Effect of Adding Maltodextrin and Malt Enzymes Extract on Low Fat Ras Cheese Quality

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Abstract

Low fat Ras cheese shows a reduced maturation, which has been attributed to the low fat content. Therefore, in the present research, attention was focused on evaluating the effect of adding maltodextrin at ratios of 2% and 3% or malt enzymes extract at ratios of 0.075% and 0.1% on the ripening and quality of low fat Ras cheese.

The resultant Ras cheese treatments were analyzed for moisture, fat, protein, pH value, salt, soluble nitrogen (SN), free amino acids (FAA) and total volatile fatty acids (TVFA) contents, as well as firmness and elasticity values when fresh and after 30, 60,90 and120 days of ripening. Organoleptic properties were examined after 30, 60,90 and120 days of ripening. Data were subjected to the statistical analysis to evaluate significance of the obtained results.

The results revealed that the control treatment of low fat Ras cheese possessed a slight cheesy flavour, hard and grainy body & texture. Adding 2% maltodextrin led to improve both body & texture but limit improve in flavour. On the other hand, increasing the ratio of maltodextrin to 3% led to a firm body & texture. Addition of malt extract at 0.075% accelerated the ripening and improved the quality of low fat Ras cheese.

Introduction

Ras cheese is a popular hard cheese in Egypt. This cheese normally marketed as a full fat cheese after a ripening period of 3-6 months. A great deal of attention has been given for reducing the fat content, using some fat replacers and/or acceleration of cheese ripening. Among these methods, Anon 1992, used Maltrin M040 (a rang of 5-dextrose equivalent maltodextrins) to replace fat in low fat cold-pack cheeses. Taha (1997) used some fat replacers, i.e. maltodextrin and Litesse and studied their effects on the quality of Ras cheese. She found that the addition of maltodextrin to cheese milk led to a limited improvement in both body & texture and flavour when compared with full fat Ras cheese.

Malt extract appears to be a potential source of protease, dipeptidase and carboxypeptidase enzymes for use in cheese making (Frey, 1986; Frey et al., 1986). Addition of malt extract led to an increase in protein degradation and flavour development in Cheddar cheese (Frey et al., 1986). Similarly, El-Tobgui (1991) and Zaki and Salem (1992) have shown that the use of malt extract as ripening agent in their studies on Gouda and Edam cheeses, improved the organoleptic quality of the resultant cheeses.

The present study aimed to assess the effect of adding two levels of maltodextrin or using Malt enzymes extract to low fat cheese milk on the ripening and quality of resultant Ras cheeses.

Materials and Methods

Ingredients:

Buffalo and cow's milk were obtained from the herds of Faculty of Agriculture, Suez Canal University, Ismailia Governrate, Egypt. Lactoccocus lactis ss. Lactis and rennet were obtained from CHR-Hansen's laboratories, Denmark.

Maltodextrin 20 was obtained from National Company for Maize Products, 10th of Ramadan City, Egypt. The specification of Maltodextin 20 was moisture content 5 % as maximum ; density at 60 °C 630 gram/liter; dextrose equivalent 20-23; pH 4-5; ash content 0.5 % as maximum. Dried germinated barley was obtained from Al-Ahram Beverage Company, Abo-Hammad, El-Sharkia Governrate, Egypt. Malt enzymes extract was prepared as described by Aly (1997). Fine grade salt was obtained from local market.

Ras cheese manufacturing:

Cow and buffaloe`s milk were mixed (1:1), The milk was divided into two portions. The first was adjusted to casein/fat ratio (C/F) of 0.62 (Table 1), pasteurized at 70°C/15 seconds and used to manufacture full fat Ras cheese as control 1. The second portion was adjusted to C/F of 1.24, pasteurized and divided into 5 parts. The first part used to manufacture low fat Ras cheese without any additives as control 2. Maltodextrin in two levels (2% and 3%) were added to the second and the third parts (treatment 1 and 2). Malt extract as ripening agent was added at two concentrations (0.075% and 0.1 %) to the fourth and fifth parts. (treatment 3 and 4). Ras cheese was manufactured according to the method suggested by Hofi et al. (1970). Saturated brine solution was used for salting the cheese at 5°C for 24 hours.

