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DRIED POTATO POWDER AS SUBSTITUTES IN PROCESSED CHEESE MAKING

Gamal El-Deen, A.A.; I. A. Abou Ayana; S.F. Mahmoud and A.E. El-Bahlool*

Dairy Res. Dept. Food Technology Res. Institute, A. R. C., Giza, Egypt.

***Agric. Economic Res. Institute, Agric. Research Center, Giza, Egypt.**

ABSTRACT

The effect of adding dried potato powder (DPP) on the chemical, microbiological qualities and organoleptic properties of six batches of processed cheese were made by using the same blend with exception of substituting varied amounts of Quark cheese in the control with the half weight of DPP (10, 20, 30, 40 and 50%). Effects of such substitution on the organoleptic properties, chemical and microbiological qualities of the obtained samples were examined. Viewing to DPP treatments, it was clear that the resultant processed cheese made from 10,20 and 30% DPP gained higher scoring points than 40 and 50% DPP, and more than40% DPP caused a decrease of the quality of produced cheese. Total solids increased by increasing the rate of substitution in the blend. The highest level of TS was found in 50% DPP cheese variant, the lowest solids were found in the control. Slightly higher values in acidity were found at the end of storage period. Fat and protein contents decreased by ad ding DPP to the blend of processed cheese. A pronounced decrease by adding DPP was noticed by increasing the amount of the substituted DPP. It was evident that ash contents of the cheese had the similar trend of TS contents, and the addition of DPP to the processed cheese blend led to an increase in ash contents. By increasing the amount of DPP in cheese blend, the cost of manufacturing markedly decreased. Generally, DPP could be successfully used in producing good quality processed cheese with lower cost. Therefore, the economic efficiency indicators are estimated for one ton of full Quark processed cheese (Control) and processed cheese with 40% DPP replacement. Saving in input costs amounted by 20% and the adding value is increased by about 40%; and the benefit of substitution was approximately 54%.

Keywords: dried potato powder; quark cheese; processed cheese; replacement

INTRODUCTION

Processed cheese is one of the most popular variety contents of cheese in Egypt, particularly, among the children. Recently, in Egypt this type of cheese received a considerable attention and many brands are now available in the Egyptian market. Improvement of the organoleptic properties of cheese plays an important role in increasing the palatability of this cheese and its consumption. In recent years, owing to the high production costs of animal fat or/and protein, the general trend now is the partial or the whole replacement of milk fat or/and milk protein by certain vegetables sources. These sources, however, are characterized by comparatively low price, high source of energy. In addition, the triglycerides of their fats would contain high ratios of unsaturated fatty acids, which are beneficial to those suffering heart disease (Amer and Myhr, 1974). Soy milk has been used in dairy industry (Hang and Jackson, 1967; Matsuoka *et al.*, 1968 *and* Kim and shin, 1971).under local conditions many studies have been carried out concerning the use soy milk in dairy products Mahfouz (1972). Badertscher and Easton

(1978) used butter oil, fractionated butter oil, casein and calcium caseinate. El-ghandour (1985) used normal butter or high fat cream with skim milk power, acid cheese curd and salted or unsalted whey protein. Many attempts were also done for improving the properties of processed cheese by adding skim milk power and vegetables oils *(price and Bush,* 1974).

The present paper aims to study the effect of partially replacement of the Quark cheese with dried potato powder (DPP) on the chemical, microbiological and organoleptic qualities of processed cheese.

MATERIALS AND METHODS

Materials

Quark cheese (acid coagulated skim milk) was obtained from Royal Foods Company, Mansoura, Egypt. Old Ras cheese (120 -150 days) was prepared in Royal Foods Company. Precooked cheese was obtained from Royal Foods Company. DPP (Total Carbohydrates: 84 -86%, Protein: 8 - 10%) was supplied by the Egyptian Company for trade, industry. Skim milk powder, low heat, of France origin was used during this work. Joha emulsifying salt (Benckiser Knapsaek Gmb H, Oldenburg, Germany) namely "S9s","S9"and "No" were used. Palm oil was obtained from Misr oil and soap Company.

