

## **CHEMICAL, MICROBIOLOGICAL AND ORGANOLEPTIC PROPERTIES OF TALLAGA CHEESE FLAVOURED WITH ERUCA SATIVA PLANT JUICE EXTRACT AND OIL**

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### **ABSTRACT**

Tallaga cheese was made from different concentrations of *Eruca sativa* oil & Juice extract (Gargir) 0.1, 0.2, 0.3, 0.4, 0.5%, respectively, and 1, 2, 3, 4, 5% and without as control.

Organoleptic pannele test revealed that Tallaga cheese made with 0.3% Gargir oil and 3% Gargir Juice extract gave the highest score and have been chosen for appreciation and follow up. The resultant cheese samples were stored in a refrigerator at 7°C + 1 for 30 days and analysed fresh and during storage chemically, microbiologically and organoleptically. Also, the antibacterial activity of *Eruca sativa* (Oil & Juice) against some pathogenic bacteria was investigated in artificially contaminated Tallaga cheese during storage as well as in nutrient agar medium.

The pH values and moisture content of control and flavoured cheese were decreased along the time of storage period. Contrarily, fat content, salt, total nitrogen, soluble nitrogen and the ratios of TN/SN were increased.

Total bacteria count was lower in cheese made by Gargir oil than control and cheese with Juice extract.

Gargir oil or Juice extract in cheese may positively affected the growth of lactic acid bacteria, since the counts in all cheese slightly increased to reach their maximum levels after 15 days, then gradually decreased along the rest time of storage period.

Coliform group was not detected after 21 d of storage in cheese with Gargir oil or juice extract.

Mould and yeast were not detected in the flavoured cheese during 30 days, but appeared at low levels after 15 d in control.

Concerning the pathogenic bacteria in artificially contaminated Tallaga cheese, flavouring with *Eruca sativa* oil or Juice resulted in a reduction of about one log cycle of *B. cereus*, *L. monocytogenes*, *E. coli* 0157 : H7, *S. aureus* and two log cycles for *Sal typhimrium* and *Pseud aeruginosa*, respectively.

Therefore, it could be recommended the use of *Eruca sativa* (0.3% Gargir oil or 3% Gargir Juice extract) to produce flavoured Tallaga cheese to serve adual purpose as natural flavoring ingredient and also as antimicrobial factor against some pathogenic bacteria.

**Keywords** : *Eruca sativa* Oil & Juice extract (Gargir). Flavoured Tallaga cheese – Chemical, Microbiological, organoleptic properties - pathogenic bacteria- Antibacterial effect.

### **INTRODUCTION**

Nawdays people are becoming highly interested in the use of organic food and ingredients all over the world. Also, the use of more safe, healthy and less hazardous food and additives as natural antioxidant and antimicrobial agents is highly recommended (Ghazalah and Ibrahim, 1996).

Since, some plant extracts (ie) spices, herbs and some oils were known to be used as antimicrobial agents by the ancient Egyptian for food

preservation and embalming the dead bodies. (Conner, 1993). As well as, many plant essential oils and spices were found to be active against different types of food borne bacteria and mould (Aureli *et al.* 1992, Tasson *et al.*, 1995 and Gould, 1996).

Plant essential oils are complexes and mixtures of different compounds. The inhibitory effect of these oils attributed mainly to the presence of aromatic nucleus containing a polar function group (Benjitali *et al.*, 1984, Farag *et al.*, 1989 and Golud, 1996).

Egyptian *Eruca sativa* (Gargir leaves), family Cruciferous, is one of the most famous and popular green vegetable, it is eaten fresh or in salad. Mahran *et al.* (1990) found that principal component in *Eruca sativa* seed volatial oil was 4-methyl thiobutyl isothiocyanate. They mentioned that the volatile oil of *Eruca sativa* seeds significantly increased Na, K and C I excretion in the urine.

On the other hand, Karawya *et al.*, (1994) reported that volatial oils of *Nigella sativa* seeds could normalize the enzymatic distribution in the liver tissue.