In each trial, cheese samples were analyzed at

Table (1): Chemical composition of cheese milk (average of three replicates).

Treatments	T.S	Fat %	Protein%	pH value	C/F
First portion	12.69	4	3.10	6.64	0.62
Second portion	10.66	2	3.10	6.62	1.24

zero time (after salting) and at 30, 60, 90 and 120 days of ripening to follow chemical, rheological while for organoleptic properties at 30,60,90 and 120 days.

Chemical analysis:

Chemical analysis included determination of moisture, fat (using Gerber method), salt contents, total nitrogen (TN) and soluble nitrogen (SN) contents were as described by Ling (1963). pH value was measured using pH meter (Jenway limited, England). Total volatile fatty acid (TVFA) values were estimated according to Kosikowski (1982). Free amino acid (FAA) values were estimated using cadmiumñninhydrin method as described by Folkertsma and Fox (1992).

Rheological parameters:

Cheese samples were sliced into one cm. thickness with 6x6 cm. (length and wide)and their firmness and elasticity were measured using Brabender Structograph model 8603 with spindle No: 449651 (cone probe 15°). The heights of resultant curve express the firmness, while the curve base express the elasticity of the cheese. These measurements were replicated three times for each cheese sample.

Organoleptic properties:

The cheese samples during the ripening period were scored for appearance, body& texture and flavour by a regular score panels of the Staff Members of the Dairy Department. The scoring was based on the following scale; flavour 50 points, body & texture 40 points and appearance 10 points. *Statistical analysis:*

All data were subjected to statistical analysis at level of 5% according to the procedures described by Snedecor and Cochran (1967), and the treatment means were compared by the new least significant difference test (new L.S.D.) Which developed by Waller and Duncan (1969).

Results and Discussion

Gross composition:

Data in Table (2&3) show a decrease in the moisture content of the cheeses as the ripening period increased. The loss of moisture might be due to evaporation during ripening and storage of Ras cheese. The greatest loss of moisture was during the first month after manufacture. Also results indicted that low fat Ras cheese treatments had higher moisture contents than full fat Ras cheese (control 1). Adding 2% maltodextrin gave the highest moisture content among all other low fat cheeses treatments. These results could be attributed to the characteristics of maltodextrin, which is hydrophilic agent designed to bind water (McMahon et al. 1996). Increasing the ratio of maltodextrin to 3 % lowered the moisture content of the cheese. This may be attributed to that the high ratio of maltodextrin may interfere with shrinkage of casein matrix; this lowering the diving force involved in expelling water from the curd particles(Perry et al. 1997and Kucukoner et al. 1998 for low fat Mozzarella and Cheddar cheeses). Addition of malt extract has a negligible effect on the moisture contents of low fat Ras cheeses.

The loss of moisture during the ripening period led to gradual increase in fat, protein and salt contents. This increase was most remarkable during the early stages of ripening followed by a less increase upon ripening periods.

From the same tables there were evident that full fat cheese has a higher pH value than low fat cheese treatments. Adding maltodextrin or malt extract to cheese milk significantly reduced the pH values of the resultant cheese. For all cheeses there were a general decrease in pH during ripening period, this mainly due to the developed of lactic acid by lactose fermentation by starter bacteria. A slight increase in the pH at the end of ripening period are shown from data for malt extract treatments, this could be due to formation of alkaline materials of phosphate and soluble nitrogenous substances (Hofi et al. 1981).

Protein degradation:

The soluble nitrogen determination is a good measurement with regarding to protein degradation occurring throughout cheese ripening. Generally, the SN content of the cheese increased during ripening. The average values of SN coefficient (SN/TN x100) are presented in Fig. (1). The results indicate that full fat Ras cheese(control 1) has a higher soluble nitrogen coefficient than low fat cheese (control 2). Addition of maltodxterin have a slight effect on the soluble nitrogen coefficient while addition of malt extract has a pronounced effect in increase the degradation of protein and acceleration ripening of low fat cheese comparatively with control low fat cheese.

