

## Study of the Quality Characteristics of Monterey Cheese Coated with Edible coating Films made from Whey Proteins and Black Seed Proteins

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### Abstract:

The current study was conducted and aimed to use whey proteins and extract black seed proteins, manufacture edible films from each of them separately use them in packaging Monterey cheese and study their role in improving the physicochemical, rheological and sensory properties of the cheese. The cheese was coated with edible films made from 5% whey proteins and other edible coatings film were manufactured from black seed proteins at a rate of 10%. The experiment included four treatments: the control treatment C which was left without coating T1 treatment which was coated with wax T2 treatment which was coated with edible films of black seed proteins, and T3 treatment, which was coated with edible films of whey proteins. Chemical tests were conducted that included an estimation of the percentage of moisture, protein, fat, ash, carbohydrates, dissolved nitrogen and total acidity, physical tests that included pH, and rheological tests that included hardness, cohesiveness and springiness in addition to conducting a sensory evaluation immediately after manufacturing and during the ripening period. The results showed a decrease in the moisture content in all cheese treatments as the ripening period progressed, as the C, T1, T2, and T3 treatments ranged on day 90 (40.05, 42.36, 40.13, 40.36)% respectively. The percentage of carbohydrates and pH also decreased as the ripening period progressed while they increased percentage of protein, fat, ash, acidity, and dissolved nitrogen for all treatments. The results of rheological tests showed a decrease in the values of hardness and cohesiveness while the values of springiness increased with the progression of the ripening period. The results of the sensory evaluation indicated an improvement in the sensory properties of the Monterey cheese treatments coated with various proteins compared to the uncoated control treatment. The T1 treatment coated with paraffin wax was also characterized by the best sensory properties

**key words:** Whey proteins, physicochemical properties, Monterey cheese, sensory properties, black seed proteins

**Introduction :**

Packaging is an important part of food manufacturing operations that aim to contain and facilitate the convenient transportation, distribution and sale of food and to preserve its nature and specifications throughout the period between manufacturing, packaging and consumption locally or after export without exposing food materials to chemical, physical and biological damage [14]. In recent years the modern world has turned to the production of edible and biodegradable packaging. Proteins are generally considered suitable polymers for forming edible and biodegradable packaging because of their ability to preserve moisture, oxygen, aromas, and flavors. In addition, proteins have a number of advantages, including Its microbial effectiveness is directed toward microscopic organisms, and food additives have been used to improve the appearance of products by adding color or shine to attract consumers. During the last two decades the food packaging industry has received great attention from those interested in producing edible covers and biodegradable packaging materials. Interest in whey proteins has increased due to their benefits and availability in quantities. It is large as waste, has no toxicity, and is low in cost and because of its high nutritional value and its suitability for packaging and protecting food from spoilage [20]. Many protein sources have been used in the manufacture of edible films, such as casein protein, gelatin, whey proteins, and in the packaging of dry and semi-dry cheeses. Dry Monterey cheese is one of the American semi-hard and semi-dry ripened cheeses whose moisture content ranges between (40-50)% and which is made from cow's milk. Found

[22] that the chemical composition of *Nigella sativa* seeds was the percentage of moisture, protein, fat, carbohydrates, ash, and fiber (4, 22, 41, 17, 4.5, and 8)% respectively. Cheese is an ideal nutritional medium for the growth of many microorganisms because it contains an appropriate moisture content and many nutritional components, including carbohydrates, fats, and proteins, as well as the availability of many different minerals and vitamins that make it a suitable environment for the growth of many microorganisms and these play an important role in causing many biological and chemical changes determines the quality of cheese its nutritional value and suitability for human consumption [25]. Extending the shelf life of food products has always been a source of great concern, especially in the dairy industry. Therefore in recent years, there has been a move to innovate different methods to prevent the deterioration of perishable food products. Cheeses are made from the milk of different types of animals and are ripened for different periods which leads to the production of many types of cheeses in terms of texture, flavor and shape, such as hard and semi-hard cheeses. These are dairy products with a high nutrient content, as cheese contains protein, carbohydrates and fats including saturated and unsaturated fatty acids. In addition, cheeses contain a group of nutrients that are beneficial to health [12]. Recent studies indicate that unsaturated fatty acids (oleic, linoleic, and linolenic) play a beneficial role in human health, and thus dairy products are considered Such as cheese, functional foods that have a cholesterol-lowering effect and therefore have a protective effect against cardiovascular

diseases. A decrease in the death rate resulting from coronary heart disease was observed when consumers consumed cheese in large quantities. A recent study reported that increasing dairy consumption may contribute to a lower risk of cardiovascular disease [41]. This study aimed to extract black seed proteins and prepare whey proteins and determine the possibility of manufacturing edible coatings films from them ,and study their properties and use in packaging Monterrey cheese and study the effect of this packaging on the physicochemical, rheological and sensory quality characteristics of the cheese .