Moreover, Egyptian *Eruca sativa* seed and leaves are known to have good biological quality. Since, it increase protein and decrease total cholestrole and glucose in blood serum content (Badee *et al.*, 2003). Also, it poses an inhibitory action against the factors which cause heart diseases. On the other hand, antimicrobial activities for whole plant tissues, leaves extracts or stem distillatory of cruciferous plant have been reported. The major and functional component of *Eruca sativa* leaves (Rocket or Gargir) is Ally isothiocyanate (Hemence and Taylor, 1981). The antifungal and antibacterial properties of this compound have been reported against a wide spectrum of microorganisms (Warde *et al.*, 1998), (Tsunoda, 1994). Since, Abdou *et al.*, (1972) reported that the curd juice of garden rocket (Gargir) (*Eruca sativa*) inhibited *E. coli*, *S. typhi* and *B. subtilis*. Furthermore, Aboul-Ela *et al.*, (1996) found that *Eruca sativa* oil had significant antifungal activities. Badee *et al.*, (2003) studied the antimicrobial activities of Egyptian *Eruca sativa* seed volatile oil against some bacterial strains. They found that its volatile oil had a significant antimicrobial activity against *Micrococcus. spp*, *Pseudomonas. spp* and *Sac. Cereviseae*. Tallaga cheese is a tradional Egyptian cheese and very popular in Egypt. This variety of cheese has aspreadable mellow soft body with a pleasant low salty and creamy test. (Hofi *et al.*, 1979 and Mehanna and Rashed, 1990).

Tallaga cheese usually have high moisture and relatively low salt contents which are good environmental condition for growth of food borne bacteria and spoild microorganisms. (Shehata *et al.*, 1995 and Ibrahim *et al.*, 2001).

Thus a modern trend in cheese manufacturing is production of natural flavoured cheese made in short time with highly nutritive value and good microbiological quality as for human consumption (Fahmy *et al.*, 1992, Abou-Zeid, 1992, Hussein, 2004, and Foda *et al.*, 2006).

Therefore, the objective of this study was to apply *Eruca sativa* essential oil and juice extract of Rocket (Gargir) in the preparation of new style soft cheese Gargir flavoured.

In tallaga flavoured cheese, the shelf life potential, panel test, chemical composition and the effect of Gargir additives (oil & juice) on the growth and survival of some food borne pathogens have been studied in fresh and during storage.

## **MATERIALS AND METHODS**

### **Materials**

#### **1- Pathogenic Bacteria Strains**

*Pseudomonas aeruginosa*, *Escherichia coli* 0157: H7, *Bacillus cereus*, *Salmonella typhimurium*, *Listeria monocytogenes* and *Staphylococcus aureus* as reference strains were obtained from central public health laboratories (Ministry of Health). These strains were maintained and propagated in Tryptone soy broth and agar until use.

#### **2. Eruca sativa seed volatile oil (Gargir essential oil)**

It was purchased, from CAP PHARM for extracting natural oil & Herbs, El-obour City – Cairo Egypt. It was stored at 7 + 1°C until use

**3. Fresh leaves of Eruca sativa (Gargir)** was purchased from Cairo market, they were washed 3 times with water and dried.

#### **4. Milk**

Milk used in this study was a mixture of cow's and buffalo's milk obtained from the herd of faculty of Agriculture, Cairo University.

### **Methods**

#### **A) Culture preparation (Test strains)**

The pathogenic strains *B. cereus*, *E. coli* 0157:H7 *Staph aureus*, *Sal. Typhimurium*, *L. monocytogenes* and *Pseud aeruginosa* were routinely transferred into brain heart infusion broth (oxiod), incubated at 37°C for 24 h. After sufficient growth (turbidity) was observed, the cultures were diluted in saline solutions to an appropriate inoculum size.

#### **B) Preparation of Diluted Eruca Sativa Oil (Gargir oil)**

Oil was suspended with 10% tween 80 in mixed phosphate buffer solution pH 7 and sterilized with sartorius filter membrane. Proper decimal dilutions from oil suspension was prepared to give concentrations of 0.1, 0.2, 0.3, 0.4 and 0.5% (V/V).

