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CHEMICAL, MICROBIOLOGICAL, RHEOLOGICAL AND ORGANOLEPTIC PROPERTIES OF PROCESSED CHEESE BLOCKS MADE BY USING MIXTURE OF SOYBEAN LECITHIN AND COMMERCIAL EMULSIFYING SALT

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ABSTRACT

Study was made to produce blocks processed cheese by adding 3% emulsifying mixture (JOHA SE + Lecithin). The results showed that all cheeses contained lecithin had no significant differences compared to control in the content of dry matter (DM)(50.77-51.36%), fat/DM (40.04-40.06%), salt/DM(4.65-4.69%), ash/DM(6.82- 6.83%) and total nitrogen(T.N)/DM (7.05-7.10 %). On the other hand, significant effect was observed in pH (5.76-5.80), acidity (1.15-1.20%) and soluble nitrogen (S.N)/DM (0.991-1.036%). Also Lecithin-contained cheese showed significant differences in meltability (11.10-12.10mm) and oil separation (9.57-13.10 cm^2) values compared to control. Texture Profile had affected significantly with using lecithin, which led to increase of hardness (67.5-191.1), but decrease in cohesiveness (2.51-2.86g/cm). Chewiness was higher in cheese containing lecithin (5011-11279g/cm). Organoleptic properties of cheese containing lecithin did not differ significantly from control; it was obtained degrees for total score ranged from 92 to 96, at the same time control also obtained 96 degrees. After 120 days of storage at refrigerator temperature (6±2°C) no significant changes on dry matter, fat/DM, salt/DM, ash/DM and T.N/DM% had been obtained. Significant effects on the acidity, S.N/DM, pH, meltability, oil separation, hardness, cohesiveness,

chewiness and Organoleptic properties were obtained in all treatments. The total count of bacteria ranged between $1.98x10^3$ to $2.15x10^3$ cfu/g. Storage at refrigerator temperature (6±2°C) for 120 days led to reduction in the total count of bacteria. Fungi, yeasts, sporformers bacteria and coliform bacteria were not detected in all samples of blocks processed cheese when fresh and along storage period.Therefore soybean lecithin as an emulsifier can be successfully used in the production of blocks processed cheese up to 60% of emulsifying salts mixture.

Key words: processed cheese blocks, emulsifying salts, soybean lecithin.

INTRODUCTION

Processed cheese enjoys great popularity all over the world, because of its favorable texture and taste and because it is easy to handle easy to eat, it is attractive to all ages, kids, teenagers and senescent **(Uhluman, 1985).**

Processed cheese is preparing by comminuting, mixing and processing of two or more varieties of cheeses with addition of emulsifying agents **(CFR,1994)**. Many unconventional ingredients may be incorporated the cheese blend **(Caric and Kalab, 1993 and Fox, 1993).** This made it possible to produce processed cheese differing in consistency, flavor ,size and shape .Processed cheese product could be as blocks ,portions,slices,spreadable,plain or flavored, sterilized or normal or even in the dry form for bakery and soups industries.

Processed cheese is considered oil in water emulsion, where an emulsion is defined as a two-phase system; one discontinuous phase dispersed in another continuous phase, separated by a layer of emulsifier **(Fox *et al*., 2000)**.

The properties of processed cheese greatly influence by the composition of blend and emulsifying agents. Emulsifying agents are used to provide a uniform structure during the melting process, and also of the products. Phosphates, polyphosphates and citrates are most common emulsifying salts, individually or in-combination **(Shimp, 1985; CFR, 1994; Patrick *et al*., 2000 and JOHA Pamphlet, 1986)**.

Without the addition of emulsifying agents during processing, the final processed cheese product would be a gummy, pudding like mass showing an excessive degree of oiling off during manufacture **(Fox *et al*., 2000)**.

Emulsifying agents supplement the emulsifying capability of cheese proteins. This is accomplished by:(i) removing calcium from the protein system ; (ii)peptizing , solubilizing and dispersing the protein ; (iii) hydrating and swelling the proteins ; (iv) emulsifying the fat and stabilizing the emulsion ; (v) controlling pH and stabilizing it; (vi) forming an appropriate structure of the product after cooling **(Caric & Kalab ,1993 and Fox *et al*.,2000)**.

Lecithin is the popular and commercial name for a naturally occurring mixture of phosphatides (also called phospholipids or, more recently by biochemists, phosphoglycerides), which varies in color from light tan to dark reddish brown and in consistency from a fluid to a plastic solid **(Shurtleff and Aoyagi, 2007)**.

