Healthy Value and Quality Characteristics of Yoghurt as Affected by Different Concentrations of Cinnamon and Dill Ethanolic Extracts

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Abstract: This work was carried out to evaluate the effect of addition of ethanolic extract of cinnamon bark (Ci) and dill (D) seed on health value and quality of resultant yoghurt. These extracts were added at levels of 0.0, o.2, 0.4, 0.6, and 0.8 gm/l to cow's milk. Addition of these extracts significantly reduced the time of yoghurt coagulation and decreased the pH values significantly. Also these extracts significantly increased the antioxidant activity and Total Phenolic Content (TPC) of resultant yoghurt. Treated yoghurt also showed significant higher content of acetaldehyde and diacetyle than control yoghurt. Also treated yoghurt showed lower synersis and higher values for firmness and apparent viscosity than control. Addition of cinnamon up to 0.6 gm/l and dill extract at 0.4 gm/l showed acceptable organoleptic properties for resultant yoghurt. More over Ci extract was more effective than D extract in improving organoleptic properties.

***Keywords*:** Yoghurt, Cinnamon, Dill ethanolic extracts, Antioxidant activity, Total Phenolic Content.

INTRODUCTION

The oxidative stability of milk and dairy products is of concern to the dairy industry. Oxidation processes in milk can result in strong off-flavors and deterioration of the nutritional quality of milk. The oxidative stability of milk and dairy products is the result of a delicate balance between the anti- and pro-oxidative processes in milk influenced by factors such as degree of fatty acid unsaturation, content of transition metal ions, and content of antioxidants as tocopherols and carotenoids.

However, factors such as processing, packaging and storage conditions also affect the shelf-life of pasteurized milk, since the two main mechanisms of milk quality deterioration are chemical oxidation through oxygen permeation and light-induced oxidation. At this moment, the oxidative stability of milk and dairy products in function of time is monitored by measuring lipid oxidation (lipid hydroperoxides, thiobarbituric acid reactive species, hexanal, volatile lipid oxidation), protein oxidation (dityrosine, carbonyl assay, free sulphydryl groups), content of vitamins (riboflavin, tocopherols, carotenoids), or the use of a sensory panel (Smet *et al.,* 2008).

In recent years, many consumers have developed an interest in learning more about nutrition and food. Consumers want food that is inherently healthy, yet easy to prepare and consume, especially with women and men working an average of 7 and 8 h per day, respectively (Gonzalez *et al.,* 2011).

Cinnamomum zeylanicum is one of the world's oldest spices that has been used as a natural preservative in food, beverage and cosmetic industries. Its oil has been reported to inhibit the growth and subsequent toxin production of *Aspergillus parasitucus* at 200-250 µg/mL. It has been reported that application of cinnamon revealed potent antimicrobial effects against *Clostridium perfringens*, *Bacteroïdes fragilis and Bifidobacterium bifidus* (Senhaji *et al.,* 2007). Dill is an annual herb. Its leaves and seeds are used as seasoning and essential oil extracted from leaves and seeds also used in chewing gums, candies and pickles. Dill leaf consumption could lower the risk of cancer and reduce the level of cholesterolaemia. Dill leaf, seed and their essential oil could provide good antioxidant activities.

Antioxidants act as radical scavengers, inhibit lipid peroxidation and other free radical-mediated processes and are able to protect the human body as well as processed foods from oxidative damage attributed to the reaction of free radicals (Rathore *et al.,* 2013).numerous food products require protection against microbial spoilage during their shelf life.

The growing demand of consumers for safe and natural products, without chemical preservatives, has resulted in thorough investigations from food authorities and researchers to assess the feasibility of mild preservation techniques and to improve the microbial quality and safety of products, while maintaining their good nutritional and organoleptic properties.

Essential oils (EOs) are volatile oily liquids obtained from different plant parts and widely used as food flavors. In spite of having been long recognized for their antibacterial, antifungal, antiviral, insecticidal and antioxidant properties, the recent interest in alternative natural substances has led to a new scientific awareness of these substances (Goni *et al.,* 2009).

The objective of this study was to examine the effect of cinnamon bark and dill seed methanolic extracts on the chemical and rheological properties of yoghurt.

MATERIALS AND METHODS

1. Materials

Fresh cow's milk was obtained from the herd of Faculty of Agriculture, Suez Canal University, Ismailia Governorate, Egypt. And the composition of milk was standardized to4% fat, 0.19% acidity3% Casein, 3.55% Protein, 15.32% T.S, 11.32% S.N.F and pH value 6.4.Direct Vat Starter (DVS) yoghurt culture was

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obtained from CHR-Hansen's laboratorie, Denmark, under commercial name type (FD-DVS-YC-X11) containing *Streptococcus thermophiles* and *Lactobacillus delbrueckii* ssp. *bulgaricus*. Bark of cinnamon and seeds of dill were purchased from market of herbal medicines in El-Arish, North Sinai Egypt. Then they processed immediately and the oil was extracted.2,2-diphenyl-1-picrylhydrazyl (DPPH), Folin & Ciocalteu's phenol reagent were obtained from Egyptian international center for import, Nasr City, Cairo, Egypt.

Preparation of yoghurt

In a primary studies, the solvent extracts (SE) of cinnamon (Ci) and dill (D) were add to yoghurt milk before incubation. The resultants yoghurt were judged for organoleptic properties. The best results were as follows:

Extracts concentrations of Ci & D				
(SE) gm/1L of Milk (mg)	0.2	0.4	0.6	0.8

5 kg fresh cow's milk (standardized to 15.32% TS &11.32% SNF using skim milk powder) was heated at 95˚C for 5 min (Vahedi *et al.,* 2008**)**, cooled to 42˚C and incubated with starter culture then divided into five equal parts each of (1L) for each plant. The first part as a control (C) while 0.2, 0.4, 0.6, and 0.8gm of solvent extract (SE) were added to the rest four parts as (Ci1), (Ci2), (Ci3) and (Ci4)and (D1), (D2), (D3) and (D4). The resultant yoghurt was stored at 4˚C for up to 12 days and examined for pH, fat, antioxidant activity, total phenolic content, acetaldehyde and diacetyle and TBA. At the same time some rheological properties including firmness, whey separation, apparent viscosity, plastic viscosity, and consistency index were carried out. All data are an average of three replicates.