Manufacture of processed cheese:

Processed cheese was made in Royal Foods Company, using methods described by Meyer (1973). Minced Ras cheese was divided into six equal portions of 15% each. The first portion (control) was prepared from 40% Quark cheese, 15% Ras cheese, 15% Palm oil, 2.5% emulsifying salt, 2.5% Skim milk powder, 5% Precooked cheese and 20% water. Substitution of Quark cheese with DPP was carried out in the other five portions by using 10, 20, 30, 40 and 50% DPP. Each formulation of the mixture blends was placed in a 40 Kg processing kettle (kustner, SA, Geneva – 22 H 210 986), closed and heated by direct steam injection at pressure of 3 – 5 Kg/cm^2 under continuous stirring, at a temperature of 95^{O} C for 10 minutes. The resultant processed cheese of all treatments were packed and stored for 3 months at (5 – 10 °C) refrigerator. The processed cheese samples were chemically, microbiologically and organoleptically analyzed while fresh at zero time and then after three months of storage.

Chemical analysis:

Moisture contents, Fat, Titratable acidity, Ash and Total nitrogenous of the examined samples were measured according to Ling (1963). Salt content, was detected by using the methods described by Davis (1932).pH value was measured by using a glass electrode pH meter (Beckman 3500).

Microbiological examination:

Total bacterial count of cheese was determined according to A.P.H.A. (1978) by using nutrient agar medium (Difco manual 1966). The count of spore-forming bacteria was determined according to chalmer (1962). Salmonella in cheese was carried out according to the American public Association (1978) using Dehydrate media xylose lysine desoxycholate (XLD) agar Difco Manual (1984). Counts of coliform bacteria were

enumerated using the method described in the stranded methods for the Examination of milk and dairy products (1960). Mackonky agar were prepared as described in Oxoid Manual (1982).For counting the proteolytic bacteria present in processed cheese samples, the proteolytic agar medium (Oxoid) described by Chalmer (1962) was used for detecting and enumerating staphylococci, appropriate dilution of the examined cheese samples were plates with staphylococcus medium No.110 (Difco 1974). Potato dextrose agar recommended by the Oxoid manual (1962) Oxoid was used for the enumeration of mould and yeasts. Lipolytic bacteria counts were carried out according to *Berry* (1933). The processed cheese samples were organoleptically assessed according to Meyer, (1973).

RESULTS AND DISCSSION

DPP used during the course of this investigation was contain about (8-10%) protein and (86-89%) carbohydrates. Six batches of processed cheese were made by using the same blend with the exception of substituting varied amount of quark cheese (10, 20, 30, 40 and 50%) in the control with the half weight of DPP in the experimental variants chemical composition of processed cheese as affected by the partial replacement of DPP.

The blends used for making the processed cheese were chemically analyzed when fresh and after three months of storing at (5-10°C).Variation could be seen (Tables 1 and 2) between the examined blend due to the amount of quark cheese being replaced by the half amount of DPP. Total solids in the blends tended to increase by increasing the rate of DPP substitution in the blends.

Table (1): Effect of adding DPP on the chemical composition of fresh processed cheese.

Treatments	Total solids %	Acidity %	pH value	Fat %	Protein %	Salt %	Ash %
Control	43.39	1.35	5.73	22.5	17.84	2.25	6.78
1	45.08	1.32	5.71	22.3	17.05	2.25	6.54
2	45.91	1.33	5.74	21.6	16.82	2.22	7.16
3	48.19	1.30	5.83	21.3	16.19	2.30	7.52
4	49.85	1.25	5.85	21.1	15.92	2.oo	7.71
5	51.23	1.22	5.91	21.1	15.46	2.10	7.93

Table (2): Effect of adding DPP on the chemical composition of processed cheese after three months of storing at (5 -10 °C)

Treatments	Total solids %	Acidity %	pH value	Fat %	Protein %	Salt %	Ash %
Control	44.71	1.37	5.72	22.8	17.46	2.52	6.81
1	46.17	1.35	5.72	21.5	17.15	2.52	6.59
2	47.04	1.38	5.73	21.5	16.70	2.52	7.32
3	49.21	1.39	5.75	21.6	16.09	2.34	7.58
4	50.93	1.41	5.72	21.4	15.56	2.17	7.75
5	52.41	1.45	5.70	21.3	15.24	2.17	8.15

This increase might be due to the high solids of DPP. Nearly similar trend was obtained by Salem *et al.*, (1987), Gouda and Safinaz (1987), Mahran *et al.*, (1989) and Alkhamy *et al* ., (1997). At the end of storage period after three months of storage in refrigerators 5-10°C, the total solids content increased, all of processed cheeses made with DPP mixtures were higher than those of control sample. These results come in agreement with those mentioned by Abd El –baky *et al.*, (1987) and El-Neshawy *et al.*,(1987). As seen from the same previous tables, it was clear that the acidity of the examined cheese sample were characterized with gradual increase by advancing the storage period.

