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## Chemical composition, radical scavenging, rheological and sensory properties of local Soft cheese (Paneeri Salik) supplemented with some natural anti-oxidant extracts

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### ABSTRACT

The aim of this research is to study the effect of herbs extracts (Mint, Dill, Tarragon and the combination of these herbs) supplementation on the chemical composition, antioxidant activities, rheological and sensory properties of local soft cheese (Paneeri Salik) during three weeks of storage. The addition ratio of herb extract was 6.5 % v/w for each cheese treatment then compared with the control cheese treatment. Only the moisture percentage was significantly different at level ( $P < 0.05$ ) in the cheese treatments which contain herbs from the control treatment, the herbs cheese moisture decreased in three weeks whereas the other chemical properties (Fat, Protein, Carbohydrate, Ash and Acidity) were not significantly different. Mint, Dill, Tarragon and mix herbs supplementation increased scavenging of free radicals and enhanced the antioxidant properties of Salik cheese, the DPPH were (79.85, 94.88, 90.52, 97.33, 99.18)% in each of (Control, Mint, Dill, Tarragon, and mix herbs), respectively in the first week then were decreased to ( 87.10, 83.62, 87.51, 83.46)% in the (Mint, Dill, Tarragon, and Mix herbs) compared to control which became 98.81% in the third week of storage. The herbs affected the hardness of cheese, which increased by increasing the storage periods. Sensory evaluation was acceptable especially in mint cheese but a few decreases in flavor were detected in the cheeses treated with herbs mix and Tarragon after three weeks of storage.

### KEY WORDS:

Antioxidant, Cheese Industry, Dairy Chemistry, Herbs extracts, Sensory evaluation

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## التركيب الكيميائي ، الكسح الجذري ، الخصائص الريولوجية والحسية للجبن الطري المحلي (بانيري سالك) المدعم ببعض المستخلصات الطبيعية المضادة للأكسدة

داستان صديق العلي ودنيا سلمان خلف

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### الخلاصة

هدف البحث دراسة تأثير مكملات مستخلصات الأعشاب (النعناع ، الشبث ، الطرخون ومزيج من هذه الأعشاب) على التركيب الكيميائي ، والفعالية المضادة للاكسدة ، والخصائص الريولوجية والحسية للجبن الطري المحلي (بانيري سالك) خلال ثلاثة أسابيع من التخزين. كانت نسبة إضافة مستخلص الأعشاب 6.5% حجم / وزن لكل معاملة جبن ثم تمت مقارنتها بمعاملة جبن السيطرة. اظهرت النتائج ان نسبة الرطوبة فقط اختلفت معنويًا عند المستوى ( $p < 0.05$ ) في معاملات الجبن التي تحتوي على أعشاب مع معاملة السيطرة التي انخفضت حتى الأسبوع الثالث بينما لم تختلف الخواص الكيميائية الأخرى (الدهون ، البروتين ، الكربوهيدرات ، الرماد ، الحموضة) بشكل كبير في الجبن الذي يحتوي على مستخلصات الأعشاب، وان مستخلصات كل من (النعناع ، الشبث ، الطرخون والمزيج من الأعشاب) زادت من إزالة الجذور الحرة وعززت الخصائص المضادة للأكسدة لجبن السلك ، ونسبة كسح الجذور الحرة (DPPH%) في كل من (النعناع ، الشبث ، الطرخون ومزيج الأعشاب) اذ كانت ( 94.88 ، 79.85 ، 90.52 ، 97.33 ، 99.18 )% على التوالي في الأسبوع الأول ثم انخفضت إلى ( 87.10 ، 83.62 ، 87.51 ، 83.46 )% في معاملة (النعناع ، الشبث ، الطرخون ، مزيج الأعشاب) مقارنة مع معاملة السيطرة والتي أصبحت 98.81% في الأسبوع الثالث من التخزين ، أثرت الأعشاب على صلابة الجبن ، والتي زادت بزيادة فترات التخزين. كان التقييم الحسي مقبولاً خاصةً في الجبن المضاد له النعناع ولكن تم الكشف عن انخفاض طفيف في النكهة في الجبن المعالج بمزيج الأعشاب والطرخون بعد 3 أسابيع من التخزين.

**الكلمات المفتاحية:** تصنيع الجبن، كيمياء الالبان، مسخلصات الاعشاب، مضادات الاكسدة، التقييم الحسي.

## INTRODUCTION

Cheeses play a big role in human nutrition, a part of its food meals, especially the local traditional cheese. Today cheese consumption is widely spread out around the world. There are various types of local cheese that are produced and marketed in Sulaimanya Province/ Kurdistan region of Iraq. One of These classes of cheese is a soft cheese, it is therefore important to define, description and developing of these cheeses. Most of white Kurdish cheeses made from raw milk by traditional methods in the village (FAO, 2003). The white cheese is one of the popular cheese types in Kurdistan region and in the all of the Iraq, manufacturing method of this cheese is known, old and traditional method in the Middle East Mediterranean countries as Jordan, Palestinian, Lebanon and Greece (Dirar, 1993). Cheese has developed to become a food of haute cuisine with epicurean qualities, as well as being highly nutritious in the local markets (Fox *et al.*, 2004). There are many imported international cheeses that compete with local cheeses, which requires attention and development them, because consumers seek foods for a healthier life style (Zantar *et al.*, 2014). Antioxidant may offer resistance against the oxidative stress by scavenging free radicals, inhibiting lipid peroxidation and by many other mechanisms and thus prevent disease, today widely used as free radicals' inhibitors in food for maintaining the freshness, flavor, and odor for longer period (Panchawat *et al.*, 2010). Cheese also contains low content of phenolic compounds, which are retained due to their interaction with milk proteins. However, water soluble compounds with low molecular weight are often lost in the cheese whey, the antioxidant activity of "native" phenolic