Lecithin is found in several foods including soybeans, whole grains and egg yolks. Soy lecithin has long been used as an emulsifier in processed foods, pharmaceuticals and cosmetics. Soy lecithin is composed principally of phospholipids **(Food Allergy News, 2001; Xuelin *et al*., 2001)**.

In Egypt, many thousand tons of soy bean are processed every year to produce edible soy bean oil, soy meal for animal feeding and soy lecithin for food processing. Local producing of lecithin makes it available every time for use as an emulsifier in food processing. In addition, lecithin as a food additive is preferable the other emulsifying agents because it is a natural substance and cheaper than the imported emulsifying agents.

The present study was planned to evaluate the chemical, rheological, microbiological, organoleptic properties and keeping quality of processed cheese blocks as affected by addition of soybean lecithin and commercial emulsifying salt in different ratios.

MATERIALS AND METHODS

Materials

Rass cheese:

Rass cheese was ripened for 3 months was obtained from Agricultural Secondary School, Damanhour, Behera Governorate.

Karish cheese:

Fresh karish cheese was obtained from Agricultural Secondary School, Damanhour, Behera Governorate.

Butterfat:

Butterfat was obtained from the imported Newzealand butterfat.

Emulsifying salts:

Commercial JOHA emulsifying salt (JOHA SE) recommended for the manufacturing of processed cheese blocks was obtained from BK Ladenburg corp., GmbH, Germany.

Lecithin:

Soybean lecithin was obtained from Extracted Oils and Its Products Company, Damanhour Behera Governorate, Egypt. All chemicals and reagents are analytical grade

Methods

Processed Cheese manufacture

Processed cheese blocks (50% DM, 40% F/DM) were manufactured by mixing Rass cheese, Karish cheese, butter fat and 3% emulsifying salts mixture (JOHA SE + Lecithin, w/w) with the following proportions: (100+0; 60+40; 50+50; 40+60; 30+70; 20+80; 10+90; 0+100). Each emulsifying salt mixture represents one treatment.

All treatments were processed in double jacket ban at 80-85ºC/ 7-10 min., then placed in plastic containers (100-120g) and slowly cooled at room temperature. All containers were stored in refrigerator at 6±2ºC for 120 days.

Samples:

Representative samples were taken for chemical, rheological, microbial analysis and organoleptic properties along storage period

at zero time and after 30, 60 and 120 days for processed cheese blocks stored at refrigerator temperature (6±2ºC).

Chemical analysis

Dry matter content was determined according to the British Standard Institutions **(B.S.I) bulletins no. 1741 (1951) and 770 (1952)**. Fat content, titratable acidity, total nitrogen content and soluble nitrogen content were determined according to methods described by **Ling (1963)**. pH value was measured using glass electrode pH meter, type-digital (model HANNA HI9321 microprocessor) according to the British Standard Institution **(B.S.I) bulletin no. 770 (1952)**. Salt content was determined using the modified Volhard's method as described by **Kosikowski (1966)**. Ash content was determined according to the method described by **AOAC (1995)**.

Rheological properties

Meltability

Melltability was measured using the meltability test apparatus as described by **Olson and Price (1958)**and modified by **Rayan *et al.* (1980)** as follow ; A Pyrex glass tube 30 mm diameters and 250 mm length was used to hold the spread during the test. One end of the tube was closed with a rubber stopper perforated by a 5 mm. glass tube to act as advent. A reference line was marked on the opposite end of the melting tube. This end of tube was also closed with a rubber stopper. A cylinder shape cheese sample (15±0.2 g) was placed in the tube with it front edge aligned with the marked reference line. Melting tube were placed in a vertical position on a rack at approximately 5 ºC for about 40 min and then in horizontal position in an oven at 110 ºC for 8 min. Flow of the hot cheese mass was stopped instantly for measurement with tilt control rack, the distance of flow from reference line to the leading edge of the melted cheese was quickly measured and recorded in (mm) as (cheese flow) or as (cheese meltability).

Oil separation

Oil separation of processed cheese was determined according to **Thomas (1973)** as follow:

A cork borer was used to obtain cylindrical samples of processed cheese approximately 17.0 mm x 17.0 mm .the samples were pressed gently between whatman filter paper No.41and incubated at 45 ºC for two hours. The diameter of the spread oil was measured in mm with a planimeter (Ushikata, electronic digital planimeter 220L, with read unit No. 96737, Tokyo, Japan) and used as oil separation index according to the following equation.

OSI = (A- B)/ B X 100

OSI: Oil Separation Index.

A: Diameter of spread after heating.

B: Diameter of spread before heating.