The highest acidity of 1.35% was measured in the control sample when fresh, but at the end of storage period data revealed that using DPP led to increase the acidity of the resultant processed cheese. As with the pH values was concerned, It was obvious that very slight variation could be detected in the experimental variants together with the control, such values generally fall in the range of 5.71-5.91. As seen from the same pervious tables, it was clear that fat contents decreased by adding DPP, and this decline increased by increasing the amount of DPP. The pronounced decrease in fat percent of the resultant cheese was almost attributed to the lower fat content of (DPP). These finding was nearly similar to those mentioned by Mahfouze *et al.* (1986) and Salem *et al.*, (1987). The obtained results also show that the protein contents decreased by adding DPP to the blend of processed cheese. A pronounced decrease by adding DPP was noticed by increasing the amount of the substituted DPP. Data revealed that using DPP led to decrease the salt content of processed cheese. Slightly higher values were also detected when the cheese samples were stored. These results are in harming with those reported by Emara., (1984) and El- Neshawy *et al* ., (1987). Ash content of control cheese was nearly similar to that obtained by Abou- Dawood *et al.*, (1983). The addition of DPP to the blend of processed cheese led to increase in ash content, this decline increased gradually by increasing the amount of DPP, this difference might be due to the fact that ash content of DPP was higher than that in quark cheese.

Microbiological analysis of processed cheese as affected by adding DPP:

Data presented in Table (3) indicate that the bacteriological quality of processed cheese measured by enumerating the total bacterial numbers, was affected by adding DPP, and by the length of time under which processed cheese were stored. It was also obvious that the total bacteria numbers present in the examined cheese variants, generally, characterized with increase by advancing the storage period. The maximal numbers were attained after three months- storage. The obtained results were agreement with those obtained by Shehata *et al.*, (1982), Emara (1984), and Farahat *et al* ., (1993) It's well know that spore forming bacteria constitute the major part of the bacteria flora of processed cheese, especially, that made with addition skim-milk powder (Nassib, 1965,and Magdoub *et al.*, 1984).

Data in the table demonstrated counts of spore formers in processed cheese with different ratio of DPP and stored at 5-10°C, spore forming bacteria counts in fresh samples were considerably lower than those detected in store samples. Similar results were also obtained by Shehata *et al.* (1982) and Omar (1994).

Table (3): Effect of adding DPP on the microbiological quality of fresh and stored Processed cheese.

Treatments	Zero time						After three months of storing					
	control	1	2	3	4	5	control	1	2	3	4	5
T.C	0.76	0.80	0.86	0.78	0.93	0.96	1.9	2.3	6.6	7.8	8.3	9.5
Spore	o.52	0.26	0.33	0.50	0.73	0.71	7.5	5.3	6.4	8.1	8.5	12.0
Proteolytic	0.66	0.43	0.56	0.46	0.27	0.08	15.0	7.8	10.2	8.5	6.7	9.7
M &Y	0.35	0.31	0.56	0.74	0.58	0.80	0.95	1.82	6.23	8.9	10.8	11.5
Lipolytic	-	-	-	-	-	-	-	-	-	-	-	-
Staph.aureus	-	-	-	-	-	-	-	-	-	-	-	-
Salmonella spp.	-	-	-	-	-	-	-	-	-	-	-	-
Coliform group	-	-	-	-	-	-	-	-	-	-	-	-

T.C: Total bacterial count x 10^3.
Spore: spore formers x 10^2
Proteolytic: Proteolytic bacteria count x10^2.
M &Y: Moulds and Yeast count x 10^2.

It could also be appeared that growth of proteolytic increased by lengthening the store period, counts of proteolytic bacteria in control were the highest numbers in all samples when fresh and after three months of storage at 5-10°C. Mould and yeast numbers were 0.35 × 10^2 org/ G in control sample when fresh and were 0.95×10^2 org /G at the cold storage period end, the maximal number were attained after three months- storage, and the highest numbers were detected in sample No.5 when fresh and the end of storage period. The presence of yeasts and moulds in three months old processed cheese were recorded by Magdoub *et al.* (1984) , they were less than 30 org./ G. Mahfouz *et al.*(1986), reported that the buty and green pepper processed cheese (local brands) contained yeast and moulds as 11 × 10^2 and 400 org. / G. in the same order.

