.86172	4.38081	3.64345	2.36172	2.25527	3.80620^{bc}
N.sativa extract	4.93449	4.84509	4.69897	4.15125	3.34242	4.83239	4.71291	3.62324	2.44509	2.04139	3.97272^{ab}
N.sativa oil	4.65321	4.22427	3.67712	2.47209	2.01897	4.27875	3.59106	2.55242	2.34630	2.28346	3.36276^{c}
Curcumin extract	4.95424	4.78532	4.64345	3.86332	3.77815	4.74242	4.27875	3.62324	2.78532	2.56820	3.96224^{ab}
											p-value = 0.001

2. Storage periods	Zero day	7 day	14 day	21 day	30 day	**p-value = 0.002**
	4.71649^{a}	4.66630^{a}	3.93536^{b}	3.50198^{bc}	3.09393^{c}	

3. Salt conc.	5 % salt	10 % salt	**p-value = 0.000**
	4.33316^{a}	3.63247^{b}	

4. Salt conc. *storage periods	5 % zero	5 % * 7 d	5 % *14 d	5 %*21d	5 % 30 d	10 * zero	10 %*7d	10 % *14d	10 %*21d	10 %*30 d	**p-value = 0.009**
	4.85862^{a}	4.82788^{a}	4.20507^{b}	4.23952^{b}	3.53467^{c}	4.57437^{ab}	4.50472^{ab}	3.66565^{c}	2.76444^{d}	2.65318^{d}	

5. Cheese groups * salt concentration

	Control	Cumin extract	Cumin oil	N.sativa extract	N.sativa oil	Curcumin extract
5 % salt	4.66722^{a}	4.635421^{a}	4.11181^{b}	4.53444^{ab}	3.64513^{bc}	4.40489^{ab}
10 % salt	4.04923^{b}	4.23402^{b}	3.50059^{bc}	3.41100^{bc}	3.08040^{c}	3.51959^{bc}
			p-value = 0.036			

Log counts with different superscripts showed significant differences at ($P \leq 0.05$).
The original counts can be obtained by the antilogarithm (Base 10) of these results.

Table 5: The effect of spices on Logarithmic total yeast and mould count in Damietta cheese with special reference to its effect 1) among groups; 2) storage periods; 3) salt conc.; 4) salt conc. and storage periods and 5) salt conc. and groups.

1. Cheese groups	5 % common salt					10 % common salt					Total group
	Zero day	7 day	14 day	21 day	30 day	Zero day	7 day	14 day	21 day	30 day	
Control	3.04139	3.34612	3.84242	4.90308	5.00000	3.24100	3.30884	3.70209	4.11122	4.60607	4.09813[a]
Cumin extract	3.32607	3.13951	3.04818	2.26205	2.01875	3.32221	3.01136	2.30103	2.07918	2.3044	3.88188[b]
Cumin oil	3.14612	3.11394	3.07918	3.07918	2.04139	3.21100	3.11222	3.01527	2.36173	2.00000	2.63990[b]
N.sativa extract	3.37918	3.11394	3.14162	3.07918	2.01000	3.34242	3.17609	3.01468	2.75587	2.53147	3.02243[b]
N.satva oil	3.31394	3.10411	3.04139	2.95424	2.00000	3.59242	3.34106	2.61278	1.79934	1.75587	2.74152[b]
Curcumin extract	3.31344	3.14612	3.00613	2.17609	2.04139	3.34242	3.05527	2.44715	2.04139	1.94448	2.66544[b]
											p-value = 0.002
2. Storage periods	Zero day		7 day		14 day		21 day		30 day		**p-value = 0.031**
	3.38917[a]		3.61155[a]		3.33431[a]		2.98521[ab]		2.55415[b]		
3. Salt conc.	5 % salt					10 % salt					**p-value = 0.028**
	3.42144[a]					2.92832[b]					
4. Salt conc.*days	5 % zero	5 % * 7 d	5 % *14 d	5 %*21d	5 % 30 d	10 * zero	10 %*7d	10 % *14d	10 %*21d	10 %*30 d	**p-value = 0.209**
	3.72011[a]	3.61063[a]	3.58390[a]	3.46564[a]	2.72692[a]	3.058247[a]	3.61247[a]	3.08472[a]	2.50479[a]	2.38139[a]	
5. Cheese groups * salt concentration											
	Control		Cumin extract		Cumin oil		N.sativa extract		N.sativa oil		Curcum extract
5 % salt	3.88660[ab]		3.07891[bc]		2.89169[cd]		3.08368[cd]		2.86273[cd]		2.92474[d]
10 % salt	4.30964[a]		2.68484[d]		2.18784[c]		2.96117[d]		2.62029[d]		2.00614[c]
					p-value = 0.006						

Log counts with different superscripts showed significant differences at ($P \leq 0.05$).
The original counts can be obtained by the antilogarithm (Base 10) of these results.

