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Enhancement of Flavour Development in Ras Cheese Made by Direct Acidification

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ABSTRACT

An attempt has been made to enhance flavour development in Ras cheese made from directly acidified milk. Addition of a ripened cheese slurry, yoghurt culture (Streptococcus thermophilus + Lactobacillus bulgaricus) *or cheese starter* (S. lactis + L. casei + Leuconostoc citrovorum) *to the chemically acidified curd enhanced flavour intensity, body characteristics, the formation of both soluble nitrogen compounds and Free Fatty Acids and stimulated bacterial growth. Sensory properties (or characteristics) of cheese from chemically acidified curd incorporating the above additives approached those of control cheese.*

INTRODUCTION

Several investigators have tried to improve the flavour of hard cheese made by direct acidification (Breene *et al.*, 1964*a*, *b*; Dodson *et al.*, 1965; O'Keeffe *et al.*, 1975; El-Neshawy *et al.*, 1984). Most of these investigators suggested the addition of selected lactic acid bacteria to cheese milk before setting.

The function of the starter was not acid development only but, rather, to control undesirable fermentation and to aid in flavour development during ripening. In addition, Abdel Baky *et al.* (1982) and Rabie *et al.* (1984) showed that the addition of ripened cheese slurry to cheese milk or curd was an effective means for accelerating flavour development in Ras

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cheese made by the conventional method. Therefore, the present work was carried out to evaluate the effect of adding cheese slurry, yoghurt or cheese starters to Ras cheese curd produced by the direct acidification technique on the quality and ripening changes of the resultant cheese.

MATERIALS AND METHODS

Milk

Cow's milk was obtained from the herd of Gimmeza Station, Institute of Animal Production Research, Ministry of Agriculture, Egypt.

Rennet

A rennet powder (1:100 000) was obtained from L. C. Glad Co. A/S, Copenhagen, Denmark.

Starter culture

Lactic cultures of *Streptococcus lactis*, *S. thermophilus*, yoghurt culture (*S. thermophilus* + *Lactobacillus bulgaris*) and cheese starter (*S. lactis* + *L. casei* + *Leuconostoc citrovorum*) were obtained from CHR Hansen's Laboratory, Denmark. All cultures were activated before being used.

Acidulants

A pure citric acid (BDH AnalaR) was obtained from BDH Chemicals Ltd, Great Britain. Glucono-delta-lactone (GDL) was obtained from the Sigma Chemical Company, USA, as a coarse powder containing essentially 100% GDL.

Cheese slurry

Two parts of good quality ripened Ras cheese were blended with one part of sodium citrate solution (0·5M) and used as an additive to cheese curd (Von Bockleman & Lodin, 1974).

Cheese making

Ras cheese was made as described by Abdel-Tawab (1963). The cheese milk was heated to 72°C for 15 s, cooled to 33°C and then divided into

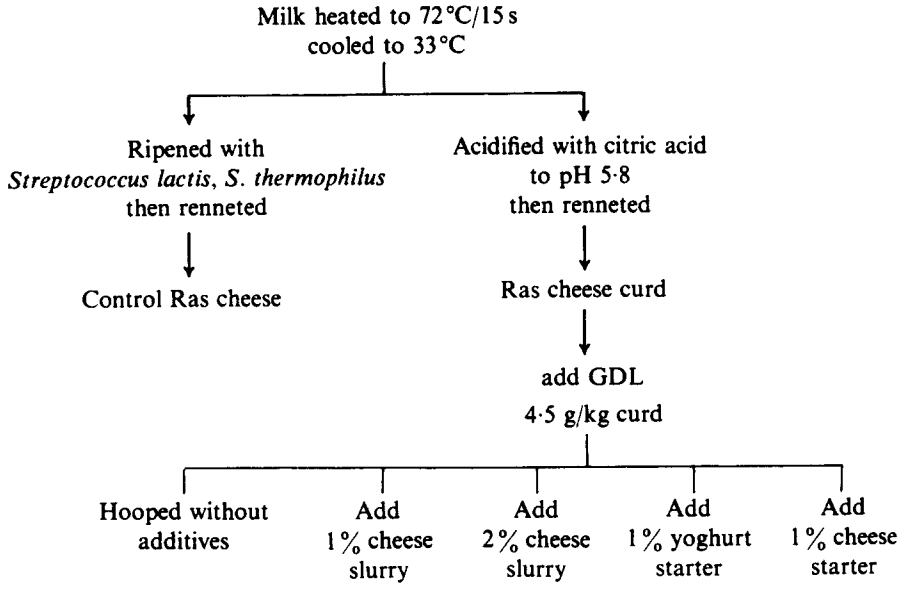

Fig. 1. Production of cheese for experiment.

