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Impact of Dietary Fibers and Starter Type on Kariesh Cheese Properties

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ABSTRACT

Kariesh cheese made by non-expolysaccharide producing bacteria (EPS-) as a control was compared with that made by exopolysaccharide producing bacteria (EPS^+). Inulin (1, 2%) and modified starch (0.1, 0.3%) were added to evaluate the impact of adding exopolysaccharide producing bacteria (EPS^+) and dietary fibers on the resultant Kariesh cheese. Kariesh cheese made by the traditional method and stored at 5°c. Samples in three replicates were taken at different intervals, and analyzed for chemical, rheological, organoleptic and microbial properties. Results indicated that the addition of inulin and modified starch decreased the acidity % and increased the pH values, compared with the control. The increase of acidity and the decrease of pH were higher in the cheese made by EPS-, either with or without the addition of dietary fibers. All EPS+ treatments characterized with higher moisture content than EPS^-, and the decrease of the total solids content in these treatments. Higher yield, moisture content and acidity % were detected in the cheese treatments with added inulin, compared with the modified starch treatments either in the presence or absence of EPS. Treatment with inulin and modified starch in the presence EPS+ resulted in higher salt % than that in the presence of EPS-. The protein% was in correlation with the total solids content, either at the beginning or at the end of the examined cheese storage. All EPS^+ treatments gained Higher curd tension, particularly, with added modified starch than EPS^- treatments. Organoleptic characteristics (appearance, body and texture) by suing modified starch or inulin, especially on EPS+ treatments were improved, but there was no remarkable difference on the taste and flavor properties. Treating with inulin and modified starch with EPS^+ improved certain rheological properties such as adhesiveness, hardiness, springiness, gumminess and chewiness. Control cheese made by either EPS+ or EPS- contained less total bacterial counts in the fresh and throughout the storage of cheese. Therefore, the addition of modified starch and inulin with EPS+ during kariesh cheese making resulted in an improvement of the properties of the experimented cheese.

Keywords: kariesh cheese, exopolysaccharid , inulin, modified starch

INTRODUCTION

For its low price, high nutritional value and high content of many constituents which are of a great effect on improvement the public health, particularly, the safety and health of bone due to its high content of calcium and phosphorus. An increase in the consumption of kariesh cheese among the people in Egypt and some Arab countries due to the previously mentioned characteristics of such cheese (Francois *et al*., 2004). So, numerous research works targeted to improve the functional and textural properties of the low fat cheese. For this purposes many of non-dairy ingredients were added to kariesh cheese throughout its making, such as hydrocolloids, carbohydrate-based fat replacers Ilze and Inga (2011). Adding of non-dairy ingredients not the only way to achieve the previous goals, where, genetic engineering also contributed to achieve these goals. Using of exopolysaccharies producing bacteria (EPS^+) also led to a progress on achieving the desired aims. There were many prebiotic ingredients, such as Inulin and modified starch could successfully be used in making many dairy products, which resulted in the activation of the growth of probiotic bacteria, and enhance the functional properties of these useful bacteria (El Ŝbieta *et al*.,2004, Oliveira *et al.,* 2010 and Tarek *et al*., 2013). The presence of prebiotic agents together with the probiotic bacteria, which called symbiotic achieved most effectiveness than either of adding them individually on the dairy or dairy foods products (Salem and El- Shibiny 2003).

As the addition of stabilizers is forbidden, the using of polysaccharids, which produce a varied group of molecules attracted the attention of researchers due to their therapeutic and functional characteristics. Using of bio-produced polysaccharids (EPS+) in making of dairy products resulted in many enhancing properties of these products such as viscosity, water binding, stabilizing and synersis properties. Many trails were carried out to activate the growth of exopolysaccharid producing bacteria by the addition of many growth factors, which enhance its vitality, and have the abilities to activate and enhance the growth of these bacteria (Cerning., 1995; Ilze and Inga 2011).

Therefore, the objective of the present work was to determine the impact of modified starch and inulin as dietary fibers on the growth of exopolysaccharid bacteria and evaluating the effect of that addition on the properties of kariesh cheese made with the exopolysaccharids producing bacteria.