Materials and methods:

- 1Materials: Raw cow's milk from the fields of the College of Agriculture / Al-Qasim Green University was used in the manufacture of cheese treatments. The fungal microbial rennet (*Rhizomucor pusillus*) produced by the Japanese company Meito Sangyo was used. Whey proteins supplied from the Iranian company Golshad were also used. Black seed proteins were extracted using nutritional methods according to [30].

-2Methods Cheese manufacturing: Monterrey cheese was made according to the method used by [4] as follows: A quantity of raw cow's milk was received and the milk was pasteurized at (63) °C for (30) minutes then the milk was cooled to a temperature of (32) °C and inoculated. With the starter consisting of *Lactococcus lactis* subsp *lactis* and *Lactococcus lactis* subsp.cremors prepared by the French company (Danisco) with direct addition and in the quantity indicated by the producing company at a rate of 6.25 g per 100 liters, then rennet was added and the milk was left for 30 minutes until the curd hardened, then the curd was cut, and then the cooking

process was carried out at 39°C for 90 minutes then draining the whey salting it wrapping it in the above-mentioned covers, then packing it and clarifying it in the ripening room .

Edible films composition: The method mentioned [11] was adopted with some modifications to form protein coatings by taking three different concentrations of whey and black seed proteins :

%10 ,%7.5 ,%5w/v and dissolving them in about 70-80 ml of distilled water with continuous stirring and heating to a temperature of 60-65°C using a magnetic stirrer with a hot plate for 15 minutes, then the plasticizer glycerol was added at a rate of 30% of the weight of the dry protein, then the solution was completed to 100 grams with distilled water and the pH was adjusted to 7 using sodium hydroxide solution 1 M then left the solution to cool, then transferred 6 g of the solution to a Petri dish with a diameter of 1.9 cm (this weight of 6 g of solutions was chosen after conducting several preliminary experiments to obtain the appropriate thickness of the membrane) and after transferring the solution and spreading it in the dish and on a flat and stable surface to ensure its uniform distribution over the surface area of the Petri dish. I used a leveling machine to adjust the level of the dish on the flat surface, then left the dishes to cool and dry at room temperature at 25±2°C for a period of 12-18 hours, after which they were transferred to the desiccator at the bottom of which was a solution saturated sodium bromide to regulate the relative humidity at 23±1% and the temperature at 1±55°C and left for the second day to dry. After that, the dry wrappers were

removed and in the refrigerator until subsequent tests were conducted on placed in polyethylene bags and stored them .

#### Cheese coating :

Monterey cheese was dipping using the method mentioned by [13] which using protein coating solutions containing concentrations of whey and black seed proteins obtained in previous experiments. The cheese samples were divided into four sections with a weight of 100 g for each model, leaving the first model without wrapping while the second model was coated with food grade paraffin wax for preserving cheeses, and the coated and uncoated were considered as models for comparison (Control) As for the third and fourth cheese models, they were coated with black seed protein at a concentration of 10% and whey protein at a concentration of 5% respectively. These concentrations were chosen because they were the best in tensile elongation and permeability properties and the cheese models surfaces were dried at  $11\pm 1^\circ\text{C}$  and a relative humidity of 40-50% for 18 hours, with stirring from time to time, . The samples that had previously been weighed before coating were weighed to estimate the ratio of the coating material they formed to the weight of the coated cheese and in order to follow changes in moisture loss. During ripening and under ripening conditions the temperature of ripening room is  $11\pm 1^\circ\text{C}$  and a variable relative humidity of  $54\pm 1\%$  and  $75\pm 1\%$  by using a dryer adapted to this humidity .

#### Physicochemical tests :

Physicochemical tests for cheese :

The percentage of moisture, ash, fat, total acidity according to [10] and protein were estimated using the Kjeldahl method according to [10] the pH was estimated using a pH meter and the percentage of carbohydrates was estimated mathematically according to what was stated by [23 ]

Carbohydrates =  $100 - (\text{ash} + \text{protein} + \text{fat} + \text{moisture})$ . Soluble nitrogen was estimated according to the aforementioned method mentioned by [17] .[

#### Texture estimation:

The texture of the cheese parameters was estimated using a texture analyzer type (CT3, 4500 Brookfield engineering lab) with a load capacity of 5 kg, according to what [26] mentioned, as the product was subjected to a compressive force using a probe or arm from above. With a distance of 30 mm the device's measurement conditions were set as follows: the initial examination speed was 1 mm/s, the final examination speed was 1 mm/s the trigger pressure force was 10.0 g, the time used for each examination was 5 seconds and the sample size was  $3 \times 2.5 \times 3$  cm, and in this method the criteria of hardness, cohesiveness and springiness were estimated .