#### **C) Preparation of Eruca Sativa Juice extract (Gargir Juice extract)**

Fresh whole leaves of *Eruca sativa* (Gargir) were washed thoroughly (3 times with run water). The plant ends were removed peeled by sharp knife and cut into small pieces. The juice extract was obtained by blending with sives and re-blended three times. The juice was centrifuged at 3000 rpm/10 min 5°C. The supernatant was filtered throughout no 5 filter paper, then sterilized with sartorius filter membrane and filled into glass tubes and stored in refrigerator at 7 + 1°C until use. Decimal dilution were obtained using phosphate buffer solution pH 7 to give concentrations of 1, 2, 3, 4 and 5% (v/v).

#### **D) Antimicrobial activity of Eruca Sativa oil & juice extract (Gargir oil & juice extract) in nutrient agar medium.**

The disc diffusion method as described by Conner and Beauchat (1984) was used for detecting the antimicrobial activity of *Eruca sativa* oil at

different concentrations at (0.1, 0.2, 0.3, 0.4, 0.5%) and juice extracts at different concentrations (1, 2, 3, 4, and 5%). The test strains each (0.1 ml) was spreaded on the plate surface of nutrient agar media (oxoid), individually. Stererile discs 6 mm diameter of whatman No.1 filter paper each, was dipped in the appropriate oil solutions or appropriate *Eruca sativa* juice extracts. Discs were blotted and then placed on the surface of the bacteria inoculated plates. The plates were incubated at 37°C for 48 h. The results were recorded by measuring the diameter of inhibition zones (mm) around the discs. The control inoculated plates were prepared as described except using discs without oil or juice extract.

#### **Tallaga cheese making**

Tallaga cheese making was carried out according to Fahmi and Sharara (1950) and modified with addition of *Eruca sativa* (Gargir oil & Gargir juice extract) as follows :

The bulk milk was divided into three parts.

Part I : without *Eruca sativa* (Gargir) as control.

Part II: with *Eruca sativa* juice extract (Gargir juice extract), 1, 2, 3, 4 and 5% v/v). Juice extract concentrations were added to 5 portions of milk, individually.

Part III: with oil, *Eruca sativa* oil (Gargir oil) 0.1, 0.2, 0.3, 0.4 and 0.5% v/v). Oil concentrations were added to 5 portions of milk, individually.

All portions were heated at 72°C for 15 sec then cold to 37-40°C, salted 3% NaCl, CaCl 0.02%, and inoculated with 1% active mixed culture of *Lactococcus lactis* sub sp *lactis* and *lactobacillus casei* (1:1) followed by adding rent (0.05%).

The curds were whey out and the obtained cheeses were packed in plastic containers and stored in a refrigerator at 7 + 1°C. Samples of cheeses were taken for analysis when fresh and after 7, 15, 21 and 30 days.

#### **Antibacterial activity of *Eruca sativa* (oil & juices) in Tallaga cheese :**

*Eruca sativa* oil 0.3% (Gargir oil) & juice 3% (Gargir juice) Tallaga cheeses, made from milk inoculated with *B. cereus*, *S. aureus*, *L. monocytogenes*, *Pseud aeruginosa*, *E. coli* 0157: H7 and *Sal. Typhimrium*, individually, with initial counts about  $1 \times 10^5$  cfu/ml, were investigated, separately.

All samples of the contaminated cheese were cold stored (7 + 1°C) and examined for survival of these pathogenic bacteria when fresh and after 7, 15, 21 and 30 days.

#### **Cheese analysis**

Cheese samples were taken aseptically fresh and after 7, 15, 21 and 30 days of storage period. Samples were chemically, microbiologically analyzed and organoleptically evaluated.

#### **Chemical Analysis**

Moisture content, fat, total nitrogen (T.N.), soluble nitrogen (S.N), titratable acidity and salt content were determined according to Ling (1963).

The pH of cheese was measured using pH meter fitted with a punction electrode (digital pH meter).