Textural properties

The Textural Profile Analysis test (TPA) such as hardness, cohesiveness and chewiness of blocks processed cheese were measured on the unmelted cheese by LFRA-Texture analyzer (1000) using computer interface software (CNS Farnell, Bore Harwood, Hertfordshire, England WD6 1WG) according to **Breene (1975) and Bourne (1978).**

Organoleptic properties

Blocks processed cheeses were organoleptically evaluated by 10 staff members at the department of Dairy Science and Technology, Faculty of Agriculture, Alexandria University and the department of Food & Dairy Science and Technology, Faculty of Agriculture, Damanhour University. The score card of blocks processed cheese was designed in the light of the score card suggested by the scheme of **Meyer (1973)** as follows: processed cheese appearance (20 points), body and texture (40points) and flavor (40points),which give total score of (100 points).

Microbiological tests

Using aseptic technique, 11g of blocks cheese samples were transferred to a sterile blend and mixed for 2 min with 99ml warmed and sterilized sodium citrate solution (2%) at speed sufficient to emulsify the sample. The necessary dilutions were prepared and the

pouring plate technique was used according to the Standard Methods for the Examination of Dairy Products **(1978)**. Samples were analyzed when fresh and monthly along the storage period for total bacterial count, moulds and yeasts count, aerobic spore forming bacterial count and coliform bacterial count according to **Foster *et al.*, (1957) and Difco's (1984).**

Statistical analysis

All obtained data were statistically analyzed using **SAS software program (2000)**. Data were analyzed as factorial arrangement of kind of emulsifying and storage period in complete randomized design with three replicates. Comparisons among the means of different treatments were achieved using the least significant difference procedure (LSD) at P= 0.05 level as illustrated by **Al-Rawi and Khalaf-Allah (1980)**.

RESULTS AND DISCUSSION

Preliminary work was done on preparation of processed cheese using different concentrations of lecithin in emulsifying salt mixture (40, 50, 60, 70, 80, 90 and 100%). Results indicated that the use of concentration more than 60% lecithin in emulsifying salt mixture resulted in rejected blocks processed cheese from technological and sensory evaluation point of view.

Chemical properties

Dry matter (DM)

Dry matter of block cheese was adjusted to be similar to those of blocks processed cheese in Egyptian markets. Table (1) show the effect of different treatments on the dry matter content of cheese which ranged from 50.77 to 51.36 % for control and tr.2 respectively at zero time. The major increment has almost occurred during the first 30 days was 0.27 % for control, the sum of increment (calculated as percentage of dry matter content at zero time).

Dry matter of all treatments including control tended to increase slowly from zero time up to the end of storage period. After 120 days dry matter values of blocks processed cheese were 51.46,

51.95, 51.58 and 51.86 % for control, tr.2, tr.3 and tr.4 respectively. The increment at the end of storage period was 1.35, 1.14, 1.28 and 1.19 % for control, tr.2, tr.3 and tr.4 respectively. **Emara (1984)**, **Abd EL-Baky *et al*. (1987), EL- Neshawy *et al.* (1987)** and **Aly *et al.* (1995)** reported that during storage at refrigerator or room temperature, there were no marked changes in the moisture content.

Statistical analysis showed no significant effect of lecithin content or storage period ($p \geq 0.05$) on dry matter content of blocks processed cheese. Data are agreed with those obtained by **Dholu *et al*. (1990)** who reported that the type of emulsifying salt had no significant influence on moisture content of processed cheese.

Drake *et al*. (1999) reported that moisture content of processed cheese with lecithin was not different from control.

Fat/dry matter (F/DM)

The calculated data of **(F/DM)** are shown in Table (1). Values of **(F/DM)** for fresh blocks processed cheese were ranged from 40.04 to 40.06 % as a maximum value for tr.2 and tr.4 respectively. While after 4 months of storage values of **(F/DM)** were 40.03, 40.03, 40.08 and 40.04 % for control, tr.2, tr.3 and tr.4 respectively. **Emara (1984)**, **Abd EL-Baky *et al*. (1987), EL- Neshawy *et al*. (1987)** and **Aly *et al*. (1995)** reported that during storage at refrigerator or room temperature, there were no marked changes in the fat content.

Analysis of variance showed that neither lecithin content nor storage period had significant effect ($p \geq 0.05$) on **(F/DM)** ratio in blocks processed cheese. Data are agree with those of **Dholu *et al* (1990)** and **Mohamed (2004)** who reported that the type of emulsifying agent or storage at 5ºC up to 3 months had no significant influence on fat content of processed cheese.

pH-value

The changes in pH value of blocks processed cheese were shown in Table (1). Values of pH were 5.76, 5.77, 5.80 and 5.80 for control, tr.2, tr.3 and tr.4 respectively at zero time. The trends of all treatments were opposite to that of titratable acidity. Control samples had the lowest pH and the value increased with increasing the ratio of soy lecithin in emulsifying mixture, so the trt4 was the highest one.