cheese compounds are very low (Han *et al.*, 2011). So various types of herbs used as a natural source of antioxidant in cheese industrial as dill, basil, fenugreek, tarragon, sage, and rosemary in each of Processed cheese products, Feta, Gouda, Bouletted'Avesnes, Cheddar, and Raclette respectively (El-Sayed and Youssef, 2019) Although a specific category for natural additives has not been defined, there are different types of natural antioxidants, sweeteners, coloring agents and antimicrobials that are derived from plants, animals, and microorganisms (Carocho *et al.*, 2015). Herbs are rich sources of powerful antioxidants, have been used for aroma, flavour, and colour before more than 2000 years, and used for preservation of beverages and foods primarily due to their phytochemicals. The antioxidants in herbs are excellent as antioxidant activity (Embuscado, 2015) so for natural products, has resulted in an increased demand for natural antioxidants. Herbs addition has been tested in different cheeses not only because of their antioxidant, antimicrobial effects but also to attract consumer's attention and to propel the sales of these cheeses, consequently to improve its marketing place and its storability (Hayaloglu and Farkey, 2011), many factors are studied to know if have affecting on the antioxidant capacity of cheeses as that prepared with cow, ewe, and goat milks, ripening times, the seasons (winter or summer ), the effect of species, ripening, seasonality, and cheese components, such as fat, protein and peptide contents, mineral composition, and fat-soluble vitamins, with which the antioxidant capacity that correlate with it (Revilla *et al.*, 2016).

Tarragon (*Artemisia dracunculus* L.): is a species of perennial herb in the family Asteraceae. It is widespread in the wild across much of Europe, Asia and North America, and is cultivated for culinary and medicinal purposes (Shultz, 2006). Is a yearly seasoning in the Asteraceae (daisy) family, which has a long history of benefit in culinary traditions. Obolskiy *et al.* (2011) also well clarified that it has a wide range of health advantages and has therefore been widely utilized as herbal medicine due to its essential oil composition and a wide range of secondary metabolites (flavonoids, phenylpropanoids, coumarins, etc.). Based on the studies by Khodakov *et al.* (2009) and Curini *et al.* (2006) it is described that the ranges of the essential oil are usually 0.15-3.1% in the aerial parts, and the major components are non-terpenoid compounds: aromatic and acetylene compounds, isocoumarin derivatives, and fatty acids. Also, they found that the main components of the essential oil vary greatly relating to the origin of the material for example methyleugenol (up to 39%), estragol (up to 82%), elemicin (up to 57%), and terpinolene (up to 25%).

Dill (*Anethum graveolens* L.): commonly known as dill belonging to the family Umbelliferae, one of the most useful essential oil-bearing spices as well as medicinal herb. Dill is cultivated throughout the world as a medicinal plant. Shyu *et al.* (2009) estimated the antioxidant activities of ethanolic extract from dill flower and its various fractions via 2,2-diphenyl-1-picrylhydrazyl radical scavenging, trolox equivalent antioxidant capacity, reducing power, chelating power, and  $\beta$ -carotene bleaching tests.

In an interesting study done by Rekha *et al.* (2010) antioxidant activity of aqueous and methanolic extracts of soup formulated with dill leaves was analyzed by measuring total phenolic content, reducing power ability, and free radical-scavenging activity. They saw that the phenolic acid profile included tannic acid, protocatechuic, gentisic, vanillic acid, and syringic acids, also the reducing power ability increased by approximately 2.5 times in aqueous and seven times in methanolic extracts, by addition of dill leaf powder. Mint: belongs to the genus *Mentha* in the family Labiatae (Lamiaceae) that includes other commonly grown oil yielding plants such as basil, sage, rosemary, marjoram, lavender and thyme. Nikavar *et al.* (2010) assess the antioxidant and free radical scavenging properties and the phenolic content of the ethanol extract from five *Mentha*

species [*M. longifolia* (L.), *M. piperita* L., *M. pulegium* L., *M. rotundifolia* (L.), and *M. spicata* L.]. They used 2, 2'-diphenyl-1-picrylhydrazyl radical (DPPH) and 2, 2'-azinobis (3-ethylbenzothiazoline-6-sulfonic acid) radical (ABTS) to analyze the antioxidant activities of the extracts. Pereira and Cardoso (2013) stated that *Mentha* species are wealthy in polyphenols and possess caffeic acid and its derivatives caftaric acid, cinnamic acid, ferulic acid, and oleanolic acid. Besides, flavonoids including luteolin and its derivatives apigenin, acacetin, diosmin, salvigenin and thymonin, have also been noticed in these plants, accounting for some 10–70 compounds out of the total phenolics, and also flavanols such as catechin, epicatechin and coumarins, including esculetin and scopoletin. Menthol, menthone, isomenthone, menthyl acetate, linalool, linalyl acetate, lippione, pulegone, carvone, piperitenone oxide and cis-piperitone epoxide are the major components of essential oils formulated from different mint species.

The aim of this study: Describing Kurdish local soft cheese (Paneeri Salik) that is common in local markets of Sulaymaniyah province. The basic steps for manufacturing it is, supplying soft cheese with three sources of herbs extracts (tarragon, mint, dill and a mixture of the aforementioned herbs) as natural antioxidants, Studying the effect of adding these herbs, either separately or in combination, on some chemical, physical, sensory properties and antioxidant activity of cheese and

## MATERIALS AND METHODS

**Milk Bulk :** The whole cow milk prepared from Bakrajow dairy cows farms (Sulaimani University, College of Agricultural Engineering Science), after milked and test, directly used to cheese making in September 2021.