2. Methods of analysis

a. Milk

Chemical composition of milk was determined according to AOAC. (1995).

b. Yoghurt analysis

Yoghurt samples were chemically analyzed and organoleptically when fresh and after 4, 8, and 12 days of cold storage. pH values were measured using Jenway pH meter with Jenway spear electrode No:29010 (Jenway limited Gransmore Green, Felsted, Dunmow, England). Acetaldehyde and diacetyl content of yoghurt samples were estimated according to (Lee and jago, 1969). Synersis (Whey off) was measured with centrifugation method (Abou El-Nour *et al.,* 2004). Firmness of yoghurt was determined at 7°C according to (Abou El-Nour *et al.,* 2004). Apparent viscosity was measured in yoghurt samples with a Brookfield rotational viscometer; model RV III (Brookfield Engineering laboratories Inc., MA, USA). A cylindrical spindle (Spindle No. SC4-14) was used in the determination of viscosity. All viscosity readings were taken at 5°C in shear rate ranging from (0.8 to 8.0 s^{-1}). All rheological parameters were performed in quad replicates. Flow curves for yoghurt were drawn from measured values of apparent dynamic viscosity & shear rate, shear stresses & shear rate, plastic viscosity & treatments and consistency index & treatments. The whole experiment was repeated three replicates for each sample. Extraction of antioxidative compounds in yoghurt was carried out (Li *et al.,* 2009). The antioxidant activity of prepared yoghurt samples was determined by DPPH method (Ravichandran *et al.,* 2013)**.**

The total phenolic content (TPC) of the previously prepared yoghurt samples were determined using the Folin-Ciocalteau method (Li *et al.,* 2009). Thiobarbaturic acid (TBA) was estimated using method of (Pearson, 1976)**.** Organoleptic properties of yoghurt samples were evaluated according to (Tamime and Robinson, 1999). All measurements were done in triplicate and analysis of variance with two factorial (treatments and storage period) were conducted by the procedure of General Linear Model (GLM) (Costat, 1998) under windows software version 6.311 and least significant different (LSD) test were employed to determine significant difference at $p < 0.05$.

RESULTS AND DISCUSSION

1. Effect of cinnamon and dill ethanolic extract on the acid development of fermented milk

Data presented in Table (1) shows that time needed to reach pH 4.6 was decreased by adding these extracts to milk, and it gradually decreased with increasing the additives concentration. These results clearly indicated that yoghurt with Ci and D extracts had faster pH lowering rates than plain yoghurt. Reaching pH 4.6 was faster for cinnamon extract yoghurt followed by dill extract yoghurt and plain yoghurt. The pH reduction rates for all yoghurt treatments were between 135 and 170 min compared to 180 min for control. This suggests that Ci and D extracts enhanced the metabolic activity of yoghurt bacteria (Amirdivani and Baba, 2011).

2. Chemical properties of yoghurt

2.1. pH values

Based on the results presented in Tables (2 and 3) addition of cinnamon and dill extracts with different concentrations decreased the pH values significantly of fresh yoghurt sample. Moreover, increasing Ci and D extracts concentrations decreased the pH values significantly compared with control sample to be 4.54, 4.56 and 4.68 for Ci, D and plain yoghurt respectively. Afterwards the pH values were continuously decreasing significantly for all the samples during the 12 days of storage period at 4˚C this attributed to the continuation of metabolic activity of starter culture (Foda *et al.,* 2007). At the end of this period (12 days) the pH values for the Ci and D yoghurt samples was lower than plain yoghurt. Yoghurt containing 0.8 mg Ci extract showed the lowest pH values followed by dill and plain yoghurt to be 4.44, 4.45 and 4.57 respectively (Tseng and Zhao, 2012).

Table (1): Time needed to reach pH 4.6 during fermentation of milk supplemented with different concentrations of cinnamon and dill extracts.

Concentrations (gm/l)	Cinnamon	Dill
Tim (min) to reach pH 4.6		
Control	180	180
0.2	160	170
0.4	150	155
0.6	140	145
0.8	135	140

Table (2): pH values of yoghurt supplemented with different concentrations of cinnamon extract.

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	4.68	4.64	4.61	4.57	4.54	4.61^{a}
4	4.65	4.61	4.58	4.55	4.5	4.57^{b}
8	4.61	4.56	4.54	4.5	4.46	4.53^{c}
12	4.57	4.51	4.49	4.46	4.44	4.49^{d}
Mean	4.63^{a}	4.58^{b}	4.55^{c}	4.52^{d}	4.48^{e}	

C: control- Ci_1: 0.2 – Ci_2: 0.4 – Ci_3: 0.6 – Ci_4: 0.8 (gm/L)
* The different letters means significant

Table (3): pH values of yoghurt supplemented with different concentrations of dill extract.