The pH value of blocks processed cheese was slightly decreased with advanced of storage period. The decreases in pH values during storage may be due to decomposition occur in emulsifying salts and their interaction with protein. It could be also due to the changes of cheese component such as lactose and proteins.

After 4 months of storage, the pH values of processed cheese treatments were 5.67, 5.67, 5.68 and 5.75 for control, tr.2, tr.3 and tr.4 respectively. Our data are in agreement with **Tamime *et al*.(1990), Younis *et al*.,(1991a), Aly *et al*.,(1995),Chamber and Daurelles(2000), Abd-ElHamid *et al*. (2000,a), Awad (2003) and Awad *et al*. (2003).**

The analysis of variance showed that the percentage of lecithin and storage period had significant effect ($p \leq 0.05$) on pH value in blocks processed cheese.

Titratable acidity

Titratable acidity of blocks processed cheese when fresh and during storage period are shown in Table (1). Acidity values of fresh cheeses were 1.20, 1.18, 1.15 and 1.16 % as lactic acid for control, tr.2, tr.3 and tr.4 respectively. Control treatment had highest acidity comparing with those containing soy lecithin, while trt3 had the lowest acidity when fresh and at the end of storage period.

The titratable acidity values of all blocks processed cheeses tended to increase with advancing of storage period. After 4 months of storage, the acidity values were 1.29, 1.29, 1.23 and 1.26 % for control, tr.2, tr.3 and tr.4 respectively. The changes in acidity values of blocks processed cheese during storage period could be due to the changes occurred in emulsifying salt form, lactose and soluble nitrogen. Data are agree with those obtained by **Younis *et al*. (1991a), Aly *et al*. (1995) and Abd-El hamid et al. (2000 a,b)** who reported that the acidity of processed cheese is increased during storage period.

The analysis of variance showed that the percentage of lecithin and storage period had significant effect ($p \leq 0.05$) on titratable acidity in blocks processed cheese.

Salt /dry matter (Salt/DM)

Table (2) shows the effect of different treatments on the ratio of Salt/DM. The values were 4.68, 4.65, 4.69 and 4.66 % for control, tr.2, tr.3 and tr.4 respectively at zero time. Values tended to decrease slowly with the progress of storage period. After four months of storage, the values ranged between 4.64 to 4.67 % for tr.2 and tr.3 respectively. **Emara (1984), Abd EL-Baky *et al.* (1987), EL-Neshway *et al.* (1987)** and **Aly *et al.* (1995)** reported that during storage at refrigerator or room temperature, there were no marked changes in salt content.The analysis of variance showed that the percentage of lecithin and storage period had no significant effect ($p \geq 0.05$) on the ratio of Salt/DM of blocks processed cheese. **Dholu *et al* (1990)** reported that the type of emulsifying agent had no significant influence on salt content of cheese spreads.

Table (1) Effect of JOHA SE:Lecithin ratio on dry matter content, fat/dray matter, pH and titratable acidity of Processed Cheese Blocks (PCB) along storage period at 6±2 ºC for 120 days.

chemical tests	Storage period (days)	Treatments			
		1	2	3	4
Dry matter %	0	50.77	51.36	50.93	51.25
	30	50.91	51.49	51.05	51.38
	60	51.17	51.68	51.27	51.59
	120	51.46	51.95	51.58	51.86
Fat / dry mater	0	40.04	40.04	40.05	40.06
	30	40.07	40.07	40.09	40.09
	60	40.06	40.11	40.04	40.05
	120	40.03	40.03	40.08	40.04
pH	0	5.76	5.77	5.80	5.80
	30	5.75	5.75	5.78	5.79
	60	5.74	5.73	5.75	5.77
	120	5.67	5.67	5.68	5.75
titratable acidity	0	1.20	1.18	1.15	1.16
	30	1.21	1.20	1.17	1.17
	60	1.24	1.23	1.19	1.20
	120	1.29	1.29	1.23	1.26

LSD .05 = 0.87, 0.415, 0.036 and 0.025 for dry matter, fat / dray matter, pH and titratable acidity respectively.
Tr.1: 3.0 % JOHA SE + 0.0 % lecithin (control)

Tr.2: 1.8 % JOHA SE + 1.2 % lecithin
Tr.3: 1.5 % JOHA SE + 1.5 % lecithin
Tr.4: 1.2 % JOHA SE + 1.8 % lecithin

Ash/dry matter (Ash/DM)

Table (2) shows the effect of different treatments on the ratio of Ash/DM in blocks processed cheese. Values were 6.83, 6.82, 6.83 and 6.82 % for control, tr.2, tr.3 and tr.4 respectively at zero time. After 4 months of storage, the ratios showed no changes, it was ranged from 6.83 to 6.84 % for tr.2 and control respectively.