As with the presence of lipolytic bacteria, Staphylococci, Coliform and Salmonella, in the examined cheese, it could also be observed that non of the control cheese or the examined variants contained any of lipolytic bacteria, Staphylococci, Coliform or Salmonella whether in the fresh or after three months of storage, The coliform bacteria were not detected in all local and imported processed cheese spread samples examined by Mahfouz *et al.*(1986), whose results agreed with the present results.

Organoleptic properties of processed cheese as affected by adding DPP:

Table (4) shows that the control cheese had the highest points of scoring during judging. Concerning that, DPP treatments were clear that the resultant processed cheese made of 10% and 20% DPP obtained higher scoring points than other levels of substituted. Adding more than 40% of DPP to the blend caused a decrease of the quality of the resultant cheese, particularly, in flavor score when fresh or after three months storage. Results clearly showed that processed cheese treated with 10, 20,30and 40% DPP had palatable flavor, acceptable delightful texture and good spreadability. It's obvious that the total score gained the examined cheese, generally decreased by advancing the storage period, similar to these results were reported by Omar, (1994). Generally, the resultant processed cheese made of more than 40% DPP needed some flavoring agents or spices to improve

the flavour of the resultant cheese. Finally, it could be conclude that the adding DPP up to 40% of quark cheese weight was successfully used in making processed cheese.

Table (4): Effect of adding DPP on the organoleptic properties of fresh and cold stored processed cheese.

	Zero time				After three months of storing			
Treatments	Out ward appearance	Inner Appearance	Flavor	Total score	Out ward appearance	Inner Appearance	Flavor	Total score
	20	40	40	100	20	40	40	100
Control	18	38	38	94	16	34	33	83
1	18	38	36	92	16	34	33	83
2	18	38	36	92	16	34	32	82
3	18	38	36	92	15	33	32	80
4	18	36	35	89	15	32	31	78
5	16	34	30	80	14	30	29	73

Table (5): Price of ingredients required for making processed cheese.

Ingredients	Price of one kg. EGP	Ingredients	Price of one kg. EGP
Ras cheese	27	Palm oil	4
Quark cheese	12	Pre-cooked cheese	10
Skim milk powder	20	Emulsifying salts	10
DPP	2.9	-	-

Table (6): Economical study of producing processed cheese by partial replacement of quark cheese with DPP

Treatments	Cost of producing 100Kg.EGP	Reducing in the production cost 100Kg.EGP	Reducing in the production cost%	Final gain 100Kg.EGP	Final gain %
Control	1070.0	-	-	430.0	28.60
1	1027.8	42.2	3.94	472.2	40.10
2	985.6	84.4	7.88	514.4	44.13
3	943.4	126.6	11.77	556.6	48.10
4	901.2	168.8	15.77	598.8	52.00
5	856.0	214.0	20.00	644.0	58.00

Economic Evaluation:

The add value means how the value add to the production value. This measure is estimated as the difference between total revenue and total input costs. The substitutive efficiency between some of inputs is indicated to how this replacement achieves a highly quantity or value of production. This indicator is calculated as the ton of production (or total revenue) divided by summation of quantities (or values) of inputs are replacement.

Using Input costs, revenues, and some of physical or technical and economic efficiency measures are estimated for one ton of full Quark processed cheese (control) and processed cheese with 40% DPP replacement. Results of experiment released that input costs was decreased by 20 percent. While, the add value was increased by about 2.1 LE. Thousand for each ton of processed cheese, presents approximately 50

percent. Meanwhile, each two kg of quark cheese and one kg of DPP in the mixed provides to over about 83 gram of processed cheese (it gains 2.5 LE.); this means that substitutive efficiency of 40% DPP replacement is about 54 % as shown in Table (7).

Table (7): Economic Evaluation of One Ton of Processed Cheese to compare between full quark cheese and 40% DPP replacement.

