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Utilization of Aqueous Extract of *Moringa oleifera* for Production of Functional Yogurt

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ABSTRACT

The aqueous extract of *Moringa oleifera* contained a bioactive compounds namely tannins, flavonoids, saponin, alkaloids and terpens. The aqueous extract has high content of total phenolic (340.82 mg/g as gallic acid), In addition to IC 50 of *Moringa oleifera* extract was 75.82 µg/ml, and therefore the addition of *Moringa oleifera* extract to yogurt enhances the nutritional value of the resultant yogurt. The aqueous extract exhibited a antibacterial activity against Gram positive bacteria (*S. aureus* , *E. faecalis* and *B. cereus*), in contrast to Gram negative (*E.coli* and S. Typhimurium) more resistance to extract of *Moringa oleifera*. The total solid of yogurt is directly proportional to addition of extract content. A slightly decrease in pH was noticed in yogurt enriched aqueous extract. The use of *Moringa oleifera* extract at mentioned concentration rates increased significantly curd tension and WHC, in addition to susceptibility of synersis was decrease. The addition of aqueous extract of *Moringa oleifera* enhanced sensory properties of the resultant yogurt. Acetaldehyde and diacetyl increased in yogurt with *Moringa oleifera* extract, compare with control. Hardness, Adhesiveness and gumminess were significantly higher ($P< 0.05$) in experimental yogurt made by using different concentration of aqueous extract of *Moringa oleifera* than control. However, the cohesiveness and springiness were significantly lower in samples of experimental yogurt made with different concentration of aqueous extract of *Moringa oleifera* than control.

Keywords: *Moringa oleifera* – Antioxidant activity- antibacterial activity- functional yogurt- Texture profile analysis- Sensory properties

INTRODUCTION

Progress of scientific in awareness the correlation between health and nutrition has an increasingly effect on consumer's behavior to nutrition which has resulted in the enhancement of the functional food concept (Bhat and Bhat, 2011). Functional dairy products can be introduced as dairy products including significant concentrations of functional components that provide a specific benefits of human health beyond the essential other nutrients (Drozen and Harrison, 1998).

Innovation dairy industries play a critical role in translating information of nutrition into consumer products in order to manufacture functional food or added value products (Hsieh and Ofori, 2007). Newfangled society, consumers want a good health and subsequently increasing demand for functional dairy products compare with basic dairy products enhances their enjoyment, wellbeing and active life style (Hsieh and Ofori, 2007).

In recent times, interest has enhanced in the using of what have become known as multi-use plants. One of this plants is *Moringa oleifera* L. It is one of the 14 species of family Moringaceae which were grown in various region in the world and widespread in tropical regions, (Qwele *et al*., 2013). It has been cultivated in South America, Southeast Asia and Caribbean Islands (Iqbal and Bhanger 2006). *Morenga oleifera* indicated to is truly a bewitching wonder among the plants (Iqbal and Bhanger 2006).

Moringa oleifera was introduced to the early 20th and used as a healthy supplement (Muluvi *et al*., 1999), industrial implementation (Foidl *et al.*, 2001) pharmacological (Caceres *et al.*,1991). Moringa leaves included high concentration of protein, vitamins , potassium, calcium and iron, in addition to they consist mainly of the essential amino acid at acceptable concentration (Mishra *et al.*,2012). The leaves extract of *Moringa oleifera* has antioxidant and reducing power activities (Chumark, *et al*., 2008). The aqueous extracts of *M. oleifera* leaves are critical role to control the hyperthyroidism (Tahiliani and Kar 2000). It considers as hypochloestrolemic agent in overweight patients (Ghasi *et al.*, 2000). The aqueous extract has high ability of antiproliferation of human cancer cells (Sreelatha *et al.*, 2011). Several *Moringa oleifera* leaves extract are important agent against many species of pathogenic bacteria, such as *Staphylococcus aureus, Psedomonus aeruginosa* and *Bacillus cereus* (Abalaka *et al.*, 2012), and also oil extract of *Moringa oleifera* used as anti skin diseases agent (Chuang *et al.*, 2007).

The objective of this research was to aimed to study the effect of addition *Moringa oleifera* leaves extract on chemical, sensory and texture profile properties of yogurt.

MATERIALS AND METHODS

Preparation of aqueous extract of *Moringa oleifera* Leaves

The *Moringa oleifera* leaves were soaked in water for 15 min to remove impurities. The leaves were dehydrated in air drier at 55°C. The dried leaves were crushed into powder by domestic grinder (BRAUN), followed by sieving with 60 mesh sieve and then stored at 7°C. Aqueous extract of *Moringa oleifera* leaves was prepared by homogenized 40 g of dried powder with 100 mL boiled water and left for 24 h at room temperature, stirring frequently with a glass rod. The extract was obtained by filtration (Whatman No. 1). Filtrate was concentrated using Rotary Evaporator (Model RE52A, China) to 8% of their initial volumes at 55 °C. The concentrated filtrate was dryness in oven at 60°C for 48 h (Shah *et al*., 2015).