The analysis of variance showed that the percentage of lecithin and storage period had no significant effect ($p \geq 0.05$) on Ash/DM in blocks processed cheese.

Total nitrogen/ dry matter (T.N/DM)

The calculated ratio of (T.N/DM) reflects the protein content of cheese expressed as a percentage of dry matter. Data have been shown in Table (2). Values were ranged from 7.05% for control as minimum to 7.10 % for tr.4 as maximum value among all treatments at zero time. Cheese containing lecithin had higher values of T.N/DM than control. That is because lecithin contains nitrogen. After 4 months of storage T.N/DM ratio were 7.05, 7.09, 7.09 and 7.10% for control, tr.2, tr.3 and tr.4 respectively.

The analysis of variance showed that the T.N/DM ratio was not significantly affected ($p \geq 0.05$) by the percentage of lecithin and storage period. Data are agree with those of **Dholu *et al* (1990) and Mohamed (2004)** found that the type of emulsifying and storage period at 5ºC up to 3 months had no significant effect on protein content of processed cheese.

Soluble nitrogen/dry matter (S.N/DM)

Ratio of soluble nitrogen in dry matter of blocks processed cheese made with different ratios of emulsifying salt and lecithin have shown in Table (2). S.N/DM of fresh cheese were 0.991 0.994, 1.025 and 1.036 % for control, tr.2, tr.3 and tr.4 respectively. The results indicated that S.N/DM was lower in control and higher in tr.4 of samples containing lecithin.

Table (2) Effect of JOHA SE:Lecithin ratio on salt/dray matter, ash/dray matter, total nitrogen/dray matter and soluble nitrogen/dray matter of Processed Cheese Blocks (PCB) along storage period at 6±2 ºC for 120 days.

Chemical tests	Storage period (days)	Treatments			
		1	2	3	4
Salt / Dray matter	0	4.68	4.65	4.69	4.66
	30	4.68	4.65	4.69	4.66
	60	4.68	4.65	4.68	4.66
	120	4.67	4.64	4.67	4.65
Ash / Dray matter	0	6.83	6.82	6.83	6.82
	30	6.83	6.82	6.83	6.82
	60	6.84	6.83	6.84	6.83
	120	6.84	6.83	6.84	6.83
Total nitrogen / Dray matter	0	7.05	7.09	7.09	7.10
	30	7.05	7.09	7.09	7.10
	60	7.06	7.09	7.09	7.10
	120	7.05	7.09	7.09	7.10
Soluble nitrogen / Dray matter	0	0.991	0.994	1.025	1.036
	30	0.993	1.000	1.029	1.037
	60	1.004	1.011	1.052	1.048
	120	1.064	1.076	1.116	1.108

LSD .05= 0.15, 0.18, 0.2 and 0.058 for salt/dray matter, ash/dray matter, total nitrogen/dray matter and soluble nitrogen/dray matter respectively.

After four months of storage, values of S.N/dm were 1.064, 1.076, 1.116 and 1.108 % for control, tr.2, tr.3 and tr.4 respectively. S.N/DM values tended to increase as the storage period progressed. The change in the S.N/ DM value during storage period could be due to the result of enzymatic activity of heat resistant proteinases.Also may be due to the hydrolysis of polyphosphate presents in emulsifying salt which cause more solubilization of proteins. These results are in agreement with those reported by **Aly *et al.* (1995), Abd El-Hamid *et al.* (2000, a), Awad (2003) and Awad *et al*. (2003).**

The analysis of variance showed that the S.N/ DM values were significantly affected ($p \leq 0.05$) by the percentage of lecithin and storage period.

Rheological properties:

Meltability

Melting index of processed cheese was expressed as the distance of cheese flow in millimeters . Meltability values of blocks

processed cheese have shown in Table (3). The lowest meltability was in tr.1 (control) and the highest was in tr.4 when fresh and during storage period.

The cheese meltability in Table (3) showed that a tendency to be decreased along the storage period in all cheese samples including control. After 4 month of storage, the meltability values were 10.00, 10.20, 10.60 and 11.10 mm for (control), tr.2, tr.3 and tr.4 respectively. The changes in meltability values of stored samples could be due to the changes occurred in chemical properties of cheese such as pH, protein state, emulsifying salts and product setting. Data are agreed with those of **Olsen and price (1958), Abd El-Salam *et al*. (1996), Abd El-Hamid *et al*. (2000, c), Awad *et al*. (2003, 2004) and Mohamed (2004).**

Analysis of variance showed that the meltability values are significantly affected ($p \leq 0.05$) by the percentages of lecithin and storage period.

