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USING MIXTURE OF SOY LECITHIN AND COMMERCIAL EMULSIFYING SALT FOR SPREADABLE PROCESSED CHEESE MANUFACTURING

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ABSTRACT

The study was designed to evaluate the utility of soybean lecithin as emulsifier in combination with commercial emulsifiers in manufacture of spreadable processed cheese. The resultant spreadable processed cheese was stored for 4 months at refrigeration temperature (6±2°C). The results indicated that using soybean lecithin as an emulsifier in the production of spreadable processed cheese was successfully applied up to 60 % of emulsifying salts mixture. Also, results showed that no significant differences between spreadable processed cheese containing lecithin and Control in the content of dry matter, fat/DM, salt/DM, ash/DM and total nitrogen (T.N)/DM. It was ranged from (44.69 to 45.11, 35.02 to 35.05, 4.70 to 4.71, 6.21 to 6.23 and 7.74 to 7.77 %) respectively. On the other hand, significant effect was observed in pH (5.88 to 5.94), soluble nitrogen (S.N)/DM (1.30 to 1.34 %) and titratable acidity (0.96- 0.99 %). In addition all cheese's containing lecithin had significant differences in rheological properties comparing with the control. The produced cheese's were acceptable by the panelists. Storage period up to 120 days at 6±2°C led to no significant differences in the content of dry matter, fat/DM, salt/DM, ash/DM and T.N/DM for all

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treatments. While a significant increase in the acidity %, S.N/DM%, oil separation, adhesiveness, gumminess and springiness. On the other hand a significant decrease in the pH- value, meltability, all treatments. Total count of bacteria ranged from $1.80x10^3$ to $1.95x10^3$ cfu/g. Storage at refrigerator temperature (6±2 °C) for 120 days led to a reduction in the total count of bacteria. The organoleptic properties of spreadable processed cheese containing lecithin did not differ significantly from control. While, the storage at refrigerator temperature 6±2 °C for 120 days resulted in significant decrease in the degree of arbitration on the organoleptic properties for all treatments.

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

INTRODUCTION

Over 18 million tones of cheese are produced annually worldwide and processed cheese is an important segment of this market **(Wohlfarth and Richarts, 2005)**. Processed cheese has maintained its popularity as an important cheese product. Its excellent shelf life over a wide range of temperatures makes it useful in tropical climates.

The United States, the largest producer of processed cheese (where 20% of all cheese consumed is processed cheese), produced 1,092,000 tonnes in 2003 **(Wohlfarth and Richarts, 2005)**. In the same year, the 25 countries of the European Union produced 655,000 tons of processed cheese **(Wohlfarth and Richarts, 2005)**.

Consumer preference for a food product is principally determined by its sensory characteristics. A number of factors determine the final quality and sensory properties of processed cheese **(Carić and Kaláb, 1993)**. These include the processing conditions used during manufacture, the composition of the ingredients, and the proportions of those ingredients added to the blend.

Sensory profiling allows various quality attributes to be identified and their intensity determined **(Brown *et al.*, 2003)**. Sensory

attributes are traditionally assessed by descriptive sensory evaluation using trained panelists.

Instrumental techniques such as texture profile analysis (**TPA)** that is one of the main instrumental techniques for texture measurement, and the 3-point bend test are available for determining the texture attributes of food products. These laboratory-based techniques are require the use of skilled personnel in their execution **(Blazquez *et al.,* 2006)**.Such a technique would assist in product quality, consistency, and customer satisfaction.

Recently, **Kealy (2006)** examined cream cheese using TPA, and compared the results with those of a trained taste panel. A strong correlation was found between the taste panel results and TPA-derived hardness and adhesiveness parameters, the correlation for cohesiveness was not straightforward.

Everard (2005) also investigated the prediction of sensory attributes of processed cheese from instrumental texture attributes derived from TPA. He could predict the texture attributes of firmness, rubbery, creamy, chewy, fragmentable, and mass-forming with a good level of accuracy.

Spreadable cheeses are characterized by a soft, creamy paste, and elastic texture. Spreadable cheeses are widely used, especially in Europe, where their mild taste, velvety texture, and versatility **(Lante *et al.*, 2006)** are prized.

During the manufacture of spreadable cheese, some water is added to produce a smooth and stable emulsion **(Berger *et al.,* 1993)**. Water is also required to achieve certain product attributes such as softness or meltability in processed cheese slices **(Lee *et al.,* 2004)**. Moisture variation can also affect the rheological properties, shelf life **(Lee *et al.*, 2004)**, and sensorial characteristics.