Storage period (Days)	Treatments					Mean
	C	D_1	D_2	D_3	D_4	
Zero time	4.68	4.66	4.64	4.6	4.56	4.63^{a}
4	4.65	4.62	4.6	4.57	4.53	4.59^{b}
8	4.61	4.58	4.56	4.53	4.48	4.55^{c}
12	4.57	4.54	4.5	4.48	4.45	4.51^{d}
Mean	4.63^{a}	4.60^{b}	4.57^{c}	4.54^{d}	4.50^{e}	

D_1:0.2 – D_2:0.4 – D_3:0.6 – D_4:0.8 (gm/L)
* The different letters means significant

2.2. Antioxidant activity

DPPH is a stable nitrogen-centred free radical, the colour of which changes from violet to yellow upon reduction by either the process of hydrogen- or electron-donation. Substances which are able to perform this reaction considered as antioxidants and therefore radical scavengers. Plant tissues contain a range of components that may be broadly classed as antioxidants. In this part Tables (4 and 5) showed the antioxidant activity in yoghurt made by different concentrations of Ciand Dsolvent extract and compared with plain yoghurt. Ci yoghurt exhibited higher significant scavenging activity at a concentration of 0.8 gm with 74.79%inhibition, followed by D yoghurt at the same concentration with 70% inhibition, plain yoghurt was found to have a lower scavenging effect, since it showed 52.08% inhibition. High potential of antioxidant activity of Ci bark and D seed solvent extract may be due to that they are rich in

phytochemical contents, which possessed high antioxidant (Christova-Bagdassarian *et al.,* 2013). Inhibition of DPPH oxidation by each yoghurt increased significantly to the values of 79.74, 75.89, and 63.86% for Ci, D and plain yoghurt, respectively on the 4th day of refrigerated storage followed by gradual significant reduction in the 8th day of storage period. Dill extract is rich in flavonoids and tannins. The reduction in antioxidant activities during refrigerated storage of yoghurt may be attributed to increasing degradation of phenolic compounds with antioxidant activities and/or increasing milk protein polyphenol interaction (Amirdivani and Baba, 2011).

Table (4): Antioxidant activity (%) of yoghurt supplemented with different concentrations of cinnamon extract.

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	52.08	66.66	69.58	72.29	74.79	67.08[b]
4	63.86	74.33	76.52	78.02	79.74	74.47[a]
8	47.06	51.26	58.63	66.22	66.85	58.00[c]
12	34.65	39.35	40.09	41.83	43.56	39.89[d]
Mean	49.41[e]	57.90[d]	61.20[c]	64.58[b]	66.21[a]	

The different letters means significant

Table (5): Antioxidant activity (%) of yoghurt supplemented with different concentrations of dill extract.

Storage period (Days)	Treatments					Mean
	C	D_1	D_1	D_1	D_1	
Zero time	52.08	58.12	64.16	66.87	70	62.24[b]
4	63.86	67.03	69.90	73.64	75.89	70.06[a]
8	47.06	53.39	57.19	60.93	63.29	56.37[c]
12	34.65	35.64	38.36	40.34	41.08	38.01[d]
Mean	49.41[e]	53.54[d]	57.40[c]	60.44[b]	62.56[a]	

The different letters means significant

2.3. Total Phenolic Content (TPC)

Phenolic compounds in plants constitute a major class of secondary plant metabolites with bioactive potential attributed to antioxidant activities. Tables (6 and 7) showed the amounts of total phenolic content in Ci and D solvent extract yoghurt and compared with control yoghurt. The TPC values of supplemented yoghurt with different concentrations of Ci & D ethanolic extract were higher than plain yoghurt and increased significantly with the increasing the extracts concentrations from 0.2 to 0.8gm. Maximum TPC found at day 4 of storage period with values of 17.10, 16.33 and 10.94 mg gallic acid/100gm of Ci, D, and plain yoghurt samples respectevily (Foda *et al.,* 2007). the TPC values in plain-yoghurt reflect phenolic compounds whichrelated to milk protein breakdown. The amino acid tyrosin for instance has a phenolic side chain suggested to give rise to the reading of TPC. Another possibility is that microbial utilization of phenolic acids such as ferulic and p-coumaric acid during fermentation process and post acidification lead to the production of other phenolic acids such as vanillic and p hydroxybenzoic acids before the aromatic ring structure is broken down. The increased TPC in herbal-yoghurts can be explained by the presence of indigenous phytochemical compounds in herbs during storage period (e.g., flavonoids and phenolic compounds) in A. graveolens (dill).As in antioxidant activity TPC content generally dropped at the 8th day of storage (Tseng and Zhao, 2012).

2.4. Thiobarbaturic acid (TBA) values

The secondary oxidation products such as malonaldehyde and 2-alkenals, are measured by thiobarbituric. The effects of solvent extracts of Ci bark and D seed on malonaldehyde formation of yoghurt samples stored at 4˚C for 12 day in terms of incubation time versus TBA value are shown in Tables (8 and 9). The results of TBA values decreased with increasing the level of Ci extracts, at zero time Ci bark solvent extract showed significant high activity for preventing the

formation of secondary oxidation products to be 0.0145 as TBA values, followed by D seed and plain yoghurt to be 0.0185 and 0.038 respectively. On the other hand, the malondehyde formation of all yoghurt samples increased significantly during storage time. At the end of the storage period the Ci and D extract treatments were appeared as being the most effective antioxidants in terms of inhibition of malonaldehyde formation. It could be concluded that the oxidation products were initially low and increased rapidly specially in the control samples during storage, however, a much slower rate of increase in oxidation products was observed in yoghurt samples treated with Ci and D solvent extracts. This is closely related to the presence of phenolic compounds as Cinnamaldehyde, Eugenol, Limonene, Carvone and Apiole which are the most abundant phenol compounds known in Ci and D extracts. So they are mainly responsible for free radical inhibitors, due to their ability to break the chain reaction during the propagation phase of oxidation by scavenging or reacting with free radicals to produce non-radical compounds, due to their high level of hydrogen donation (Rasmy *et al.,* 2012).

