

EFFECT OF PARTIAL SUBSTITUTION OF MILK SOLIDS WITH WHEY PROTEIN CONCENTRATE POWDER IN "LABNEH" MADE BY ULTRAFILTRATION

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ABSTRACT

The aim of this study was to investigate the compositional, rheological and organoleptical characteristics of Labneh made by ultrafiltration as affected by partial substitution of milk solids with whey protein concentrate powder (WPCP). Labneh based on 26% total solids (TS) and 0.5% NaCl was made from buffaloes' milk retentate concentrated by ultrafiltration. The milk solids in the retentate was partially substituted with WPCP at the levels of 0, 10, 20, 30 and 40%. The results indicated that the fat and lactose contents as well as pH values of Labneh decreased with increasing the ratio of WPCP. However, the protein content, ash, titratable acidity (%) increased with increasing the added amount of WPCP. The Labneh consistency coefficient and the yield stress were obviously increased as the level of WPCP increased. During cold storage of Labneh, its acidity and diacetyl contents increased up to 21 days, while acetaldehyde content increased up to 7 days of cold storage then decreased thereafter. Organoleptically, the Labneh quality was improved by adding WPCP with all of the examined levels, and remained acceptable during cold storage up to 21 days. Thus, milk solids in UF buffalo's milk retentate could be substituted by WPCP at level of 30% in Labneh made with acceptable quality at lower cost.

Keywords: Labneh manufacture, Buffalo's milk retentate, Whey protein concentrate powder, Milk solids not fat substitution

INTRODUCTION

Consumers nowadays are increasingly interested in their personal health, and expect that foods they eat to be beyond attractiveness are also safe and healthy. As interest in the link between diet and health gathers pace, many consumers seek ways to feel and stay healthy by eating nutritionally designed foods (Pimiae *et al.* 2003).

The traditional manufacture of Labneh is labour intensive and unhygienic. Besides the losses of product due to its adherence to the cloth bags are quite higher, therefore, during over the past three decades, several techniques of Labneh manufacture have been developed. In one of them, Labneh is produced from yoghurt by centrifugation (Dagher and Ali, 1985 and El-Kenany, 1995). Alternatively, Labneh may be made by concentrating a mixture of yoghurt and brine (Kharrazi, 1984) using centrifugal separator. In another method, warm skim milk-yoghurt is concentrated to desired level of solids using a nozzle of quarg separator and cream is later blended with the product (Salji *et al.* 1983; Tamime & Robinson, 1983 and Rasic, 1987). Labneh can also be made from ultrafiltration process (Abd-El-Salam & El-Alamy, 1982; El-Samragy & Zall, 1988; Tamime *et al.* 1989 and Ozer *et al.* 1998). Furthermore, other modifications were declared in the Labneh production such as direct supplementation of milk solid with dried milk,

whether to the final level (Gilles, 1978 and Gilles & Lawrence, 1981) or partially (Hamad & Al-Sheikh, 1989 and Amer *et al.* 1997).

With that in view, the objective of the present research was to manufacture Labneh from buffaloes' milk retentate with partial substitution of milk solids with whey protein concentrate powder (WPCP) which might lower the cost of its production.

MATERIALS AND METHODS

Buffaloes' milk retentate was obtained from the UF plant of Agricultural Research Center, Giza, Egypt. Whey protein concentrate powder was obtained from SFK DATABZIAD, Hvidovce & Viborg, Denmark. The gross composition of these materials is presented in Table (1). Salt produced by El-Nasr Salines Company was obtained from the local market. Freez-dried yoghurt culture which consists of *Streptococcus savlvarious* sub. *thermophilus* TCC-3 and *Lactobacillus delbruecki* subsp. *bulgaricus* were purchased from Chr. Hansen's Laboratories, Denmark.

The milk retentate (control batch) was heat treated to 85°C/5 min., then cooled to 42°C. Fermentation of UF-retentate was done according to Tamime and Robinson (1983). Total solids of buffaloes' milk retentate (26%) was substituted with WPCP at ratios of 10, 20, 30 and 40%, respectively. The mixtures were heat treated to 85°C/ 5 min., cooled to 42°C and fermented as mentioned before. The cold fermented Labneh treatments were salted at the rate of 0.5% NaCl. Three replicates were done.

Titrate acidity, moisture, total protein, fat, lactose and ash contents of Labneh were determined according to the methods described by A.O.A.C. (2000). pH values of Labneh samples were recorded by using digital pH meter model SA720 (Orion, USA).

Acetaldehyde and Diacetyl contents were determined according to Lees and Jago (1969). Rheological properties were measured at 10°C using a rotary viscometer (RHEOTEST, type RV Medingen, Dresden) as described by Toledo (1980).