Preparation of yogurt:

The buffaloes' milk was heated to 85°C for 15 min followed by cooling at 43°C. The buffaloes' milk divided into 5 portions. The first one is considered as control. The second, third, fourth and fifth were mixed individually with 0.1, 0.2, 0.3 and 0.4% of aqueous

extract respectively and then inoculated with 2% (v/v) starter culture and allowed to incubate at 43 °C for 3 h. Experimental Yogurt samples were stored at 4°C.

The Chemical Analysis of *Moringa oleifera*

Fat, moisture, total fiber, protein and ash were determined according to AOAC (2005).

Phytochemical detection of *Moringa oleifera* Leaves extract

Phytochemical of *Moringa oleifera* extract was determined according to AOAC (1980).

Minerals content

Total contents of potassium, phosphorus, calcium and sodium were determined according to AOAC (2005).

Identification and determination of phenolic compounds:

Phenolic compounds determination of aqueous extract of *Moringa oleifera* Leaves were performed according to the method reported by Waskmundzka *et al.,* (2007)**.**

Radical Scavenging Activity DPPH Determination:

Activity of radical scavenging DPPH was determined according **to** Mau *et al.,* (2001).

Determination of antibacterial activity of aqueous extract of *Moringa oleifera*

The antibacterial potential activity of *Moringa oleifera* extract was determined according to the method described by Bonjiar, (2004).

The chemical analysis of yogurt

The fat, total solid content, total nitrogen and acidity were determined according to AOAC (1984). Water holding capacity, Curd tension and rate of curd syneresis were determined as reported by Mehanna (1989).

Organoleptic Evaluation

Yogurt samples were determined at zero time, 7 and 14 days. Ten trained panelists from the staff members of the Dairy Department, Faculty of Agriculture, Mansoura University evaluated each of the yogurt samples and used a quality rating score card for evaluation of flavor (10points), texture (10 points) and appearance (10 points)(Ahmed *et al.*,2005).

Determination of Diacetyl and acetaldehyde:

The concentration of diacetyl and acetaldehyde in samples of yogurt were determined by Spectrophotometer (Jenway UV/visible spectrophotometer) as mentioned by Less and Jago (1970).

Texture profile analysis

Properties of yogurt texture were determined using texture profile analyzer (TA 1000, Lab Pro (FRC TMS-Pro), USA). According to Bourne (1978).

Statistical analysis:

Statistical analysis was performed by SAS (2004) software and probability of ($P<0.05$) was used to establish statistical significance

RESULTS AND DISCUSSION

Chemical composition of dried *Moringa oleifera* leaves:

The chemical composition included moisture, ash, protein, carbohydrates, fiber of dried *Moringa oleifera* leaves sample were determined (Table 1), the dried leaves of *Moringa oleifera* contained high carbohydrates, crude fiber and protein values. This result indicates that *Moringa oleifera* is a good source of these compounds especially carbohydrates and crude fiber. The dried *Moringa oleifera* leaves also contained high content of some essential nutrients namely Ca, P and K being 845, 108 and 421 mg/kg, respectively. The present results are consistent with these reported by Compaore *et al*., (2011), who found that the seeds of *Moringa oleifera* are particularly rich in protein (35.37%) and lipids (43.56%). So as Charles *et al*., (2011), stated that the proteins, moisture, fat, carbohydrates contents of fresh and dried leaves were 11.9, 73.9, 1.1 and 10.6 and 27.2, 5.9, 17.1 and 38.6%, respectively. This variation might be as a result of difference in climatic condition.

phytochemical screening of Moringa *oleifera* extract:

The preliminary phytochemical screening of *Moringa oleifera* leaves aqueous extract presented the presence of different types of chemical groups that are summarized in Table (2). Data indicated that all bioactive compounds namely tannins, flavonoids, saponin, alkaloids and terpens were present in aqueous extract. Therefore, majority of the extracts contained the secondary metabolite this obtained results were in accordance with those found by (Esther and Oladipo 2012 and Shahriar *et al*., 2012).

Total phenolic compounds (TPC) contents (mg/g) and antioxidants activity (DPPH%) of *Moringa oleifera*

DPPH is a free radical compound that has been widely used to assess the free radical-scavenging ability of different samples (Amarowicz *et al*.,2000). The free radical scavenging activity determined by DPPH was expressed as IC 50 (the effective concentration of extract required to inhibit 50% of the initial DPPH free radical). The IC 50 of aqueous extract was 75.82 µg/ml higher than IC 50 of synthetic antioxidant TBHQ (28.48 µg/ml) as presented in Table (3). Content of plant phenolic is playing a critical role for antioxidant activity of aqueous extract of *Moringa oleifera* leaves (Zeada *et al*., 2007). On the other hand, total phenolic compounds being 340.82 mg/g as Gallic acid in *Moringa oleifera* (Table 3). The phenolic content of *Moringa. oleifera leaves* extract observed in this study are in agreement with those found by Frum and Viljoen (2006) and Sreelatha and Padma (2009).