two parts (Fig. 1). The first part was ripened with a starter culture of *Streptococcus lactis* and *Streptococcus thermophilus* and manufactured into control Ras cheese. The second part was acidified to pH 5·8 using citric acid and converted into Ras cheese curd. The resultant curd was treated with 4·5 g of GDL per kilogram of curd and divided into five equal portions. The first portion was hooped without additives. The second and third portions were treated with 1% and 2% cheese slurry before hooping. The fourth and fifth portions were treated with 1% of yoghurt or cheese starters, respectively. Trials were conducted in triplicate. Cheese made by each treatment was ripened at 12 ± 2°C for 4 months.

Cheese analysis

Cheese samples were analysed for moisture, fat salt, acidity, total nitrogen (TN), soluble nitrogen (SN) and non-protein nitrogen (NPN) as described by Ling (1963). The amino acid nitrogen (AN) was determined according to Stadhouders (1959). Free Fatty Acids (C_2, C_3, C_4 and C_5, and higher) were determined by the method of Harper (1953). Cheese was assessed organoleptically as described by Abdou *et al.* (1977).

Bacteriological examination

Total count and lipolytic and proteolytic bacterial counts were determined as described by Marth (1978).

RESULTS AND DISCUSSION

Gross chemical composition

Table 1 shows that addition of ripened cheese slurry, a yoghurt starter containing *S. thermophilus* and *Lactobacillus bulgaricus* or cheese starter consisting of *S. lactis*, *L. casei* and *Leu. citrovorum* to cheese curd, made from directly acidified milk, had a slight effect on the moisture, fat and salt contents of the cheese, but these treatments enhanced the development of titratable acidity during ripening. Dodson *et al.* (1965)

TABLE 1
Gross Chemical Composition of Directly Acidified Milk Cheese as Affected by Some Additives

Property (%)	*Ripening period* (*months*)	*Control cheese*	*Directly acidified cheese*				
			Without additives	*Cheese slurry*		*Cheese starter*	*Yoghurt starter*
				1%	*2%*		
Moisture	Fresh	39·00	40·58	40·62	40·68	40·35	40·28
	2	37·30	38·45	38·51	38·18	38·10	38·15
	4	36·11	37·48	37·42	37·28	37·15	37·10
Fat (DM)[a]	Fresh	49·7	50·0	49·7	51·9	50·8	51·8
	2	49·4	49·8	49·9	52·2	50·9	52·1
	4	49·5	49·6	50·0	51·8	51·1	51·8
Salt	Fresh	4·24	4·47	4·60	4·53	4·40	4·70
	2	4·55	4·60	4·71	4·67	4·64	4·76
	4	4·78	4·82	4·85	4·77	4·74	4·78
Acidity[b]	Fresh	0·60	0·45	0·62	0·65	0·62	0·61
	2	1·05	0·94	1·04	1·11	1·06	1·08
	4	1·45	1·22	1·48	1·50	1·51	1·50

[a] DM = dry matter.
[b] Expressed as per cent of lactic acid.

found that addition of certain lactic cultures to cheese milk prior to renneting had little effect on the gross chemical composition of Cheddar cheese. Abdel Baky *et al.* (1982) showed that the use of cheese slurry to accelerate ripening of Ras cheese had a slight effect on the gross chemical composition of the cheese.

Ripening indices

Changes in soluble nitrogen, non-protein nitrogen, amino acid nitrogen and Free Volatile Fatty Acids were considered as indices of cheese ripening.

Changes in SN, NPN and AN

Figures 2 to 4 show that the addition of cheese slurry, yoghurt starter and cheese starter to chemically acidified Ras cheese curd stimulated the formation of soluble nitrogen (SN), non-protein nitrogen (NPN) and amino acid nitrogen (AN). The increased rate of soluble nitrogen formation was proportional to the amount of added cheese slurry. Also, yoghurt starter was more effective in this respect. Concentrations of SN, NPN and AN of the direct acidified cheese with added cheese slurry, yoghurt starter and cheese starter were similar to, or higher than, those of