MATERIALS AND METHODS

Fresh skim buffalo's milk (0.2 % fat, 9.5 % SNF, 3.82 % protein) was obtained from the experimental centre of the Dairy Department, Faculty of Agriculture, Mansoura University. Exopolysaccharides producing *Lactobacillus delbrueckii ssp. bulgaricus* (FD-DVS YC-X11-YO-Flex and non-producing Lyophilized Yoghurt starter culture "*Streptococcus thermophilus and Lactobacillus delbrukii subsp bulgaricus*". were obtained from Ch. Hansen's Laboratories, Denmark. Inulin (frutafit® IQ) imported from sunOpta group-Holland, and modified potato starch imported from KMC Herningvej 60 DK-7330 Brand Denmark. Chemicals used for detecting of the acidity, protein, etc, were obtained from El-Gomhoria company for chemicals and glasses.

Kariesh cheese was made according to Abou-Donia, (2008).Samples of kariesh cheese were collected in three replicates at varying periods (zero, 15 days). 100gm of cheese were taken from the interior and exterior of the blocks . They are mixed and used for analysis. Total solids were estimated according to AOAC (2005) .Titratable acidity as lactic acid % , total protein and salt % were estimated according to Ling, (1963). pH values, fat % and moisture content were detected as mentioned in American Public Health Association (1992) and AOAC (2000). Total viable bacterial count (T.C), coliform bacterial count (CFBC), staphylococci and Fungi and Yeasts count (FYC)

were estimated according to Chalmers (1962), and the media used in their detection were used as mentioned in the Difco Manual (1977).. Rheological parameters were evaluated using the texture analyzer (Texture Pro CT3V1.2, BrooKfield, Middleboro , USA) according to the method of Tarek *et al* ., (2013). Curd tension was detected according to Chandrasekhara *et al*.,(1957). Curd synersis was determined according to Mehanna and Mehanna,(1989). Organoleptic properties of Kariesh cheese were carried out due to Nelson and Trout, 1981).

Cheese yield was estimated according to the mentioned below formula described by Koca and Metin, (2004).

$$\text{Cheese yield} = \frac{\text{Amount of cheese (kg)}}{\text{Amount of skimmed milk (kg)}} \times 100$$

RESULTS AND DISCUSSION

Dietary fibers as fat replacers were used in processing of dairy products imitations such as soft cheese, fermented milk and ice cream. This work aims to evaluate the use of inulin and modified starch by different addition ratio as types of dietary fibers on making of kariesh cheese fermented with variant starter cultures. Kariesh cheese made by the traditional method, which described by Abu-Donia (2008). Cheese samples were preserved and analyzed as mentioned in Materials and Methods. Obtained data were illustrated as the following:-

Results in Table (1) show the effect of modified starch and inulin on the pH values and titratable acidity (%) of kariesh cheese fermented with EPS+ or EPS$^-$. Slight differences were observed for the acidity (%) and pH values among the examined treatments and the control. In addition, the pH values of cheese made with EPS$^-$ were lower than those made in the presence of EPS+. On the other hand, acidity(%) of EPS$^+$ treatments were higher than that in EPS$^-$. The pH values of EPS$^-$ treatments ranged between 4.2 to 4.4, and 0.81 to 0.83 for acidity(%). In addition the corresponding values in the presence of EPS$^+$ were 4.1 to 4.3 for pH. and 0.82 to 0.85 for the acidity (%). Results in the same Table also show that there was a slight decrease in the pH values during the prolongation of storage period of all cheese treatments. Slight increase was also observed in the acidity (%) during the cheese storage.

Cheese fermented with either EPS$^+$ or EPS$^-$ characterized with higher pH decrease throughout its storage, compared with other treatments being supplemented with different levels of inulin or the modified starch, whereas, the treatments with EPS+ and EPS- free from any additives characterized with higher pH D.R% 2.38- 2.32%, respectively. Furthermore, the addition of inulin and modified starch resulted in an increase in the pH D.R% in EPS+ treatments more than in EPS$^-$ treatments throughout its storage period.