In general, processed cheese is made by blending different types of natural cheeses with different degrees of ripening and nondairy ingredients such as emulsifiers and certain salts. These emulsifiers are strongly effective on the rheological and sensorial properties of produced cheese.

Therefore, the objectives of this study were to investigate the effect of emulsifier mixture contains lecithin and commercial emulsifying salt

(JOHA S9special) added in different ratios on the microbiological, rheological and sensorial characteristics of processed cheese spread.

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MATERIALS AND METHODS

Materials

Ras cheese:

Ras cheese (6 months old) 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 S9special) recommended for spreadable processed cheese making 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 used in this study were analytical grade.

Methods

Processed Cheese manufacture

Spreadable Processed cheese (44%DM & 35% F/DM) was manufactured by mixing Ras cheese (57.3%), karish cheese (14.3%), butter fat (6.7%), water (18.7%) and emulsifying salts mixture (3%). Emulsifying salts mixture contains (JOHA S9 special + Lecithin, w/w) with the following proportions: (100+0; 60+40; 50+50; 40+60; 30+70; 20+80; 10+90; 0+100).

All treatments were processed in double jacket ban at 90-98 ºC/8-12 min. then placed in plastic containers (100-120 g) and rapidly cooled to 10-14 ºC/30 min. All containers were stored in refrigerator at 6±2ºC for 120 days.

Samples

Representative samples were taken for chemical, rheological, microbial analysis and organoleptic assessment along storage period at zero time, 30, 60 and 120 days.

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 adhesiveness, gumminess and springiness of spreadable 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 **Breen (1975) and Bourne (1978).**

Organoleptic properties

Spreadable 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 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 (40 points) and flavor (40 points), which give total score of (100 points).

Microbiological tests

Using aseptic technique, 11g of spreadable processed cheeses samples were transferred to a sterile blend and mixed for 2 min with 99 ml 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 (plate count agar medium), moulds and yeasts count (sabouraud dextrose agar medium), aerobic spore

forming bacterial count (nutrient agar medium) and coliform bacterial count (macConkey agar medium) 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 spreadable processed cheese from technological and sensory evaluation point of view.

Chemical properties

Dry matter (DM)

Dry matter of spreadable processed cheese was adjusted to be similar as those of spreadable processed cheese in Egyptian markets. Table (1) shows the effect of different treatments on the dry matter content of cheese which ranged from 44.69 to 45.11% for tr.2 and tr.4 at zero time respectively. The major increment has almost occurred during the first 30 days of storage.

Dry matter of all treatments including control tended to increase gradualy from zero time up to the end of storage period. After 4 months dry matter values were 45.64, 45.35, 45.41 and 45.75 % for control, tr.2, tr.3 and tr.4 respectively. The increment at the end of storage period was (1.47, 1.48, 1.36 and 1.42%) 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.

The analysis of variance showed that the percentages of lecithin and storage period had no significant effect ($p \geq 0.05$) on dry matter content in spreadable processed cheese. Data are agree with those obtained by **Dholu *et al.* (1990)** who reported that the type of emulsifying salt had no significant influence on moisture content of cheese spreads.

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 fat/dry matter (F/DM) are shown in Table (1). Values for fresh spreadable processed cheese were ranged from 35.02 % as minimum to 35.05% as maximum value for tr.4 and tr.2 respectively. While after 4 months of storage, values were 35.05, 35.06, 35.01 and 35.04 % 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.

Statistical analysis showed that the percentages of lecithin and storage period had no significant effect ($p \geq 0.05$) on f/dm in spreadable processed cheese. Data are in agreement with those obtained by **Dholu *et al* (1990) and Mohamed (2004)** who reported that, the type of emulsifying salt and storage period at 5ºC up to 3 months had no significant influence on fat content of processed cheese.

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Table (1) Effect of JOHA S9special: Lecithin ratio on dry matter %, fat / dray matter %, pH and titratable acidity of Spreadable Processed Cheese (SPC) along storage period (120 days) at 6±2 ºC.

