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IMPROVEMENT THE KEEPING QUALITY AND FLAVOUR OF PROCESSED CHEESE ANALOGUE.

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ABSTRACT

Processed cheese spreads was manufactured by using natural additives (garlic, white pepper,pickled olive slices and black pepper) which added at a levels of 3.5% w/w of garlic and pickled olive slices and 0.75 % w/w both white and black pepper. In all treatments the cheese base are the same, the only different in all treatments was the addition of different tested natural additives to determine thier effect on the quality of processed cheese spreads. The processed cheese spreads were chemically, microbiologically and sensory evaluated. all experiments and each analysis were carried out in triplicates and average values were tabulated and statistically analyzed (pr≤ 0.05).The resultant cheese spreads packed and stored at 10 ˚C for 60 days.

Results cleared that processed cheese spreads analogues with garlic, black and white pepper additives can be manufactured without any chemical preservatives, this might be due to the presence of bacteriostatic and aroma compounds in the tested natural additives, which improves falvour of the resultant cheese.
Keywords: processed cheese, spices, and natural additives.

INTRODUCTION

Processed cheese is a dairy product that is prepared by mixing and emulsifying hard and semi–hard cheese with other ingredients under cooking conditions (Sunesen *et al*., 2002).NATIONAL DAIRY COUCIL (2000) classified processed cheese into three categories:-a: Pasteurized processed cheese is the food made by grinding and blending, with the aid of heat (not less than 150°F for at least 30 seconds) and an emulsifying agent (e.g., sodium salts of phosphoric acid), one or more natural cheeses of the same or two or more varieties into a homogeneous mass. Allowable optional ingredients such as fruits, vegetables, or meats may be added. b: pasteurized processed cheese foods is similar to pasteurized processed cheese except for the addition of one or more of the following optional dairy ingredients: cream, milk, nonfat milk, buttermilk, cheese whey, anhydrous milk fat, dehydrated cream, or skim milk cheese for manufacturing. At least 51% of the weight of cheese foods must consist of the cheese ingredient. Other optional ingredients include emulsifying agents, acidifying agents, water, salt, artificial coloring, and spices and flavorings. Pasteurized processed cheese food is higher in moisture and lower in fat content than pasteurized processed cheese. Fruits, vegetables, or meats may be added according to federal definitions and standards of identity. **C:** pasteurized processed cheese spread is similar to pasteurized processed cheese food except that no emulsifying agent is used. Added moisture is permitted in pasteurized processed cheese spreads to give a spreading quality to the product at room

temperature (70°F). The addition of moisture may require the use of water-retaining ingredients such as gums, gelatin, and algin in an amount not to exceed 0.8% of the weight of the finished product. Other optional ingredients specified for pasteurized processed cheese food, as well as sweetening agents such as sugar, dextrose, maltose, and corn syrup, may also be added. The cheeses used must contribute at least 51% of the weight of the finished product. A pasteurized processed cheese spread is lower in fat and higher in moisture content than a pasteurized processed cheese food. Federal standards of identity define pasteurized processed cheese spreads with fruits, vegetables, meats, or mixtures of these additions.

It is known from hundreds of years ago that foods prepared with spices have longer keeping periods because of their effect in retarding food spoilage caused by microorganisms. The antimicrobial constituents of spices as mentioned by Zaika (1988) are presented in table (1).

Table (1): Antimicrobial Constituents Of Spices And Herbs*

Compound	Occurrence
Allicin	Garlic
Allyl isothiocyanate	Mustard
Anethole	Anise, staranise, fennel
Carvone	Caraway, dill
1.8- Cineole	Sage, rosemary, laurel, cardamom
Cinnamaldehyde	Cinnamon, Cassia
P. Cymene	Pepper, thyme, oregan
Eugenol	Clove, allspice, cinnamon
Limonene	Celery seed, Caraway, dill
Linalool	Coriander, sage, rosemary, basil
Thymol	Thyme, oregano
Thymoquinone (Alkgul and Kivance, 1989)	Black pepper

* **Zaika (1988)**

However, the mechanism of the effect of spices on microorganisms is not fully understood. Zaika (1988) reported that the antiseptic power of spices in microbiological growth media and food systems resides in their essential oils and in some cases can be attributed to their major components. The reactivity of drastic compounds is related to the presence of an aromatic moiety such as OH group, which is quiet reactive and easily forms hydrogen bonds with active sites of target enzymes.