The acidity increasing rate (I.R %) was of a different behavior with the pH D.R % for all cheese treatments during its storage period. The control cheese and its treatments gained higher acidity I.R% than those in cheese treatments with EPS+ either with or without modified starch and inulin addition. The treatments fermented with EPS- had acidity I.R% ranged among 1.2 in EPS$^-$ +2% M.S and 2.5% in both EPS- +1 % M.S and EPS- + 0.3 % inulin. On the other hand, EPS+ treatments had acidity I.R% ranged between 1.17 in EPS$^+$ + 0.3 % inulin and 3.7 % in EPS$^+$ + 2 %M.S .This finding are in harmony with the results obtained by Ismail *et al*., (2010). From the previous data it could be concluded that the increase of titratable acidity(%) was related with the type of dietary fiber and its addition level. Also, the addition of inulin had the higher effect on the acidity content and its increasing rate during the cheese storage.

Table 1. Impact of inulin and modified starch on the pH and acidity% of kariesh cheese fermented with different starters.

Treatments	Shelf Life/day	pH value	pH D.R %	Acidity %	Acidity I.R%
Control	0	4.3		0.83	
EPS$^-$	15	4.2	2.32	0.85	2.4
M.S 1%	0	4.4		0.81	
	15	4.33	1.59	0.83	2.5
M.S 2%	0	4.4		0.82	
	15	4.3	2.27	0.83	1.2
Inulin0.1%	0	4.2		0.83	
	15	4.19	0.24	0.85	2.4
Inulin 0.3%	0	4.35		0.81	
	15	4.3	1.14	0.83	2.5
Eps$^+$	0	4.2		0.84	
	15	4.1	2.38	0.86	2.38
M.S 1%	0	4.3		0.82	
	15	4.2	2.32	0.83	1.2
M.S 2%	0	4.29		0.82	
	15	4.1	4.43	0.85	3.7
Inulin 0.1%	0	4.1		0.84	
	15	4.0	2.43	0.86	2.38
Inulin 0.3%	0	4.1		0.85	
	15	4.0	2.43	0.86	1.17

EPS$^-$: Exopolysaccharide non-producing starter
EPS$^+$: Exopolysaccharide producing starter
M.S: Modified starch
D.R: Decreasing rate
I.R: Increasing rate

Data in Table (2) show the changes on moisture, fat and dry matter (DM) of Kariesh cheese made with EPS$^-$ and EPS$^+$, and with or without modified starch or inulin addition. Adding EPS$^+$ resulted in higher moisture content, and lower total solids (dry matter DM) than those in EPS$^-$ treatments. This might be due to the high water binding capacity of modified starch and inulin, which increase the moisture content. Similar results were reported by Kahyaoglu and Kaya, (2003). Moisture content of cheese in the presence of EPS$^+$ ranged between 72 to 76% and 24 to 28% for total solids, compared with 69 to 73 for moisture content and 27 to 31% for total solids in EPS$^-$ treatments. This increase in the moisture content might be due to the increasing of water binding ability of Eps$^+$, which might be refered to the presence of bacterial capsules, which bind more water in the curd and decrease its total solids content and increase its moisture, compared with the same parameters in EPS$^-$ treatments. Similar findings were obtained by Korish and Abd EL-Hamid, (2011)

In addition, inulin treatments in the presence of both starter bacteria used in cheese making resulted in higher yield, moisture contents and acidity(%), compared

with modified starch treatments. This increase in inulin parameter might be due to the enhancing effect of inulin on the bacterial growth, which led to an increase in its counts and the of capsules, which increase the water binding capacity and led in the final increase in the previous parameters.

Data in the same Table show that there were slight differences on moisture content between inulin treatments (0.1 and 0.3%), particularly in the EPS^- treatments, but these differences were more obviouse in EPS^+ treatments. These differences in the effect of inulin in both starter bacteria used in cheese making might be due to its enhancing effect and the amount of bacterial capsules in resultant cheese.

Results in Table (2) also show that yield of fresh cheeses of treatments yield calculated by the equation mentioned in the Materials and Methods. The type of starter was of a great effect on the cheese yield EPS^- treatment which gave 20%, while EPS^+ increased the yield to reach 23%. It is well known that EPS^+ had the ability to hold the moisture and increase the yield by the addition of either M.S or inulin increased yield of both Eps^+ and Eps^-. Treatments with EPS- (1% or 2% M.S) to some extent had the same level of increase, while 2% M.S highly increased the yield of EPS^+, being 26% and only 25% for 1% M.S. Similar to M.S, inulin with tow level had the same increase in yield being, 23%, 24% for 0.1 and 0.3. The presence of exopolysaccarides and inulin highly increased the yield to reach 25.5 and 27%, respectively. These results agree with Tuinier *et al*., (2002), who reported that the use of hydrocolloids increased the yield of cheese and its moisture.