Parameters	Storage period (days)	Treatments			
		1	2	3	4
Dry matter %	0	44.98	44.69	44.80	45.11
	30	45.10	44.82	44.92	45.26
	60	45.31	45.07	45.15	45.44
	120	45.64	45.35	45.41	45.75
Fat / dry mater	0	35.05	35.05	35.04	35.02
	30	35.03	35.02	35.02	35.05
	60	35.01	35.05	35.06	35.06
	120	35.05	35.06	35.01	35.04
pH	0	5.88	5.90	5.91	5.94
	30	5.86	5.89	5.89	5.92
	60	5.84	5.86	5.86	5.90
	120	5.78	5.81	5.80	5.83
Titratable acidity	0	0.99	0.98	0.98	0.96
	30	1.01	1.00	0.99	0.97
	60	1.05	1.03	1.03	1.00
	120	1.12	1.08	1.07	1.05

LSD .05= 0.83, 0.365, 0.03 and 0.024 for dray matter, fat / dray matter, pH and titratable acidity respectively.
Tr.1: 3.0 % JOHA S9 + 0.0 % lecithin (control)
Tr.2: 1.8 % JOHA S9 + 1.2 % lecithin
Tr.3: 1.5 % JOHA S9 + 1.5 % lecithin
Tr.4: 1.2 % JOHA S9 + 1.8 % lecithin

pH Values

The pH values of spreadable processed cheese are shown in Table (1).Values were 5.88, 5.90, 5.91and 5.94 for control, tr.2, tr.3 and tr.4 respectively at zero time. The tendency of all treatments was reverse to that of titratable acidity. Therefore control cheese had the lowest pH and the values increased with increasing the ratio of soy lecithin in emulsifying mixture, so tr.4 was the highest one. pH was slightly decreased with the advance of storage period.

After 4 months of storage, pH values were 5.78, 5.81, 5.80 and 5.83 for control, tr.2, tr.3 and tr.4 respectively. The decrease in pH values along storage period may due to decomposition occurred in emulsifying salts and their interaction with protein. It could be also due to the changes of cheese component such as lactose and proteins. The results are in agreement with those of **Tamime *et al.* (1990-b), Younis *et al.* (1991-a), Aly *et al.* (1995), Chambre and Daurelles(2000), Abd-Hamid *et al.*(2000,a), Awad (2003) and Awad *et al.* (2003).**

Statistical analysis showed that both the percentages of lecithin and storage period had a significant effect ($p \leq 0.05$) on the pH of spreadable processed cheese.

Titratable acidity

Titratable acidity of spreadable processed cheese are shown in Table (1).Acidity of fresh cheese 0.99, 0.98, 0.98 and 0.96% as lactic acid for control, tr.2, trt3 and tr.4 respectively. Control treatment had higher acidity than that containing soy lecithin. Increasing the ratio of soy lecithin in the emulsifying salt mixture decreased titratable acidity.

Titratable acidity of all samples tended to increase with advancing of storage period. After 4 months of storage, the acidity values were 1.12, 1.08, 1.07 and 1.05% for control, tr.2, tr.3 and tr.4 respectively. Changes in acidity during storage could be returned to the changes occurred in emulsifying salt form, lactose and soluble nitrogen. Data are in agreement with those obtained by **Younis *et al.* (1991), Aly *et al.* (1995) and Abd-El Hamid *et al.* (2000 a,b)**.

Statistical analysis showed that the percentages of lecithin and storage period had significant effect ($p \leq 0.05$) on titratable acidity of spreadable processed cheese.

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Salt /dry matter (salt/DM)

Table (2) shows the effect of JOHA S9:Lecithin ratio on salt/DM of spreadable processed cheese. The values of salt /DM were 4.70, 4.71, 4.71and 4.70 % for control, Tr.2, Tr.3 and Tr.4 respectively at zero time. Values of salt/dm tended to decrease gradually with the progress of storage period. After four months of storage, values were ranged from 4.67 to 4.69% for tr.4 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.

Statistical analysis showed that the percentages of lecithin and storage period had no significant effect ($p \geq 0.05$) on the ratio of salt/dm in spreadable processed cheese. Data are in agreement with those of **Dholu *et al.* (1990)** who reported that the type of emulsifying salt had no significant influence on salt content of cheese spreads.

Ash/dry matter (ash/DM)

Table (2) shows the effect of different treatments on ratio of ash/DM in spreadable processed cheese. Values of ash/dm were 6.23 6.21, 6.22 and 6.23 for control, tr.2, tr.3 and tr.4 respectively at zero time. After 4 months of storage samples showed no marked changes in the ratio of ash/dm, it was ranged from 6.22 to 6.23 % for tr.3 and tr.4 respectively.