Davidson *et al*.,(1983) and Adnan and pierson (1990) suggested that the spice oils may affect the vegetative growth by a mechanism similar to that of phenols, which affect cell membrane of bacteria, by altering permeability of the membranes, transport systems, electron transport and energy production. All researchers for enhancement of these effects (Maria and Dimitrios, 1994) consider the presence of other groups in aromatic moiety.

Cort (1974) and Banias *et al* (1992) reported numerous studies on the antioxidant activity of spices and their extracts in pure lipid system or dressings and similar products. It is evident from their reports that spices showed different antioxidant activities. The most antioxidant properties of these spices reside in their oils, where several compounds with antioxidant

properties have been isolated, i. e. the phenolic compounds. These compounds apparently exert their influence by interrupting the chain reaction in autoxidation by capture of the free radicals necessary for continuation of hydroperoxide formation. It must be stressed, however, that a phenolic compound is not always a prerequisite for the formation of stable free radicals which interrupt the chain reaction, linalool and linalyl acetate, e.g. which have an ethylidene group may inhibit oxidation in heated oil in a manner similar to that of plant sterols (Gordon and Magos, 1983), where the ethylidene side chain present in sterols reacts with lipid free radical.

This work aims to improve the keeping quality and flavour of processed cheese analogue by using natural additives such as garlic, white pepper, black pepper and pickled olive slices.

MATERIAL AND METHODS

Fresh buffalo's milk, obtained from Dairy Research Unit, Faculty of Agriculture, Mansoura University, El Mansoura, Egypt. RAS cheese, which made at Dairy Research Unit, Faculty of Agriculture Mansoura University was used in the experimental search. Skim milk powder made in Poland by “VARIMEX" was used. Commercial grade salt (NaCl), garlic, black pepper, white pepper and oils were purchased from the local market.

Joha S_9, S_4. It was obtained from Misr Milk Company.(Joha Co., Germany).

The manufacture of processed cheese spread was carried out by using batch method in the dairy department faculty of agriculture Mansoura University according to the method described by El- Assar, (1991).

Moisture content of processed cheese, soft and hard cheese was determined as described by the Association of official analytical chemists (A. O. A. C., 1990).

The total nitrogen of the processed cheese measured by the micro-Kjeldahl method as recommended by the A.O.A.C. (1990) the total protein content was calculated in processed cheese by the factor 6.38 according to Ling (1963).

Fat content of processed cheese was determined by using Gerber method and titratable acidity determined according to (Ling, 1963).

Ph values measured in the processed cheese using Digital pH meter (LTU Italy).

Total volatile free fatty acids of the processed cheese was determined by the direct distillation method as described by kosikowski (1982). It is expressed as volume of NaOH (0.1 N) /100 gm of cheese.

The processed cheese spread samples organoleptically evaluated when it was fresh and during storage period, according, to scheme reported by Mayer (1973). Regular scoring panel of members in the dairy department, Faculty of Agriculture, Mansoura University, carried out the evaluation. The scoring sheet for processed cheese spread was as follows:

Outer appearance	20
Inert appearance	40
Flavor	40
Total	100

Ten gram of the cheese sample accurately weighted under aseptic conditions, and transferred into a sterile mortar, which was previously sterilized by alcohol and flaming. Ten ml of 20 % sodium citrates solution was placed in the mortar and cheese was thoroughly ground into a homogenous suspension, then 80 ml of sterile saline solution, previously warmed at 37 º C were added and mixed well, giving the 1-10 dilution which used for preparing the other dilution according to the American Public Health Association (A.P.H.A.) (1960).