Dynamic viscosity and consistency coefficient were calculated from the descending flow curve using the following equation: $\text{Log } \sigma = \text{Log } K + \text{Log } y$:

Where: σ = shearing stress, y = shearing gradient or shear rate
and κ = consistency coefficient

The yield stress was calculated by the equation of (Bourne, 1982)

$$\sqrt{\delta} = \sqrt{\delta_0} = \eta_a \sqrt{y}$$

δ = shear stress

δ_0 = yield stress

η_a = apparent viscosity and y = shear rate

Labneh treatments were organoleptically assessed by a panel of the staff persons from dairy department, Food Technology Institute, Agriculture Research Center according to Pappas *et al.* (1996).

RESULTS AND DISCUSSION

As seen from Tables (1 and 2) the gross composition of Labneh made from milk retentate by partial substitution of milk solids with WPCP decreased in T.S., fat and lactose contents, while increased in those those of protein and ash. This might be due to the higher contents of protein and ash increased by increasing of supplementation ratios of WPCP. These results are in agreement with those of Abd El-Salam & El-Alamy (1982) and Hofi (1988 and 1990).

Table 1. Average gross composition of dairy materials used

Properties	Buffaloes' milk	Ultrafiltration retentate	Whey protein concentrate powder
T.S %	16	26.12	44.80
Protein %	4.0	9.11	80.83
Fat %	7.0	10.93	8.50
Lactose %	4.2	4.20	2.50
Ash %	0.80	1.88	3.00

Table 2. Gross composition of Labneh made from milk retentate by partial substitution of milk solids with WPCP

Properties	Level of WPCP substation				
	Control	10%	20%	30%	40%
T.S %	25.62	25.79	25.61	25.43	25.25
Protein %	9.11	9.56	9.63	9.69	9.76
Fat %	10.93	10.21	8.02	7.83	6.64
Lactose %	4.2	4.03	3.86	3.69	3.52
Ash %	1.88	1.992	2.104	2.216	2.328

WPCP= Whey protein concentrate powder

Regarding the rheological properties of Labneh made from milk retentate by partial substitution of milk solids with WPCP, the obtained data (Table 3) indicate that there were an increase in all the rheological parameters measured, i.e. consistency, yield stress and apparent viscosity with the increase of the supplementation ratio. These results are in agreement with those reported by Ozer *et al.* (1998) and Jensen & Nielsen (1982).

Table 3. Rheological properties of Labneh made from milk retentate by partial substitution of milk solids with WPCP

Properties	Level of WPCP substation				
	Control	10%	20%	30%	40%
Consistency coefficient (dyne. Sec./cm ²)	226.569	298.650	358.720	390.147	415.314
Yield stress (dyne/cm ²)	148.512	168.580	175.580	197.614	248.312
Apparent viscosity (poise)	53.12	55.28	56.91	57.82	58.75

WPCP= Whey protein concentrate powder

Titrateable acidity and pH values were determined in all Labneh treatments when fresh and during cold storage. The results in Table (4) show that the Labneh acidity increased as the level of WPCP increased. Also, the acidity was further increased by cold storage up to 21 days. The trend of the changes in pH values of all treatments was opposite to that of acidity which may led to protein ratio increase and lactic acid production as s result of microorganisms metabolism (Abd-Allah et al. 1993)

Table 4. Titrateable acidity (TA%) and pH values of Labneh made from milk retentate by partial substitution of milk solids with WPCP during cold storage.

Cold storage period (days)	Level of WPCP substitution									
	Control		10%		20%		30%		40%	
	TA	pH	TA	pH	TA	pH	TA	pH	TA	pH
Fresh	1.68	4.39	1.84	4.23	1.92	3.98	2.13	3.87	2.31	3.7
7	1.94	4.27	1.96	3.94	2.13	3.83	2.34	3.75	2.52	3.69
14	2.25	3.98	2.42	3.85	2.31	3.78	2.52	3.69	2.63	3.62
21	2.34	3.86	2.54	3.78	2.65	3.69	2.71	3.60	2.78	3.56

WPCP= Whey protein concentrate powder

Table (5) demonstrates the acetaldehyde (AC) and diacetyl (DA) contents in Labneh made from milk retentate by partial substitution of milk solids with WPCP. The results reveal that both of AC and DA contents of Labneh gradually increased as the ratio of WPCP increased. The levels raised further until the 7th day of cold storage for AC and until the 14th day for DA. Thenafter, the levels of both compounds reduced until the end of the cold storage period. These results are in agreement with the results obtained by Hassanein et al. (2008).