Table 6: The effect of spices on Logarithmic *S.aureus* count in Damietta cheese with special reference to its effect 1) among groups; 2) storage periods; 3) salt conc.; 4) salt conc. and storage periods and 5) salt conc. and groups.

Log counts with different superscripts showed significant differences at ($P \leq 0.05$).

1. Cheese groups	5 % common salt					10 % common salt					Total group
	Zero d	7 d	14 d	21 d	30 d	Zero d	7 d	14 d	21 d	30 d	
Control	3.41497	3.46239	3.51851	4.47712	4.71600	3.38021	3.66607	3.82275	3.90845	3.99934	3.91658[a]
Cumin extract	3.65978	3.57321	3.49136	2.45527	2.30103	3.61278	3.32221	2.99563	2.77609	2.25527	2.96426[b]
Cumin oil	3.49136	3.44715	2.61278	1.95424	0	3.46239	2.04139	1.06332	0	0	2.55323[bc]
N.sativa extract	3.37103	3.32221	3.25527	3.00000	2.54139	3.80172	3.10617	2.32221	2.07918	1.89209	2.73813[bc]
N.sativa oil	3.50514	2.44715	2.38021	1.47712	0	3.24139	2.46239	1.99122	0	0	2.47209[bc]
Curcumin extract	3.32222	2.57978	2.07918	1.00000	0	3.10000	2.15527	2.00000	0	0	2.31949[c]
											p-value = 0.001
2. Storage periods	Zero day		7 day		14 day		21 day		30 day		**p-value = 0.003**
	3.37275[a]		3.05212[ab]		2.68104[bc]		2.36972[c]		2.83418[bc]		
3. Salt conc.	5 % salt					10 % salt					**p-value = 0.057**
	2.96614[a]					2.81323[a]					
4. Salt conc. *storage periods	5 % zero	5 % * 7 d	5 % *14 d	5 %*21d	5 % 30 d	10 * zero	10 %*7d	10 % *14d	10 %*21d	10 %*30 d	**p-value = 0.201**
	3.43575[a]	3.15198[a]	2.88954[a]	2.36062[a]	3.0194[a]	3.30975[a]	2.95225[a]	2.47252[a]	2.38791[a]	2.64890[a]	
5. Cheese groups * salt concentration											
	Control		Cumin extract		Cumin oil		N.sativa extract		N.sativa oil		Curcumin extract
5 % salt	3.91780[a]		3.05613[a]		2.87638[a]		2.98398[a]		2.45241[a]		2.24529[a]
10 % salt	3.91537[a]		2.87240[a]		2.12237[a]		2.49228[a]		2.49833[a]		2.41842[a]
					p-value = 0.120						

The original counts can be obtained by the antilogarithm (Base 10) of these results.

DISCUSSION

Weak organic acids are the most classical preservative agents, but now there has been increase concern of consumers about food free or with lower level of chemical preservatives, because these could be toxic for human. So, natural antimicrobial preservatives are used in food industry either to control natural spoilage of food, or to control disease producing organisms. Other benefits are decreasing the development of antibiotic resistance pathogens or strengthening immune system of human being (Gaysinsky and Weiss, 2007).

Cheeses treated with aqueous extract of cumin, N.sativa and curcumin were gave unchanged flavors (taste and odor) during the first two weeks. As the ripening period progress, the flavor characteristics were gradually increased leading to improvement of organoleptic properties, compared with control one. These findings were in agreement with Hosny *et al.* (2011); Samir *et al.* (2013) and Hassanein *et al.* (2014). On contrary, cheese treated with cumin oil gave slightly pronounced flavor of fair quality (score: 5.0 vs. 7.0). Similar findings were reported by Li and Jiang (2004), who proved that cumin oil has a distinctive flavor and strong warm aroma due to the essential oil contents. Moreover, the curcumin treated cheese showed faint-yellow color of slight good appearance (score: 6.2 vs 8.0); these findings were run parallel to those reported by Hosny *et al.* (2011).