Changes in total free amino acids value (FAA) are shown in Fig.2. The data indicate that the concentration of free amino acids gradually increased during ripening periods. Control low fat Ras cheese(control 2) had significantly higher concentrations of free amino acids (FAA) than full fat cheese (control 1). Adding maltodextrin has a slight effect on FAA content of resultant cheese. It is observed that increasing maltodextrin ratio

Table (2) chemical composition of Ras cheese during ripening period
(Average of three replicates)

Treatment**	Ripening period (Days)	Moisture (%)	Fat%	Total protein%	Salt%	PH value
Control 1	Fresh	42.86 d*	31.08	22.65	1.76	5.48 a*
	30	39.91 c	32.71	23.73	1.86	5.40 a
	60	37.06 c	33.63	24.63	1.93	5.34 b
	90	36.70 c	34.42	25.20	1.98	5.27 c
	120	36.15 c	35.08	25.58	2.01	5.22 c
Control 2	Fresh	45.50 b	20.00	30.94	1.80	5.43 b
	30	42.43 b	21.25	32.66	1.91	5.36 b
	60	40.41 b	22.13	33.81	1.98	5.30 c
	90	38.86 b	22.75	34..64	2.04	5.23 d
	120	37.66 b	23.25	35.28	2.09	5.17 d

** Control 1: Full fat Ras cheese, Control 2: Low fat Ras cheese
*a, b, c, d, e : Means with the same letter among the treatments in the same storage period are not significantly different ($p > 0.05$)

Table (3) chemical composition of low fat Ras cheese treatments during ripening period
(Average of three replicates)

Treatment	Ripening period (Days)	Moisture (%)	Fat%	Total protein%	Salt%	PH value
Treatment 1	Fresh	46.81 a	19.20	28.77	1.82	5.38 d
	30	43.96 a	20.38	30.37	1.92	5.32 c
	60	42.20 a	21.08	31.33	1.99	5.26 d
	90	40.61 a	21.75	32.22	2.05	5.20 e
	120	39.47 a	22.25	32.86	2.10	5.13 e
Treatment 2	Fresh	44.33 c	20.25	29.54	1.81	5.35 e
	30	41.60 b	21.42	31.07	1.91	5.28 d
	60	39.64 b	22.20	32.09	1.98	5.22 e
	90	38.03 b	22.92	32.92	2.05	5.16 f
	120	36.79 b	23.50	33.56	2.10	5.10 f
Treatment 3	Fresh	44.90 b	20.13	31.45	1.82	5.39 c
	30	41.75 b	21.38	33.18	1.93	5.35 b
	60	39.42 b	22.42	34.32	2.01	5.40 a
	90	38.10 b	23.00	35.15	2.06	5.46 b
	120	36.96 b	23.50	35.79	2.11	5.53 b
Treatment 4	Fresh	44.96 b	20.13	31.33	1.83	5.36 de
	30	41.82 b	21.42	33.05	1.94	5.32 c
	60	39.75 b	22.38	34.13	2.02	5.39 a
	90	38.25 b	23.00	34.96	2.07	5.48 a
	120	37.04 b	23.50	35.60	2.12	5.57 a

Treatment 1: Maltodextrin 2 %, Treatment 2: Maltodextrin 3%
Treatment 3: Malt extract 0.075%, Treatment 4: Malt extract 0.1%
*a, b, c, d, e : Means with the same letter among the treatments in the same Storage period are not significantly different ($p > 0.05$)

decreased FAA content. Addition of malt enzymes extract accelerated proteolysis and significantly increases the FAA values. These results could be attributed to activity of enzymes found in malt enzymes extract (Frey et al. 1986)

Fat lipolysis:

The total volatile fatty acids (TVFA) value(as measure of fat lipolysis) increased throughout ripening period in all cheese treatments (Fig. 3). The full fat Ras cheese had the highest TVFA values when fresh and along the ripening period than all other treatments. Addition of 2% maltodextrin significantly increased the TVFA values than control low fat Ras cheese (control 2), in contrary, increasing maltodextrin ratio to 3%, decreased the TVFA values. Addition of malt enzymes extract greatly enhanced the formation of TVFA comparatively with maltodextrin. The high ratio of malt extract add, the high value TVFA in cheese.