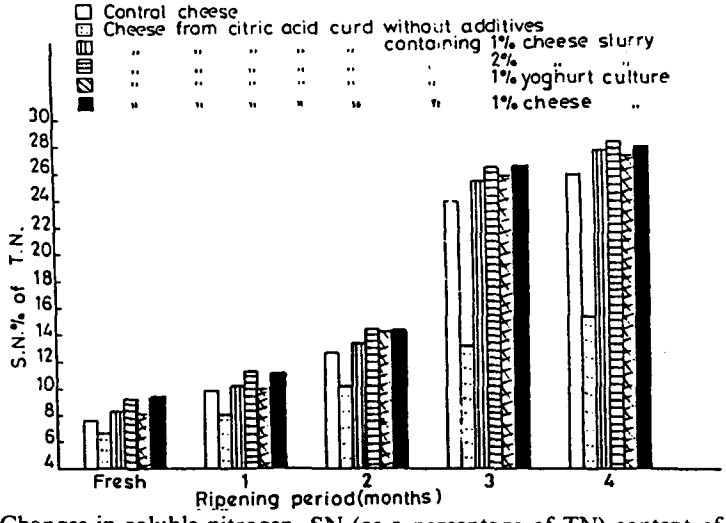

Fig. 2. Changes in soluble nitrogen, SN (as a percentage of TN) content of directly acidified Ras cheese as affected by some additives.

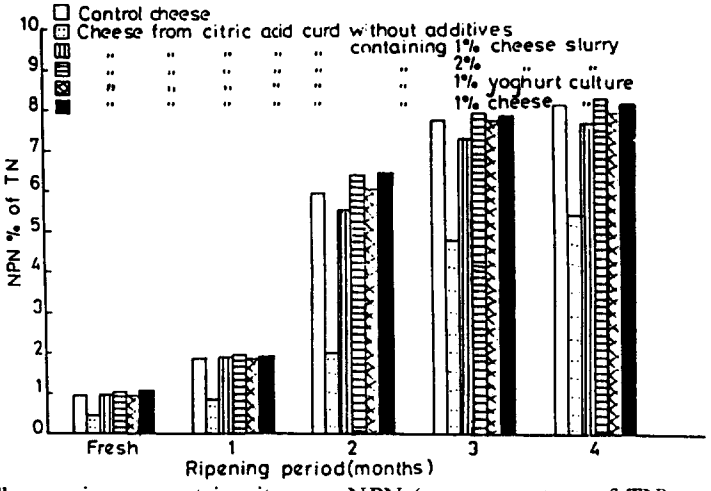

Fig. 3. Changes in non-protein nitrogen, NPN (as a percentage of TN) content of directly acidified Ras cheese as affected by some additives.

control cheese for the same ripening period. The high rate of protein degradation in cheese-containing slurry could be explained on the basis that cheese slurry provides the curd with the mixed flora of ripened cheese, particularly the proteolytic and lipolytic bacteria (Von Bockelman & Ladin, 1974). The higher concentrations of soluble nitrogenous compounds in the directly acidified cheese with added starter cultures

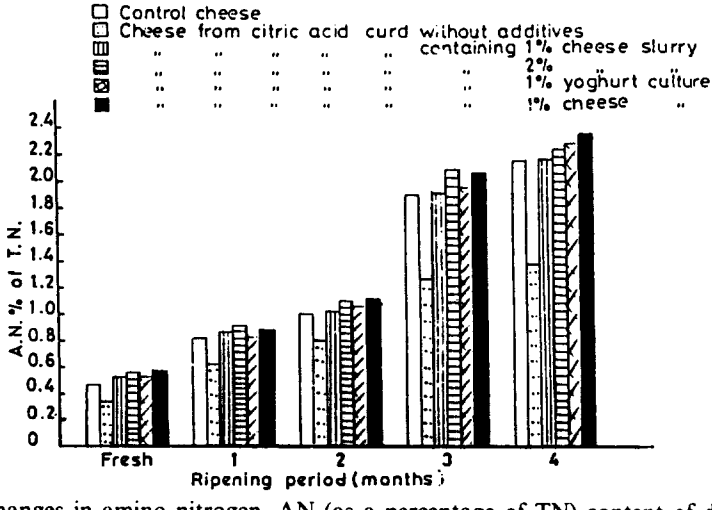

Fig. 4. Changes in amino nitrogen, AN (as a percentage of TN) content of directly acidified Ras cheese as affected by some additives.

could be explained on the basis that lactic acid bacteria contain a wide range of proteinases and peptidases which cause protein degradation (Desmazeaud & Zevaco, 1979). Lactobacilli were more active proteolytically than streptococci (El-Soda *et al.*, 1978).