Table 2. Impact of inulin and modified starch on some chemical parameters of kariesh cheese fermented with different starters.

Treatments	Shelf life/days	Moisture %	MD.R %	Yield %	Fat %	DM.
Control EPS^-	Fresh	69	1.5	20%	1.00	31
	15	68			1.2	32
M.S 1%	Fresh	72.5	2.1	23.5	0.85	27.5
	15	71			1.0	29
M.S 2%	Fresh	72	2.8	23	0.9	28
	15	70			1.1	30
Inulin 0.1%	Fresh	72	0.69	23	0.9	28
	15	71.5			1.0	28.5
Inulin 0.3%	Fresh	73	2.73	24	0.8	27
	15	71			0.9	29
Eps^+	Fresh	72	0.69	23	0.8	28
	15	71.5			0.9	28.5
M.S 1%	Fresh	74	2.02	25	0.8	26
	15	72.5			0.9	27.5
M.S 2%	Fresh	75	1.33	26	0.7	25
	15	74			0.8	26
Inulin 0.1%	Fresh	74.5	0.67	25.5	0.75	25.5
	15	74			0.85	26
Inulin 0.3%	Fresh	76	0.65	27	0.6	24
	15	75.5			0.7	24.5

The resultant cheese contained little amount of fat which ranged between 0.6 to 1.2% in all treatments according to its moisture content. In addition, the EPS^- treatments characterized with higher fat content, compared with those in EPS^+ treatments. Moreover, the fat content of the resultant cheese varied according to the type of supplemented dietary fiber used, and its concentration, but these differences were very slight, which might be due to the low fat content in the skimmed milk used in the cheese processing. As the matter in all parameters The fat content in control cheese and in all of cheese treatments increased with the progress of its storage period. These results are in harmony with Rapaille and Vanhemelrijck (1994)

Results in Table (3) show the changes in salt and protein content of Kariesh cheese fermented with EPS^- and EPS^+ and its treatments. It could be seen that the EPS^+ treatments contained higher salt content than those in EPS^- treatments, at the same time using the modified starch treatments resulted in higher salt content, compared with inulin treatments in both types of starter bacteria used in cheese processing. These changes in the salt content might be due to the differences in the moisture content of the resultant cheese either treated with EPS^- or EPS^+. These data indicate that the cheese made by both starters without any additions contained higher protein content than the corresponding treatments with inulin or modified starch. On the other hand, the control cheese made by EPS^- characterized with higher protein content of 18.93% than the other treatment made by EPS^+(16.5%) without any supplemented material, which might be due to its high moisture of 72%, compare with 69% in EPS^- cheese.

In addition, inulin treatments was found of lower protein content (17.42- 17.64%) than the modified starch treatments (17.53-17.88%) at zero time. There were also slight differences between different treatments of both inulin and modified starch. These differences might be related to the variations in the moisture content of cheese treatments, which affects its total solids. These results showed that the modified starch and inulin decreased the total protein content, compared with the control cheese. These results are in agreement of those reported by (Kahyaoglu and Kaya, 2003).

Table 3. Impact of inulin and modified starch on protein and salt % of kariesh cheese fermented with different starters.

Treatments	Shelf life/day	Protein %	P. I.R %	Salt	Moisture %
Control EPS^-	Fresh	18.93	1.53	1.62	69
	15	19.22		1.61	68
M.S 1%	Fresh	17.63	4.93	1.66	72.5
	15	18.5		1.64	71
M.S 2%	Fresh	17.88	3.57	1.64	72
	15	18.52		1.63	70
Inulin 0.1%	Fresh	17.42	5.1	1.64	72
	15	18.31		1.62	71.5
Inulin 0.3%	Fresh	17.64	3.11	1.66	73
	15	18.19		1.64	71
Eps^+	Fresh	16.5	2.30	1.66	72
	15	16.88		1.63	71.5
M.S 1%	Fresh	15.75	7.42	1.70	74
	15	16.92		1.65	72.5
M.S 2%	Fresh	15.36	3.32	1.72	75
	15	15.87		1.69	74
Inulin 0.1%	Fresh	16.25	0.36	1.72	74.5
	15	16.19		1.70	74
Inulin 0.3%	Fresh	15.5	2.06	1.73	76
	15	15.82		1.72	75.5