**The Herbs:** The Herbs cultivated in Bazian farm, were used to made of cheese directly, the scientific names of Tarragon, Mint, Dill, are *Artemisia dracunculus* L., *Mentha spicata* L., *Anethum graveolens* L. respectively.

**Herbs Extracts:** The leaves of fresh herbs were cleaned and washed, 100g of each herbs leaves blended for 15 minutes, then filtered through a double layer of cheese cloth in the refrigerator overnight, the volumes of the aqueous part of herbs extracts were (67.5, 68.5, 77.5) ml of (Tarragon, Mint, Dill) respectively then used to produce cheese, 6.5% volume per weight of each one of herbs extracts were added to the cheese curd treatments.

**Production Method of Salik Cheese:** Whole cow milk (4.63 %fat) was used to produce Salik cheese treatments after pasteurized it at 63°C/30 minutes, cooling to 37°C then curdling enzyme was added, coagulation done through 30 min, after 10 min the curd was cutting, then the whey drainage, the curd cheese were divided into five treatments, various herbs extracts (6.5% v/w) were added to the curd of salik cheese treatments. After blending curd of Salik cheese with extracts of herbs in same ratio, put into cheese cloth and formed to molds. The cheese treatments were stored at 4 °C and were sampled after 1, 2 and 3 week of storage periods for analysis, the treatments of cheese were: T1: Control treatment, T2: mint extract treatment, T3: Dill extract treatment, T4: Tarragon extract treatment, T5: Herbs extract (1:1:1) of (Mint, Dill, and Tarragon) treatment.

**Chemical Analysis of Milk:** The milk samples which used for manufacturing of cheese were analyzed by Ekomilk (Eon Co., Europe origin), for each of protein%, fat%, lactose%, total solids T.S%, solids nonfat SNF%, titratable acidity%, density kg/l, Freezing point°C, Temperature°C.

## Chemical Analysis of Cheese

**Determination of Fat Contents:** Fat contents of cheese were estimated by hexane solvent extract according to AOAC, (2000), by used Soxhlet apparatus(Buchi/ Switzerland) with heating plate and hexane (40-60°C) to fat extraction from about 2 g of dried cheese (103°C/4hr), the process was to not less than 8 hours (rate of syphoning4/hr).

### Determination of Moisture and Total Solid (TS) Content

Moisture% and TS% were estimated according to the (AOAC, 2000), using drying oven at 102°C/4 hr as in the below:

$$\text{Moisture\%} = \frac{\text{weight of the sample before drying} - \text{weight of the sample after drying}}{\text{weight of the sample before drying}} \times 100$$

$$\text{TS \%} = 100 - \text{Moisture\%}$$

**Measuring Titratable Acidity and Ph Values:** Titratable acidity (TA) values of cheese were measured, distilled water at 40°C added to 10 g of sample until the total volume was 105 ml, shaken vigorously and filtered. 25ml portions of filter (about 2.5 g) of cheese were titrated with 0.1N NaOH, using Phenolphthalein indicator. 1 ml 0.1N NaOH = 0.009g lactic acid, then applied the equation in bellow (AOAC, 2000):

$$\text{TA \%} = ((\text{NaOH volume} \times \text{N (0.1)} \times 0.009 \times 100) / (\text{weight of the sample}))$$

The pH value of cheese was measured by immersion the electrode of pH meter directly into the Salik cheese samples, three replicates were made to establish the correct pH and measuring of TA.

**Protein and Ash Determination:** According to AOAC, (2000) each of protein and ash determined, using muffle (Dahlan Labtech Co., ltd / Korea) device for 16 hours at 550 °C to determine of ash, while micro Kjeldahl was used to determine general content of nitrogen, 6.38 was used as a conversion factor to measuring of protein%.

## Antioxidant Activity

**Sample Extraction:** According to Shimada *et al.* (1992), 2 grams of cheese samples mixed with 10 ml of ethanol 70 % and shaken at room temperature for 24 hours. Samples centrifuged in 8000 rpm for 10 minutes and supernatant separated for analysis, Extracts were stored in refrigerator till analysed.

**DPPH Assay:** DPPH scavenging assay was performed based on Shimada *et al.* (1992). So, 0.16 mM DPPH (Sigmaaldrich) in 96% ethanol (Merck) was prepared and stored in dark condition. Extract and DPPH (1,1-diphenyl-2-picrylhydrazyl) solution mixed in 1:1 and incubated in dark condition for 30 minutes at room temperature. The absorbance of the resulting solution was measured at 517 nm absorbance analysis. DPPH and ethanol solution were used as a negative control. Ascorbic acid 100 mg/ml was used as a calibrator, using UV-vis spectrophotometer, all reactions were measured in triplicates. DPPH radical scavenging percent was calculated as:

$$\text{DPPH\%} = \frac{\text{Absorbance}_{517} \text{ of control} - \text{Absorbance}_{517} \text{ of sample}}{\text{Absorbance}_{517} \text{ of control}} \times 100$$

**Measuring of Firmness in Cheese:** According to Şeyma and Fatih (Texture Profile Analyzer (TPA)) was used to measuring firmness with a specific probe (5 cm diameter), the cheese samples were taken from three location of the cheese middle, edge, and surface to give a good result. the samples were test with TRIGGER: 0.5, DEFORMATION: 50mm, SPEED: 1mm/S, the firmness was determined according to the texture analyzer manual.