Oil Separation

Oil separation of fresh cheese samples and during storage period is represented in Table (3). Values of oil separation of fresh cheese made with lecithin were 10.35, 12.90, 13.10 cm2 for tr.2, tr.3 and tr.4 respectively, while it was 9.57 cm2 for control treatment. Tr.4 showed the highest one among the treatments when fresh and during storage period while tr.1 (control) had the lowest values when fresh and during storage period.

Oil separation values increased with increasing the soy lecithin ratio in all treatments. After four months of storage, the samples of cheese have a separation index of 14.16, 15.36, 17.86 and 18.93 cm2 for control, tr.2, tr.3 and tr.4 respectively. Oil separation index of stored samples increased with prolonging the storage period. Data are agreed with those of **Abd El hamid *et al*. (2000, c), El shabrawy *et al*. (2002), Awad (2003) and Awad *et al*. (2003, 2004).**

The analysis of variance showed that the oil separation values were significantly affected ($p \leq 0.05$) by the presence of lecithin and storage period.

Table (3) Effect of treatments on meltability and oil separation of Processed Cheese Blocks (BPC) using (JOHA SE +Lecithin) along storage period at 6±2 ºC.

chemical tests	Storage period (days)	Treatments			
		1	2	3	4
Meltability (mm)	0	11.10	11.30	11.50	12.10
	30	10.90	11.00	11.30	11.80
	60	10.50	10.70	11.00	11.50
	120	10.00	10.20	10.60	11.10
Oil separation ($cm^{2)}$	0	9.57	10.35	12.90	13.10
	30	11.10	11.53	14.70	15.23
	60	11.40	12.36	16.60	16.61
	120	14.16	15.36	17.86	18.93

LSD .05= 0.62 and 2.91 for meltability and oil separation respectively.

Texture Profile Analysis (TPA):

Hardness, Chewiness and Cohesiveness

Hardness is a parameter for cheese quality (soft, firm and hard). Hardness values of blocks processed cheese in different treatments are shown in Table (4). At zero time hardness values were ranged from 189 to 514 g for control and tr.4 respectively. Hardness values is higher in blocks processed cheese containing lecithin than control. **Drake *et al*., (1999)** reported that processed cheese containing hydrogenated lecithin was more firm than control. It can be noticed that hardness values increased with the increasing of the amount of lecithin in emulsifying salt mixture.

Reverse relationship was existed between moisture content and hardness. The decrease in moisture content led to increase in hardness. Hardness values of all treatments increased as storage period had been progressed. At the end of storage period, hardness values were 361, 471, 641 and 654 g for control, tr.2, tr.3 and tr.4 respectively. The increment in the values may due to the decomposition of emulsifying salt. Data are in agreement with those obtained by **Awad *et al*. (2002, 2004).**

Table (4) Effect of treatments on texture profile analysis (TPA) (hardness, chewiness and cohesiveness) of Blocks Processed Cheese (BPC) using (JOHA SE +Lecithin) along storage period at 6±2 ºC.

TPA	Storage period (days)	Treatments			
		1	2	3	4
Hardeness (g)	0	189	287	411	514
	30	124	134	136	172
	60	209	287	433	521
	120	361	471	641	654
Chewiness g / cm	0	5011	6987	9660	11279
	30	3053	3221	3017	3096
	60	4897	6812	10627	9857
	120	7848	10682	18982	15545
Cohesiveness (g / cm)	0	2.59	2.37	2.26	2.09
	30	2.36	2.29	2.09	1.70
	60	2.02	2.04	2.08	1.59
	120	1.64	1.53	1.85	1.47

LSD .05= 83.16, 748.41 and 0.52 for hardness, chewiness and cohesiveness, respectively.

Statistical analysis showed that adding of lecithin and storage period had significant effect ($p \leq 0.05$) on hardness values in blocks processed cheese.

Mohamed (2009) found that hardness was increased significantly with the progress of storage period.

Chewiness Values were 5011, 6987, 9660 and 11279g/cm for control, tr.2, tr.3 and tr.4 at zero time. Processed cheese containing soy lecithin was higher in chewiness value than control. The samples also showed different values during storage and the change did not show a clear trend but generally increased with the advance of storage period. After 4 months of storage, chewiness values were ranged from 7848 to 18982 g/cm for control and tr.3 respectively.