Total bacterial count of cheese was determined according to the American Public Health Association (1978) by plating suitable dilution in duplicates by using nutrient agar medium (Difco Manual, 1966). Plates were incubated at 32ºC for 3 days before counting and recording the results.

Tubes of mixed samples were placed in water bath at 85ºC for 15 min., and then cooled to room temperature. Samples were plated in duplicated on nutrient agar media (Difco Manual, 1966). The plates incubated at 32ºC for 3 days before counting as described by the American Public Health Association (1980).

The total coliform bacterial count was determined according to American Public Health Association (1960) by using MacConkey agar. The plates were incubated at 37ºC for 48 hr before counting as described by American Public Health Association (1980).

Potato dextrose agar recommended by the Oxoid Manual (1962) used for the enumeration of moulds and yeasts. Inoculated plates were incubated at 25ºC for 5 days.

For detecting and enumerating staphylococci, appropriate dilution of examined cheese samples were plated with staphylococcus medium No.110 (Difco 1974). Plates incubated at 37ºC for 40-43 hrs.

Three replicates were carried out from each treatment. The results were analyzed statistically for analysis of variance according to Steel and Torrie (1960) by SAS computer program.

REULTS AND DISCUSSION

Processed cheese spreads were manufactured by using natural additives (garlic, white pepper,pickled olive slices and black pepper) which were added at (3.5% (W/W) of each of garlic and pickled olive slices and 0.75 % (W/W) of both white and black pepper. In all treatments the cheese base was the same, the only difference was the addition of tested natural additives to determine their effect on the properties of processed cheese spreads. The resultant cheese was chemically, microbiologically and sensory evaluated. All experiments and analysis were carried out in triplicate and average values were tabulated and statistically analyzed.

The resultant cheese spreads packaged and stored at 10 ºC for 60 days.

Data Illustrated in table (1) and Fig.1 reveale the titratable acidity values in the fresh and stored processed cheese spreads. T2(Treatment2) (garlic) shows the highest titratable acidity values till 30 days of storage. This might be due to the presence of volatille compound in the garlic which could affect the total acidity value. But by the end of storage period the higer

titratable acidity value was T1 (control),which might be due to the increase of microbial growth by that time. During storage, very slight increase in titratable acidity was observed in all samples. Statistical analysis of variance (table 3) showed that the differences in the acidity values between treatments(T), storage time (S), and interaction between TXS were highly significant in T,S and non significant for (TXS)($p<0.05$).

Data in Table (1) show the changes in the pH values in fresh and stored processd cheese treatments. Slight decrease in the pH values during storage were observed, which might be due to the adjustment the blend's pH to 5.8-5.9 by using the emulsifying salts during the manufacturing process. Also, the same data reveales that, T4 possessed the highest pH values compared with other treatments, which could be attributed to the presence of alkaline compounds in the pickled olive slices. These results are in accordance with Mann (1982) and El-sayed (1984). The differences in pH between treatments(T), storage time (S), and interaction between TXS were highly significant($p<0.05$)

Data presented in Table (1) and Fig.1 indicate the changes occurring in the total and soluble nitrogen content of processed cheese spreads analogues during cold storage. It appears that the total and soluble nitrogen content of fresh and stored processed cheese slightly increased during storage. The total nitrogen content ranged from 1.32- 1.34%, while the soluble nitrogen content ranged from 0.20- 0.22% at zero time. The changes in the total nitrogen might be due to the loss of some water content during storage, but the significant increasing in the soluble nitrogen might be in relation with the growth of microorganisms in the processed cheese.

From the above results, it could be concluded that the lower S.N content at the garlic, black and white pepper treatments might be a result of bacteriostatic effects of these natural additives. These results are in agreement with Guirguis *et al.* (1985).