Data of proteolysis and lipolysis indicate that utilization of maltodextrin as a fat replacer had a limited effect on proteolysis and lipolysis of low fat Ras cheese compared with malt enzymes extract. So, it could be concluded that utilization of malt extract had a pronounced effect on accelerating ripening of low fat Ras cheese, followed by 2 % maltodextrin.

Rheological properties:

The firmness values of full fat Ras cheese (control 1) are markedly less than that of low fat cheese (control 2) at all ripening periods (Table 4). This may be due to that the low fat cheese has a more compact protein matrix with less open spaces that would be occupied by milk fat globules . Compact appearance of the protein network decreased with reduction in fat content of cheeses, even though they where significantly higher in moisture content (Bryant et al, 1995 and Guinee et al, 2000). Addition of maltodextrin at 2% significantly increase the cheese firmness. On the other hand, increasing maltodextrin ratio to 3 % had an opposite effect on the cheese firmness. The firmness decreased by adding malt enzymes extract. The higher ratio of malt enzymes extract, the lower was the value of firmness. The firmness values also decreased by extending the ripening period.

The changes in firmness values of cheese during ripening could be related the differences in the chemical composition especially, moisture content, pH value, proteolysis and rate of structure changes and protein network breakdown (Zammar 2000).

Elasticity can be defined as the tendency of cheese to recover its original shape and dimension upon removal of an applied stress .So, from the same Table, it was noticed that the elasticity of low fat Ras cheese (control 2) is markedly higher than that of full fat cheese (control 1) when fresh and throughout the ripening period. The values of elasticity tend to decrease during the ripening period. Fox et al (2000) stated that an increase in the fat in dry matter of cheese was paralleled by the decrease of elasticity. Addition of 2 % maltodextrin has a slight effect on improving the elasticity values of low fat cheese. On the other hand, addition of 3 % maltodextrin to cheese milk increased the elasticity of cheese compared to control low fat cheese. Adding malt enzymes extract at two levels (0.075 and 0.1 %) had no a significantly effect on decreasing cheese elasticity till 60 days of ripening.

Organoleptic properties:

The organoleptic properties of examined cheeses with the corresponding score points are presented in Table (5). The full fat cheese (Control 1) at the end of ripening period attained a typically Ras cheese flavour and had the highest total score. While low fat cheese (control 2) possessed a slight cheesy flavour, hard and grainy body & texture and scored the lowest points. Adding 2% maltodextrin led to improve in both body & texture but limit improve in flavour. On the other hand, increasing the maltodextrin to 3% led to firm body& texture. Addition of malt extract at 0.075% had clear effect on improving the flavour quality of low fat Ras cheese, after 120 days of ripening period the cheese flavour was quite close to full ripened Ras cheese (control 1) .Addition of malt extract at 0.1 % has the same effect of adding 0.075%.

Table (4): Effect of adding maltodextrin and malt extract on firmness and elasticity of low fat Ras cheese during ripening periods (average of three replicates).

Treatments	Ripening periods (days)									
	Fresh		30		60		90		120	
	Firmness	Elasticity	Firmness	Elasticity	Firmness	Elasticity	Firmness	Elasticity	Firmness	Elasticity
Control 1	94 e**	92 d	93 e	90 d	91 e	88 d	89 e	86 e	86 e	48 e
Control 2	119 b	112 b	118 b	110 ab	116 b	108 b	114 b	106 b	112 b	103 b
Treatment 1	105 d	107 c	103 d	105 c	101 d	103 c	99 d	100 d	96 d	97 d
Treatment 2	130 a	116 a	128 a	114 a	126 a	112 a	124 a	110 a	122 a	108 a
Treatment 3	110 c	112 b	108 c	110 ab	108 c	107 b	102 c	104 bc	99 c	100 c
Treatment 4	107 d	111b	105 d	109 bc	105 d	106 b	99 d	103 c	96 d	99 cd

*See legend tables 1and 2

**a, b, c, d,: Means with the same letter among the treatments in the same storage period are not Significantly different ($p > 0.05$).