Statistical analysis showed that the percentages of lecithin and storage period had no significant effect ($p \geq 0.05$) on ash/dm % ratio in spreadable processed cheese.

Total nitrogen/ dry matter (TN/DM)

The calculated ratio of (TN/DM) reflects the nitrogen content of cheese expressed as a percentage of dry matter as shown in Table (2).

Table (2) Effect of JOHA S9special: Lecithin ratio on salt / dry matter, ash / dry matter, total nitrogen / dry matter and soluble nitrogen / dry matter of Spreadable Processed Cheese (SPC) along storage period (120 days) at 6±2 ºC.

Parameters	Storage period (days)	Treatments			
		1	2	3	4
Salt / Dry matter	0	4.70	4.71	4.71	4.70
	30	4.70	4.71	4.71	4.69
	60	4.69	4.70	4.70	4.68
	120	4.68	4.69	4.69	4.67
Ash / Dry matter	0	6.23	6.21	6.22	6.23
	30	6.23	6.22	6.22	6.21
	60	6.22	6.22	6.22	6.23
	120	6.22	6.23	6.22	6.23
Total nitrogen / Dry matter	0	7.74	7.77	7.78	7.80
	30	7.74	7.77	7.78	7.80
	60	7.74	7.78	7.78	7.80
	120	7.74	7.78	7.78	7.80
Soluble nitrogen / Dry matter	0	1.31	1.34	1.34	1.35
	30	1.31	1.34	1.35	1.36
	60	1.32	1.35	1.36	1.37
	120	1.39	1.43	1.43	1.44

LSD .05= 0.166, 0.19, 0.26 and 0.066 for salt / dry matter, ash / dry matter, total nitrogen / dry matter and soluble nitrogen / dry matter respectively.

It ranged from 7.74% (control) as minimum to 7.80% for tr.4 as maximum value among all treatments at zero time. Processed cheese containing lecithin was higher in T.N/DM values than control due to nitrogen-containing lecithin. After 4 months of storage TN/DM ratios were 7.74, 7.78, 7.78 and 7.80 % for control, tr.2, tr.3 and tr.4 respectively.

Analysis of variance showed no significant effect ($p \geq 0.05$) of the percentages of lecithin and storage period on the ratio of **TN/DM** in processed cheese spread. Data are in agreement with those of **Dholu *et al.* (1990) and Mohamed, (2004)** who 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 spreads.

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

Ratios of soluble nitrogen in dry matter (S.N/DM) of spreadable processed cheese made with different emulsifying salt mixtures are shown in Table (2). S.N/ DM values of fresh cheese were 1.30, 1.33, 1.34 and 1.35 % for control, tr.2, tr.3 and tr.4 respectively. The results indicated that S.N/DM varied among treatments that contained soy lecithin due to the nitrogen proportion in lecithin molecules.

After four months of storage, values of S.N/DM were 1.39, 1.42, 1.42 and 1.43 % 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 attributed to the resultants of enzymatic activity of heat resistant proteinases. Also may due to the hydrolysis of poly phosphate present in emulsifying salt which causes 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).**

Analysis of variance showed that the S.N/DM was significantly affected ($p \leq 0.05$) by the percentages of lecithin and storage period.

The chemical compositions of processed cheese spreads were reported to be changed very slightly during storage at the refrigerator temperature **(Abd El-Salam *et al.* (1996), Hamid *et al.* (1997), El-Sorbaty *et al.* (1998) and Mohamed (2004)).**

Rheological properties

Meltability

Meltability is an important character, which determines to a great extent, the quality of processed cheese .Meltability of processed cheese was expressed as the distance of cheese flow in millimeters. Data in table (3) show that meltability of spreadable processed cheese containing soy lecithin was the highest, while that of control was the lowest when fresh and during storage.

Fresh spreadable processed cheese exhibited meltability values of 19.8, 19.9, 20.2 and 20.4 mm for control, tr.2, tr.3 and tr.4 at zero time respectively. Differences in meltability values with increasing the ratio of soy lecithin led to higher meltability as indicated in treatments 2, 3 and 4 being proportional to substituting ratio.

Table (3) Effect of JOHA S9special: Lecithin ratio on rheological properties (meltability and oil separation) of Speardable Processed Cheese (SPC) along storage period (120 days) at 6±2 ºC.