#### **Organoleptic Properties :**

Organoleptic properties of cheese samples were evaluated according to **El-Koussy (1966)** when fresh, 7, 15, 21 and 30 days of refrigerated storage by ten expert panelists of members of Dairy Science and Technology Department, National Research Center.

#### **Microbiological Analysis**

Cheese samples (25 g) each were homogenized for 1 min with 225 ml of sterile solution (2% w/v) of sodium citrate.

Methods of microbiological analysis were followed according to **APHA, (1992)** for : -

Total bacteria count on plate count agar (oxid). Total coliforms on violet Red Bile agar (oxid), mould and yeast on acidified potato dextrose agar (oxid).

- *Staphylococcus. aureus* on Baird-parker medim (oxid).
- *E. coli* 0157: H7 was determined on sorbitol MacConkey agar (oxid).
- *Pseudomonas. aeruginosa* on pseudomonas agar base (oxid).
- *Bacillus. cereus* was enumerated on manitol egg yolk polymyxin agar (oxid) following the surface plate method and incubated at 37°C for 18-24 h (**Holbrook & Andreson, 1980**).

*Salmonella tyhimurium* was enumerated by surface plating technique on salmonella shigella agar (oxid).

*Listeria monocytogenes* was enumerated on oxford selective agar base (oxid) supplemented with listeria selective supplement using surface plating technique, plates were incubated at 32°C for 48 h (Curtis *et al.*, 1989).

Lactic acid bacteria (LAB) on Elliker medim according to Elliker *et al.*, (1956).

## **RESULTS AND DISCUSSION**

### **Antibacterial activity of Eruca sativa oil & Juice extract (Gargir).**

The antibacterial activity of Gargir oil at different concentrations (0.1-0.5%) and Gargir juice at different concentrations (1-5%), respectively are presented in table (1). Results reveal that Gargir oil at these different concentrations showed antibacterial activity upon all of the tested pathogenic bacteria. Since, growth inhibition zones varied greatly according to the increasing concentrations of oil or juice and to the type pathogens. The maximum inhibitory effect appeared with using concentrations of 0.5% oil and 5% juice. Consequently, the most sensitive strains were ordered as *Psed. aeruginosa*, *Sal. typhimurium*, *E. coli* 0157: H7, *List. monocytogenes*, *Staph. aureus* then *B. cereus*. However, results announced the inhibitory effect of Gargir juice similar to Gargir oil but with lesser extend.

The obtained results are in concomitant with those obtained by Abdou *et al.* (1972) who reported that the crud juice of gardan rocket (Gargir) (*Eruca sativa*) inhibited the growth of *E. coli*, *Sal. typhi* and *B. subtilis*. Also, Badee *et al.* (2003) and Hussein (2003) found the inhibitory effect of *Eruca sativa* oil and other oils at different concentrations upon *Micrococcus*. Spp and *Pseudomonas*, spp, *staph. aureus*, *Sal. chloerasuis* and *E. coli* 0157: H7.

**Table (1): Inhibitory effect of Eruca sativa juice extract (Gargir juice )**

and *Eruca sativa* oil(Gargir oil)against some tested pathogenic bacteria.

**Organoleptic Properties of *Eruca Sativa* (oil & juice) (Gargir) of Tallaga Cheeses:**

Tallaga cheese batches individually prepared with *Eruca sativa* oil

Pathogenic bacteria	Eruca sativa concentration									
	Gargir oil (%)					Gargir juice extract ( % )				
	0.1%	0.2%	0.3%	0.4%	0.5%	1%	2%	3%	4%	5%
	Diameter of inhibition zone (mm)									
<i>Pseud.aeruginosa</i>	7	8	9	9	9	3	4	5	6	7
<i>Sal.typhimurum</i>	5	6	7	7	8	2	3	4	4	5
<i>E. coli 0.157:H7</i>	4	5	6	6	7	2	2	3	3	4
<i>S.aureus</i>	2	3	4	5	6	1	1	2	3	3
<i>L.monocytogenes</i>	3	4	5	5	5	1	2	2	3	4
<i>B. cereus</i>	1	2	2	3	3	1	1	1	1	2

(Gargir oil) at different concentrations (0.1 to 0.5%) and *Eruca sativa* juice extract (Gargir juice) at different concentrations (1 to 5%) were organoleptically paneled by expert panelists.