Table 1. chemical composition of dried *Moringa oleifera* leaves. All values are means of three separate ± standard error.

Chemical composition %	Leaves of dried *Moringa oleifera*							
	Moisture	Ash	Protein	Carbohydrates	Crude fiber	Minerals mg/kg ca	P	K
	8.54±0.21	7.72±0.13	22.86±0.05	33.69±0.12	24.47±0.11	845	108	414

Table 2. Preliminary phytochemical screening of *Moringa oleifera* aqueous extract.

Phytochemical	Flavonoids	Saponin	Tannins	Terpens	Alkaloids
Aqueous extract of *Moringa oleifera* leaves	+	+	+	+	+

Table 3. Total phenolic compounds (TPC) contents (mg/g.) and antioxidants activity (DPPH%) of *Moringa oleifera*. All values are means of three separate trails ± standard error.

Samples	TPC(mg/g)as gallic acid	Antioxidants activity (IC50µg/ml)
Moringa oleifera leaf	340±0.05	75.82 ± 0.18
TBHQ	-	28.48 ± 0.23

The synergistic effect of phenolic compounds might be contributed to the ability of the extracts to adsorb and neutralize free radicals or decompose peroxides and their ability as free radical scavengers could be due to their redox properties, presence of conjugated ring structures and carboxylic group which have been reported to inhibit lipid peroxidation.

Determination of Phenolic compounds concentration (ppm):

The concentration of phenolic compounds in aqueous extract of *Morenga oleifera* was determined (Table 4). There was a great variation in concentration of components which were identified (Table 4). Aqueous extract of *Moringa oleifera* leaves contained 17 fractions of phenolic compounds, the most abundant one being e-vanilic 1988.32 ppm concerning to the other derivatives with benzoic being 920.3 ppm while Catechol and pyrogallol were almost nearly 415.3 and 458.6 ppm, respectively. Data in the same Table showed also that were Alpha-coumaric, Gallic being 7.85 and 8.99. This difference in phenolics compounds might be responsible for the higher DPPH activity in reducing oxidation for this extract.

Table 4. Estimation of Phenolic compounds content (ppm) in *Moringa oleifera* leaves extract.

Phenolic Compounds	*Moringa oleifera* leaves extract
Syringic	888.25
Gallic	8.99
Pyrogallol	415.32
4-amino- benzoic	3.56
Catechein	51.39
Chlorogenic	40.76
Catechol	458.65
Caffeine	109.21
p-OH-benzoic	66.03
Caffeic	49.51
Vanillic	54.32
Ferulic	19.11
Iso-Ferulic	22.03
e-vanillic	1988.32
Ellagic	89.91
Alpha-coumaric	7.85
Benzoic	920.3

The Antimicrobial activity of water-based *Moringa oleifera* extract:

Antimicrobial activity of different concentration (0.1, 0.2, 0.3 and 0.4%) of water-based *Moringa oleifera* extract against indicator microorganisms presented in Table (5). The aqueous extracts with different concentration were active against Gram positive bacteria, such as *S. aureus* , *E.faecalis*, and *B. cereus* .However *E.coli* and S. Typhimurium were resistant to experimental concentration of the aqueous extract of *Moringa oleifera*. The previous results are consistent with those reported by Vieira *et al*., (2010) who detected the inhibitory effect of water – based Moringa extract against *S. aureus* and *Vibrio cholera*. However, *Moringa oleifera* extract did not exhibit any antimicrobial efficacy against *E.coli* and *Salmonella Enteritidis*. Jahn *et al*., (1986) also found pterygospermin, benzyl isothiocyanate, phyenl acetonitrile as bactericidal compounds in moringa seeds, the previous substances have been reported to inhibit mainly *Bacillus subtilis, Serratia marcescens, Pseudomonas aeruginosa, Shigella sonnii.*

Chemical composition of yogurt made by different percentage of *Moringa oleifera* aqueous extract:

The influence of aqueous extract of *Moringa oleifera* leaves with different concentration on main chemical composition of yogurt are presented in Table (6). Slight changes were determined in fat, total solid and total nitrogen over storage for fifteen days. However, significant reduction ($P < 0.05$) was observed in pH over storage at 5 C for 15 days in all treatment, including control. Generally a slightly decrease in pH was recorded in yogurt fortified crude extract of *Moringa oleifera* compare with the control. This is due to the ability of crude extract to stimulate growth rate of yogurt starter culture (Hassan *et al*., 2016). The using of crude extract of *Moringa oleifera* for functional yogurt production was of no effect on fat level compare with control (Table 6). The total solid was about 0.45% higher in the yogurt made with 0.4% of crude extract of *Moringa oleifera* when compared with control. The total solid of yogurt is directly proportional to the added concentration of *Moringa oleifera* crude extract. The fortified of yogurt with 0.1% and 0.2% was of no effect on TN of samples when compare with control, whereas the using of 0.3% and 0.4% resulted in slightly higher content of TN than control.