M : Moisture
P : Protein

Results in Table (4) illustrate the changes of the curd tension and curd synersis of Kariesh cheese fermented with EPS+ and EPS-, with or without modified starch or inulin addition. Curd tension (C.T.) was measured after the end of coagulation time. It was calculated as the weight of the needed mass to remove the fork out of the curd. Slight differences were observed on the C.T. values according to the type of starter used on the fermentation process. Higher value was recorded by using the EPS+ producing bacteria (108 gm), compared with 106 gm in EPS-. This slight increase might be due to the formation of exopolysaccharide capsules, which exerts more viscosity in the cheese curd. These results are similar to those observed by Ahmed *et al*., (2004). Data in the same Table indicate that the use of either M.S or inulin at different ratios increased the C.T values in all treatments, but this increase was more pronounced in treatments made by using EPS- starter bacteria (122, 134 in EPS-, compared with 117.5, 115.5 in EPS+ for M.S and 112, 119.25 in EPS-, compared with 110, 112 in EPS+ for inulin), which might be due to the absence of smoothness being related with the formation of exopolysaccharids capsules in EPS+ treatments. The addition of M.S, on the other hand, resulted in highly increase, compared with inulin addition in the two types of starter bacteria (EPS – and EPS+), which might be due to the increase of the M.S ratio, and T.S.% in its treatments. Also, the decrease of T.S in inulin treatments might be due to the increase in the viability of starter bacteria, which develop more acidity, and resulted in a clearer effect on the decrease of the strength of body and texture of EPS+ starter bacterial treatments.

Table 4. Impact of inulin and modified starch on curd tension and synersis of kariesh cheese fermented with different starters.

Sample	Curd Tension/gm	Synersis			
		1 hr	2 hr	Acidity curd	pH Curd
EPS-	106	6.0	7.5	0.83	4.39
EPS- + M.S 1%	122	5.5	6.5	0.80	4.42
EPS- + M.S 2%	134	6.0	6.75	0.81	4.41
EPS- +Inulin0.1%	112	5.75	6.25	0.80	4.4
EPS- +Inulin0.3%	119.25	5.5	6	0.79	4.43
EPS+	108	5.5	6.75	0.81	4.3
E.P.S + M.S 1%	117.5	5.25	6.5	0.81	4.32
E.P.S + M.S 2%	115.5	5.0	6	0.82	4.31
E.P.S + Inulin0.1%	110	5.0	5.5	0.83	4.25
E.P.S + Inulin0.3%	112	5.25	5.3	0.84	4.21

Synersis was performed by weighting 15 gm of curd from each treatment and let it to filtrate over the metal net for various intervals. EPS^+ had higher holding capacity for water than EPS^-. All treatment were of lower curd synersis, compared with control cheese which was fermented by EPS^-. Differences among all treatments were in correlation with the type and the concentration of addition of fat replacer (Modified Starch, Inulin). The curd synersis values varied among the treatments of the same fat replacer, and this difference was related to its ration which affected on the progress of acidity which had more effect on the amount of excluded whey.

The addition of inulin to EPS^+ had two different effects, as it enhanced the growth of starter bacteria and, in the same time, increased the binding water capacity by the capsules of starter microflora in the cheese curd. The effect of starter microflora was of more affecting factor on the acidity development in the curd.

The previous information indicate that using of 0.3% inulin in cheese making being fermented with E.P.S+ resulted in lower curd synersis(%) among the other treatments fermented either by E.P.S- or E.P.S+ starter.

These results are similar to those mentioned by Kaya, (2002), who established an inverse relationship between the bacterial activity and the concentration of inulin due to its inhibiting effect.