2.5. Aroma compound

2.5.1. Acetaldehyde and Diacetyle

Data presented in Figs (1 and 2) showed the effect of solvent extract of Ci bark and D seed on the acetaldehyde values of yoghurt at different concentrations. Ci & D extract yoghurt had significant higher values of acetaldehyde than plain yoghurt and high concentrations of acetaldehyde were necessary to produce a desirable flavor in yoghurt. The higher concentration of acetaldehyde was reported to be due to the low utilization rate of this compound. The lack of alcohol dehydrogenase enzyme in the bacteria, responsible for the conversion of acetaldehyde into ethanol, which was suggested to be the reason of low utilization of acetaldehyde. Good flavor resulted when concentration was greater than 8.0 ppm of acetaldehyde was produced. The highest values obtained for yoghurt containing 0.8 mg of Ci extract was 69.7 ppm while the lowest values obtained for the untreated control yoghurt was 46.9 ppm. Concerning diacetyle, data presented in Figs (3 and 4) exhibit that its production approximately took the same trend of acedaldehyde production at cold storage period. The harsh flavors were caused by overproduction of acetaldehyde in comparison with to diacetyl. Despite the controversies over the role of diacetyl in the overall aroma expression of yogurt, diacetyl was one of the other major aroma compounds. Yoghurt supplemented with cinnamon extract contained the highest level of acetaldehyde and diacetyle whatever at zero time or during cold storage period followed by dill extract.

Table (6): Total phenolic content (TPC) (mg Gallic acid/100 gm sample) of yoghurt supplemented with different concentrations of cinnamon extract.

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	9.28	11.17	13.03	14.69	16.13	12.86^{b}
4	10.94	11.69	13.98	16.10	17.10	13.96^{a}
8	8.70	10.20	11.60	13.26	14.46	11.64^{c}
12	4.40	9.16	10.28	11.40	12.23	9.49^{d}
Mean	8.33^{e}	10.55^{d}	12.22^{c}	13.86^{b}	14.98^{a}	

The different letters means significant

Table (7): Total phenolic content (TPC) (mg Gallic acid/100 gm sample) of yoghurt supplemented with different concentrations of dill extract.

Storage period(Day)	Treatments					Mean
	C	D_1	D_2	D_3	D_4	
Zero time	9.28	10.16	11.77	13.40	14.61	11.84^{b}
4	10.94	11.40	13.41	14.89	16.33	13.39^{a}
8	8.70	9.16	10.88	12.03	13.38	10.83^{c}
12	4.40	7.83	9.16	10.31	11.57	8.65^{d}
Mean	8.33^{e}	9.63^{d}	11.30^{c}	12.65^{b}	13.97^{a}	

The different letters means significant

Table (8): TBA absorbance of yoghurt supplemented with different concentrations of cinnamon extract.

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	0.038	0.029	0.018	0.016	0.0145	0.023^{d}
4	0.0435	0.0345	0.0255	0.0235	0.0205	0.029^{c}
8	0.053	0.0425	0.032	0.0295	0.025	0.036^{b}
12	0.063	0.048	0.039	0.035	0.0315	0.042^{a}
Mean	0.049^{a}	0.038^{b}	0.028^{c}	0.026^{cd}	0.022^{d}	

The different letters means significant

Table (9): TBA absorbance of yoghurt supplemented with different concentrations of dill extract.

Storage period (Days)	Treatments					Mean
	C	D_1	D_2	D_3	D_4	
Zero time	0.038	0.0305	0.024	0.019	0.0185	0.026^{d}
4	0.0435	0.036	0.031	0.028	0.0235	0.032^{c}
8	0.053	0.047	0.0365	0.034	0.0295	0.04^{b}
12	0.063	0.0545	0.0445	0.0405	0.035	0.047^{a}
Mean	0.049^{a}	0.042^{b}	0.034^{c}	0.030^{cd}	0.026^{d}	

The different letters means significant.

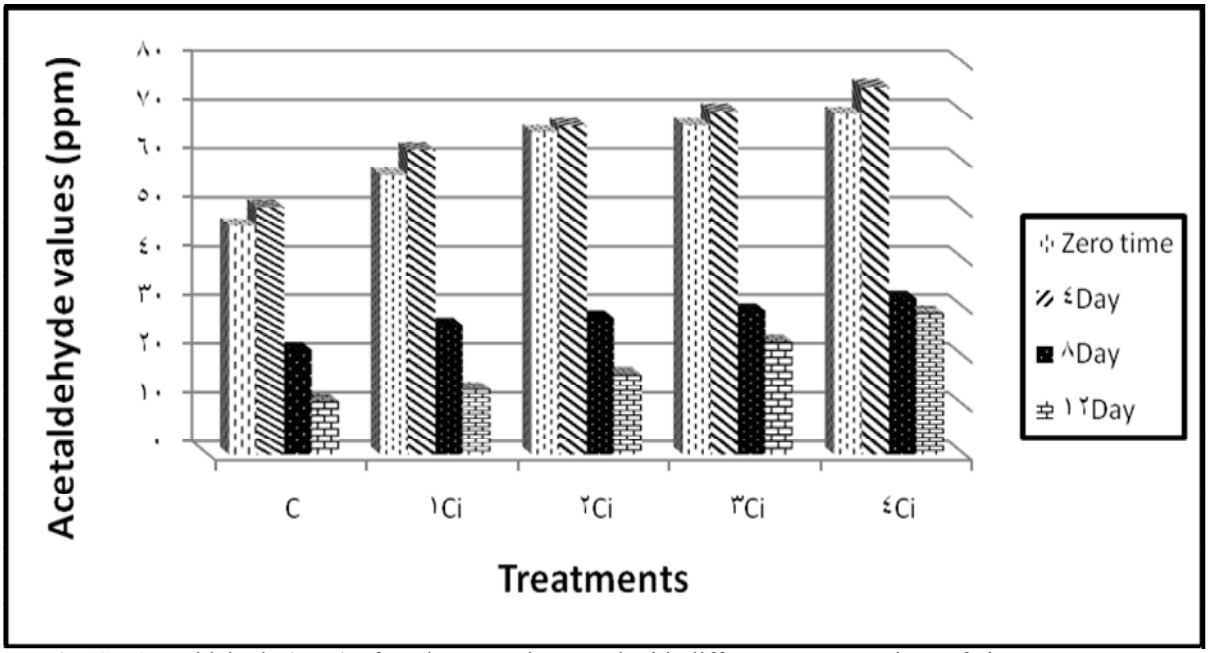

Fig (1): Acetaldehyde (ppm) of yoghurt supplemented with different concentrations of cinnamon extract.