The above results are consistent with those reported by Hassan, (2016), who found that the yogurt samples were fortified with different concentration (0.1, 0.2, 0.3 and 0.4%) of *Moringa oleifera* crude leaves, the all of treatments had higher content of total solids, total protein, and lower pH than control.

Table 5. The antimicrobial activity of water-based *Moringa oleifera* extract

Concentration of extract %	Inhibition zone (mm)			
	Salmonella Typhimurium	*E.coli*	*Enterococcus faecalis*	*Bacillus cereus*
0.1	-	20	15	16
0.2	-	21	17	19
0.3	-	22	19	20
0.4	-	24	21	22

Table 6. Chemical composition of yogurt made by different percentage of *Moringa oleifera* Aqueous extract during storage .

Yogurt treatments	Storage periods (days)	pH value	Fat (g/100g)	TS (g/100g)	T.N (g/ 100g)
Control	Zero	4.65	6.20	17.20	0.6
	7	4.43	6.40	17.90	0.64
	14	4.26	6.50	18.85	0.69
	Mean	4.45	6.37	17.98	0.64
0.1%	Zero	4.56	6.22	17.33	0.60
	7	4.38	6.38	18.05	0.64
	14	4.2	6.47	18.95	0.69
	Mean	4.38	6.36	18.11	0.64
0.2	Zero	4.5	6.23	17.4	0.61
	7	4.31	6.43	18.17	0.65
	14	4.17	6.51	19.1	0.70
	Mean	4.33	6.39	18.22	0.64
0.3	Zero	4.45	6.20	17.54	0.61
	7	4.21	6.39	18.22	0.65
	14	4.15	6.52	19.22	0.70
	Mean	4.27	6.37	18.33	0.65
0.4	Zero	4.38	6.22	17.61	0.62
	7	4.17	6.44	18.38	0.66
	14	4.11	6.53	19.31	0.71
	Mean	4.22	6.40	18.43	0.66

The effect of *Moringa oleifera* aqueous extract at mentioned concentration on the curd tension, water holding capacity and susceptibility syneresis of yogurt:

The influence of *Moringa oleifera* aqueous extract at tested concentrations on the instrumental measurements are showed in Figures (1 & 2). The different concentration of *Moringa oleifera* enhanced the curd tension and water holding capacity (WHC) of yogurt, the use of *Moringa oleifera* extract at mentioned concentration rates increased significantly ($P< 0.05$) the curd tension and WHC of yogurt as compared with the control, either fresh or during storage.

Experimental yogurt sample contained *Moringa oleifera* aqueous extract at a concentration of 0.4% showed the highest values of curd tension and WHC when fresh and at the end of the storage period.

From the results in Figure (3), the susceptibility to syneresis was decreased significantly ($P< 0.05$) with the addition of *Moringa oleifera* extract at mentioned levels, compare with control. Yogurt enriched with 0.4% of *Moringa oleifera* extract exhibited the lowest synersis when fresh and at the end of storage period.

The above results are consistent with those reported by El-sayed *et al*.,(2002), who found that the addition of different concentration of xanthan gum increased the curd tension of yogurt, while the use of xanthin gum decreased the susceptibility to synersis of yogurt.

Sensory Evaluation:

The scores for sensory evaluation of the samples were showed in figure 4. For appearance and flavor the addition of *Moringa oleifera* extract at mentioned concentrations had no unfavorable effect on appearance and flavor of the yogurt samples. However, the treatments had variable effects on the yogurt texture. The yogurt was fortified with *Moringa oleifera* extract at a concentration of 0.4% gained the highest score, followed by the yogurt containing *Moringa oleifera* at concentration of 0.3%, whereas the control had the lowest value.

The scores of sensory properties of all treatments and control gradually decreased over storage until 15 days for appearance, flavour and texture (Fig 5 and 6). The yogurt containing 0.4% of *Moringa oleifera* extract was lowest decreasing rate for score of texture compare with other treatment and control.