**Sensory Evaluation:** The sensory properties of the cheese samples with different herbs during storage period at (1, 2 and 3) week of manufacturing were evaluated, according to the 0-7 point scale all the sensory characteristics((Texture with Finger(Roughness/Surface/Springing),Texture in

mouths(Firmness/ Friability/Adhesiveness/Solubility/Granularity/Moisture in mouth) Basic Taste(Saltiness/ Acid/ Sweetness/Pungent), Odor and Flavor(Odor intensity /Odor assessment / Flavor intensity / Flavor assessment/ Odor and flavor persistence/ Total Assessment) ) were evaluated by the lecturers of Food Science and quality control department (Bero'dier *et al.*, 1996). Sensory analysis forms of Soft cheese with different herbs at (1, 2 and 3 weeks) of manufacturing: Attributes scored on a 7-point scale.

**Form (1)**

	<b>Texture with Finger</b>	<b>Texture in mouths</b>
T	Roughness /Surface /Springing	Firmness / Friability / Adhesiveness / Solubility / Granularity / Moisture in mouth
T1		
T2		
T3		
T4		
T5		

**Form (2)**

	<b>Basic Taste</b>	<b>Odor and Flavor</b>
T	Saltiness / Acid / Sweetness/ Pungent	Odor intensity /Odor assessment /Flavor intensity /Flavor assessment/Odor& flavor persistence/ Total Assessment
T1		
T2		
T3		
T4		
T5		

### Statistical Analyses

The analysis of variance of traits (tarragon, dill and mint additives) was done in the form of a factorial format based on a completely random unbalanced design with two replications. The first factor was the type of cheese processing (in 5 levels, including cheese, a combination of cheese with mint, cheese with dill, cheese with tarragon, cheese with a mixture of mint, dill and tarragon) and the second factor was storage time (time intervals of one, two and three weeks). ANOVA was used for data analysis, the differences between means were determined by Duncan's multiple ranges at  $P \leq 0.05$ .

### RESULTS AND DISCUSSION

The chemical composition of whole milk which used for manufacturing of Salik cheese were analyzed for selected parameters as clear in table 1. Table 2 shows the percentage of fat content for all the cheese treatments , Fat content in control treatment and herbs treatments, the mean comparison between the treatments for fat showed that treatment combination T1(control treatment) ( 35.59%) was highest value than the others combination at first week of storage, because they contain (6.5% v/w) of herbs extract ( mint, dill, tarragon, and herbs mix) and that cause decrease of fat percentage and other components of cheese compared with control treatment, while the T2 which contain a mint herb extract had a low fat content (27.73%) compared with other treatments, but T4 which contain tarragon herb extract had a high value of fat (30.00%) compared to other herbs treatments. could see the fifth treatment T5 that contain a mix of herbs extract had a high percentage of fat (36.19%) till third week compared to control treatment due to the fiber content in the extracts of herbs as a fat binder, also other treatments keeps of their fat contents compared with control treatment in the third week, that was agree with Himed-Idir *et al.* (2021) who used rosemary powder and its dried ethanolic extract at various concentrations (g/100 g) for

the formulation of fresh cheeses. The results revealed that physicochemical parameters (pH, proteins, fat) of the formulated cheeses were not influenced by this supplementation but the plant extracts enhanced phenolic content and antioxidant capacity when compared to the control cheese. Also agree with previous study of Atwaa *et al.* (2020) who made cheese supplemented with sweet red pepper paste, the results fat content decrease with addition SRPP, but the fat content of control cheese was highest value compared with the other treatments, whilst the fat content of all treatments increased along with the storage period up to the end of the storage period. So only the simple effect of treatment became very significant, and the simple effect of time and the interaction effect of treatment and time were not significant.

**Table (1):** Chemical composition and physicochemical analysis of whole milk used for cheese production

Parameters	Results
pH	6.34
Lactose	5.00%
Conductivity	3.69
Acidity	0.18%
Fat	4.63%
S.N. F	9.15%
Density	1.030 g/cm <sup>3</sup>
Protein	3.46%
Freezing point	-0.55°C
Temperature	38.3°C

Significant differences was found between the treatments at 0.05 level, observed higher percentage of the moisture in the (T2) of cheese at first week (56.61%), while the lowest percentage of the moisture was in the control treatment ( 48.18%) compared to all the treatments that contain of the herbs extract (tarragon, dill and mint) or herb mixture which increased of moisture content in the cheese, whilst control treatment was the least loosing of moisture during storage(48.00%) compared to all of herbs extracts treatments that were more loosing of moisture(51.83, 49.91, 48.54, 47.31) % in each of the T2, T3, T4, T5 respectively, as well as all the evaluation factors including treatment, time and interaction effect of treatment and time were significant and highly significant at 0.05 level. Table (2) displayed that total solids content of all treatments (control and supplemented herbs cheese) increased significantly with increasing storage time the might be due to the shrinkage of the curd as a result as acid development, similar results were reported by Hala *et al.* (2010) for low fat UF- Soft cheese supplemented with rosemary extract as natural oxidant and found decreasing in the moisture in 30 days of storage. El-Sayed (2020) got similar results were used spinach powder as functional ingredient in the manufacture of UF soft cheese by added different concentrations to the cheese.