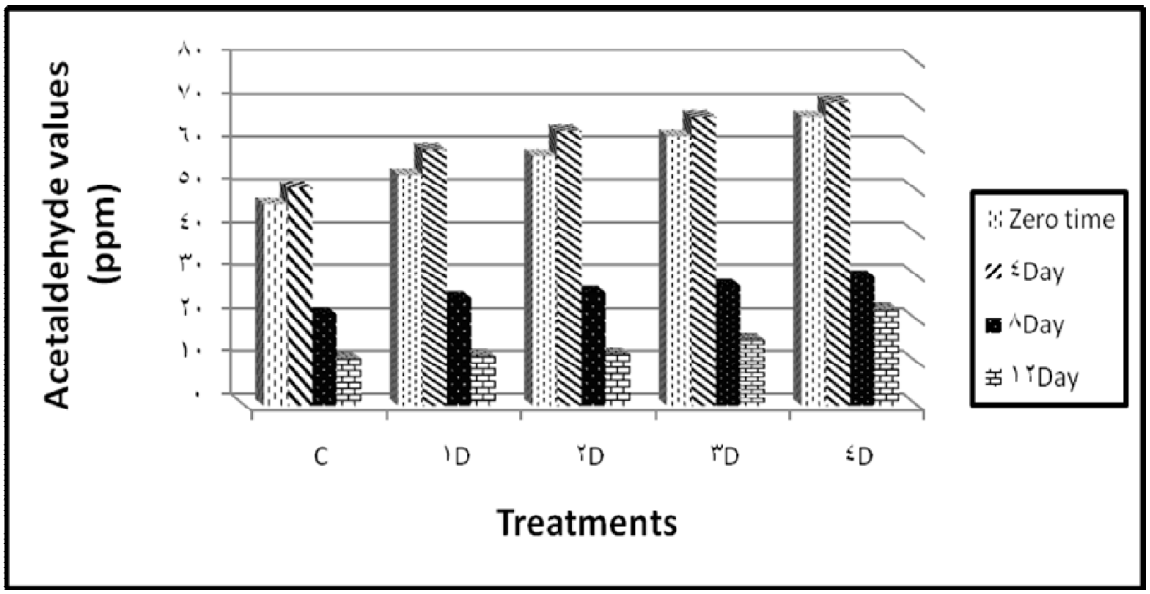

Fig (2): Acetaldehyde (ppm) of yoghurt supplemented with different concentrations of dill extract.

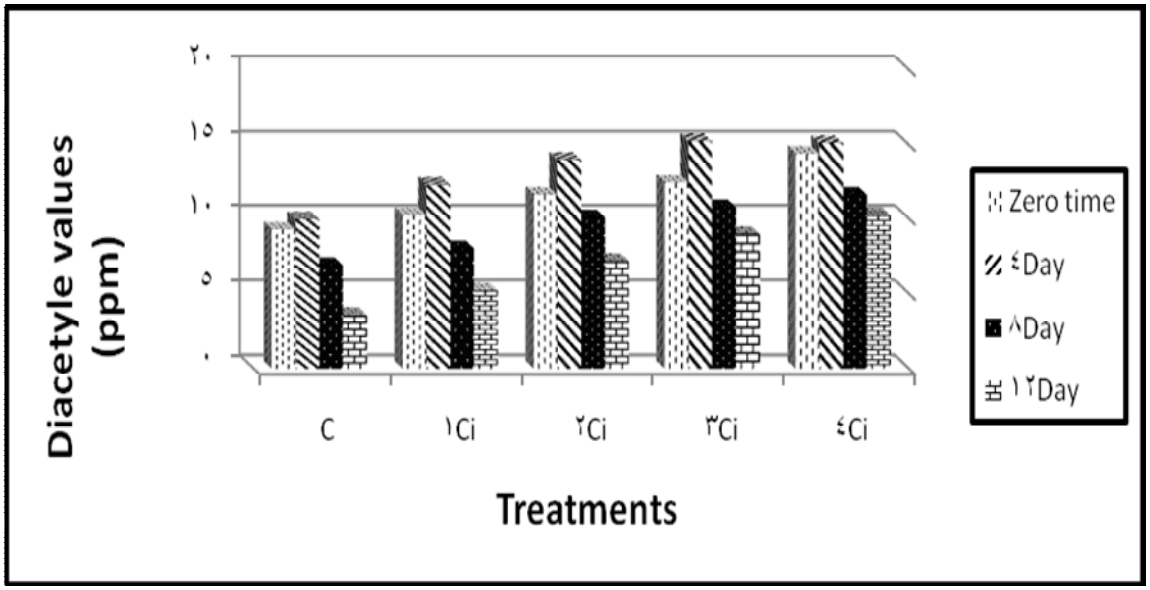

Fig (3): Diacetyle (ppm) of yoghurt supplemented with different concentrations of cinnamon extract.