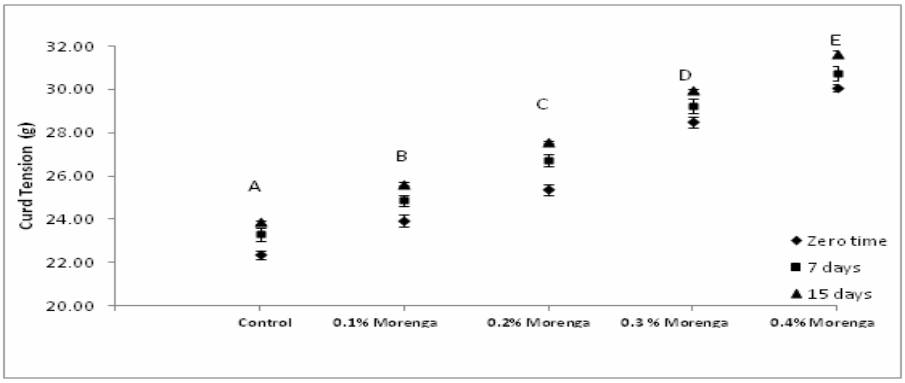

Fig. 1. The effect of *Moringa oleifera* extract at mentioned concentration on curd tension of yogurt. Curd tension values are means of at least 3 separate determinations, and error bars represent ± SE.

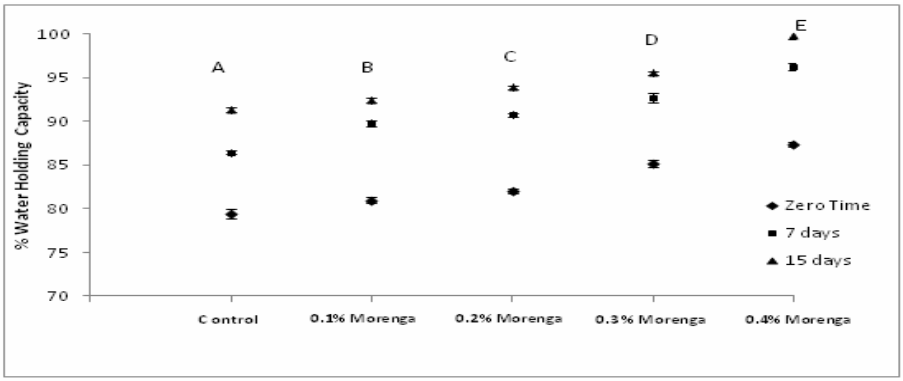

Fig. 2. The effect of *Moringa oleifera* extract at mentioned concentration on water holding capacity of yogurt. WHC values are means of at least 3 separate determinations, and error bars represent ± SE.

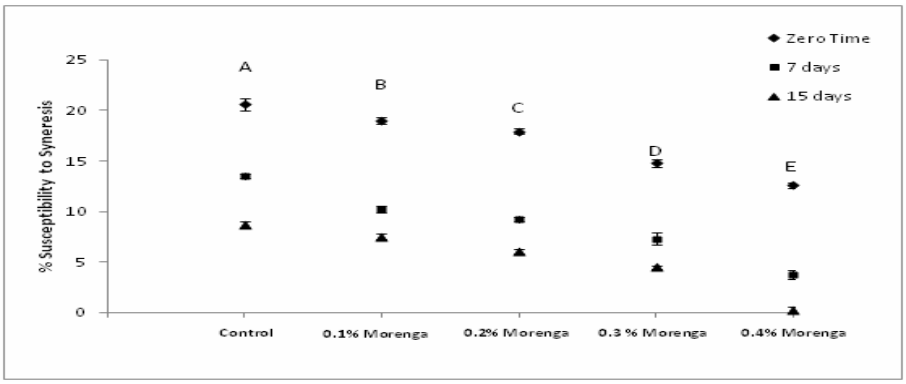

Fig. 3. The effect of *Moringa oleifera* extract at mentioned concentration on the susceptibility syneresis of yogurt. Susceptibility syneresis values are means of at least 3 separate determinations, and error bars represent ± SE.

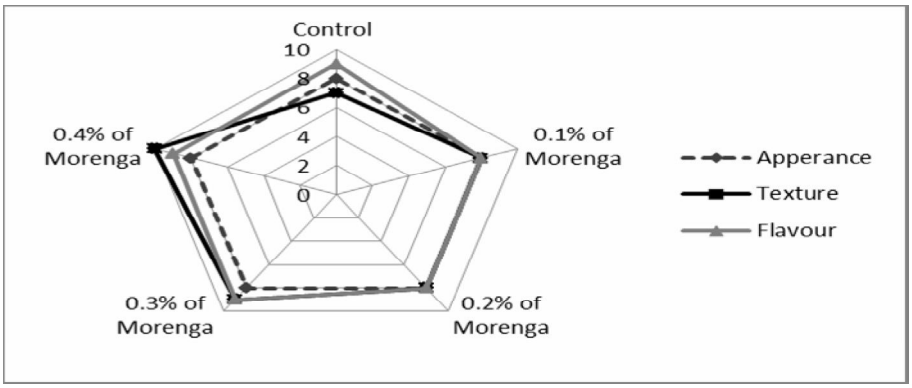

Fig. 4. The effect of addition of *Moringa oleifera* extract on sensory properties of experimental fresh yogurt samples.