The changes in the rheological parameters were determined by the texture profile analyzer (TPA) in terms of hardness, Adhesiveness, cohesiveness, springiness, chewiness and gumminess of fresh Kariesh cheese and the results are collected in Table (5).

Results in Table (5) show that by adding M.S (1% , 2%), inulin (0.1 , 0.3 %), hardness values in fresh cheese were 1226, 1323, 1050, 1034 and 1059 N. in control EPS-. From these results it could be observed that control cheese was harder than the E.P.S+, which might be due to the increase of moisture content in E.P.S+. Adding Inulin decreased the hardness of fresh cheese, While adding M.S increased the hardness. This might be due to the decrease of moisture content, and the increase of total solids. It was indicated that relative amounts of water, protein, and fat were the dominant factors affecting cheese hardness. Similar results have been reported by Koca and Metin,(2004), who used two commercial fat replacers: (modified corn starch-based).

Table (5) shows that in the presence of E.P.S+ by adding M.S (1%, 2%) and Inulin (0.1, 0.3 %), the hardness of fresh cheese was 1251, 1228, 1020, 1010 and 1049 in the E.P.S+. From these results it could be observed that adding M.S 1%, 2% increase the hardness than inulin. This might be due to the thickener property of starch and viscosity capsular in the E.P.S+. These results are similar to (Zisu and Shah, 2005).

Adhesiveness values of fresh cheese samples are tabulated in Table (5). Values in fresh cheese were 59.78, 57.66, 61.69, 64.95 and 56.99 in control EPS- . These values mainly increased by using fat replacers (modified starch or inulin). It could also be observed that using fat replacers (starch or inulin) had an increase effect on adhesiveness values, compared with control. This might be due to the thickener property of starch and the gelling property of Inulin.

The E.P.S+ by adding M.S (1%, 2%) and Inulin (0.1, 0.3%), resulted in values of 86.32, 68.99, 92.68, 94.70 and 61.4 for the E.P.S+. The addition of M.S and Inulin increased the adhesiveness, which might be due to the thickener property of starch and viscosity capsular in the E.P.S+. These results are similar to Mounsey and O'Riordan, (2001).

A comparison of the values for the cohesiveness as obtained by the texture profile analysis (TPA) test for fresh kariesh cheese samples are presented in Table (5). Values for fresh samples were 0.48 , 0.45 , 0.44 , 0.24 and 0.50 for control EPS$^-$. It can be observed that the addition of starch and inulin decrease the cohesiveness. This might be due to the increase of the moisture and the decrease of total solids contents. Similar results were also obtained by Ahmed *et al*.,(2004).

Table (5) shows that in the E.P.S+ by adding M.S (1%, 2%) and inulin (0.1, 0.3%) values were 0.51, 0.52, 0.56, 0.57 and 0.49 for the E.P.S+ without any additives, which suggested before, this may be due to the thickener property of starch. Gelling of inulin and the might due to the viscosity of capsules in the E.P.S+, as also observed by Kaya, (2002).

Springiness values for fresh cheese samples were 11.51 , 10.44 , 10.46 , 11.36 and 10.37 for control EPS-. It is noticeable that the fresh control EPS- characterized with the lowest springiness value than the other cheese treatments. Using fat replacers was of an increasing effect on the increase of the springiness values, which might be due to the increase of moisture content. Results in Table (5) show that in the E.P.S+, by adding M.S (1%, 2%) and inulin (0.1, 0.3 %) values were 11.38, 12.65, 11.81, 12.32 and 11.33 for the E.P.S+ in fresh kariesh cheese. Which might be due to the increase of moisture content. Similar results were also mentioned by Koca and Metin, (2004).

Table (5) shows that gumminess values in fresh samples were 649, 632, 539, 540 and 546 in control EPS-. From these results it could be observed that modified starch had increased gumminess values in the experimened cheese samples EPS+. Using inulin decreased the gumminess values. Similar observation were found by Awad *et al*., (2005). It could also be seen from the same Table that in the E.P.S+, by adding M.S (1%, 2%) and Inulin (0.1, 0.3%) values were 679, 666, 663, 669 and 563 for the E.P.S+ in fresh kariesh cheese, due to the increase of moisture content and the viscosity of capsules in the E.P.S+. Similar results were mentioned by Romeih *et al*., (2002), who attributed the gumminess reduction to the functional properties of the individual fat replacers or their higher proteolysis levels.