Concerning the microbiological quality of cheeses, cumin oil showed a stronger antimicrobial effect than cumin aqueous extract leading to rapid reduction of the microbial groups in treated cheeses, compared with initial count (0 day), These findings were run parallel to that obtained by Dorman and Deans (2000), who reported that essential oils have strong effect than spices itself or its aqueous extract. The antibacterial activity of bitter cumin could be attributed to a number of polyphenolic compounds including gallic acid, protocatechuic acid, caffeic acid, ellagic acid, ferulic acid, as well as flavonoid compounds such as quercetin and kaempferol (Ani *et al.,* 2006). Also, they proved in an experiment that Gram-positive bacteria were found to be more sensitive to bitter cumin extracts than Gram-negative bacteria. The bacterial species *B. subtilis, B. cereus* and *S. aureus* were found to be highly sensitive and showed a significant inhibition of the growth in the presence of bitter cumin extract. *Enterobacter spp.* and *L. monocytogenes* were moderately inhibited, while *E. coli* and *Y. enterocolitica* were resistant to bitter cumin extract. They explained that the antibacterial activity of flavonoids was attributed to the inhibition of the synthesis of DNA and RNA and other related macromolecules. Further, it was found that phenolic compounds with more than three 3-OH possess antibacterial activity.

N.sativa oil was more effective than N. sativa aqueous extract causing rapid reduction to all microbial groups in treated cheeses, compared with initial count (0 day). The obtained results go hand to hand with those reported by Wahba *et al.* (2004); Badawi *et al.* (2009) and Alsawaf and Alnaemi (2011), who recorded a rapid reduction of microbial counts in soft cheese containing N.sativa seed and oil added during preparation. Burits and Bucar (2000) attributed the microbial reduction to presence of Thymoquinone TQ (2-isopropyl-5-methyl-benzoquinone) which was considered as one of the major components of N.sativa volatile oils and fixed oils. Kahasi (2002) explained that antimicrobial effect of TQ was related to the inhibition of RNA and protein synthesis. In addition, the unsaturated bicyclic monoterpene hydrocarbon which also present in N. sativa oil exerts antibacterial action. Therefore, bacterial types present in cheeses treated with N. sativa oil will be more exposed to the antibacterial action than those present in cheeses treated with N. sativa seed. Ahn *et al.* (2004) found that the antimicrobial action of bioactive compounds in N.sativa oil which mainly contain phenolic compounds cause bacteriostatic and antiproliferative actions against bacterial growth. Luther *et al.* (2007) proved that N.sativa oil characterized by high level of phenolics which are considered as powerful active compounds expressing strong antimicrobial activities. Bettaieb *et al.* (2010) attributed this activity mainly to their redox potential, which can play an important role in adsorbing and neutralizing free radicals and chelating metals, especially iron and copper cations.

Curcumin extract was found to be the most effective additives among the aqueous spices extract used giving a rapid reduction to all microbial groups in treated cheeses, compared with initial counts. The obtained results were in agreement with those reported by Murad (1998); Tajbakash *et al.* (2008) and Hosny *et al.* (2011), who found that Curcumin has wide spectra of antibacterial activity against Gram-negative and Gram-positive pathogenic or non-pathogenic bacteria in soft cheese. The antibacterial activity of Curcumin was related to the presence of compounds belonging to flavonoids and terpens particularly to borneol, cymene, cuparene, p-tolymethyl-carbinol, curcumin and careen (Thongson *et al.,* 2005). In addition, Curcumin has wide spectra of biological actions such as anti-inflammatory (Puntihavathi *et al.,* 2000), antifungal activities, (Chatopadhyay *et al.,* 2004), antidiabetic (Lotempio *et al.,* 2005), antiviral (Suzuki *et al.,* 2005), antiallergic (Aggarwal *et al.,* 2007) and anticancer (Menon and sudheer, 2007). Curcumin contains a mixture of powerful antioxidant phytonutrients known as Curcuminoids that inhibits cancer at initiation, promotion and progression stages of tumor development. Also, it is a strong anti-oxidant which supports colon health, exerts neuroprotective activity

and helps to maintain a healthy cardiovascular system (Siddiqui *et al.,* 2006).

Regarding the comparison between both types of control and treated cheeses, the microbial groups showed rapid multiplication rates in control cheeses of 5 % salt, compared with control one of 10 % salt along the storage periods. These findings agree with those obtained by Alsawaf and Alnaemi (2011), who found that control cheese of 10 % salt revealed slightly increase in microbial counts which may be attributed to the high concentration of sodium chloride used in manufacturing. On contrary, the reduction rates of the microbial groups were rapid in treated cheeses of 10 % salt, compared with 5 % salt, these findings explained the role of spices in improvement the microbial quality of cheeses especially that manufactured from raw milk. Also, there was a high significant difference for the microbial groups between treated cheeses and control one (p-value 0.001 - 0.002). These findings were run parallel to that reported by Hayaloglu and Farkye (2011), who attributed that to the combined effect of salt and spices extract.