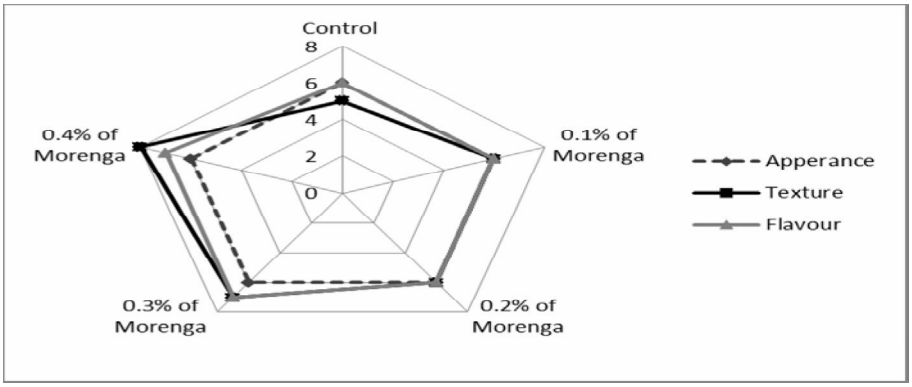

Fig. 5. The effect of addition of *Moringa oleifera* extract on sensory properties of experimental yogurt samples stored at 4°C for 7 days.

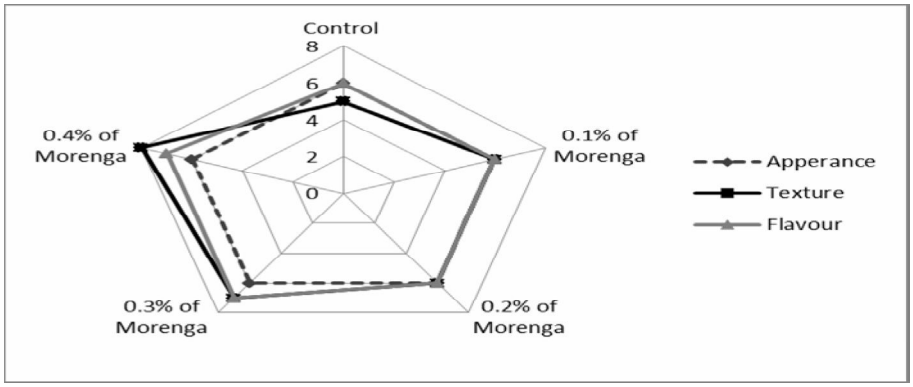

Fig. 6. The effect of addition of *Moringa oleifera* extract on sensory properties of experimental yogurt samples stored at 4°C for 15 days.

Flavour Compounds:

The changes in acetaldehyde and diacetyl of yogurt samples during storage were estimated (Table 7).The acetaldehyde concentration decreased significantly ($p< 0.05$) over storage at 10°C. The concentration of acetaldehyde in crude extract of *Moringa oleifera* (0.1, 0.2, 0.3 and 0.4%) containing yogurt were higher than control at zero time, 7 days and 15 days. However the yogurt sample containing 0.1% aqueous extract of *Moringa oleifera* was closest to the control and differed significantly ($p< 0.05$) from other treatments at zero time, furthermore the yogurt sample containing 0.1% *Moringa oleifera* extract increased significantly ($p< 0.05$) compare with control during storage (7 and 15 days). These results are agreement with Hassan *et al.,* (2016), who reported that the yogurt made by using 0.5% leaves powder of *Moringa oleifera* had was highest acetaldehyde content compare with other treatment. Furthermore the decrease in acetaldehyde concentration of yogurt containing plant polysaccharides during storage was investigated by Hussein *et al.,* (2011).

The effect of cold storage on diacetyl concentration in yogurt samples did not take the same trend of acetaldehyde concentration in both fresh and during storage (Table7), where there was a significant increase in diacetyl concentration of all yogurt samples during cold storage (Table7). The diacetyl concentration in different concentration of *Moringa oleifera*e extract containing yogurt was higher than fresh control and during cold storage at 10°C for 7 or 15 days. These results are agreement with Law (1981), who observed that there was significant increase in diacetyl concentration associated with rapid drop in pH value.