Sensory evaluation of cheese: Sensory tests were conducted for models of Monterey cheese coated with edible protein coatings according to a sensory evaluation form derived from the proposals for edible coating applications proposed by [28] comparing them with models of cheese coated with paraffin wax and uncoated cheese, and other notes were added regarding Paint condition and

other characteristics.

Statistical analysis :  
The statistical program (GenStat 12th Edition) was used to analyze the data to study the effect of various factors on the studied traits according to a completely randomized design (CRD) and the significant differences between the means were compared with the Least Significant Difference (LSD) test and  $p \leq 0.05$  [6].

Results and discussion:

The results shown in Table (1) show the physicochemical tests of Monterey cheese for the different cheese treatments, as it is clear from them regarding the moisture content that there are significant differences  $P \leq 0.05$  in the value for the coated treatments compared to the control treatment .

**Table (1) Chemical composition of the different Monterey cheese treatments (C, T1, T2, T3,) immediately after manufacturing and during the ripening period of 90 days.**

Treatment	Cheese age (day)	Moisture	Protein%	Fat%	Carbohydrates %	Ash %	Acidity%	pH	Soluble nitrogen%
C	1	43.32	22.65	23.12	8.42	2.49	0.35	4.45	0.17
	45	41.33	24.63	27.08	6.12	2.57	0.41	4.20	0.36
	90	40.05	26.32	28.68	3.64	2.62	0.56	3.90	0.52
T <sub>1</sub>	1	44.30	23.02	22.17	8.09	2.42	0.35	4.32	0.16
	45	43.63	24.43	23.87	5.59	2.48	0.38	3.92	0.22
	90	42.36	26.35	24.62	4.11	2.56	0.44	3.70	0.31
T <sub>2</sub>	1	44.85	25.79	24.14	2.69	2.54	0.42	4.69	0.18
	45	41.52	27.47	26.42	2.0	2.59	0.48	4.31	0.24
	90	40.13	28.04	27.26	1.93	2.64	0.63	4.10	0.38
T <sub>3</sub>	1	43.90	24.93	24.92	3.74	2.51	0.39	3.23	0.15
	45	41.85	26.68	25.62	1.81	2.58	0.46	4.26	0.21
	90	40.36	27.42	27.37	0.91	2.63	0.58	3.90	0.33
LSD		0.11	0.09	0.48	0.19	0.08	0.09	0.11	0.07

Where C = control treatment cheese, T<sub>1</sub> = cheese coated with paraffin wax, T<sub>2</sub> = cheese coated with black seed protein solution, and T<sub>3</sub> = cheese coated with whey protein solution .

The moisture percentage for cheese treatments C,T<sub>1</sub>,T<sub>2</sub> ,T<sub>3</sub> on the first day reached 43.32,

44.30,44.85, 43.90% respectively. These results are consistent with what was found by [7] who indicated that the moisture percentage of Monterey cheese made from fresh cow's milk after manufacturing was 42.44%. It is noteworthy that these percentages fall within the moisture percentage specified by the Iraqi standard specification (2000) for semi-hard cheeses, which falls between 40-50%. It is

also noted from the results that the moisture content of all cheese treatments decreased as the ripening period progressed, as the percentages after 45 days were 41.33, 43.63, 41.52, 41.85% respectively. While after 90 days of ripening reached 40.05, 42.36, 40.13, 40.36% for C,T1,T2 and T3 respectively. It is noted from the same table that the moisture decreases in the uncoated control model compared to the models coated with coatings of whey proteins and black seed proteins. The differences were slight between the simple and treated coated models. The reason for the discrepancy in the rates of decrease in moisture content is due to the membranes of whey proteins and black seed proteins, as they contribute to retaining moisture and preventing its evaporation. This is an indicator of their moisture retention efficiency, and increasing crosslinking through chemical, physical and enzymatic treatments increases their reservation efficiency. This It confirms what was stated by [38]. The reason for the decrease in moisture as ripening progresses may be attributed to evaporation, continued whey ripening, starter activity and its production of organic acids, and then lowering the pH which leads to a decrease in the ability of the protein to hold water which increases the rate of moisture evaporation from the product [24].