Data Illustrated in table (3) show that the differences in the T.N and S.N between treatments(T), storage time (S), and interaction between TXS were significant in (T), highly significant in (S) and non significant for interactions (TXS)($p<0.05$).

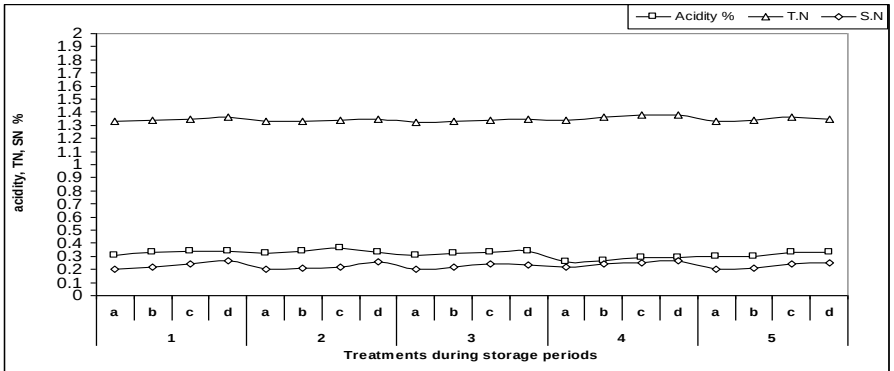

Fig.(1): The Effect of Natural Additives and Storage Periods on the Chemical Properties of Spread Processed Cheese

Data illustrated in table (1) and fig.2 show the changes of total volatile free fatty acids (T.V.F.A) in fresh and stored processed cheese analogues. The highest total volatile free fatty acids content was found in T2 (garlic) (26, 27, 28, and 30.66) at zero-time and after 15, 30 and 60 days, respectively. This might be due to the high percent of volatile compound in the garlic, followed by treatments 3 and 5. T4 (olive) showed the lowest T.V.F.A during all storage periods (21.33, 23.33, 26 and 29) at zero-time and after 15, 30 and 60 days, respectively. In addition, data in the same table show that there was an increase in the total volatile free fatty acids in all treatments during the storage, which might be due to the presence of residual active heat resistant lipases of the cheese used in the blends. These results agree with those reported by Hala (2001)

Table (1): The Effect of Natural Additives and Storage Periods on the Chemical Properties of Spread Processed Cheese

TREATMETS	STORAGE PERIODS	pH values	Acidity %	T.V.F.A	T.N	S.N
1	**A**	5.89	0.31	22.65	1.33	0.20
	B	5.88	0.33	24.00	1.34	0.22
	C	5.82	0.34	27.00	1.35	0.24
	D	5.83	0.34	32.00	1.36	0.27
2	**A**	5.88	0.32	26.00	1.33	0.20
	B	5.88	0.34	27.00	1.33	0.21
	C	5.87	0.36	28.00	1.34	0.22
	D	5.87	0.33	30.66	1.35	0.26
3	**A**	5.87	0.31	25.33	1.32	0.20
	B	5.85	0.32	26.66	1.33	0.22
	C	5.82	0.33	29.33	1.34	0.24
	D	5.83	0.34	32.66	1.35	0.23
4	**A**	5.91	0.26	21.33	1.34	0.22
	B	5.90	0.27	23.33	1.36	0.24
	C	5.85	0.29	26.00	1.38	0.25
	D	5.86	0.29	29.00	1.38	0.27
5	**A**	5.89	0.30	25.33	1.33	0.20
	B	5.87	0.30	26.66	1.34	0.21
	C	5.85	0.33	29.33	1.36	0.24
	D	5.86	0.33	32.00	1.35	0.25

T.V.: (Total volatile free fatty acids= ml on NaOH (0.1N)/100 gm of cheese)