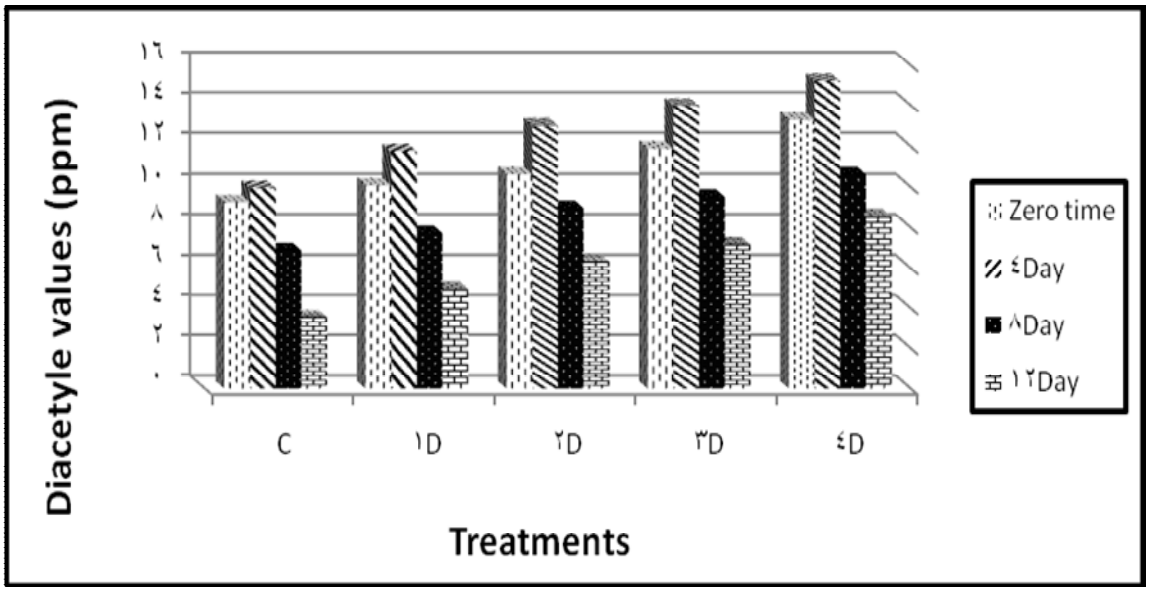

Fig (4): Diacetyle (ppm) of yoghurt supplemented with different concentrations of dill extract.

2.6. Rheological properties

2.6.1. Synersis (whey off)

The syneresis of yoghurt was affected significantly by both extract concentration and storage time; the changes are shown in Tables (10 and 11).The results indicated that the addition of Ci bark and D seed extracts to the yoghurt at different concentrations decreased the level of whey loss of fresh yoghurt, from8.5 mL of control to 6.75 mL and 4.9mL non significantly for the Ci and D yoghurt, respectively. It is known that faster rates of acidification results in higher levels of whey separation however, these results demonstrated that although extracts induced high rates of acidification and earlier gelation of milk gels, the incorporation of Ci and D extracts into the yoghurt formulation also reduced the whey loss. Data showed that the value of whey off of D extract yoghurt was lower than in Ci extract yoghurt. The results from the rheological measurements and microstructure characterization suggest that D extract at the pH of yoghurt could interact with the protein matrix through electrostatic interactions and particles are soft deformable particles that can hold a large amount of water, With an increase in the concentration of D extract into the yoghurt formulation, its gel network would become denser with less void space within the network, thus resulting in an increase in the gel firmness and reduction in whey loss (McCann and Li Day, 2011). Generally in all treatments the values of whey off increased at the end of storage period this was referred to the decreased in the pH values, but the control yoghurt had significant highest values of the whey off at the end of storage period.

Table (10): Synersis (ml whey/25 gm) of yoghurt supplemented with different concentrations of cinnamon extract.

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	8.5	7.8	7.1	7	6.75	7.49^{a}
4	7.75	7.3	6.55	5.9	5.3	6.56^{b}
8	7.05	6.25	5.8	5.05	4.55	5.74^{c}
12	10.35	8	7	6.35	5.6	7.46^{a}
Mean	8.41^{a}	7.41^{b}	6.61^{bc}	6.07^{cd}	5.55^{d}	

The different letters means significant

Table (11): Synersis (ml whey/25 gm) of yoghurt supplemented with different concentrations of dill extract.

Storage period (Days)	Treatments					Mean
	C	D_1	D_2	D_3	D_4	
Zero time	8.5	6.45	5.7	5.3	4.9	6.17^{a}
4	7.75	5.85	5.4	4.75	4.2	5.59^{ab}
8	7.05	5.3	4.8	4	3.6	4.95^{b}
12	10.35	7.05	6	5.4	4.75	6.71^{a}
Mean	8.41^{a}	6.16^{b}	5.47^{bc}	4.86^{c}	4.36^{c}	

The different letters means significant

2.6.2. Firmness values

Yoghurt firmness as affected by different concentrations of Ci and D extracts in fresh or during cold storage at 4˚C for 12 days are presented in Tables (12 and 13). Adding of Ci and D extracts was increased yoghurt firmness significantly compared with control samples. Moreover, firmness values increased as the Ci and D extracts increased to be 40, 35.2, 22.5 for D, Ci, and plain yoghurt respectively when fresh. These results may be due to the rearrangement within the network produced by attractive forces between individual casein particles and these extracts leading to affect the yoghurt gel (foda *et al.,* 2007).The firmness values of yoghurt manufacture with different concentrations of D extract was higher than of Ci extract yoghurt because of particles of dill extract are soft deformable particles that can hold a large amount of water.

2.6.3. Apparent viscosity properties

Data presented in Tables (14 and 15) showed the effect of different concentrations of Ci and D extracts on one of rheological parameter of yoghurt like apparent viscosity. dill extract yoghurt recorded higher values of apparent viscosity than Ci yoghurt to be 1522.5, 1516 and 923.6for D, Ci, and control yoghurt respectively, this reflected that D powder may be more interaction with milk protein (foda *et al.,* 2007). In all samples apparent viscosity increased significantly as storage period increased. Finally yoghurt with high milk viscosity tends to have high Firmness (Barrantes *et al.,* 1994).