Acetldehyde can be converted into to ethanol by alcohol dehydrogenase (Tamime and Robinsonm 1983). This may explain the lower amount of acetaldehyde observed during the cold storage period.

Table 5. Acetaldehyde (AC) and diacetyl (DA) (µmol/100 g) of Labneh made from milk retentate by partial substitution of milk solids with WPCP during cold storage

Cold storage period (day)	Level of WPCP substitution									
	Control		10%		20%		30%		40%	
	AC	DA	AC	DA	AC	DA	AC	DA	AC	DA
Fresh	183.5	100.1	185.5	100.3	189.2	100.9	192.5	103.5	198.5	106.2
7	352.5	130.8	359.2	132.3	362.1	135.6	367.2	139.5	380.0	142.1
14	300.9	149.5	305.1	150.9	309.5	152.6	310.5	158.2	320.3	160.5
21	163.8	150.4	169.3	166.1	172.1	168.7	175.3	172.4	179.2	179.6

WPCP= Whey protein concentrate powder

Panel scores are listed in Table (6) which indicate that the appearance, consistency and flavour of Labneh made from milk retentate by partial substitution of milk solids with WPCP. There was no effect on

organoleptic quality at cold storage till 14th day at the level of 10% of WPCP substitution. All other treatments gained lower scores with cold storage after the 7th days.

Generally, the total score that reflecting the overall sensory quality of Labneh indicated that all samples remained acceptable until the end of the 7th day. Our results are in agreement with Mahfouz *et al.* (1992).

Table 6. Organoleptic scoring of Labneh made from milk retentate by partial substitution of milk solids with WPCP during cold storage

Level of WPCP	Cold storage period (days)	Organoleptic attributes			
		Appearance (5 points)	Consistency (5 points)	Flavour (5 points)	Total (15 points)
Control	Fresh	5	5	5	15
	7	5	5	5	15
	14	5	5	5	15
	21	4.5	4.5	4.5	13.5
10%	Fresh	5	5	5	15
	7	5	5	5	15
	14	5	5	5	15
	21	4.5	4.0	4.5	14.0
20%	Fresh	5	5	5	15
	7	5	5	5	15
	14	4.5	4.5	4.5	13.5
	21	4.5	4.5	4.5	13.5
30%	Fresh	5	5	5	15
	7	5	5	5	15
	14	4.5	4.5	4.5	13.5
	21	4.5	4.5	4.5	13.5
40%	Fresh	5	5	5	15
	7	5	5	5	15
	14	4.5	4.5	4.5	13.5
	21	4.0	4.0	4.0	13.0

WPCP= Whey protein concentrate powder

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تأثير الاستبدال الجزئي للمادة الصلبة اللبنية بمسحوق مركز بروتينات الشرش في صناعة اللبنة بالترشيح الفائق

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يهدف هذا البحث لدراسة الخواص التركيبية والريولوجية والحسية لللبنة المصنعة من اللبن الجاموسي المركز بالترشيح الفائق والتي استبدل فيها جزء من المواد الصلبة اللبنية بمسحوق مركز بروتينات الشرش للحصول على لبنة بخواص مناسبة وبتكاليف أقل. وقد تم صناعة اللبنة من اللبن الجاموسي المركز بالترشيح الفائق والمحتوى على جوامد كلية ٢٦% وبإضافة ٠,٥% ملح، كما تم إجراء استبدال جزئي للمادة الصلبة اللبنية مسحوق مركز بروتينات الشرش بنسب ١٠، ٢٠، ٣٠، ٤٠% لخفض تكاليف الانتاج.

وأظهرت النتائج حدوث إنخفاض في كل من نسب الدهن واللاكتوز وقيم الـ pH بزيادة نسب الإستبدال بينما حدث زيادة لكل من المحتوى البروتيني والرماد والحموضة بزيادة نسب الإضافة كما زادت نسب الحموضة والمحتوى من مركب الداى اسيتايل بزيادة فترة تخزين اللبنة في الثلاجة حتى ٢١ يوم بينما زاد المحتوى من الاسيتالدهيد حتى اليوم السابع فقط من التخزين وانخفض بعد ذلك.

وبالنسبة للخواص الريولوجية والخواص الحسية فقد أعطى استبدال الجوامد اللبنية بمسحوق مركز بروتينات الشرش بمستوى ١٠% لبنة ذات خواص مناسبة مشابهة لعينة المقارنة مع خفض تكاليف الانتاج. كما يمكن الاستبدال بمستوى حتى ٤٠% مع التخزين المبرد حتى سبعة أيام.

قام بتحكيم البحث

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