It is also clear from the table that there are significant differences  $p \leq 0.05$  in the protein content of protein edible film coated cheese treatments, as it is noted that the protein value increased on the first day for treatments coated with black seed protein and whey protein T2 and T3 respectively which amounted to 25.79% and 24.93% respectively, compared to C,T1 in which the protein content reached

22.65% and 23.02% respectively. It is also noted from the results that the protein content increased for all treatments as the ripening period progressed as it reached after 45 days 24.63 , 24.43 , 27.47, 26.68 % . while after 90 days reached 26.32 ,26.35 ,28.04 ,27.42%, for C,T1,T2,T3 treatments respectively. This may be due to the contribution of whey proteins and black seed proteins in retaining moisture and preventing its evaporation. This is considered an indicator of their moisture-reserving efficiency and thus the protein percentage increases. These results are in addition to the findings of [21] which confirmed that the increase in the percentage of protein during the ripening period is due to the decrease in the moisture content of the cheese, and that the increase in the decrease in the percentage of moisture in the cheese during the ripening period affects the state of balance in the proportions of other components, including protein, which leads to an increase in The proportions of these components along with [2] who noted that the rate of increase in protein proportions during ripening reached 3.7, 1.98, 1.89 and 1.91% for uncoated cheese and those coated with wax, casein and gelatin respectively. As for the fat content of the different cheese treatments, it is clear from the table that the fat percentage on the first day were 23.12, 22.17, 24.14, 24.92% for C,T1,T2 and T3 treatments respectively. It is also noted that the fat percentage for all treatments increased as the ripening period progressed where after 45 days it reached 27.08, 23.87, 26.42, 25.62% respectively while after 90 days it reached 28.68, 24.62, 27.26, 27.37% respectively. The reason for the increase in fat percentages as cheese ages is due to the decrease in moisture

content, which in turn leads to an increase in the percentage of total solids of which fat is one of the components [18]. It is also noted that the increase in the percentage of fat as the ripening period progressed for the treatments coated with whey and black seed protein coatings was less compared to the uncoated control treatment and that this difference may be due to the difference in moisture content values between these treatments and to the components that make up the coatings used, which causes a difference. In the amount of lost fat, and when comparing these results with what other researchers found, we notice that they agree with what [3] and [7] found when they studied Monterey cheese under different manufacturing conditions. found [19] The high percentage of fat is due to the decrease in moisture content and the increase in total solids. As for Monterey cheese carbohydrates content it reached 8.42, 8.09, 2.69, 3.74% for C, T1, T2 and T3 treatments respectively. It is noted from the results that the percentage of carbohydrates was reduced because the coating in which the cheese was wrapped, with a thickness of 1 micron consisted mostly of protein, which made the model contain a large percentage of protein, which led to an increase in the percentage of total solids, of which protein represents the highest percentage, and thus the percentage of carbohydrates in the T3 treatments decreased T2, T3. It is also noted that the carbohydrates content of for all treatments decreased as the ripening period progressed, so it was after 45 days reached 6.12, 5.59, 2.0, 1.81% respectively while after 90 days it was 3.64, 4.11, 1.93, 0.91% respectively for the aforementioned treatments, respectively. The reason for the

decrease in the percentage of carbohydrates during the ripening stages may be due to the activity of starter culture under ripening conditions, which works to convert the sugar lactose into lactic acid, in addition to the loss of a portion of the carbohydrates with the expressed whey during ripening [31].

For cheese ash content it is noted from the statistical analysis that significant differences  $P \leq 0.05$  were found for all cheese treatments compared to the control, as the ash content on the first day was 2.49, 2.42, 2.54, 2.51% respectively. It is also noted that the ash content for all treatments increased as the ripening period progressed, as after 45 days it reached 2.57, 2.48, 2.59, 2.58% respectively while after 90 days it was 2.62, 2.56, 2.64, 2.63% respectively for the previously mentioned treatments. The increase in the percentage of ash is due to the loss of part of the moisture during ripening, which leads to an increase in the percentage of total solids of which ash is one of the components [16]. The results agreed with what was reported by [9] regarding an increase in the percentage of ash as the aging of semi-dry cheeses increased. No significant differences  $P \leq 0.05$  were observed in the percentage of total acidity in the different Monterey cheese treatments, as it reached 0.35, 0.35, 0.42, 0.39% on the first day.

The results converged with [27] who found that the acidity percentage of Monterey cheese during the ripening period ranged between .