Table (12): Firmness values of yoghurt supplemented with different concentrations of cinnamon extract (used brabender units).

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	22.5	26.5	28.5	32.75	35.2	29.09^{c}
4	24.5	31	35.5	37.5	38.5	33.4^{b}
8	30	35	37	39	39	36^{a}
12	20	24.5	28.5	33	34.5	28.1^{c}
Mean	24.25^{d}	29.25^{c}	32.37^{b}	35.56^{a}	36.8^{a}	

The different letters means significant

Table (13): Firmness values of yoghurt supplemented with different concentrations of dill extract (used brabender units).

Storage period (Days)	Treatments					Mean
	C	D_1	D_2	D_3	D_4	
Zero time	22.5	30	32.5	37	40	32.4^{c}
4	24.5	35.5	36.75	40.5	44.7	36.39^{b}
8	30	37.5	39.75	43	46	39.25^{a}
12	20	28	31	37	38.75	30.95^{c}
Mean	24.25^{e}	32.75^{d}	35^{c}	39.37^{b}	42.36^{a}	

The different letters means significant

Table (14): Apparent viscosity (mpas) properties of yoghurt supplemented with different concentrations of cinnamon extract.

Storage period (Days)	Treatments					Mean
	C	Ci_1	Ci_2	Ci_3	Ci_4	
Zero time	923.6	1055.5	1291.5	1462	1516	1249.72^{d}
4	1048.5	1222.5	1457	1540	1640	1381.6^{c}
8	1166.5	1491.5	1569.5	1730.5	1928	1577.2^{b}
12	1327	1590.5	1749	1951	2243	1772.1^{a}
Mean	1116.4^{e}	1340^{d}	1516.75^{c}	1670.8^{b}	1831.7^{a}	

The different letters means significant

Table (15): Apparent viscosity (mpas) properties of yoghurt supplemented with different concentrations of dill extract.

Storage period (Days)	Treatments					Mean
	C	D_1	D_2	D_3	D_4	
Zero time	923.6	1147	1326.5	1461.5	1522.5	1276.2^{d}
4	1048.5	1305.5	1500	1750	1793	1479.4^{c}
8	1166.5	1524	1708.5	1777.5	2018.5	1639^{b}
12	1327	1619.5	1827	1911.5	2409.5	1818.9^{a}
Mean	1116.4^{e}	1399^{d}	1590.5^{c}	1725.1^{b}	1935.8^{a}	

The different letters means significant

2.7. Organoleptic properties

Tables (16 and 17) response of consumers to the idea of supplementing yoghurt with different concentrations of Ci and D extract. Flavor liking and total acceptance liking among the 0.2, 0.4 and 0.8 mg Ci solvent extract yoghurt similar to control yoghurt by the panelists. However, 0.8 Ci extract yoghurt sample received significant lower score on flavor and total acceptance. Regarding the flavor evaluation of yoghurt supplemented with different concentrations of dill extract, Some panelists indicated their appreciation for taste of D extract yoghurt, but others stated their disliking related to aftertaste which might come from the astringency of tannin D extract, so that yoghurt was accepted significantly with 0.2 and 0.4 mg of D extract up to the 12th day of storage period. So it was obvious that lower concentration of D extract (0.2 & 0.4) has got the highest preference score. However increasing D extract concentration reduced the acceptability of yoghurt similar observations were reported by (foda *et al.,* 2007)**.** Appearance and color of Ci extract yoghurt decreased with increasing Ci concentrations compared to control yoghurt. D yoghurt had high score for appearance and color than in Ci yoghurt. From the foregoing results we could concluded that added cinnamon extract up to 0.6 (g/L) and dill extract up to 0.4 (g/L) to yoghurt milk improve the overall quality of the resultant yoghurt.

Table (16): The organoleptic properties of yoghurt supplemented with different concentrations of cinnamon extract.

Treatments	Storage period (days)				Mean
	Zero time	4	8	12	
			Flavor (0-10)		
Control	9	9.25	9	8.75	9^{b}
T1$_{Ci}$	9.5	9.5	9.5	9	9.37^{a}
T2$_{Ci}$	9.5	9.5	9.5	9	9.37^{a}
T3$_{Ci}$	9.25	9.25	8.75	8.25	8.87^{b}
T4$_{Ci}$	8.25	8.5	7.5	7.5	7.93^{c}
Mean	9.1^{a}	9.2^{a}	8.85^{b}	8.5^{c}	
			(Body & Texture 0-5)		
Control	4.25	4.25	4.25	3.75	4.12^{a}
T1$_{Ci}$	4	4	4	3.75	3.93^{b}
T2$_{Ci}$	4	4	4	3.75	3.93^{b}
T3$_{Ci}$	4	4	4	3.25	3.81^{b}
T4$_{Ci}$	4	4	4	3.25	3.81^{b}
Mean	4.05^{a}	4.05^{a}	4.05^{a}	3.55^{b}	
			Appearance and color (0-5)		
Control	4	4	4	4	4^{a}
T1$_{Ci}$	3.75	3.75	3.75	3.75	3.75^{b}
T2$_{Ci}$	3.75	3.75	3.75	3.75	3.75^{b}
T3$_{Ci}$	3.75	3.75	3.75	3.75	3.75^{b}
T4$_{Ci}$	3.75	3.75	3.75	3.75	3.75^{b}
Mean	3.8^{a}	3.8^{a}	3.8^{a}	3.8^{a}	
			Total acceptance (0-20)		
Control	17.25	17.5	17.25	16.5	17.12^{a}
T1$_{Ci}$	17.75	17.75	17.75	16.75	17.06^{a}
T2$_{Ci}$	17.75	17.75	17.75	16.75	17.06^{a}
T3$_{Ci}$	17.5	17.5	16.75	16	16.43^{b}
T4$_{Ci}$	16.5	16.75	15.5	15.25	15.5^{c}
Mean	16.95^{ab}	17.05^{a}	16.7^{b}	15.85^{c}	

The different letters means significant

Table (17): The organoleptic properties of yoghurt supplemented with different concentrations of dill extract.