Chewiness values of fresh Kariesh cheese are presented in Table (5). Values in fresh sample were 5664,56 , 5421.73 , 4919.76 , 3736.42 and 5770.47 in control EPS-. It could be concluded that using either modified starch or inulin caused decline in chewiness values. The present results are in accordance with those reported by Romeih *et al*., (2002). Table (5) shows that in the E.P.S+, by adding M.S (1%, 2%) and Inulin (0.1, 0.3%) values were 7961.99, 8200.69, 7979.87 , 8389.36 and 6330.49 for the E.P.S+. this might be due to the thickening property of starch. Gelling of inulin and the viscosity capsular in the E.P.S+. These results are similar to (Zisu and Shah, 2005).

Table 5. Impact of inulin and modified starch on some rheological properties of kariesh cheese fermented with different starters.

Treatments	Hardness (g)	Adhesiveness (g)	Cohesiveness (g)	Springness (mm)	Gumminess (g)	Chewiness (g.mm)
E.P.S$^-$	1059	56.99	0.50	10.37	546	5770.47
E.P.S$^-$ M.S 1 %	1226	59.78	0.48	11.51	649	5664.56
E.P.S$^-$ + M.S 2 %	1323	57.66	0.45	10.44	639	5421.73
E.P.S$^-$ + Inulin 0.1 %	1050	61.69	0.44	10.46	539	4919.76
E.P.S$^-$ + Inulin 0.3 %	1034	64.95	0.42	11.36	540	3736.42
E.P.S+	1049	61.04	0.49	11.33	563	6330.49
E.P.S+ + M.S 1 %	1251	86.32	0.51	11.38	664	7961.99
E.P.S+ + M.S 2 %	1228	68.99	0.52	12.65	666	8200.69
E.P.S+ + Inulin 0.1%	1020	92.68	0.56	11.81	661	7979.87
E.P.S+ + Inulin 0.3%	1010	94.70	0.57	12.32	663	8389.36

Data presented in Table (6) shows the sensory properties of kariesh cheese fortified with certain modified starch, inulin and EPS+. Generally, the organoleptic properties of kariesh cheese of all treatments improved. The results clearly indicate that the fortification of cheese with modified starch, inulin and EPS+ resulted in more smoothness in the body and improved the quality of cheese, when compared with the control. On the other hand, no considerable differences were observed in the flavor of cheese among all treatments and control. Inulin (0.3%) resulted in the highest total score of 95%, and the lowest was found in the treatment of 2% M.s (80%). This decrease in total score for M.s (2 %) due to more softness in the body& texture, which was not accepted for the judges. From the previous data, it could be concluded that the use modified starch, inulin and EPS+ enhanced the organoleptic and texture properties of the resultant cheese, compared with the control. The addition of inulin and modified starch to the EPS+ has higher score than with the EPS-. These results are similar to (Tarek *et al* ., 2013).

Table 6. Impact of inulin and modified starch on sensory evaluation terms of kariesh cheese fermented with different starters.

Treatments	Shelf Life	Color& Appearance (15)	Body &Texture (35)	Flavour (50)	Total (100)
Eps (-)	0	15	28	44	87
	15	13	26	40	79
Ms (1%)	0	14	30	45	89
	15	12	28	43	83
M.s (2%)	0	13	30	45	88
	15	11	27	42	80
Inulin (0.1%)	0	13	31	46	90
	15	12	30	44	89
Inulin (0.3%)	0	14	32	45	91
	15	12	31	42	89
Eps (+)	0	15	30	45	90
	15	13	29	44	86
Ms (1%)	0	15	31	44	92
	15	11	29	42	89
M.s (2%)	0	15	31	44	90
	15	11	29	42	82
Inulin (0.1%)	0	14	32	47	93
	15	13	31	46	90
Inulin (0.3%)	0	14	33	48	95
	15	13	31	47	91

Regarding the influence of modified starch or inulin on the microbiological quality of Kariesh cheese made by different starters, it could be seen from Table (7) that a slightly increase in total viable bacterial occurred during the storage. The total viable bacterial count in control is slightly lower than that of other treatments. The results also showed that the viable count of moulds and yeasts in all treatments less than the limit of Egyptian standard specification of Kariesh cheese (400 CFU/gm). Moulds and yeasts slightly increase during storage. Coliform group was undetectable in all treatments. The above results are consistent with those reported by Tarek *et al* ., (2013).