It is also noted from the results that the percentage of total acidity increased as the ripening period progressed, reaching after 45 days 0.41, 0.38, 0.48, 0.46% respectively, while

after 90 days, it reached 0.56, 0.44, 0.63, 0.58% respectively for treatments C,T1,T2 and T3. It is worth noting that the increase in acidity was consistent with the moisture content of the cheese and this is due to the increased activity of starter bacteria and the conversion of lactose into lactic acid. In the treatments that were characterized by their high moisture content. The reason for the high acidity percentage may be due to the high percentage of protein in the treatments coated with edible protein coatings, as the protein content has a significant impact on the acidity level in the milk. These results are consistent with what was found by [2] who indicated the acidity increases as the cheese ripens as a result of the fermentation of lactose into lactic acid

It is noted pH values of cheese treatments, that they did not have significant differences.  $P \leq 0.05$ . The pH on the first day reached 4.45, 4.32, 4.69, 3.23 respectively. It is also noted that these pH values decreased for all Monterey cheese treatments as the ripening period progressed, which after 45 days reached 4.20, 3.92, 4.31, 4.26, respectively, while after 90 days, they reached 3.90, 3.70, 4.10, 3.90 for C,T1,T2 and T3 treatments respectively. The reason for this decrease may be attributed to the conversion of the remaining lactose sugar in the cheese into lactic acid which consequently leads to a decrease in the pH. This result is consistent

Rhiological analysis :

with what was found by [35] which indicated a decrease in the pH values of Monterey cheese when end of ripening period. The results are also consistent with [37] which observed a decrease in the pH levels of processed cheese as the ripening period progressed who indicated that there is a correspondence between the decrease in pH values and the increase in the percentage of total acidity of the cheese as ripening progresses.

Soluble nitrogen content on the first day, reached 0.17, 0.16, 0.18, 0.15 %, respectively,. As the ripening period of the cheese progressed, this percentage increased, reaching after 45 days 0.36, 0.22, 0.24, 0.21 % respectively while after 90 days of ripening, it reached 0.52, 0.31, 0.38, 0.33% for C ,T1,T2 and T3 treatments respectively,. The reason for this increase is attributed to the decomposition of protein into small water-soluble compounds such as peptides by hydrolytic enzymes (proteases and peptidases) produced from Initiators used in ripening, and this is consistent with what was stated by [39] who showed an increase in the percentage of dissolved nitrogen in cheese during the ripening period. The reason for this increase in the soluble nitrogen content during ripening may also be due to the action of proteolytic enzymes and the remains of rennet enzymes, as well as to the action of starter protease residues [15].

Figure (1) shows the results of hardness tests for different Monterey cheeses C ,T1,T2 and T3 treatments immediately after manufacturing and during the ripening period of 90 days.

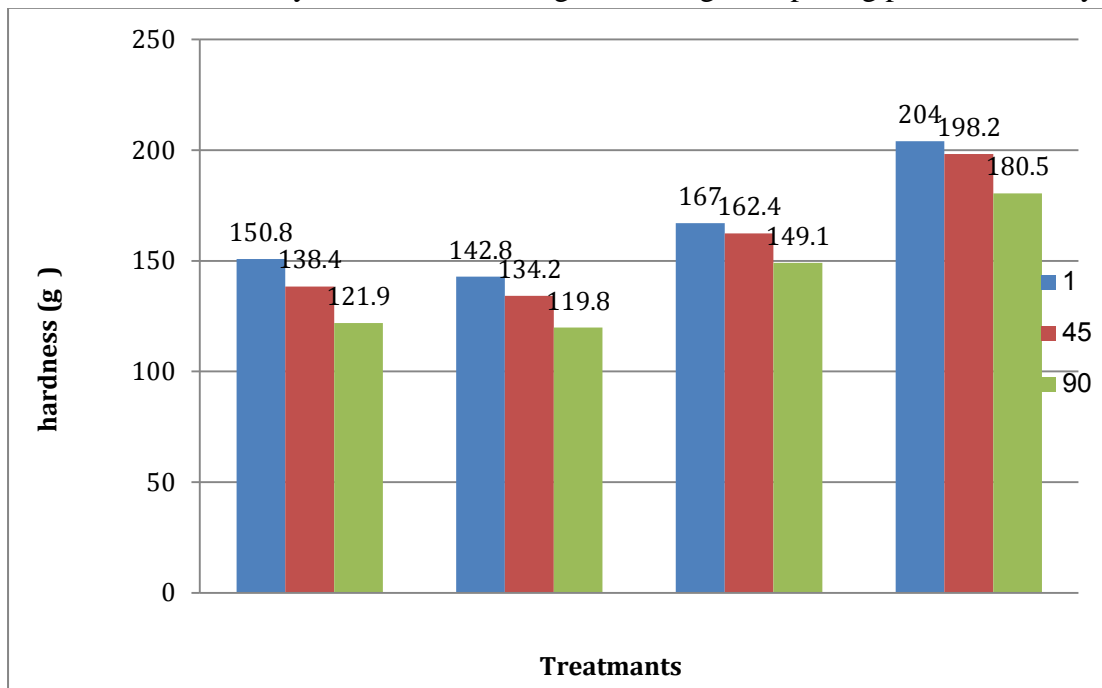


Figure (1): Hardness values of the different Monterey cheese treatments (C, T1, T2, and T3) immediately after manufacturing and during the ripening period of 90 days