Results revealed that Tallaga cheese made with 0.3% Gargir oil and 3% Gargir juice gave the highest score and have been appreciated as compared with the control cheese.

Generally, Tallaga cheese made with different concentrations of Gargir oil showed more white colour when compared with control. While cheese made with Gargir extract showed that the light green got darker with increasing the concentration of extract to become peel green to dark green.

Hereupon, tallaga cheese made with 0.3% Gargir oil and 3% Gargir juice extract, individual, have been chosen for further chemically, microbiological and organoleptical investigations during 30 days for the cheese kept at 7°C + 1.

Results obtained by the panelists revealed that cheese with Gargir oil gave the highest score flowed by cheese with Gargir juice extract then the control cheese (without) Table (2).

During storage the flavour of Gargir (oil or juice) cheese samples was not markedly changed. While the flavour of the control cheese samples was markedly got changed after 30 days.

Therefore, it could be concluded that preparing Tallaga cheese with *Eruca sativa* oil (Gargir oil) and *Eruca sativa* juice extract (Gargir Juice extract) enhanced its orgnoleptic properties, flavour in particular and announced an appreciation by the panelists. Also, the flavoured cheese showed better keeping quality and longer shelf-life more than plane Tallaga cheese (control).

Abou-Zeid (1992) reported similar findings for the enhancement of organoleptic properties of Domiati cheese containing parsley or Rocket. He determined its ripening period within 3 weeks of storage depending on its organoleptic properties. Also the current results are similar to those obtained by Hussein (2004), who used some natural essential oils, Rocket is one of them and successfully applied it to get better sensory characteristics and elongate the shelf-life of Tallaga cheese.

**Table (2) Organoleptic properties of Tallaga cheese with *Eruca sativa* juice extract (Gargir juice) and oil (Gargir oil) during cold storage at 7±1°C for 30 days.**

C = Control cheese

J = Cheese made with 3% *Eruca sativa* juice extract ( Gargir extract)

O = Cheese made with 0.3% *Eruca sativa* oil ( Gargir oil )

**Chemical composition of Tallaga cheese made with *Eruca sativa* (oil &**

Treatment	Storage period days	Appearance colour (10)	Body & texture (30)	Flavour (60)	Total (100)
C	Fresh	8	26	45	79
O		9	26	48	83
J		9	26	46	81
C	7day	8	24	48	80
O		9	26	50	84
J		9	26	47	82
C	15day	8	23	46	77
O		9	25	51	85
J		9	25	49	83
C	21day	7	22	45	74
O		8	23	52	83
J		8	23	48	80
C	30day	7	21	36	65
O		8	23	50	81
J		8	22	47	77

**juice) Gargir:**

The effect of adding *Eruca sativa* juice extract 3% and oil 0.3% (Gargir) on chemical composition of Tallaga cheese when fresh and during cold storage period (30 days) at 7°C + 1 are shown in Table (3) & Fig. (1).

Results revealed that Tallaga cheese made with *Eruca sativa* oil (Gargir oil) contained lower moisture content than cheese made with *Eruca sativa* juice and control. The moisture content in all samples decreased as storage period progressed. This decrease might be due to concentration of the curd as a result of acid development during storage period, which help to expel the whey out from the curd, and the different holding capacities of cheese treatment.

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**Table (3): Chemical composition of Tallaga cheese with Eruca Sativa juice extract (Gargri juice) or oil (Gargir oil) during cold storage at  $\pm 7^{\circ}\text{C}$  for 30 days.**