Parameters	Storage period (days)	Treatments			
		1	2	3	4
Meltability (mm)	0	19.8	19.9	20.2	20.4
	30	19.6	19.7	20.1	20.2
	60	19.3	19.3	19.7	19.9
	120	19.0	8.9	19.2	19.5
Oil separation ($cm^{2)}$	0	4.4	4.6	5.1	6.0
	30	5.6	5.7	6.8	7.2
	60	6.5	6.6	7.8	8.9
	120	8.4	8.4	9.6	10.3

LSD .05= 0.415 and 1.41 for meltability and oil separation respectively

The melting index of all treatments even control tended to decrease as the storage period progressed. After 4 months of storage, the meltability values were 19.0, 18.9, 19.2 and 19.5 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 spreadable processed cheese such as pH, protein state ,emulsifying salts and product setting . Data are in agreement with that of **Olson and price (1958), Abd El -Salam *et al.* (1996), Abd El-Hamid *et al.* (2000, c), Awad *et al.* (2003, 2004) and Mohamed (2004).**

The analysis of variance showed that the meltability was significantly affected ($p \leq 0.05$) by the percentages of lecithin and storage period.

Oil Separation

As shown in Table (3), lecithin showed a pronounced effect on the oil separation of spreadable processed cheese .The oil separation values of fresh spreadable processed cheese made with soy lecithin

ranged from 4.6 to 6.0 cm^2 for tr.2 and tr.4 respectively, while it was 4.4 cm^2 for fresh control treatment. Tr.4 showed the highest one among treatments when fresh and during storage period while tr.1 (control) had the lowest when fresh and during storage period. Oil separation values increased with increasing the soy lecithin ratio in all treatments.

Oil separation index of stored samples increased with prolonging the storage period. After four months of storage, samples have a separation index of 8.4, 8.4, 9.6 and 10.3 cm^2 for control, tr.2, tr.3 and tr.4 respectively. 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).**

Analysis of variance showed that oil separation had no significantly affected ($p \leq 0.05$) by the percentages of lecithin, while storage period had significantly effect.

Texture Profile Analysis (TPA)

Adhesivenss, Gumminess and Springiness

Adhesiveness values for spreadable processed cheese are shown in Table (4). At zero time adhesiveness values were 47.7, 16.9, 10.1 and 12.7 for control, tr.2, tr.3 and tr.4 respectively. Adhesiveness values for processed cheese containing soy lecithin were lower than control. Adhesiveness of all treatments increased as storage period prolonged. After 4 months it ranged from 52 to 68.3 for tr.4 and control respectively. Results are in agreement with those obtained by **Zehern and Nasbum (1992) and Awad *et al.* (2002).**

Statistical analysis showed that the addition of lecithin and storage period had significant effect ($p \leq 0.05$) on adhesiveness values of spreadable processed cheese. **Mohamed (2009)** found that adhesiveness values increased significantly as storage period progressed.

Gumminess one of TPA parameter derived from hardness and cohesiveness. Any change in value of hardness and cohesiveness led to change in gumminess value. The gumminess values for all treatments are shown in Table (4). Values of gumminess for fresh spreadable processed cheese were 193, 367, 377 and 347 g/cm for control, tr.2, tr.3 and tr.4 respectively. Processed cheese containing soy lecithin was higher in gumminess value than control. On the other

hand, tr.3 exhibited the higher gumminess value when fresh and during storage period. The samples also showed different values during storage and the changes did not show a clear trend but generally the values increased with increasing storage period except tr.4 that decreased with the progress of storage period. At the end of storage period (4 months), gumminess values were 221, 562, 607 and 226 g/cm for control, tr.2, tr.3 and tr.4 respectively.

Statistical analysis showed that addition of lecithin and storage period had significant effect ($p \leq 0.05$) on gumminess value in spreadable processed cheese, also the interactions between emulsifier mixtures by storage period was significant.

Springiness of cheese indicates the ability of cheese to return back to its undeformed condition after removing the deforming force. The differences in springiness values for all treatment are shown in Table (4). Springiness values of fresh cheese were 10.2, 10.4, 10.4 and 10.5 mm for control, tr.2, tr.3 and tr.4 respectively. Cheese made with lecithin was higher in springiness value than control. **Drake *et al*. (1999)** reported that processed cheese containing hydrogenated soy lecithin was more elastic than control. The values of springiness tended to increase with increasing the amount of soy lecithin in emulsifying salt mixture.