Where C = control treatment cheese, T1 = cheese coated with paraffin wax, T2 = cheese coated with black seed protein solution, and T3 = cheese coated with whey protein solution

It is clear from Fig (1) that there are significant differences  $P \leq 0.05$  in the hardness values for the coated treatments compared to the control treatment, which reached on the first day 150.8, 142.8, 167.0, 204.0 g for C, T1, T2 and T3 treatments respectively. It is also noted that the hardness values for all treatments decreased as the ripening period

progressed reaching after 45 days 138.4, 134.2, 162.4, 198.2 g respectively. While after 90 days, it reached 121.9, 119.8, 149.1, 180.5 g respectively. The reason for the difference in the cheese hardness values may be due to the moisture, protein and fat content of the cheese samples as the fat in full-fat cheeses is through the process of lubrication it can penetrate into the protein matrix to make the cheese more tender [29].

In addition the texture of cheese with high moisture content is softer and softer than cheese with low moisture content [2]. It is also clear that adding the starter culture led to an

increase in the acidity of the cheese and a decrease in pH which affected the moisture content and thus the hardness of the cheese

[5]. As for the Cohesiveness of the different cheese treatments which is shown in Figure (2)

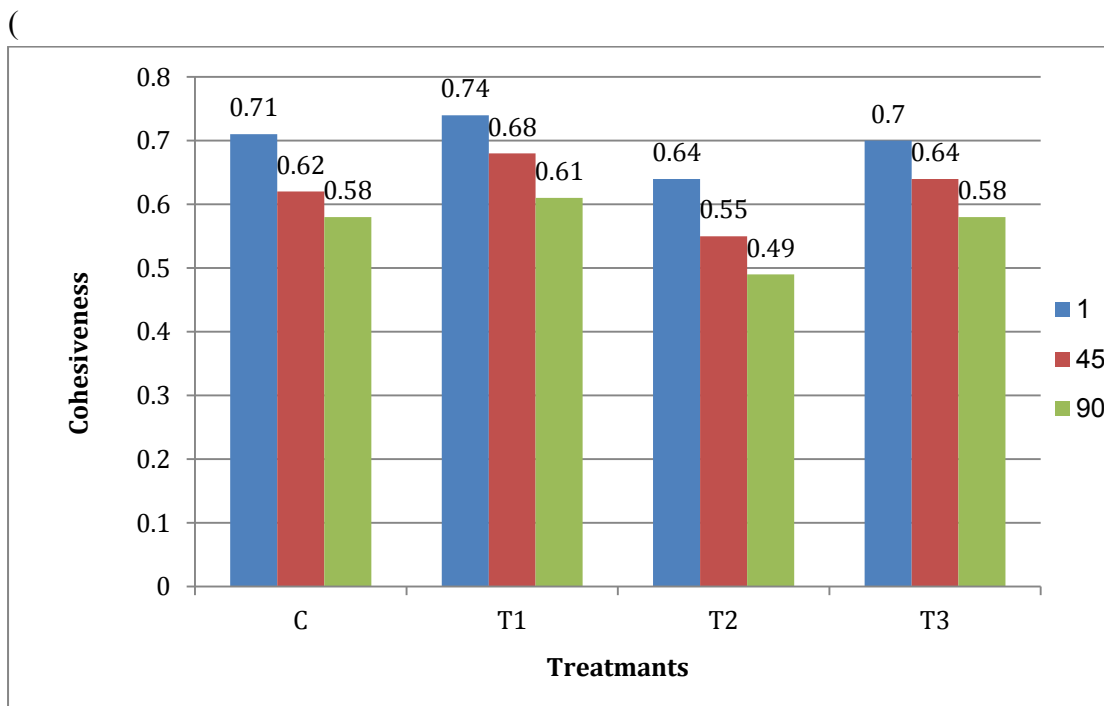


Figure (2): Cohesiveness values of the different Monterey cheese treatments (C, T1, T2, and T3) immediately after manufacturing and during the ripening period of 90 days

Where C = control treatment cheese, T1 = cheese coated with paraffin wax, T2 = cheese coated with black seed protein solution, and T3 = cheese coated with whey protein solution.