The cohesiveness as one of TP parameter in fresh and during storage has shown in table (4). Cohesiveness values of fresh cheese were 2.59, 2.37, 2.26 and 2.09 g/cm for control, tr.2, tr.3 and tr.4 respectively. **Drake *et al.* (1999)** reported that processed cheese containing hydrogenated or granular soy lecithin had lower cohesiveness values than control

Cohesiveness values of all samples tend to decrease with the advance of storage period. At the end of storage period (4 months) cohesiveness values were 1.64, 1.53, 1.85 and 1.47 g/cm for control, tr.2, tr.3 and tr.4 respectively. Our results are in agreement with those obtained by **Awad *et al.*, (2002).**

Statistical analysis showed that adding of lecithin had no significant effect ($p \leq 0.05$) on cohesiveness values of blocks processed cheese, while storage period had significant effect ($p \leq 0.05$). **Mohamed (2009)** found that cohesiveness values increased significantly as storage period was progressed.

Organoleptic properties

Organoleptic properties of blocks processed cheese was carried out at zero time, as well as every (30) days up to the end of storage period of 120 days. Table (5), showed the score of appearance, body & texture and flavor of blocks processed cheese. The score of cheese appearance showed that tr.2 and tr.3 were similar to that of control while tr.4 scored the lowest value at zero time. Score of appearance of all processed cheese tended to decrease with the advance of storage period which ranged from 14 to 18 points for tr.4 and control sample respectively.

Body & texture scored the higher value in tr.2 as in control while tr.3 scored slightly lower and tr.4 scored the lowest value at zero time. The differences among all treatments in body & texture are related to the effect of emulsifying salt mixture on the protein peptidization as well as the degree of emulsification in final product. Body & texture values including control tended to decrease with the progress of storage period which were 36, 35, 35 and 32 point for control, tr.2, tr.3 and tr.4 respectively.

Flavor with lecithin scored 39, 38 and 37 point for tr.2, tr.3 and tr.4 respectively compared to 39 point for control at zero time. Flavor values of all cheese samples tended to decrease with the advance of storage period which ranged from 31 to 37 point for tr.4 and tr.1 (control) respectively.

Total palatability of produced cheese showed that tr.2 and tr.3 were acceptable as ordinary control. Tr.4 was significantly differed from other treatments showing lowest acceptability.

Cheese containing lecithin gained total score less than control. **Drake *et al*., (1999)**, found that processed cheese containing soy lecithin less acceptable than control. Acceptability of all treatments of blocks processed cheese reduced with the progress of storage period. After 4 months, values of total score were 91, 89, 88 and 77 degree for control, tr.2, tr.3 and tr.4 respectively. These results are in agreement with those obtained by **Aly *et al*. (1995) and Awad *et al*. (2004).**
Analysis of variance showed that the percentage of lecithin had no significant effect ($p \leq 0.05$) on organoleptic properties, while storage period were significantly effected.

Table (5) Effect of JOHA SE:Lecithin ratios on the appearance, body& texture and flavor of Blocks Processed Cheese (BPC) along storage period at 6±2 ºC for 120 days.

Organoleptic properties	Storage period (days)	Treatments			
		1	2	3	4
Appearance (20)	0	19	19	19	18
	30	19	19	18	18
	60	19	19	18	17
	120	18	18	17	14
Body & Texture (40)	0	38	38	37	37
	30	37	37	36	36
	60	37	37	36	34
	120	36	35	35	32
Flavor (40)	0	39	39	38	37
	30	38	38	37	35
	60	38	37	36	34
	120	37	37	36	31
Total (100)	0	96	96	94	92
	30	94	94	91	89
	60	94	94	90	85
	120	91	90	88	77

LSD .05 for total score = 4.98

Microbial content

The microbiological counts of blocks processed cheese are shown in Table (6). Total bacterial count for treatments containing lecithin was ranged from $1.98x10^3$ to $2.15x10^3$ cfu/g for trt4 and

control. A slight reduction in the total bacterial count was observed along storage period. Values of total bacterial count at the end of storage period after 4 month were $1.61x10^3$, $1.52x10^3$, $1.65x10^3$ and $1.43x10^3$ cfu/g for control, tr.2, tr.3 and tr.4 respectively.

Data also indicated that the yeasts & moulds, coliforms and aerobic spore forming bacteria were not detected in any of treatments when cheese was fresh or during storage.

Aly *et al*. (1995) found an increasing in the numbers of total bacterial count and sporeformers bacteria in the cheese spread during storage for 3 months at refregirator (5-8 ºC) or room temperature (20-25 ºC).

Muir *et al.* (1999) reported that a slight reduction in bacterial count was observed by the end of 4 months storage, while coliforms were not recovered from any of samples when fresh or during storage.