Texture profile analysis of Experimental yogurt

Hardness, Adhesiveness, cohesiveness, springiness and gumminess of experimental yogurt samples were determined (Fig.7,8 and 9). Texture properties of yogurt samples were significantly ($P< 0.05$) affected by using different concentration of aqueous extract of *Moringa oleifera*. Hardness, Adhesiveness and gumminess were significantly higher ($P< 0.05$) in experimental yogurt samples made using different concentration of aqueous extract of *Moringa oleifera* than control (Fig. 7). However the cohesiveness and springiness were significantly lower in samples of experimental yogurt made with different concentration of aqueous extract of *Moringa oleifera* than control. It could be noticed that the hardness and adhesiveness are inversely proportional to cohesiveness and springiness (Lobato-Calleros *et al.*, 1997). A gradual decline in cohesiveness and springiness were found over progress of storage period in all experimental samples, in contrast to hardness, adhesiveness and gumminess were significantly higher in all experimental samples of yogurt during storage period (Fig 8 and 9). The high level of experimental samples hardness may be related to the individual or combined effect of high content of total solid, the presence of polysaccharide, high ability of water capacity binding and the length of storage period (Fizman and Salvador, 1999; Salvador and Fiszman, 2004 and Uprit and Mishra 2004). The high degree of proteolysis of protein matrix over storage is responsible for decreasing of cohesiveness and springiness (Tunick, 2000; Imm *et al.,* 2003 and Van hekken *et al.,* 2004).

Table 7. The concentration of Acetaldehyde and diacetyl in yogurt made by different concentration of aqueous extract of *Moringa oleifera* .

Treatment	Storage period (days)		
	Fresh	7	15
Acetaldehyde (µmol/ 100 g yogurt)			
Control	$81.13^{c} \pm 2.00$	$58.87^{c} \pm 1.07$	$54.50^{c} \pm 0.40$
0.1%	$82.07^{c} \pm 1.76$	$63.07^{d} \pm 1.38$	$57.99^{d} \pm 0.85$
0.2%	$85.57^{b} \pm 1.07$	$75.50^{c} \pm 0.87$	$63.78^{c} \pm 0.97$
0.3%	$87.13^{ab} \pm 1.20$	$79.41^{b} \pm 0.30$	$68.11^{b} \pm 0.29$
0.4%	$88.17^{a} \pm 0.98$	$83.12^{a} \pm 0.83$	$73.37^{a} \pm 0.45$
Diacetyl (µmol/ 100 g yogurt)			
Control	$0.48^{c} \pm 0.04$	$6.97^{d} \pm 0.19$	$8.67^{c} \pm 0.18$
0.1%	$0.52^{c} \pm 0.03$	$7.40^{c} \pm 0.17$	$8.87^{bc} \pm 0.09$
0.2%	$0.61^{b} \pm 0.02$	$7.61^{b} \pm 0.14$	$8.97^{b} \pm 0.18$
0.3%	$0.67^{a} \pm 0.02$	$7.77^{b} \pm 0.07$	$9.40^{a} \pm 0.09$
0.4%	$0.70^{a} \pm 0.06$	$7.93^{a} \pm 0.09$	$9.54^{a} \pm 0.07$

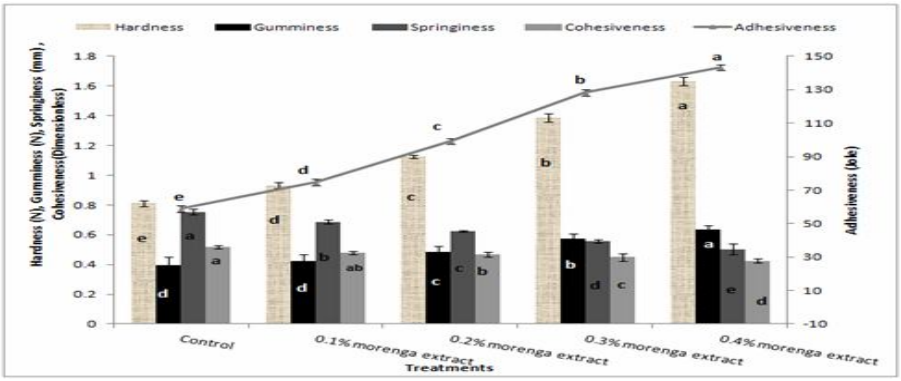

Fig. 7. Texture profile analysis of fresh yogurt manufactured by different concentration of aqueous extract of *Moringa oleifera*. TSA values are means of at least 3 separate determinations, and error bars represent ± SE.