Table 7. The effect of modified starch and inulin addition to kariesh cheese fermented with different starters on its microbiological properties :

Treatments	Shelf Life (days)	Microbiological properties	
		TCx10^6 cfu/gm	M&Y x10 cfu/gm
E.P.S-	Fresh	3	NF
	15	5	2
M.S 1%	Fresh	4	NF
	15	7	1
M.S 2%	Fresh	5	NF
	15	9	2
Inulin 0.1 %	Fresh	6	2
	15	8	4
Inulin 0.3%	Fresh	8	NF
	15	11	3
E.P.S+	Fresh	5	1
	15	7	4
M.S 1%	Fresh	6	3
	15	8	5
M.S 2%	Fresh	7	3
	15	9	4
Inulin 0.1 %	Fresh	9	1
	15	12	3
Inulin 0.3%	Fresh	11	2
	15	15	4

T.C.: total bacterialcount - M & Y: moulds and yeasts – NF: not found

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تأثير الالياف الغذائية ونوع البادئ علي صفات الجبن القريش

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لدراسة تأثير السكريات العديدة المنتجة من البكتريا علي خواص الجبن القريش تم اضافة بادي يحتوي علي بكتريا منتجة للسكريات العديدة وتم مقارنة الجبن الناتج بالجبن المصنع باستخدام بادئ غير منتج للسكريات العديدة (كعينة مقارنة) وتم إضافة النشا المعدل والانيولين بنسبة 1 أو 2 % للاول و 0.1 أو 0.3 للثاني لكلا المعاملتين. تم تصنيع جميع المعاملات بالطريقة التقليدية وتم حفظ الجبن الناتج علي 5 درجة مئوية حتي نهاية فترة صلاحية الجبن. اوضحت النتائج حدوث انخفاض في قيم الحموضة وارتفاع في قيم الـ pH عند اضافة النشا المعدل والانيولين مقارنة بالكنترول ولكن معدلات زيادة الحموضة او انخفاض قيم الـ pH كانت اعلي في الجبن المصنع باستخدام البادئ الغير مفرز للسكريات العديدة سواء المصنعة مع او بدون اضافة الانيولين او النشا المعدل , احتوت جميع معاملات البادئ المفرز للسكريات العديدة علي مستوي رطوبة اعلي من تلك المصنعة باستخدام البادئ التقليدي الغير مفرز للسكريات العديدة الامر الذي انعكس علي مستوي المادة الصلبة بكلا منهما. حققت معاملات الانيولين قيما اعلي في محصول الجبن ومستوي الرطوبة ودرجة الحموضة مقارنة بمعاملات النشا المعدل, ارتفع محتوي الملح في الجبن المعامل بالانيولين والنشا المعدل وكان هذا الارتفاع اكثر وضوحا في معاملات البادئ المفرز للسكريات العديدة. تأثرت قيم % للبروتين بمستويات المادة الصلبة تأثرا طرديا في جميع المعاملات والكنترول سواء في بداية او نهاية فترة صلاحية الجبن, حققت جميع معاملات البادئ المفرز للسكريات العديدة قيما اعلي في الـ curd tension خاصة في معاملات النشا المعدل. ارتفعت الخواص الحسية لجميع معاملات البادئ المفرز للسكريات العديدة خاصة فيما يتعلق بالمظهر والقوام ولم تكن هناك فروق ملموسة في الطعم والنكهة بين جميع المعاملات. تحسنت بعض الخواص الريولوجية في معاملات البادئ المفرز مع اضافة النشا المعدل او الانيولين خاصة الصلابة hardening - springiness - gumminess والـ chewiness ، كذلك احتوت المعاملات الغير محتوية علي النشا المعدل او الانيولين مع استخدام البادئ المفرز او الغير مفرز للسكريات العديدة علي تعداد اقل من البكتيريا عن باقي المعاملات المضافة اليها سواء في بداية او نهاية صلاحية الجبن المصنع.