Table (5): Effect of adding maltodextrin and malt extract on the organoleptic properties of low fat Ras cheese during ripening periods (average of three replicates).

Treatments	Ripening periods (days)	Flavour 50	Body& Texture 30	Appearance 10	Total 100	Consistency	Flavour
Control 1	30	35	31	7	73e*	Rubbery, compact	Slight flat, clean
	60	39	35	8	82 a	Short, few holes	Slight cheesy, slight bitter
	90	40	35	8	83 a	Rather short, slight smooth	Mild flavour
	120	42	36	8	86 a	Firm, smooth	Full ripened, mild aroma
Control 2	30	32	28	7	67 b	Hard, tough	Distinct flat
	60	32	28	7	67 c	Distinct hard, brittle	Slight flat, slight bitter
	90	35	28.5	8	71.5d	Distinct hard, dry body	Lacking in flavour
	120	36	30	8	74 d	Hard, harsh, grainy	Slight flavour
Treatment 1	30	32	29	7	68 b	Short, curdy	Flat
	60	33	30	8	71 b	Slight curdy	Slight flat, slight bitter
	90	35	31	8	74 c	Slight smooth	Lacking in flavour
	120	37	32	8	77 c	Slight smooth	Mild flavour
Treatment 2	30	32	26	7	65 b	Hard, tough	Flat
	60	32	28	7	67 c	Distinct dry	Flat, slight bitter
	90	35	28.5	8	71.5 d	Distinct dry, brittle	Slight flat
	120	36	30	8	74 d	Hard, harsh, grainy	Lacking in flavour
Treatment 3	30	32	26	7	65 b	Hard, tough	Flat, slight bitter
	60	34	29	8	71 b	Hard, tough	bitter
	90	38	30	8	76 b	Slight dry, some holes	mild flavour, slight cheesy
	120	40	31	8	79 b	Slight smooth, some holes	Full ripened
Treatment 4	30	32	28	7	67 b	Distinct hard, brittle	Slight bitter, flat
	60	33	29	8	70 b	Distinct hard, brittle	bitter
	90	37	30	8	75 bc	Slight dry	slight cheesy
	120	38	31	8	77 c	Slight smooth	cheesy flavour, slight bitter

*a, b, c, d : Means with the same letter among the treatments in the same Storage period are not significantly different (p> .05).

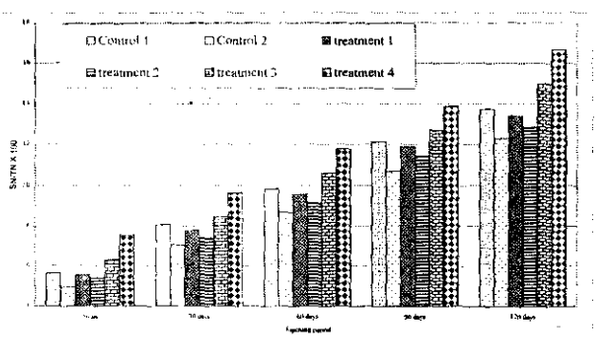

Fig. (1): Effect of adding maltodextrin and malt enzymes extract on soluble nitrogen coefficient of low fat Ras cheese during ripening.

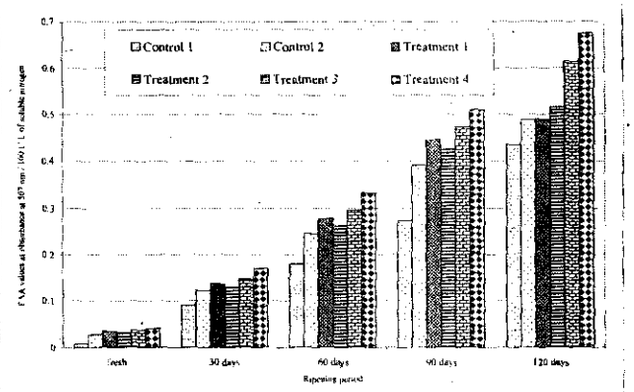

Fig. (2): Effect of adding maltodextrin and malt enzymes extract on free amino acids values of low fat Ras cheese during ripening.