Table (2) shows that the simple effect of treatment and time was very significant, the results of the pH content of all treatments decreased during storage period, pH in the mint cheese higher than to the other treatments then dill and tarragon this result due to the pH in the mint, pH in the supplemented cheeses with mint, dill, tarragon and herbs mix similar to the control but it's a bit

more due to these herbs are alkaline, acidity content of all treatment increased during the storage period due to the lactose fermentation to the lactic acid and degradation of intermediates components of protein and fat, the highest amount of acidity was observed in the third week and no significant difference was observed between the first and second weeks, the interaction effect of treatment x time was not significant. These results were similar to the results gained by El-Sayed and Ibrahim (2021) who manufactured soft cheese contain red radish root nano powder used at levels (1, 2, and %3), acidity increased during the storage period but different to control cheese. These results were in good agreement with the result discovered by Aktypis *et al.* (2018) was manufactured fresh ovine cheese supplemented with saffron, the pH of saffron cheese decrease during storage period and had a very significant reaction.

Table (2) indicated that protein content of cheese treatments was increased along of storage, and observed non-significant variation among various treatments and control at level of 0.05 and that was expected because of increased total solids and loss of whey by syneresis, however Tarragon cheese is superior in protein content than other treatments including control treatment, as such herbs cheese treatments had a high protein content compared with T1 except the dill cheese treatment which recorded a low value of protein among treatments, These results are agree with Hala *et al.* (2010) who manufactured low fat UF- Soft cheese supplemented with rosemary extract as natural oxidant that caused increased of protein during storage period. Whereas similar results reported by Khan *et al.* (2018) who were prepared Gouda cheese and fortified it with mango.

Table (2) shows the simple effect of time was very significant and the simple effect of treatment and the interaction effect of treatment with time were not significant. Carbohydrate decrease through the storage period in all the treatments, the ratio in the treatment depend on the residual lactose sugar content in the cheese where the most of them remove with the whey, and the other hand the partial of remaining lactose fermented to the lactic acid by lactic acid bacteria. Table (2) demonstrates none of the factors were significant ( $P \leq 0.05$ ) between treatments and control treatment of cheese for these trait, although that the ash percentage decreased till the third week of storage, the control cheese treatment showed the highest content of ash compared to other treatment, while mint cheese the lowest of ash content compared to other treatments due to the high content of the minerals in the cheese, this result agree with Vukić, *et al.* (2022) when produced kombucha cheese fortified with sage herbal powder stored for (10) days and reported that the ash in the control cheese was highest compared to other treatments but not significant in ash content among different samples, as well as Farahat *et al.* (2021) observed that ash increased during storage period in processed cheese supplemented with vegetables.

Figure(1) illustrates that no significant difference was observed among treatments or between the control and other treatments although the control treatment had a low value of DPPH in the first week compared with the herbs cheese treatments which had a high value of DPPH, but observed the DPPH values decreased in the herbs cheese treatments at the third week of storage, The antioxidant in control cheese increased through storage period due to reduce the moisture content, that caused increased of antioxidant dissimilar the other treatments when supplemented with herbs extract which decreased during storage period might be because extraction method of herbs or loss partial of them with whey during storage. The herbs mix extract cheese treatment was the best one among treatment and had a high activity due to contain of three source of antioxidant instead of one compared with other treatments. similar results recorded by Atwaa *et al.* (2020) when manufacture spreadable cheese supplemented with sweet red pepper paste that had antioxidant activity higher in



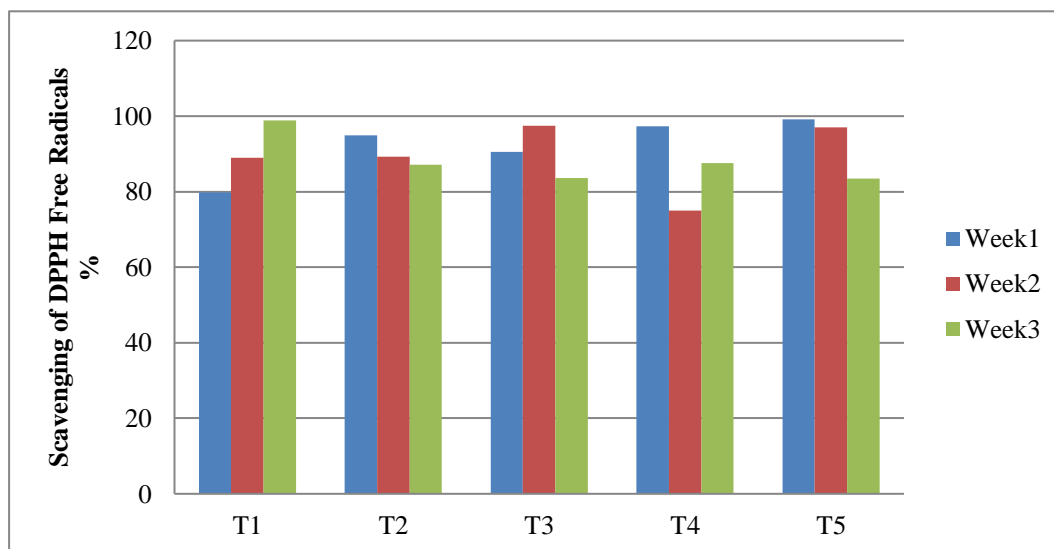
supplemented cheese compared to control cheese and in another study by Mehanna *et al.* (2017) found the addition of tomato juice cause decreasing total phenolic content during storage period, or this due to changing of phenolic compounds to unstable compound.