1: control cheese
2:garlic cheese
3:white pepper cheese
4: pickled olive slice cheese
5:black pepper cheese

a: zero time
b: 15 days
c: 30 days
d: 60 days

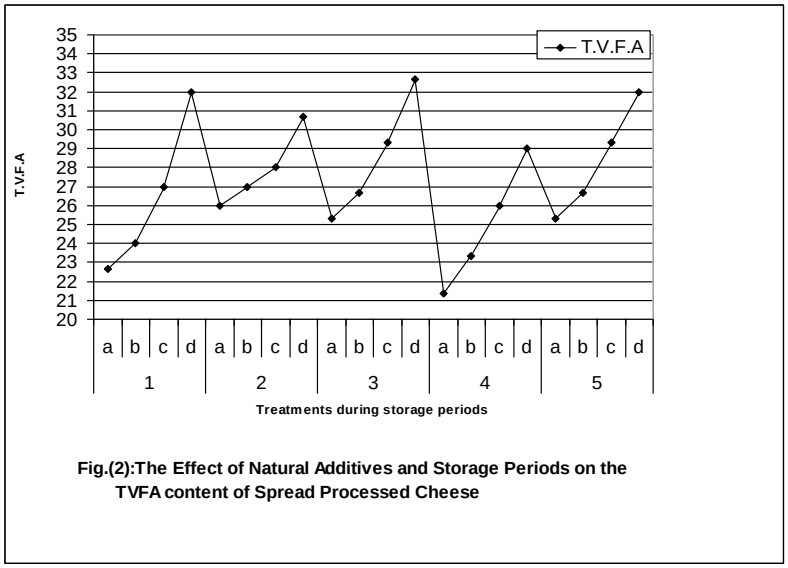

Fig.(2):The Effect of Natural Additives and Storage Periods on the TVFA content of Spread Processed Cheese

Table (2): The Effect of Natural Additives and Storage Periods on the Organoleptic Properties of Processed Cheese Spreads.

TREATMETS	STORAGE PERIODS	outrap	Inertap.	Flav.	Total
		20	40	40	100
1	a	16.37	34.23	34.27	84.87
	b	16.33	34.08	33.89	84.30
	c	16.23	32.97	33.15	82.35
	d	14.20	24.37	32.27	70.84
2	a	16.11	35.62	30.27	82.00
	b	16.07	36.37	28.13	80.57
	c	16.33	32.17	24.27	72.77
	d	15.93	30.30	24.45	70.68
3	a	16.40	30.00	29.80	76.20
	b	16.43	32.10	30.37	78.90
	c	16.40	33.10	28.40	77.90
	d	16.13	31.17	32.03	79.33
4	a	16.30	30.33	32.27	78.90
	b	16.33	30.17	32.93	79.43
	c	14.87	25.17	32.47	72.51
	d	12.13	23.50	26.43	62.06
5	a	14.00	29.67	29.93	73.60
	b	14.33	31.00	29.03	74.36
	c	14.80	35.63	29.73	80.16
	d	15.87	34.57	29.73	80.17

1: control cheese
2:garlic cheese
3:white pepper cheese
4: pickled olive slice cheese
5:black pepper cheese

a: zero time
b: 15 days
c: 30 days
d: 60 days

Outrap.: outer appearance
Inertap.: inert appearance
Flav.: flavour

Analysis of variance (Table 3) indicate that, there were highly significant differences in the T.V.F.A between treatments (T), storage time (S), and non significant differences at the interaction between them ($p<0.05$).

Data in Table (4) show the microbiological content of processed cheese analogue spreads. It is worth mentioning that all treatments were free from coliform bacteria when they were fresh but the presence of coliform bacteria occurred after 15 days of storage, which might be resulted from the post - contamination in the control treatment followed by T4 (olive). In addition, data presented in Table (4) shows that the highest coliform bacteria content was in T4. On the other hand the lowest coliform bacteria content were found in T2 [garlic] at all storage periods.