Treatment	storage period days	Mositure	fat	TN	SN	SN/TN	salt	PH	acidity
C	0	63.97	17.2	2.21	0.2	9.49	3.43	6	0.37
J		63.88	17.5	2.28	0.26	11.4	3.47	5.56	0.58
O		62.77	19	2.23	0.23	10.26	3.45	5.84	0.45
C	7	63.33	18	2.42	0.25	11.16	3.52	5.84	0.69
J		63.17	18.5	2.47	0.36	14.57	3.56	8.34	0.86
O		62.2	20	2.45	0.34	13.87	3.55	5.75	0.81
C	15	62.83	19	2.43	0.31	12.75	3.54	5.59	0.93
J		62.73	19.8	2.59	0.41	15.83	3.59	5.42	1.11
O		61.39	21	2.52	0.38	15.07	3.57	5.56	1.08
C	21	61.81	20	2.84	0.36	14.51	3.58	5.28	1.2
J		61.5	20.4	2.6	0.52	20	3.61	4.97	1.41
O		59.97	23.2	2.55	0.39	15.29	3.59	5.23	1.39
C	30	61.71	21.4	2.53	0.38	15.01	3.59	5.12	1.24
J		61.22	24	2.64	0.45	20.45	3.63	4.73	1.47
O		58.66	22	2.61	0.49	18.77	3.61	4.91	1.4

**C = Control cheese**

**J = Cheese made with 3% Eruca sativa juice extract ( Gargir extract)**

**O = Cheese made with 0.3% Eruca sativa oil ( Gargir oil )**

The current results are in agreement with those obtained by Abou Zied (1992) who found that cheeses with parsley or rocket had lower moisture content than control. Also, results in Table (3) and Fig. (1) revealed that adding Gargir oil gave higher fat content than cheese with juice extract and control. While storage period elongate fat content increased. It seem that fat content increased as results of moisture expel or solid not fat decrease. The results are in conform with those obtained by Tarakci *et al.*, (2004) who found that fat content increased significantly until 30 days of ripening in Tulum cheese made with black cumin. Contrarily, Foda *et al.* (2006) reported that adding herbs (celery or thyme) to cheese had no significant effect on moisture, total fat or total protein. Also, similar trend was noticed with salt content in all cheese treatments. Since, it increased gradually until the end of storage period. Results of protein content of cheese represented as total nitrogen (TN), soluble nitrogen (SN), and SN/TN ratio are shown in Table (3) and Fig. (1). The results revealed that as the storage period progressed, the TN, SN and subsequently SN/TN% of all cheese treatments gradually increased. This might be attributed to the addition of oil or juice on the proteolysis of cheese protein during the storage period. The obtained results were in agreement with those obtained by Abou-Zeid (1992) who found that addition of parsley or Rocket to cheese, increase SN/TN ratio, markedly. Also, Coskun and Tuncturk (2000) found that cheese made with wild garlic had higher content of SN/TN ratio than control. Moreover, results obtained by Tarakci *et al.* (2004) and Foda *et al.* (2006) concerning cheeses made with different herbs showed similar effect on those parameters as in the current results. pH value of fresh control cheese was higher than in cheese with oil and juice, where all values decreased gradually by the end of storage.

Contrarily, acidity percent increased up to the end of storage period and was higher in cheese contained juice extract or oil than control, Table (3) & Fig. (1). The increase formation of lactic acid during storage of cheese containing Gargir may be due stimulation of lactic acid bacteria by either juice extract (Gargir) or oil. These results were in agreement with that reported by Abou-Zeid (1992) who found increase of acidity percent during ripening of cheese, specially with parsley or Rocket which showed higher acidity than control. Also, Tarakci *et al.* (2004) gave higher acidity values than control and Foda *et al.* (2006) reported higher acidity in herby cheeses whether during storage or ripening than control. Moreover, Hussein (2004) made Tallaga cheeses with and without essential oils and reported similar chemical composition to the cheese in the current study.

**Microbiological quality of Tallaga cheese made with *Eruca Staiva* (Oil & Juice) Gargir :**

Data in Fig. (2) illustrate changes in counts of some microbial groups and spoilage microorganisms in Tallaga cheese due to the effect of using *Eruca sativa* juice extract 3% (Gargir extract) or oil 0.3% (Gargir oil) in cheese making, when fresh or kept under cold storage at 7 + 1°C. Total bacteria count, was similar in fresh control cheese as well as in Gargir (oil or juice) Fig. (2). While, during storage total bacteria counts of Gargir cheese slightly decreased gradually with a slight increase in control cheese up to 21 days, then decreased to the end of storage period.