**Table (2):** Chemical characteristics of Salik cheese

Parameters	The Periods	T1	T2	T3	T4	T5
Moisture%	W1	48.18 <sup>hi</sup>	56.61 <sup>a</sup>	55.31 <sup>ab</sup>	53.53 <sup>bcde</sup>	54.63 <sup>abc</sup>
	W2	48.10 <sup>hi</sup>	53.84 <sup>abcd</sup>	54.70 <sup>abc</sup>	51.26 <sup>defg</sup>	51.54 <sup>def</sup>
	W3	48.00 <sup>hi</sup>	51.83 <sup>cdef</sup>	49.91 <sup>fghi</sup>	48.54 <sup>ghi</sup>	47.31 <sup>i</sup>
Total Solids%	W1	51.82 <sup>ns</sup>	43.40 <sup>ns</sup>	44.69 <sup>ns</sup>	46.47 <sup>ns</sup>	45.37 <sup>ns</sup>
	W2	51.90 <sup>ns</sup>	46.16 <sup>ns</sup>	45.30 <sup>ns</sup>	48.74 <sup>ns</sup>	48.46 <sup>ns</sup>
	W3	52.00 <sup>ns</sup>	48.17 <sup>ns</sup>	50.09 <sup>ns</sup>	51.46 <sup>ns</sup>	52.69 <sup>ns</sup>
Protein%	W1	11.23 <sup>ns</sup>	12.30 <sup>ns</sup>	10.73 <sup>ns</sup>	12.89 <sup>ns</sup>	12.86 <sup>ns</sup>
	W2	11.31 <sup>ns</sup>	12.10 <sup>ns</sup>	11.24 <sup>ns</sup>	12.10 <sup>ns</sup>	11.98 <sup>ns</sup>
	W3	13.15 <sup>ns</sup>	12.62 <sup>ns</sup>	12.41 <sup>ns</sup>	13.14 <sup>ns</sup>	13.13 <sup>ns</sup>
Fat%	W1	35.59 <sup>b</sup>	27.73 <sup>ab</sup>	29.90 <sup>a</sup>	30.00 <sup>a</sup>	28.29 <sup>a</sup>
	W2	36.10 <sup>b</sup>	30.24 <sup>a</sup>	30.51 <sup>a</sup>	33.35 <sup>b</sup>	32.68 <sup>a</sup>
	W3	34.29 <sup>b</sup>	32.14 <sup>a</sup>	33.48 <sup>b</sup>	34.27 <sup>b</sup>	36.19 <sup>ab</sup>
Carbohydrates %	W1	1.6700 <sup>a</sup>	1.6900 <sup>a</sup>	1.5200 <sup>a</sup>	1.7100 <sup>a</sup>	1.6190 <sup>a</sup>
	W2	1.1100 <sup>ab</sup>	1.4034 <sup>ab</sup>	1.0500 <sup>ab</sup>	0.8510 <sup>ab</sup>	1.0451 <sup>ab</sup>
	W3	0.7800 <sup>b</sup>	0.9100 <sup>b</sup>	0.6765 <sup>b</sup>	0.8699 <sup>b</sup>	0.5741 <sup>b</sup>
Ash%	W1	3.1200 <sup>ns</sup>	1.5000 <sup>ns</sup>	2.3500 <sup>ns</sup>	1.6702 <sup>ns</sup>	2.3880 <sup>ns</sup>
	W2	3.1400 <sup>ns</sup>	2.2266 <sup>ns</sup>	2.2909 <sup>ns</sup>	2.2300 <sup>ns</sup>	2.5049 <sup>ns</sup>
	W3	3.5800 <sup>ns</sup>	2.3003 <sup>ns</sup>	3.2735 <sup>ns</sup>	2.8901 <sup>ns</sup>	2.5059 <sup>ns</sup>
The Acidity%	W1	0.21 <sup>a</sup>	0.18 <sup>b</sup>	0.19 <sup>ab</sup>	0.20 <sup>a</sup>	0.21 <sup>a</sup>
	W2	0.24 <sup>a</sup>	0.19 <sup>b</sup>	0.21 <sup>ab</sup>	0.21 <sup>a</sup>	0.25 <sup>a</sup>
	W3	0.29 <sup>a</sup>	0.20 <sup>b</sup>	0.25 <sup>ab</sup>	0.29 <sup>a</sup>	0.29 <sup>a</sup>
pH	W1	6.41 <sup>ns</sup>	6.88 <sup>ns</sup>	6.50 <sup>ns</sup>	6.48 <sup>ns</sup>	6.44 <sup>ns</sup>
	W2	6.21 <sup>ns</sup>	6.67 <sup>ns</sup>	6.48 <sup>ns</sup>	6.33 <sup>ns</sup>	6.23 <sup>ns</sup>
	W3	6.11 <sup>ns</sup>	6.60 <sup>ns</sup>	6.60 <sup>ns</sup>	6.17 <sup>ns</sup>	6 <sup>ns</sup>

T1: Control treatment, T2: mint extract, T3: Dill extract, T4: Tarragon extract, T5: Mix extracts (Mint, Dill, and Tarragon), different letters indicate presence of statistical differences at the level of  $P \leq 0.05$ , ns: not significant difference.