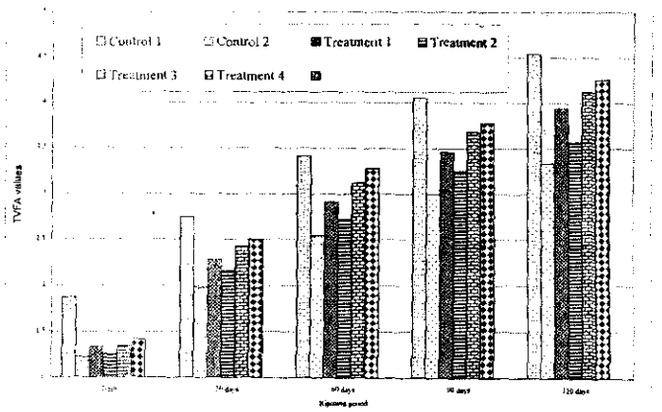

Fig. (3): Effect of adding maltodextrin and malt enzymes extract ontotal volatile fatty acids values of low fat Ras cheese during ripening.

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تأثير إضافة المالتودكسترين و مستخلص أنزيمات المولت على جودة الجبن الراس منخفضة الدهن

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تمثل الجبن الراس الصنف الرئيسي كجبن جاف في جمهورية مصر العربية وهناك دراسات عديدة لانتاج جبن الراس ذات محتوى منخفض من الدهن مع تحسين درجة جودتها لتكون أكثر قبولا للمستهلك حيث إن انخفاض محتوى الدهن في الجبن يؤدى إلى ظهور بعض العيوب مثل زيادة درجة الخشونة، زيادة الصلابة، نقص معدل التسوية و نقص في طعم الجبن الناتج. واهتم هذا البحث بدراسة اثر استخدام بعض الإضافات مثل المالتودكسترين و مستخلص أنزيمات المولت على صفات الجبن الراس منخفضة الدهن الناتج.

وقد تم إضافه المالتودكسترين بنسبتي ٢%، ٣% ومستخلص أنزيمات المولت بنسبتي ٠.٧٠، ١.٠٠% إلى اللبن المعد لصناعة الجبن المحتوى على ٢% دهن كما تم تصنيع جبن راس، دهن ٢٪ دهن بدون أي إضافات إلى اللبن لتعمل كجبن مقارنة منخفضة الدهن. وتم تصنيع جبن راس من لبن ٤٪ دهن لتعمل كجبن مقارنة كاملة الدسم.

أدت إضافة المالتودكسترين بنسبة ٢٪ إلى تحسين قوام وتركيب الجبن ولكن درجة تحسن النكهة كانت ضعيفة بينما إضافة المالتودكسترين ٣٪ لم تحسن قوام أو تركيب الجبن. وأدت إضافة مستخلص المولت بنسبة ٠.٥٧٠% إلى تحسن النكهة و إسراع تسوية الجبن الناتجة وبزيادة نسبة مستخلص أنزيمات المولت إلى ١.٠٠% أدى إلى ظهور بعض المرارة البسيطة فى الطعم.

ومن النتائج المتحصل عليها يمكن القول أن إضافة مستخلص المولت بنسبة ٠.٥٧٠% أو إضافة المالتودكسترين بنسبة ٢٪ كان لها تأثير كبير على تحسين جودة الجبن منخفضة الدهن من حيث الخواص الحسية، القوام والتركيب. إلا أن درجة التحسن كانت أكبر في معاملة مستخلص المولت كما أنها أدت إلى إسراع تسوية الجبن في خلال ٩٠ يوما من الصناعة مقابل ١٢٠ يوما في تجربة المقارنة منخفضة الدهن.