It could be noticed that bacteria count was lower in cheese made by Gargir oil than control or cheese made with Gargir juice extract.

Results were in concomitant with that reported by Abou-Zeid (1992) who found that total bacteria count in Domiati cheese made with parsley or rocket was higher than in control cheese. Also, Hussein (2004) reported that total bacteria count of control Tallaga cheese was higher than Tallaga cheese made with different types of essential oils during storage period. Foda *et al.* (2006) noticed that count of total bacteria was lower in herby cheese made with thyme or celery than with control.

Lactic acid bacteria (LAB) count was as similar ( $\sim 10^5$ ) as in cheese made with Gargir extract, control and cheese made with Gargir oil when fresh Fig. (2). Meanwhile, during storage lactic acid bacteria counts in all cheese samples slightly increased to reach their maximum levels after 15 days. Thenafter, the counts gradually decreased along the rest of storage period to reach their minimum levels after 30 days. Thus adding Gargir juice or oil in cheese may affected the growth of lactic acid bacteria.

In this respect, Abou-Zeid, (1992) stated that rocket or parsley used in manufacture of Domiati cheese may be stimulate the activity of lactic acid bacteria.

Mould and yeast, were not detected in both of cheese flavoured whether made with Gargir juice or Gargir oil when fresh or during the storage period (30 days). In control cheese, mould and yeast appeared at low level (10 cfu/g) after 15 day of storage and reached to  $9 \times 10^3$  cfu/g after 30 days of storage. Results were in agreement with those obtained by Aboul-Ela *et al.* (1996) who reported that *Eruca sativa* oil had significant antifungal activity. Moreover, Badee *et al.* (2003) reported antimicrobial activities of Egyptian

*Eruca sativa* seed, volatile oil, against *Micrococcus* spp, *Pseudomonas* spp and *Sacc. cereviseae*.

Coliforms, were detected in all fresh cheeses samples at a similar level. Coliform group survived 30 and 21 days at 7°C in control and treated cheese samples, respectively. However, Coliform organisms were not detected and disappeared after 21 days of storage in cheese with Gargir juice extract or Gargir oil, Fig. (2). Hereupon, the inhibitory effect upon Coliforms in treated cheeses could be attributed to an antimicrobial effect of Gargir extract or Gargir oil which might prevent the growth of Coliform organisms (Abd-Alla *et al.*, 2000 & Hussien, 2003 and Abdou *et al.*, 1972). The current results are also in agreement with those reported by Coskon, (1998) and Foda *et al.* (2006) who found that herby cheese containing wild garlic, thyme or celery had lower coliform count than the plane cheese.

#### **Antibacterial activity of *Eruca Sativa* (oil & juice) (Gargir) in Tallaga Cheese :**

The behavior of pathogenic bacteria in artificially contaminated Tallaga Gargir cheese during cold storage at 7°C + 1 for 30 days, individually, are shown in Figure (3).

The obtained results revealed that the addition of Gargir oil 0.3% and Gargir extract 3% achieved a reduction of about one log cycles of *B. cereus*, *L. monocytogenes*, *E. coli* 0157: H7, *S. aureus* and two log cycle of *Sal. typhimurium* and *Pseud. aeruginosa*, respectively. This is in respect with control cheese during 30 days of cold storage, Fig. (3).

The current results were in concomitant with those obtained in various, investigations, since Abdou *et al.*, (1972) reported that crud juice of garden rocket (Gargir) (*Eruca sativa*) inhibited *E. coli*, *B. subtilis* and *Salmonella typhi*. Also Badee *et al.* (2003) found that the Egyptian *Eruca sativa* seed, volatile oil (Gargir oil) had a significant antimicrobial activity against *Micrococcus*. Spp, *Pseudomonas* spp and *Sac. cereviseae*.