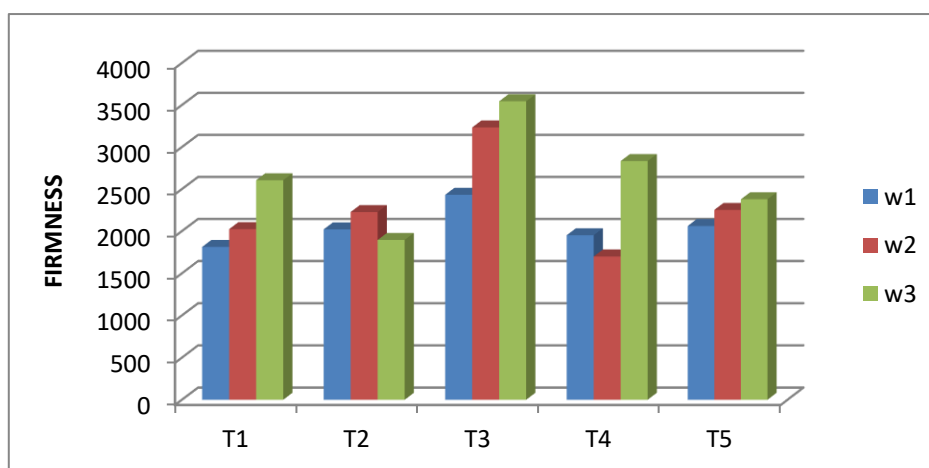
Aktypis *et al.* (2018) found same results by supplemented of fresh ovine cheese with saffron and observed the antioxidant in the cheese decreased during increase storage period, Vukić, *et al.* (2022) reached a similar results that antioxidant capacity higher in the fresh kombucha cheese fortified with sage herbal dust at first week but remained high after stored for (10) days compared to control cheese. As well as Shaimaa and Yasser (2018) got a good results when their adding Dried Rosemary, Thyme and Basil with Fresh Garlic on Quality Characteristics of Ricotta Cheese. Han *et al.* (2011) created a functional cheese product with the addition of grape extract, green tea extract, and dehydrated cranberry powder. They noticed that the concentration of 0.5 mg/ml of polyphenols in the cheese curd displayed an efficacious free radical scavenging capacity.



T1: Control treatment, T2: mint extract, T3: Dill extract, T4: Tarragon extract, T5: Mix extracts (Mint, Dill, and Tarragon)

**Figure (1):** DPPH radical scavenging activity of Salik cheese treatments

Figure (2) illustrates the Firmness of cheese during storage, we can see the maximum level was recorded for Dill cheese treatment after three week of storage, control treatment was a lowest firmness at all absolutely, but generally the firmness was increased in all treatments except the mint cheese treatment during storage, so observed the simple effect of treatment and time was very significant and the interaction effect between treatment and time was not significant at level 0.05, this increase in the firmness was expected during storage due to removing of whey from cheese surface, Shaimaa and Yasser (2018) had positive results, and found Thyme garlic-added Ricotta cheese has highest scores for texture, which was best to that of the other treatments.

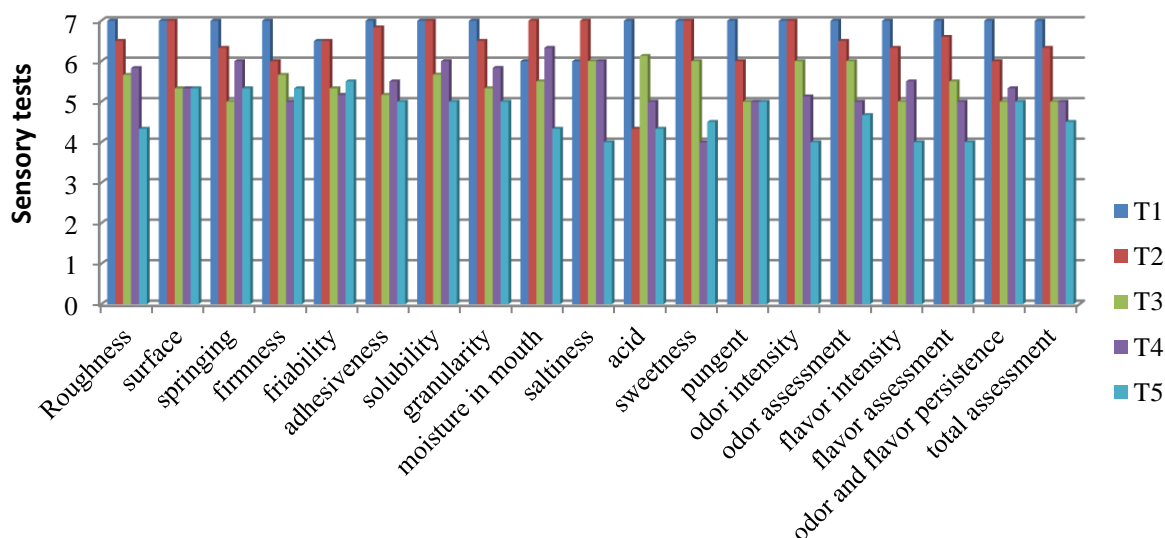


T1: Control treatment, T2: mint extract, T3: Dill extract, T4: Tarragon extract, T5: Mix extracts (Mint, Dill, and Tarragon)