Free Fatty Acids

Figure 5 shows that Ras cheese made from directly acidified milk without additives contains lower levels of Free Fatty Acids than that of control cheese. Addition of cheese slurry and of starter cultures to the directly acidified curd enhanced the formation of Free Fatty Acids, cheese slurry being the more effective. This could be explained on the basis that the added slurry contains several factors relative to fat hydrolysis, e.g. lipases and lipolytic bacteria, which, in turn, enhance the liberation of Free Fatty Acids. On the other hand, lactic acid bacteria had a limited rôle in the hydrolysis of milk fat.

Stadhouders & Verringa (1973) carried out the most definitive study on the lipolytic activity of lactic streptococci and concluded that they hydrolyzed mono- and diglycerides but that their activity against triglycerides was very weak. The authors concluded that the Volatile Fatty Acids are likely to be produced in small amounts by starter streptococci in most cheese varieties. Although Nakae & Elliott (1965) have shown that

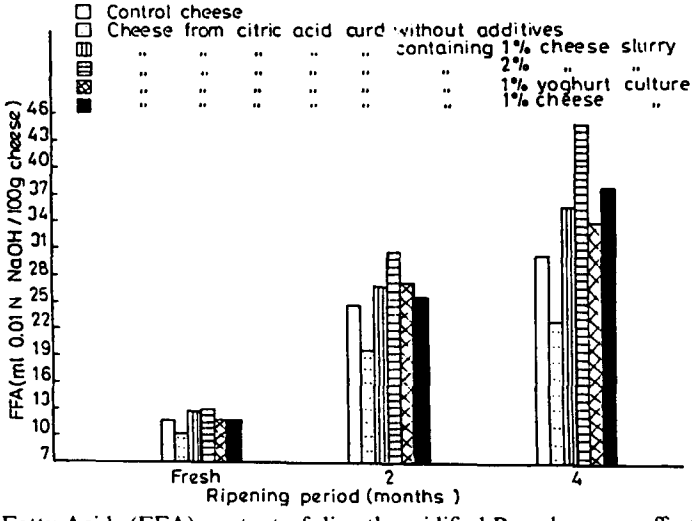

Fig. 5. Free Fatty Acids (FFA) content of directly acidified Ras cheese as affected by some additives.

Volatile Fatty Acids are also produced from amino acids via oxidative deamination by *Streptococcus diacetilactis*, it is not certain whether such a pathway operates in cheese since Dully & Grieve (1974) demonstrated that milk fat, rather than the acetate, was necessary for the production of volatile acids in Cheddar cheese.

Bacteriological properties of cheese

The total, proteolytic and lipolytic counts of Ras cheese made from directly acidified curd with added cheese slurry or yoghurt and cheese starter are given in Figs 6–8. Cheese made from the directly acidified curd without additives showed lower numbers of these bacterial groups. Addition of cheese slurry or the starter cultures to the directly acidified curd increased bacterial counts, especially proteolytic and lipolytic counts, in cheese. These results agree with those reported by Abdel Baky *et al.* (1982) who found that the addition of cheese slurry stimulated the

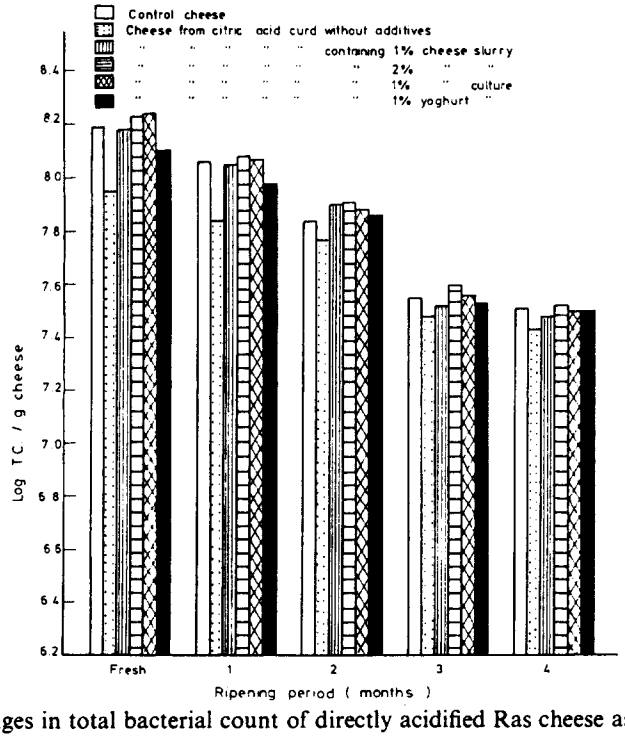

Fig. 6. Changes in total bacterial count of directly acidified Ras cheese as affected by some additives.