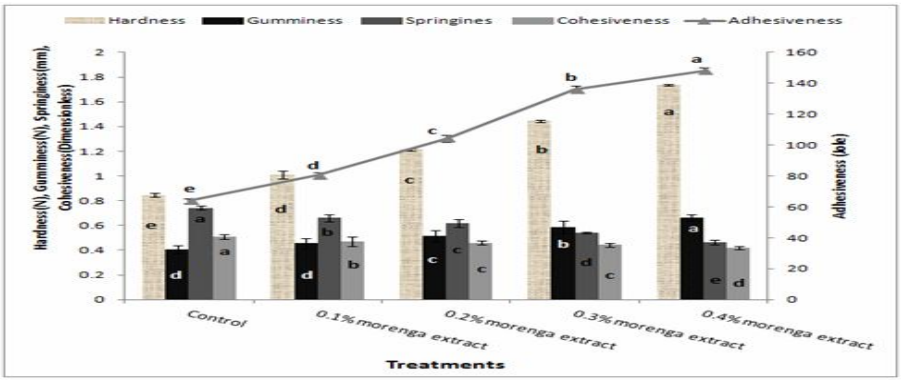

Fig. 8. Texture profile analysis fresh yogurt manufactured by different concentration of aqueous extract of *Moringa oleifera* stored at 7°C for 7 days. TSA values are means of at least 3 separate determinations, and error bars represent ± SE.

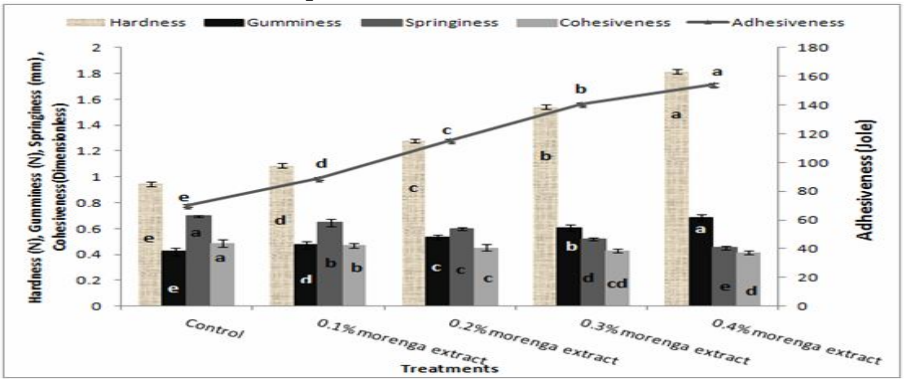

Fig. 9. Texture profile analysis fresh yogurt manufactured by different concentration of aqueous extract of *Moringa oleifera* stored at 7°C for 15 days. TSA values are means of at least 3 separate determinations, and error bars represent ± SE.

CONCLUSION

The 0.4% of *Moringa oleifera* aqueous extract was the most appropriate in manufacture of functional yogurt. This content enhances the sensory , texture profile, chemically characteristics and Nutritional value of resultant yogurt.

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استخدام المستخلص المائي لأوراق نبات المورينجا *Moringa oleifera* في انتاج الزبادي الوظيفي

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تهدف هذه الدراسة إلي استخدام المستخلص المائي لأوراق نبات *Moringa oleifera* في انتاج الزبادي الوظيفي. يحتوي المستخلص المائي علي العديد من المركبات الفعالة ومنها التنينات والفلافونيدات والسابونين والالكالويد والتربينات. أظهرت النتائج ارتفاع محتوي المستخلص المائي من المركبات الفينولية الكلية حيث وصل تركيزها 340.82 ملجرام/ جرام مستخلص بالإضافة لذلك وصل مقدار IC50 إلي ما يقرب من 75.82 ميكروجرام/ مل مما يدل علي ارتفاع النشاط المضاد للأكسدة للمستخلص المائي لنبات *Moringa oleifera* وهذه النتائج تدل علي أن إضافة المستخلص المائي بالتركيزات المختلفة سوف يعمل علي تحسين القيمة الغذائية للزبادي الناتج. وجد أن المستخلص له نشاط مضاد للبكتريا الموجبة لجرام(*S.aureus* و *E. faecalis* و *B.cereus*) علي الجانب الأخر ليس للمستخلص أي نشاط تجاه البكتريا السالبة لجرام (*E.coli* و S. Typhimurium). تحدث زيادة طفيفة في المادة الصلبة الكلية في الزبادي الناتج من إضافة المستخلص المائي، كذلك يلاحظ أن معدل الإنخفاض في درجات pH يكون أكبر مقارنة بالكنترول. لوحظ أن إضافة المستخلص يعمل علي تحسين الخواص الحسية للزبادي الناتج بالإضافة لذلك يلاحظ زيادة تركيز كلاً من الاسيتالدهيد والداي استيل سواء في الزبادي الطازج أو أثناء التخزين مقارنة بالكنترول. كما لوحظ أن إضافة المستخلص تؤثر معنويا علي الصفات الريولوجية للزبادي الناتج حيث وجد أنه يحدث زيادة في الصلابة وقوة الالتصاق والقوة الصمغية مقارنة بالكنترول، علي النقيض من ذلك يحدث انخفاض في قوة التماسك والمرونة مقارنة بالكنترول.