Mohamed (2004) found that processed cheese were free from moulds, yeasts, coliform and anaerobic bacteria during storage at 5ºC or 25ºC.

These results showed that the blocks processed cheese was initially produced under effective hygienic control and the reduction in microbial count during storage period reflects the effect of storage at 6±2.

Table (6) Effect of treatments on (total bacterial count, moulds & yeasts count, total coliform bacterial count and total aerobic spore forming count) cfu/g of Blocks Processed Cheese(BPC) using (JOHA SE+Lecithin) along storage period at 6±2 ºC for 120 days.

Microbial test	Storage period (days)	Treatments			
		1	2	3	4
		Count (cfu/g)			
Total bacterial count	0	2.15×10^3	2.05×10^3	2.13×10^3	1.98×10^3
	30	1.95×10^3	1.79×10^3	1.91×10^3	1.76×10^3
	60	1.73×10^3	1.65×10^3	1.76×10^3	1.58×10^3
	120	1.61×10^3	1.52×10^3	1.65×10^3	1.43×10^3
Moulds & Yeasts	0	N.D	N.D	N.D	N.D
	30	N.D	N.D	N.D	N.D
	60	N.D	N.D	N.D	N.D
	120	N.D	N.D	N.D	N.D
Coliform group	0	N.D	N.D	N.D	N.D
	30	N.D	N.D	N.D	N.D
	60	N.D	N.D	N.D	N.D
	120	N.D	N.D	N.D	N.D
Aerobic spore forming bacteria	0	N.D	N.D	N.D	N.D
	30	N.D	N.D	N.D	N.D
	60	N.D	N.D	N.D	N.D
	120	N.D	N.D	N.D	N.D

N.D: not detected

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الملخص العربى

الخواص الكيماوية والميكروبيولوجية والريولوجية والعضوية الحسية للجبن المطبوخ القوالب المصنع بإستخدام خليط من ليسيثين فول الصويا وأملاح الإستحلاب التجارية

تم استخدام ليسيثين فول الصويا كمادة استحلاب فى صورة مخلوط مع أملاح الاستحلاب التجارية (يوها SE) فى تصنيع الجبن المطبوخ القوالب وأظهرت النتائج :

-عدم وجود فروق معنوية بين بين الجبن المطبوخ المحتوى على الليسيثين وبين الكنترول فى كل من المادة الجافة (50.37- 51.36 %) ، ونسبة الدهن/ المادة الجافة (40.04-40.06%) ، ونسبة الملح / المادة الجافة (4.65- 4.69%) ، ونسبة الرماد/ الجافة(6.82-6.83%) ، ونسبة النتروجين الكلى/ المادة الجافة (7.05-7.1%). وكانت الاختلافات معنوية بين الجبن المحتوى على الليسيثين والكنترول فى كل من قيمة الـpH (5.76-5.80) ، ونسبة الحموضة (1.15-1.20 %) ، ونسبة النتروجين الذائب/ المادة الجافة (0.99-1.036%) ، والإنصهارية (11.1-12.1مم) ، وانفصال الدهن (9.75- 13.1 سم 2) ، بالإضافة إلى زيادة الصلابة (189.9- 514 جم) ، والمضغية (5011-11279 جم/سم)، بينما أنخفضت القدرة على التماسك (2.09-2.59 جم/سم). وأظهرت نتائج التحكيم على الخواص العضوية الحسية عدم وجود اختلافات بين المعاملات والكنترول(92-96 درجة).أما التخزين على درجة حرارة الثلاجة 2±6°م لمدة 120 يوم لم يظهر أى تغيرات معنوية فى كل من المادة الجافة ، ونسبة الدهن/ المادة الجافة ، ونسبة الملح / المادة الجافة ، ونسبة الرماد/ الجافة ، ونسبة النتروجين الكلى/ المادة الجافة. لكنه كان معنويا على الحموصة، والـpH ، ونسبة النتروجين الذائب/ المادة الجافة، والقابلية للإنصهار ، وفصل الدهن ، والصلابة ، والقدرة على التماسك ، والمضغية والخواص الحسية العضوية.

ترواح العد الكلى للبكتيريا ما بين 1.98-2.15 X 103 خلية/جرام وأدت فترة التخزين إلى انخفاض العدد الكلى للبكتيريا وكانت خالية تماما من الفطريات والخمائر والبكتيريا المتجرثمة وبكتيريا الكوليفورم. ولهذا فإنه يمكن استخدام ليسيثين فول الصويا كعامل استحلاب (60%) فى إنتاج الجبن المطبوخ القوالب.