**Figure (2):** Firmness of Salik cheese treatments

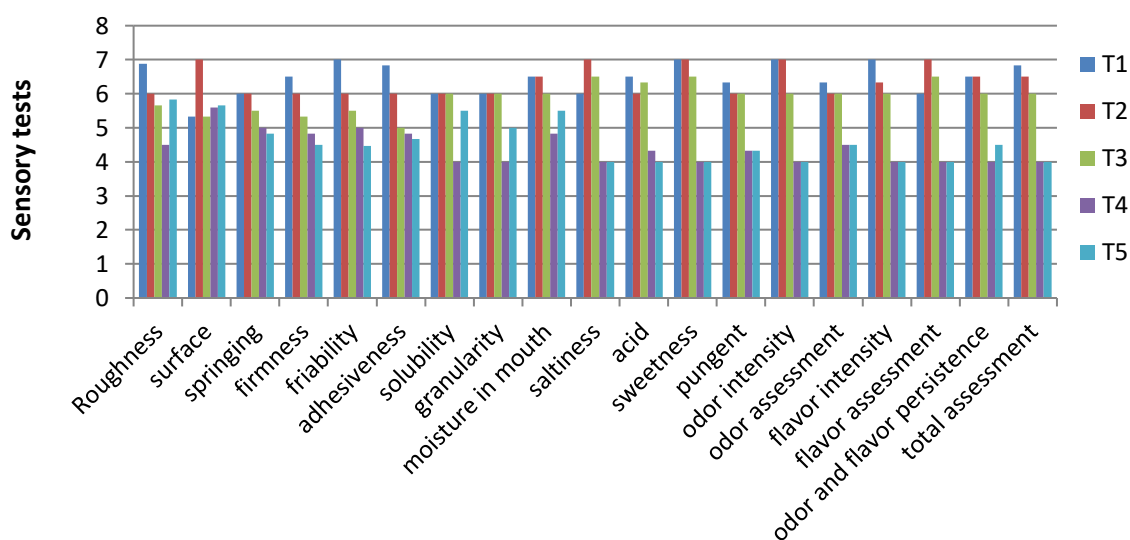
Figure (3) shows that the all cheese treatments had acceptable evaluation in total assessments and no significant differences were observed among treatments at level 0.05 but although these results that the control treatment exceed of all the treatments at first week followed by mint then Tarragon herbs cheese, while treatment of herbs mixture was the lowest. Figure (4)

illustrate that no big different between first and second week of storage in sensory evaluation of salik cheese, control treatment had a high score of sensory evaluation followed by mint then Dill herbs cheese but the Tarragon cheese had lowest scores in evaluation, the similar results of evaluation recorded at third week as shown in the Figure (5) but the fourth and fifth treatments were deteriorated. Similar results recorded by Hala *et al.* (2010) when manufactured low fat UF soft cheese supplemented with rosemary extract by different concentrations ( 1-5%), during cold storage at(6°C±2°C), 3% concentration had a similar score of control treatment for their appearance when was fresh and after 30 days , but at concentration 5% highly acceptable regarding flavor than control cheese, same results was recorded by Vukić *et al.* (2022) when manufactured Kombucha fresh cheese with different types of sage preparations, gave valuable dairy product with good taste.



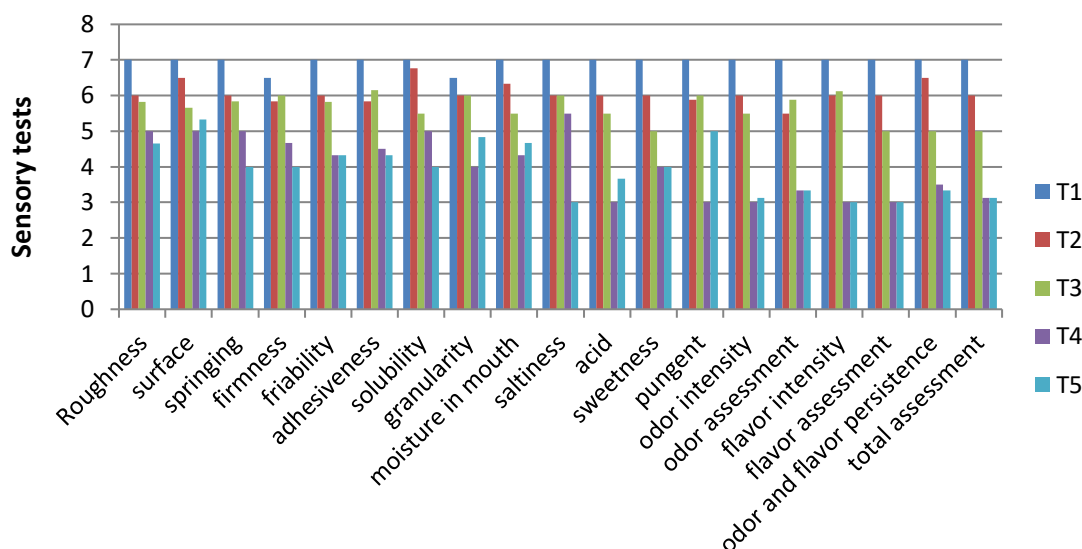
T1: Control treatment, T2: mint extract, T3: Dill extract, T4: Tarragon extract, T5: Mix extracts (Mint, Dill, and Tarragon)

**Figure: (3) :** The Sensory Tests of Salik Cheese in the first week



T1: Control treatment, T2: mint extract, T3: Dill extract, T4: Tarragon extract, T5: Mix extracts (Mint, Dill, and Tarragon)

**Figure: (4) :**The Sensory Tests of Salik Cheese in the second week



T1: Control treatment, T2: mint extract, T3: Dill extract, T4: Tarragon extract, T5: Mix extracts (Mint, Dill, and Tarragon)

**Figure: (5):** The Sensory Tests of Salik Cheese in the third week

## CONCLUSION

Supply of local Soft cheese (Paneer Salik) with 6.5% v/w of some natural anti-oxidant extracts (mint, dill, tarragon and mix herbs) did not significantly differenced in fat, protein, carbohydrate, ash contents with control treatment, but differed during storage for three weeks with control treatment. The DPPH values increased in the cheeses supplied with herbs at first week comparison with control treatment, and that lead to increased antioxidant activity and improved the quality of cheese, but the DPPH values decreased in the cheeses after three weeks of storage. Generally, the firmness increased during storage in all herbs cheese treatments except the mint cheese treatment. Supplying of soft cheese with mint, dill, tarragon and herbs mix extracts improved the quality of cheese in some chemical properties and sensory properties during storage for three weeks in comparison with control treatment.

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