ITEM	40% Quark Cheese		40% DPP		Different		
	Quantity (Kg)	Value (LE)	Quantity (Kg)	Value (LE)	Quantity (Kg)	Value (LE)	Value (%) *
Quark Cheese	400	4800	240	2880	-160	-1920	-40
DPP	0	0	80	232	80	232	-
Ras Cheese	150	4050	150	4050	0	0	0
skim milk powder	25	500	25	500	0	0	0
Palm Oil	150	600	150	600	0	0	0
Precooked Cheese	50	500	50	500	0	0	0
Emulsifying salts	25	250	25	250	0	0	0
Water	200	0	280	0	80	0	-
Intermediate Input Costs	-	10700	-	9012	-	-1688	-16
Value of product	-	15000	-	15000	-	0	0
Added Value	-	4300	-	5988	-	1688	39
Efficiency of Replacement 40% of Quark Cheese by DPP	2.50	3.13	3.13	4.82	0.63	1.70	54

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استخدام بودرة البطاطس المجففة في صناعة الجبن المطبوخ

أحمد أحمد جمال الدين، إبراهيم عبد الباقي أبوعيانة، سامى فاروق محمود و أحمد الموافي البهلول*

قسم بحوث الألبان- معهد بحوث تكنولوجيا الأغذية- مركز البحوث الزراعية-الجيزة- مصر.

***معهد بحوث الاقتصاد الزراعي- مركز البحوث الزراعية-الجيزة- مصر.**

في محاولة لخفض تكاليف الإنتاج للجبن المطبوخ باستخدام مادة غذائية آمنة تم دراسة تأثير إضافة بودرة البطاطس المجففة على الصفات الحسية و التركيبية الجودة الميكروبية و الحفظية للجبن المطبوخ الناتج ، تم استخدام ست معاملات من الجبن المطبوخ تتكون من مخلوط واحد باستثناء احلال بودرة البطاطس المجففة بدلا من الكوارك بنسب مختلفة و يتكون المخلوط القياسى من% ٤٠ من جبن كوارك ١٥،% جبن راس،١٥% زيت نباتي،٥% سابق طبخ ،٢,٥% لبن فرز مجفف و٢,٥% أملح إستحلاب وإكمال باقي الخلطة حتي ١٠٠% ماء. ولتصنيع الخمس معاملات الأخرى فإن نفس المخلوط هو المستعمل مع استبدال ١٠و٢٠ و٣٠ و٤٠ و٥٠ % من الكوارك بنفس النسبة من البطاطس المجففة ، ثم أجريت الاختبارات المختلفة علي الجبن الناتج من المعاملات السابقة بعد الطبخ مباشرة وبعد ثلاثة أشهر من التخزين علي درجة حرارة الثلاجة(٥-١٠ م°). أوضحت النتائج المتحصل عليها ما يلي:-

أدت إضافة بودرة البطاطس المجففة لجميع نسب الإضافة إلي رفع الجوامد الكلية والرماد وكان الارتفاع يزداد بزيادة نسبة الإضافة، بينما انخفضت نسبة البروتين،وملاحظة تغير طفيف في نسبة الدهن والملح وقيم الـ pH من ٥,٧٣ – ٥,٩١ .بينما ارتفعت الحموضة بنسبة بسيطة في نهاية مدة التخزين ، كان العد البكتيري الكلي وكذلك البكتريا المتجرثمة الهوائية والفطريات والخمائر أعلي في المعاملة الأخيرة (ذات نسبة الاستبدال ٥٠%) عن باقي المعاملات الأخرى سواء في الجبن الطازج أو المخزن.

خلت عينات الجبن المطبوخ سواء الطازج أو المخزن من البكتريا المحللة للدهون والبكتريا الممرضة. *Staphylococcus auraus*, *Salmonella* spp, Coliform group.

ومن خلال التقيم الإقتصادي لإستبدال ٤٠% من وزن جبن الكوارك ببودرة البطاطس المجففة إتضح إنخفاض تكاليف صناعة الجبن المطبوخ بنحو ١٦%،وزيادة القيمة المضافة بحوالي ٣٩% ،كما قدرت كفاءة الإستبدال بما يقرب من ٥٤%،وذلك مع المحافظة علي جودة الجبن الناتج.

قام بتحكيم البحث

أ.د / محمد شلبي جمعة — كلية الزراعه – جامعة المنصوره

أ.د / مصطفي عبد المنعم زيدان — مركز البحوث الزراعية