After 120 days of storage, springiness values were 15.8, 15.9, 15.9 and 15.9 mm for control, tr.2, tr.3 and tr.4 respectively. **Awad *et al.* (2002) and Mohamed (2009)** found that the cheese samples exhibited a slightly increase in springiness during storage.

The analysis of variance showed that adding of lecithin had no significant effect ($p \leq 0.05$) on springiness of spreadable processed cheese, while storage period had significant effect.

Organoleptic properties

Organoleptic properties of spreadable 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) shows the appearance, body & texture and flavor of spreadable processed cheese. The score of appearance showed that the treatments containing lecithin was similar to that of control which gained 19 point out of 20 point at zero time. Values of all processed cheese tended to decrease with the advance of

storage period which ranged from 15 to 18 point for tr.4 and control respectively, after 120 days of storage.

Body & texture scored the higher value for tr.2 and control while tr.3 scored slightly lower and tr.4 scored the lowest value at zero time.

Table (4) Effect of JOHA S9special: Lecithin ratio on texture profile analysis (TPA) (adhesiveness, gumminess and springiness) of Spreadable Processed Cheese (SPC) along storage period (120 days) at 6±2 ºC.

TPA	Storage period (days)	Treatments			
		1	2	3	4
Adhesiveness	0	47.7	16.9	10.1	12.7
	30	54.2	46.1	41.5	31.5
	60	60.5	47.2	44.5	37.8
	120	68.3	52.4	64.0	52.0
Gumminess g / cm	0	193	367	377	347
	30	130	237	275	234
	60	206	349	388	127
	120	221	562	607	226
Springiness (mm)	0	10.2	10.4	10.4	10.5
	30	10.4	10.4	10.4	10.5
	60	10.5	10.7	11.7	11.8
	120	15.8	15.9	15.9	15.9

LSD .05= 8.32, 41.58 and 2 for adhesiveness, gumminess and Springine respectively.

The difference among all treatments in body & texture are related to the effect of emulsifying salt mixture used in the formula on the protein peptidization as well as degree of emulsification in final product. Body & texture values of processed cheeses including control tended to decrease with the progress of storage period which were 36, 36, 35 and 32 point for control, tr.2, tr.3 and tr.4 respectively.

Flavor of spreadable processed cheese with lecithin scored 39, 38 and 37 points for tr.2, tr.3 and tr.4 respectively comparing to 40 point for

control at zero time. Flavor values of all processed cheese tended to decrease with the advance of storage period which ranged from 37 to 33 point for control and tr.4 respectively.

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

Results indicated that spreadable processed cheese containing lecithin gained total score less than control. Results are in agreement with those obtained by **Drake *et al.*, (1999)** who found that processed cheese containing soy lecithin less acceptable than control. Acceptability of all spreadable processed cheese was reduced with the progress of storage period. After 4 months of storage, values of total score were 91, 90, 87 and 80 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).**

The analysis of variance showed that the percentages of lecithin had no significant effect ($p \leq 0.05$) on organoleptic properties, while storage period had significantly affected.

Table (5) Effect of JOHA S9special: Lecithin ratio on appearance, body& texture and flavor of Spreadable Processed Cheese (SPC) along storage period (120 days) at 6±2 ºC.

Organoleptic properties	Storage period (days)	Treatments			
		1	2	3	4
Appearance (20)	0	19	19	19	19
	30	19	19	18	18
	60	19	19	18	16
	120	18	18	16	15
Body & Texture (40)	0	39	39	38	37
	30	38	38	37	35
	60	37	37	36	34
	120	36	36	35	32
Flavor (40)	0	40	39	38	37
	30	39	39	38	36
	60	38	38	37	34
	120	37	36	36	33
Total (100)	0	98	97	95	93
	30	96	96	93	89
	60	94	94	91	84
	120	91	90	87	80

LSD .05 for total score = 4.98

Microbial content

The microbial counts of spreadable processed cheese are shown in Table (6). Total bacterial count for treatments containing lecithin was ranged from $1.8x10^3$ to $1.95x10^3$ cfu/g. A slight reduction in the total bacterial count was observed along storage period. Total bacterial count at the end of storage period (4 month) were $1.46 x10^3$, $1.51x10^3$, $1.48x10^3$ and $1.30x10^3$ 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 all treatments. Fresh cheese and along storage at 6±2 ºC for 120 days .