Treatments	Storage period (days)				Mean
	Zero time	4	8	12	
			Flavor (0-10)		
Control	9	9.25	9	8.75	9^{a}
$T1_D$	9	8.75	8.5	7.5	8.43^{b}
$T2_D$	8.5	8.25	7.5	6.75	7.75^{c}
$T3_D$	7.75	7	6.75	6	6.87^{d}
$T4_D$	7	6	6.5	5.5	6.27^{e}
Mean	8.25^{a}	7.85^{b}	7.66^{b}	6.9^{c}	
			(Body & Texture 0-5)		
Control	4.25	4.25	4.25	3.75	4.125^{b}
$T1_D$	4.5	4.5	4.5	4	4.37^{a}
$T2_D$	4.5	4.5	4.5	4	4.37^{a}
$T3_D$	4.5	4.5	4.25	4	4.31^{a}
$T4_D$	4.5	4.5	4.25	4	4.31^{a}
Mean	4.45^{a}	4.45^{a}	4.35^{a}	3.95^{b}	
			Appearance and color (0-5)		
Control	4	4	4	4	--
$T1_D$	4	4	4	4	--
$T2_D$	4	4	4	4	--
$T3_D$	4	4	4	4	--
$T4_D$	4	4	4	4	--
			Total acceptance (0-20)		
Control	17.25	17.5	17.25	16.5	17.12^{a}
$T1_D$	17	16.75	16.5	15.25	16.81^{b}
$T2_D$	16.5	16.25	15.5	14.5	16.12^{c}
$T3_D$	15.75	15	14.75	13.25	15.18^{d}
$T4_D$	15	14	14.5	12.75	14.56^{e}
Mean	16.7^{a}	16.3^{b}	16^{c}	14.85^{d}	

The different letters means significant

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تأثير إضافة تركيزات مختلفة للمستخلص الإيثانولي للقرفة وبذور الشبت على القيمة الصحية وخصائص الجودة للزبادي

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يهدف هذا البحث إلى دراسة تأثير استخدام تركيزات مختلفة من المستخلص الإيثانولي لقلف القرفة و بذور الشبت على الجودة الصحية والصفات الكيميائية والريولوجية للزبادي. وتم الحصول على مستخلصات كلا من قلف القرفة و بذور الشبت باستخدام طريقة الاستخلاص الكحولي، وكانت التركيزات المستخدمة ٠.٢، ٠.٤، ٠.٦، ٠.٨ جم/١ لتر لبن من كل منها. وفيما يتعلق بالوقت المتطلب لصناعة الزبادي المدعمة بتركيزات مختلفة من المستخلص الكحولي للقرفة والشبت استغرقت وقتا اقل من المعاملة الكنترول (C)، وقد لوحظ أن معاملات الزبادي بزيت القرفة استغرق وقتا اقل من معاملات الزبادي بزيت الشبت. كما أظهرت معاملات الزبادي المصنعة بإضافة مستخلص القرفة نشاط مضاد للأكسدة عالي عند تركيز ٠.٨ جم بنسبة ٧٤.٧٩% ثم اتبعها مستخلص الشبت عند نفس التركيز بنسبة ٧٠%، أظهرت المعاملة الكنترول أقل نشاط مضاد للأكسدة بنسبة ٥٢.٠٨%. ازداد النشاط المضاد للأكسدة للمعاملات ووصل إلى أعلى معدل له في اليوم الرابع من التخزين البارد لكلا من معاملات القرفة والشبت والمعاملة الكنترول على التوالي، ثم أتبعها انخفاض عند اليوم الثامن من فترة التخزين على البارد. كما لوحظ ارتفاع المحتوى الكلي للفينولات للزبادي المدعمة بتركيزات مختلفة من المستخلص الكحولي للقرفة و الشبت عن المعاملة الكنترول، وكانت هذه القيم تزداد بزيادة تركيز هذه المستخلصات من ٠.٢ إلى ٠.٨ جم. أعلى قيم للمحتوى الكلي للفينولات كانت في اليوم الرابع من فترة التخزين وكانت القيم ١٧.١٥,١٦.٣٣,١٠.٩٤ مجم حامض جاليك/١٠٠ جم لكلا من مستخلصات القرفة والشبت والمعاملة الكنترول على التوالي. وقد أشارت قيم الخواص الحسية من ناحية الطعم والقبول العام في التحكيم على الزبادي المصنعة بالتركيزات ٠.٢، ٠.٤، ٠.٦ جم من المستخلص الكحولي للقرفة مقارب للمعاملة الكنترول. من ناحية أخرى التركيز ٠.٨ للمستخلص الكحولي للقرفة أظهر أقل النتائج من ناحية الطعم والقبول العام. قيم الطعم للزبادي المصنعة بتركيزات مختلفة من المستخلص الكحولي للشبت فقد أظهرت النتائج أن استخدام تركيز ٠.٢، ٠.٤ جم من المستخلص لمدة ١٢ يوم من التخزين كانت مقبولة. ونوصي في نهاية هذا البحث بتصنيع الزبادي وتدعيمه بالمستخلص الكحولي لقلف القرفة حتى تركيز ٠.٦ جم ومستخلص بذور الشبت حتى تركيز ٠.٤ جم وحفظه على ٤°م لمدة ١٢ يوم أعطت منتج مقبول.