It is clear from this that the consistency values of the different treatments of Monterey cheese reached on the first day 0.71, 0.74, 0.64, 0.70, for C, T1, T2 and T3 treatments respectively. It is noted from the results that these values decreased with the progress of ripening, as in the middle of the ripening period they reached 0.62, 0.68, 0.55, 0.64 respectively while After 90 days it reached 0.58, 0.61, 0.49, 0.58

respectively. Our results agreed with what [34] found when studied rheological tests in cheddar cheese produced from goat's milk compared to cheddar cheese produced from cow's milk where he found a decrease in the cohesiveness values of cheddar cheese during the ripening period [8] pointed out that the three-dimensional protein network is most responsible for the cohesive characteristic

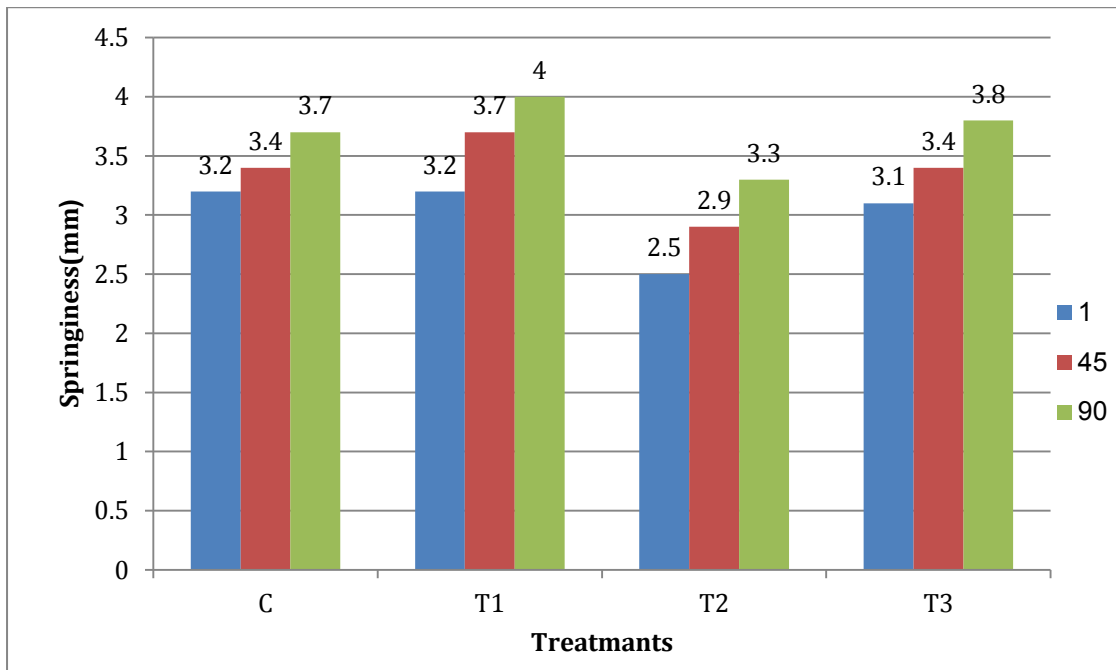


Figure (3) springiness of the different Monterey cheese treatments (C, T1, T2, and T3) immediately after manufacturing and during the ripening period of 90 days

Where C = control treatment cheese, T1 = cheese coated with paraffin wax, T2 = cheese coated with black seed protein solution, and T3 = cheese coated with whey protein solution.

For springiness values fig (3) the results of which are shown for the treatments C, T1, T2, T3 reached immediately after manufacturing 3.2, 3.2, 2.5, 3.1 mm respectively. It is noted that the springiness values for all treatments increased as the ripening period progressed reaching after 45 days 3.4, 3.7, 2.9, 3.4 mm respectively while after 90 days it was 3.7, 4.0, 3.3, 3.8 mm respectively. This is consistent with what [34] found when he studied the rheological properties of cheddar cheese produced from goat's milk compared to cheddar cheese produced from cow's milk, where he found an increase in elasticity values during the ripening period. Fuond [40] that the rheological properties of cheese are greatly affected by the content of the cheese, the duration of storage, and the storage temperature, as cheeses with a high fat content

showed a noticeable decrease in springiness values during the storage period.