Data in the same table shows that the presence of moulds and yeasts in the processed cheese analogue spreads differed from one treatment to another. The highest moulds and yeasts content was found in T4 (pickled olive slices), followed by the control, whether fresh or stored product.

Also, illustrated data in Table (4) revealed that T2 (garlic), followed by black and white pepper showed the lowest content of both lipolytic and proteolytic bacteria in contrast to T4 that had the highest lipolytic and proteolytic bacteria at all storage periods.

From previous data, it could be concluded that garlic, white and black pepper had a high bacteriostatic effect against the growth of all of the examined bacteria. These results are in agreement with Mohamed (1997) and Mousmi and Parbir (2003).

Table (2) shows that T1 (control) had the highest scores even after 15 days of storage period, but at the end of storage, T5 (black pepper) had the highest scores, followed by the T 3 (white pepper). On the other hand, the olive T4 gave the lowest score at the end of storage. From the same data in table (2), it could be observed that T2 (garlic) had high scores in outer and inert appearance but had the lowest scores in the flavour.

Statistical analysis of variance (table 3) showed that the differences in pH between treatments(T), storage time (S), and interaction between TXS were highly significant($p<0.05$).

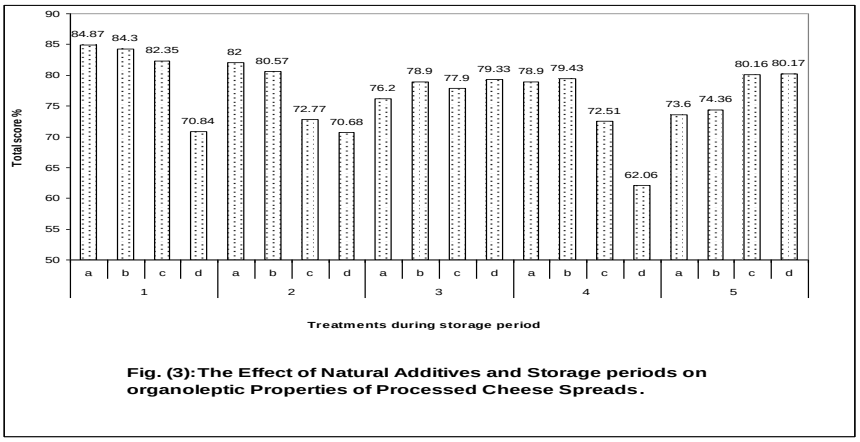

Fig. (3): The Effect of Natural Additives and Storage periods on organoleptic Properties of Processed Cheese Spreads.

Table (3): The source of variances among processed cheese analogues during storage periods

Source of variance	pH	acidity	TVFA	S.N	T.N	Outer.	Iner.	Flav.	Total
Treatments(T)	**	**	**	**	**	**	**	**	**
Storage (S)	**	**	**	**	**	**	**	**	**
T*S	*	N.S	N.S	N.S	N.S	**	**	**	**

Significant differences at Pr≤ (0.05).
****: highly significant**
***: significant**
N.S: nonsignificant

Outer: outerappearance
Iner.: intraappearance
Flav.: Falvour

Table (4): The Effect of Natural Additives and Storage Periods on the Microbial Analysis of Spread Processed Cheese