With regard to the effect of storage periods on the microbial groups tested, the statistical results point out that TBC, *Enterobactericeaea* and Enterococci, compared with 0 day, showed highly significant reduction (p-values 0.001 - 0.003), while YMC showed a significant reduction (p-value 0.031) in both types (5 & 10 % salt) of treated cheeses.

According to the effect of salt concentration on the microbial groups, the total results indicated that both TBC and YMC showed significant reduction (p-value $\leq$ 0.05), while both *Enterobactericeae* and Enterococci showed high significant reduction (p-value 0.001), whereas *S.aureus* showed no significance (p-value 0.57). Concerning salt concentration and cheese groups, there was a difference between cheeses of 5 % and 10 % salt in all cheese groups ranged from significant (p-value $\leq$ 0.05) to high significant (p-value 0.006) for all the affected microbial groups, except *S.aureus* that showed un significant difference (p-value 0.120). These findings were supported by Kang and Park (1984), who found that the high concentration of sodium chloride (10 %) probably inhibits the growth of many microorganisms by raising the osmotic pressure of the brine leading to migration of water inside the microbial cell through the membrane into the brine causing a partial dehydration of the cell and consequently slows metabolic processes resulting in interference with the multiplication of the microorganisms (Sumner *et al.,* 1990). The failure of high salt content to affect *S.aureus* was probably attributed to that the organism was salt tolerant (Bruins *et al.,* 2007).

The fungal growth were observed at 21 days of storage over cheese surface and whey in control cheese of 5 % salt only, The obtained findings explained the role of spices in inhibiting the fungal growth in soft cheese of low salt content. These results were supported by those obtained by Murad (1998), who found that some natural extracts can control yeast growth in yoghurt. Also, the absence of fungal growth in control cheese of high salt content (10%) and in other treated cheeses along the storage periods supported these findings.

It could be conclude that addition of the selected spices to soft cheese will improve its sensory and microbial quality, moreover, some of spices can eliminate *S.aureus*, as food poisoning microorganisms, from soft cheeses. Therefore, cheese contained natural compounds may become an important approach for many consumers, to achieve their desires, to reduce the risk of diseases and to treat minor illnesses. Also, the uses of essential oils have strong antimicrobial effect than the spices itself or its aqueous extract.

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تحسيين جودة الجبن الدمياطي باستخدام مستخلصات بعض البهارات

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تم إجراء الدراسة التجريبية لتقييم تأثير اضافة بعض أنواع من مستخلص البهارات (الكمون، حبة البركة والكركم) علي جودة الجبن الدمياطي. وقد أظهرت نتائج التقييم الحسي أن الجبن المضاف له زيت الكمون قد تميز بالطعم والرائحة النفاذة البسيطة ، بينما أظهرت أنواع الجبن المضاف اليها أنواع البهارات الأخري عدم وجود أى اختلاف في الطعم والرائحة مقارنة بالجبن العادي. وقد تميز الجبن المضاف اليه الكركم باللون الأصفر الباهت ذات لون جيد قليلا.. وقد أثبتت نتائج التقييم الميكروبيولوجي أن كلا من زيت الكمون وزيت حبة البركة كان أكثر فاعلية عن المستخلص المائي لهما ضد مجموعات الميكروبات التي تم فحصها. أما مستخلص الكركم المائي فقد وجد أنه الأكثر تأثيرا من بين المستخلص المائي للبهارات المستخدمة ضد مجموعات الميكروبات المختبرة. وطبقا لتأثير فترة التخزين ، وجد زيادة معنوية في معدل تكاثر الميكروبات المختبرة في الجبن الدمياطي الغير معالج بالبهارات المحتوي علي ٥ % ملح طعام عن نفس نوع الجبن المحتوي علي ١٠ % ملح طعام. وبالعكس وجد انخفاض معنوي لكل المجموعات المختبرة في الجبن المعالج بمستخلص البهارات ويحتوي علي ٥ % ملح طعام عن الجبن المحتوي علي ١٠ % ملح طعام. وقد وجد فرق معنوي للميكروبات المختبرة في الجبن المعالج بالبهارات عن الجبن الغير معالج. وبالنسبة لتركيز الملح وجد فرق معنوي بين نوعي الجبن (٥ % وال ١٠ % ملح طعام) ضد كل الميكروبات ما عدا الميكروب المكور العنقودي الذهبي ، وقد وجد أيضا فرق معنوي بين كل مجموعات الجبن التي تم اختبارها المحتوية علي ٥ % و ١٠ % ملح طعام.. وقد أثبتت نتائج الملاحظة العينية ظهور نمو الفطر والخمائر علي سطح الجبن الغير معالج بالبهارات (٥ % ملح طعام) والشرش الخاص به فقط عند ٢١ يوم من بدء التجربة.