Warde *et al.*, (1998) found that *E. coli* 0157: H7, *L. monocytogenes*, *S. typhimrium* and *S. aureus* were inhibited by Ally isothiocyanate, the major and functional component in *Eruca sativa* (rocket or Gargir), and considered as the most sensitive pathogens. Also, Hussein, (2003) found the antimicrobial activity of ten essential oil including Gargir oil against enterotoxigenic *S. aureus* sub *aureus* and *salmonella cholerasus* sub *cholerasus* and *E. coli* 0157: H7 in Tallaga cheese stored at 7°C for 25 days. Therefore, it could be recommended that the addition of Gargir oil or extract to milk might have a slight effect to hinder the growth of these pathogenic bacteria in Tallaga cheese made from, more or less up to 30 days of cold storage.

In conclusion the aforementioned results announce that Gargir oil or extract could be incorporated into soft cheese to serve adual purposes as flavoring ingredients and also as antimicrobial agents against harmful pathogens common in cheese.



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### الخواص الكيماوية والميكروبيولوجية والحسية لجبن الثلجة المطعم بمستخلص وزيت نبات الجرجير وجيه إبراهيم الخولى قسم علوم وتكنولوجيا الألبان - المركز القومي للبحوث - الدقى - القاهرة

فى هذا البحث تم استخدام عصير وزيت نبات الجرجير بتركيزات مختلفة (١، ٢، ٣، ٤، ٥%) و (١، ٢، ٣، ٤، ٥، ٦، ٧، ٨، ٩، ١٠%) على الترتيب فى تصنيع جبن ثلجة. حيث أظهرت النتائج أن أعلى درجة تحكيم حسى للجبن كانت عند استخدام تركيزات ٠,٣% زيت الجرجير وعند ٣% لمستخلص العصير وقد خزن الجبن المصنع منهما بالثلجة على ٧م + ١ لمدة ٣٠ يوم وأجرى تحليل الجبن حسياً وكيماوياً وبكتريولوجياً وكذلك تم دراسة التأثير المضاد لهذه التركيزات من العصير والزيت على بعض الميكروبات المرضية فى بيئة الأجار المغذى وفى جبن الثلجة الملوثة بهذه الميكروبات.

وقد وجد أن قيم الـ pH ومحتوى الرطوبة يتناقص أثناء فترة التخزين فى أنواع الجبن المختلفة بينما يزداد نسب كل من الدهن والملح والحموضة والمحتوى الكلى للنيتروجين وكذلك نسبة النيتروجين الكلى إلى النيتروجين الذائب بتقدم فترة التخزين كما أظهرت النتائج أيضاً:

- أن أقصى نشاط تثبيطى تجاه الميكروبات المرطبة فى بيئة الأجار الطبيعية هو عند ٥,٥%, ٥% لزيت ومستخلص الجرجير على الترتيب. أما فى الجبن فلو حظ إنخفاض العدد الكلى للبكتيريا فى الجبن المضاف إليه ٠,٣% زيت الجرجير و٣% عصر الجرجير.
- زادت أعداد بكتيريا حمض اللاكتيك زيادة طفيفة بعد ١٥ يوم ثم بدأت فى التناقص تدريجياً مع تقدم مدة التخزين كما اختفت بكتيريا القولون بعد ٢١ يوم فى جبن المعاملة وبعد ٣٠ يوم فى الجبن غير المعامل.
- وفى الجبن المعامل خلت من الفطريات والخمائر بينما ظهرت بأعداد قليلة فى الجبن غير المعامل بعد ١٥ يوم وصلت أقصاها فى نهاية مدة التخزين.
- فى الجبن المعامل الملوثة بالميكروبات المرضية تناقص أعداد كل من بكتيريا *B. cereus*، *L. monocytogenes*، *E. coli* 0157: H7 و *S. aureus* بمقدار دورة واحدة لو غارتمية فى حين تناقص أعداد كل من بكتيريا *Sal. typhimrium*، *Pseud. aeruginosa* بمقدار دورتين لو غاريتمتين. ولذا يوصى باستخدام أى من الإضافتين لإنتاج جبن الثلجة ذو نكهة طبيعية مرغوبة جديدة وكمضاد طبيعى للميكروبات المرضية لحماية جبن الثلجة.