treatments	Storage periods	T.C * 10^6	E.coli* 10^3	M&y * 10^3	Staph. *10^3	Sp.b* 10^3	Ly.b* 10^3	Pro.b *10^3
1	a	0.25	N.D	0.83	N.D	0.54	0.12	0.41
	b	0.45	0.16	1.20	N.D	0.5	0.37	0.29
	c	1.45	0.58	2.16	N.D	0.37	1.08	0.50
	d	2.00	N.D	2.83	N.D	0.33	1.66	1.33
2	a	0.00	0.00	0.33	N.D	0.66	0.33	0.33
	b	0.00	N.D	0.16	N.D	0.50	0.50	0.66
	c	0.50	0.16	0.16	N.D	0.16	0.50	0.83
	d	0.66	N.D	0.33	N.D	N.D	0.83	1.16
3	a	0.16	N.D	N.D	N.D	0.33	0.66	0.66
	b	0.33	N.D	N.D	N.D	0.33	1.00	1.00
	c	0.83	0.66	0.33	N.D	0.33	1.33	1.33
	d	1.16	0.50	1.33	N.D	0.33	1.00	1.66
4	a	1.16	N.D	1.83	N.D	1.50	1.00	0.16
	b	1.16	0.16	2.16	N.D	1.50	1.16	0.83
	c	1.83	2.50	2.83	N.D	0.83	2.00	1.16
	d	2.83	1.50	3.5	N.D	0.50	2.16	1.66
5	a	0.33	N.D	0.83	N.D	0.83	0.50	0.66
	b	0.83	0.16	1.00	N.D	0.66	0.66	0.33
	C	1.33	1.33	1.33	N.D	0.33	1.33	1.16
	D	1.66	0.83	1.5	N.D	0.16	1.33	1.83

1: control cheese
2:garlic cheese
3:white pepper cheese
4: pickled olive slice cheese
5:black pepper cheese

T.C: total bacterial count
Staph.: staphylococcuas ourus
SP.b: sporforming bacteria
Ly.b.: lypoletic bacteria
Pro.b.: protioletic bacteria

a: zero time
b: 15 days
c: 30 days
d: 60 days

Conclusion

From previous data, it could be concluded that processed cheese analogue spreads with the natural additives (garlic, black and white pepper) except pickled olive slices can be manufactured without any chemical preservatives. This might be due to the presence of bacteriostatic and aroma compounds, which improves keeping quality and falvour of the resultant cheese.

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تحسين القدرة الحفظية ونكهة الجبن المطبوخ

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استهدف العمل دراسة اثر بعض الإضافات الغذائية الغير لبنية علي تحسين القدرة الحفظية ونكهة الجبن المطبوخ, استخدم كلا من الثوم وشرائح الزيتون (٣,٥ % وزن/وزن) والفلفل الأبيض والفلفل الأسود (٠,٧٥ % وزن/وزن) والتي أضيفت إلي معجون الجبن المطبوخ الخالي من أي مواد حافظة سواء ميكروبية أو فطرية وتم حفظ الجبن الناتج علي درجة حرارة ١٠ ° م لمدة ٦٠ يوم مع التقييم الكيماوي و الميكروبي والحسي للجبن الناتج. كانت هناك اختلافات معنوية في قيم الـ pH بين جميع العينات وبعضها عند مستوي معنوية (٠,٠٥) . وقد لوحظ انخفاض قيم الـ pH للمعاملة التي استخدم فيها شرائح الزيتون عن باقي العينات سواء كانت طازجة أو خلال فترة التخزين. كذلك وجدت اختلافات عالية المعنوية في قيم كلا من الحموضة والاحماض الدهنية الطيارة.وبشكل عام حصلت جميع المعاملات علي درجات تقييم حسي اعلي من ٦٥ % مما يدل علي إمكانية استخدامها بكفاءة عالية في تصنيع الجبن المطبوخ سهل الفرد.كذلك أظهرت نتائج التحليل الميكروبيولوجي تفوق المعاملات المستخدم فيها كلا من الثوم والفلفل الأبيض والفلفل الأسود في تحسين الجودة الميكروبيولوجية للجبن المطبوخ سواء الطازجة أو المخزنة.نستنتجمن ذلك انه يمكن استخدام الثوم والفلفل الأبيض والأسود كمواد ذات اثر حفظي للجبن المطبوخ دون اللجوء إلي استخدام أي مواد حفظ كيماوية علاوة علي ذلك تلعب هذه المواد أيضا دورا هاما في تحسين طعم ونكهة الجبن الناتج.