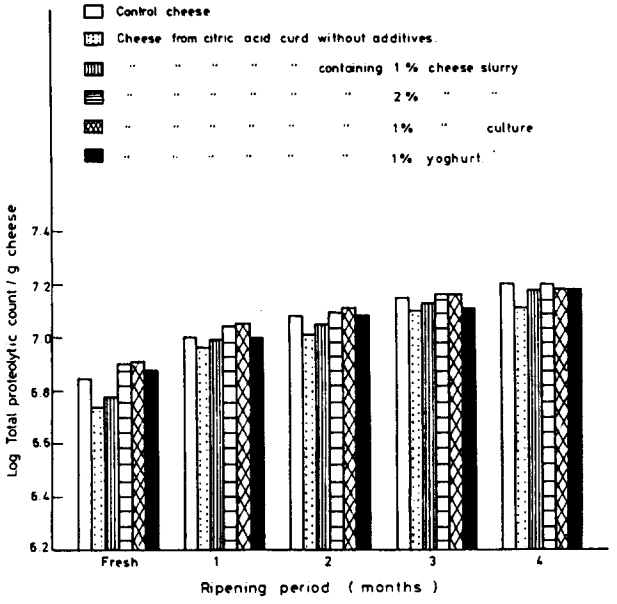

Fig. 7. Changes in proteolytic bacterial count of directly acidified Ras cheese as affected by some additives.

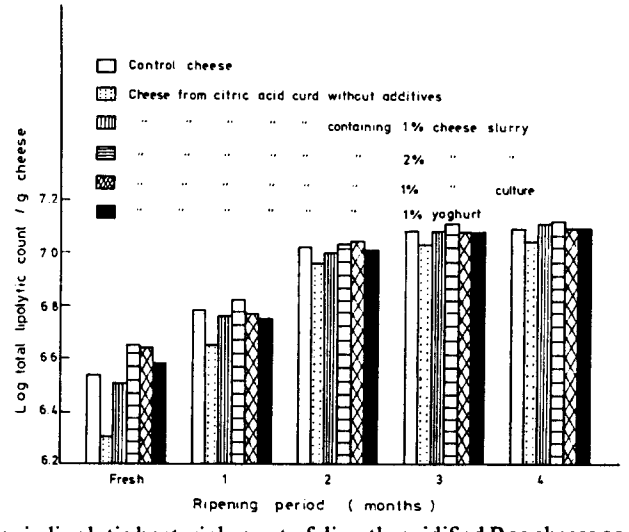

Fig. 8. Changes in lipolytic bacterial count of directly acidified Ras cheese as affected by some additives.

lipolytic and proteolytic bacteria of Ras cheese made by the conventional method.

Organoleptic properties

Ras cheese made from directly acidified curd with added cheese slurry or yoghurt and cheese cultures showed better body characteristics than cheese with added slurry (Fig. 5). Liebech *et al.* (1970) reported that development was also enhanced by these treatments, in particular by the addition of cheese slurry. Cheese made from directly acidified curd with added cheese slurry gained higher scores than other experimental cheese. This could be attributed to the high levels of Volatile Free Fatty Acids in cheese with added slurry (Fig. 5). Liebech *et al.* (1970) reported that Volatile Fatty Acids from fat hydrolysis are the basis of cheese flavour.

TABLE 2
Organoleptic Properties of Ras Cheese made from Directly Acidified Milk as Affected by Some Additives

Ripening period (months)	*Property*[a]	*Control cheese*	*Directly acidified cheese*				
			Without additives	*Cheese slurry*		*Cheese starter*	*Yoghurt starter*
				1%	*2%*		
1	Appearance	7	7	7	7	7	7
	Body and texture	30	26	28	28	27	27
	Flavour	35	24	29	38	35	37
	Total	72·0	57·0	64·0	73·0	69·0	71·0
2	Appearance	8	8	8	8	8	8
	Body and texture	32	28	32	33	32	33
	Flavour	40	29	36	42	40	41
	Total	80·0	65·0	76·0	83·0	80·0	82·0
3	Appearance	9	9	9	9	9	9
	Body and texture	34	30	33	34	33	34
	Flavour	44	34	39	45	44	45
	Total	87·0	73·0	81·0	88·0	86·0	88·0
4	Appearance	9	9	9·0	9·0	9·0	9·0
	Body and texture	35	31	36	37	36	36
	Flavour	46	36	45	48	47	48
	Total	90·0	76	90·0	94·0	92·0	93·0

[a] Maximum score points for appearance, flavour, body and texture are 10, 50 and 40, respectively.

Addition of a slurry of ripened cheese to a curd prepared by direct acidification enhanced its body and flavour.

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