Sensory evaluation :

Sensory evaluation expresses the extent to which the consumer accepts the product and also indicates the extent to which it has achieved the desired goal of the manufacturing process. Sensory properties such as flavor, color, and texture constitute major factors paving the way for acceptance of the final product [1] so the evaluation process is carried out. Sensory when making some modifications in the manufacturing process, such as packaging the product such as packaging with edible protein films, and when considering practical applications to form edible films, the desired qualities such as flavor, taste, texture and general acceptability must be taken into account [36]. The method of sensory

evaluation of some sensory characteristics related to taste, flavor, external appearance, color, texture, cohesion, adhesion, fat separation or non-separation and mold growth on the surface of cheese is one of the preferred methods in determining the suitability of cheese for consumption and its acceptance by the consumer, and when thinking about

conducting practical applications for the formation of biodegradable membranes. For eating, attention must be paid to the desired properties, such as cohesion and adhesion to the surface of the food item and its ability to be tolerated during storage and handling [32].

**Table (2) Sensory evaluation of the different treatments of Monterrey cheese (C ,T1,T2 andT3) immediately after manufacturing and during the ripening period of 90 days.**

Treatment	Cheese age(day)	Appearance	Body	Texture	Flavour	Fat separation	Surface mold growth
C	1	10	10	10	9	10	10
	45	9	8	9	8	9	9
	90	7	8	9	7	9	8
T <sub>1</sub>	1	10	10	9	9	10	10
	45	9	9	8	8	10	10
	90	9	8	8	8	10	10
T <sub>2</sub>	1	10	9	9	8	10	10
	45	9	8	8	8	10	9
	90	8	8	8	9	10	7
T <sub>3</sub>	1	10	9	8	8	10	10
	45	8	9	8	9	10	10
	90	8	8	9	9	10	8
LSD		1.77	1.77	2.17	2.17	0.88	1.25

Where C = control treatment cheese, T<sub>1</sub> = cheese coated with paraffin wax, T<sub>2</sub> = cheese coated with black seed protein solution, and T<sub>3</sub> = cheese coated with whey protein solution.

The results in this table indicate in their significance to the taste and flavor characteristics that they obtained the highest evaluation scores for each of the coated cheese treatments for the cheese coated with black seed proteins coatings and whey proteins (T<sub>2</sub> and T<sub>3</sub>) compared to the C, T<sub>1</sub> treatments, especially on days 45. And the reason for this

may be due to the flavor and acceptable taste of whey proteins, which make it a good choice in packaging operations for food products especially those whose flavor is affected during preservation, and to the role of protein membranes and their ability to retain fat and flavor compounds due to their compact structure and interconnected protein chains.

Among them, they increase the retention process, which qualifies them for use in preservation processes, especially foods that quickly perish due to oxidation and other processes [2]. Proteins play a major role in reducing the decomposition processes that cause the appearance of unwanted foreign tastes which made evaluators give higher grades to the parameters (T2, T3) compared with treatments (C, T1) due to the unpalatable flavors and bitterness that appeared in them at the end of the ripening period. As for the characteristics of the external appearance, texture and cohesion relatively varying degrees were given to the cheese treatments, and the evaluations of the appearance characteristic were not high. They were for the control samples to some extent for the cheese samples coated with protein coatings, as the appearance of the coated and uncoated cheese seemed somewhat similar, especially in the first days of Ripening may be due to the effect of protein, which improved the sensory characteristics of the cheese and helped give the coated cheese its flavor and taste [21]. As for the character of fat separation, fat separation was not observed in all models as relatively similar scores were given, with the exception of the control Monterey cheese model (treatment C) especially on days 45 and 90 of ripening. Fat separation was observed in that treatment, and the reason may be due to the lack of fat separation. In other studies, the role of protein coatings and wax coatings in trapping oxygen, fatty substances, and some flavor compounds due to their compact structure and the regularity of hydrogen bonding between the polymer chains which encourages the use of protein coatings in preserving foods especially foods that are

sensitive to oxidative damage [33]. The results of the sensory evaluation also indicated the presence of apparent mold growth on the surface of uncoated Monterey cheese starting on the 45th day of ripening. As for the model of Monterey cheese coated with a paraffin coating, no mold growth was observed during ripening while no mold growth appeared in the cheese models. Monterey coated with protein coatings for treatments T2 and T3 on the first day of ripening, but during ripening, mold growth appeared in these samples .

#### Conclusion :

These results indicate the possibility of using black seed proteins and whey proteins in making edible protein coating films and using in Monterey cheese packaging, in addition to the anaerobic conditions provided by the protein coatings which also contribute to preventing the growth of molds on the surface of the cheese. Also coating cheese with solutions of whey protein coatings and black seed proteins contributed to reducing the percentage of lost moisture. The storage period of cheese was prolonged. It was also possible to maintain the qualitative and physicochemical characteristics of Monterey cheese samples by covering them with protein coatings made from whey proteins at a concentration of 5% and black seed proteins at a concentration of 10% which gave them a positive effect on the physicochemical properties of the cheeses coated with the manufactured coatings .

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