Zeidan (1993) found that total bacteria, Yeast, mould and spore forming counts increased in all samples during storage at 5ºC or 25ºC, while coliforms and anaerobic spores were not detected in any of the samples.

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

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

The obtained results Table (6) showed that the spreadable processed cheese was initially produced under effective hygienic control and the reduction in the count during storage period reflects the effect of storage at 6±2 ºC.

Table (6) Effect of JOHA S9special: Lecithin ratio on total bacterial count, yeasts &moulds count, total coliform bacterial count and total aerobic spore forming count (cfu/g) of Spreadable Processed Cheese(SPC) along storage period (120 days) at 6±2 ºC.

Microbial test	Storage period (days)	Treatments			
		1	2	3	4
		Count (cfu / g)			
Total bacterial count	0	1.83×10^3	1.95×10^3	1.88×10^3	1.80×10^3
	30	1.65×10^3	1.79×10^3	1.71×10^3	1.56×10^3
	60	1.58×10^3	1.65×10^3	1.59×10^3	1.41×10^3
	120	1.46×10^3	1.51×10^3	1.48×10^3	1.30×10^3
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

cfu: Colony Forming Unit N.D: Not detected

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الملخص العربي

استخدام خليط من ليسيثين فول الصويا وأملاح الاستحلاب التجارية فى صناعة الجبن المطبوخ القابل للفرد

تمت الدراسة بهدف تقييم استخدام ليسيثين فول الصويا كمادة استحلاب فى صورة خليط مع أملاح الإستحلاب التجارية (يوها S9 الخاص) فى صناعة الجبن المطبوخ القابل للفرد، الجبن المطبوخ الناتج تم تخزينه على درجة حرارة الثلاجة 6±2مْ لمدة 120 يوم.أوضحت النتائج نجاح استخدام ليسيثين فول الصويا بنسبة تصل إلى 60 % من مخلوط أملاح الاستحلاب المستخدم فى انتاج الجبن المطبوخ القابل للفرد. وكان للمعاملات تأثير غير معنوى بالمقارنة بالكنترول فى محتواها من المادة الجافة ، نسبة الدهن/المادة الجافة ، نسبة الملح/المادة الجافة ، نسبة الرماد/ المادة الجافة والنتروجين الكلى/ المادة الجافة ، حيث تراوحت هذه النسب ما بين(44.69 : 45.11 ، 35.02 : 35.05 ، 4.70 : 4.71 ، 6.21 : 6.23 ، 7.74 : 7.77 %) على الترتيب.ومن ناحية أخرى كان للمعاملات تأثير معنوى على قيمة الـpH (5.88-5.94)، والحموضة (0.96-0.99%)، والنتروجين الذائب/ المادة الجافة (1.30-1.34%).وفى نفس الوقت أوضحت النتائج أن الجبن المطبوخ القابل للفرد المحتوى على ليسيثين فول الصويا اختلف معنويا فى خواصه الريولوجيه مقارنة بالكنترول.بينما وجد أن التخزين على درجة حرارة الثلاجة 6±2مْ لمدة 120 يوم لم يؤدى الى حدوث تغيرات معنوية فى محتوى الجبن من المادة الجافة ، نسبة الدهن/المادة الجافة ، نسبة الملح/المادة الجافة ، نسبة الرماد/ المادة الجافة والنتروجين الكلى/ المادة الجافة.بينما أدى إلى زيادة معنوية فى نسبة الحموضة ونسبة النتروجين الذائب/المادة الجافة ، وانفصال الزيت، والالتصاق، والصمغية ، والقدرة على استعادة الشكل ، وعلى العكس من ذلك أدى إلى حدوث انخفاض معنوى فى كل من الـpH ، والانصهارية. تراوح العدد الكلى للبكتيريا ما بين $1.80\text{-}1.95 \times 10^3$ ، وأدى تخزين الجبن على درجة حرارة الثلاجة 6±2مْ لمدة 120 يوم إلى انخفاض العدد الكلى للبكتيريا فى كل المعاملات. وكان الجبن الناتج ذو خواص عضوية حسية جيدة لم تختلف معنويا فيما بينها. وأدى التخزين على درجة حرارة الثلاجة 6±2مْ لمدة 120 يوم إلى حدوث انخفاض معنوى فى قيم التحكيم الحسى على الخواص العضوية الحسية .