

Ricotta Cheese from Whey Protein Concentrate

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Abstract: Ricotta cheese was made from UF-whey protein concentrate (WPC) fortified with 2, 4 and 6 % skim milk powder (SMP), and acidified with 0.14 g/kg citric acid or 1.5 % Glucono-Delta-Lactone (GDL). All WPC mixtures were homogenized at 300 k_p/cm² first stage and 200 k_p/cm² second stage at 60°C. The fresh cheese yield was determined. Samples were taken from whey, WPC mixtures and cheese. The samples were analysed for moisture, nitrogen, ash, pH, lactose and fat contents. Viscosity of WPC mixtures and cheeses were also assessed. The cheese samples were also assessed for organoleptic properties. The best results were obtained from cheese treated with citric acid , this treatment showed the higher cheese yield, higher viscosity and best organoleptic quality than those made with GDL. Ricotta cheese made from WPC showed the best organoleptic properties followed by that made from WPC fortified with 2% SMP. The results indicated that WPC ingredient can be successfully use in the manufacture of Ricotta cheese. [Journal of American Science. 2010;6(8):321-325]. (ISSN: 1545-1003).

Key words: Ricotta cheese, WPC, SMP, Citric acid, GDL

1. Introduction

The consumption and manufacture of cheese is increasing worldwide at a rate of about 2% per year. As a result, the amount of cheese whey is also increasing and is estimated to be some 130 million tonnes annually (Korhonen et al., 1998).

The disposal of whey represented a serious environmental problems, as it contains a great deal of organic substances with a high (B.O.D). In fact whey contains (6-7%) more than half of the solids in the original milk, including about 20% of the protein, and most of lactose, minerals and water-soluble vitamins (Zall, 1992).

Now, whey is increasingly used for human consumption, the principal processes applied are concentration, drying and isolation of whey proteins by means of membrane separation, such as reverse osmosis (RO), ultrafiltration (UF) and diafiltration.

Whey proteins are known by their health effects. Boumou et al. (1988) reported the immune enhancing property of WPC. A commercial preparation of whey proteins inhibited HIV virus (Bounos, 1997). McIntosh et al. (1998) demonstrated the anticarcinogenic effect of whey proteins against colon cancer. This has been due to their high content of sulphur amino acids.

Nowadays, utilization of whey proteins and WPC to food and dairy products is considered to be one of the most important functional foods due to their effects either on the product characteristics and/or the health promotion (Shenana, et al. 2007)

Ricotta cheese is a dairy product of Italian origin, which means "recooked", it is produced by boiling acidified cheese whey (Maubois and Kosikowski, 1978).

Ricotta cheese is a high moisture soft cheese (Modler and Emmons, 2001). It can be produced using cheese whey or milk, or a mixture of both (Pizzillo et al., 2005). Ricotta cheese is very mild and it is used in many Italian dishes.

Several methods have been developed for utilization of whey, one of these methods is the manufacture of Ricotta cheese. Fresh Ricotta cheese had a mild and nutty flavour and is used as a flavour enhancer in Salad (Kosikowski, 1982). Several methods have been suggested for Ricotta cheese making (Weatherup, 1986 and Modler & Emmons, 1994). These include study the effect of type of acidulant on the quality of Ricotta cheese.

Production of Ricotta cheese has been considered to be one of the economical way for the utilization of whey. So, the manufacture of Ricotta cheese could easily be undertaken as an additional source of income (Shukla et al., 1986).

Therefore, this work was carried out to study the effect of use WPC fortified with SMP on the composition and quality of Ricotta cheese.

2. Materials and Methods

Preparation of WPC:

The method of EL-Sheikh et al., (2001) for the preparation of WPC was adopted as follows:

-Ultrafiltration of Edam cheese whey obtained from Arab Dairy Company (Kaha-Kalubia, Egypt) was carried out in National Research Centre by using a Carbosep pilot plant (Orelis-France) with 6.3 m² inorganic membranes at 4 bars transmembrane pressure at 50°C and pH 7 had in a batch system to volume concentration 20.

-SMP: Skim milk powder (low heat) USA origin with average chemical composition (according to supplier):

Moisture: 5.20 %
 Proteins: 32.15 %
 Fat : 1.20 %
 Ash: 7.44 %
 Lactose: 54.30 %

-Acidulants: Food grade, Citric acid and GDL were used

Preparation of WPC mixtures:

WPC was fortified with 2, 4, and 6% SMP respectively. Control cheese was made from WPC without SMP addition. Ricotta cheese making (each of three replicated) as follows:

- Control 2 Kg WPC
- Tr.1 1.96 Kg WPC + 0.04 Kg SMP
- Tr.2 1.92 Kg WPC + 0.08 Kg SMP
- Tr.3 1.88 Kg WPC + 0.12 Kg SMP

All treatments were acidified using 0.14 gm/Kg citric acid or 1.5 % GDL.

Ricotta cheese manufacture:

Ricotta cheese was manufactured as described by Mahran et al., (1999).

All WPC mixtures were homogenized (2 stage) at 300/200 Kp/cm² at 60°C using laboratory homogenizer (Rannie, Copenhagen). All mixtures were heated at 90°C/15-30 min. The curd was left in the whey for 10 min and then scooped in plastic frame lined with cheesecloth and placed over a drainage table and allows to achieve complete drainage in 24 hr. The curd was packed in plastic container and stored at 4°C.

Methods of analysis:

The whey, WPC mixtures and cheese samples were analysed for moisture, fat and ash as given by A.O.A.C.(1990) and total nitrogen as described in IDF Standard (1986). Lactose was determined according to Barnett and Abdel-Tawab (1957). pH value was measured using a laboratory pH meter with glass electrode.

Determination of WPC viscosity:

The viscosity of WPC mixtures were measured according to Farrag et al. (2006). A coaxial cylinder viscometer (Bohlin V88, Sweden) attached to a work station loaded with soft ware V88 viscometry programme was used. The system (C30) was filled with the WPC samples at 25 °C and measurement of shear stress and viscosity was carried out in the up mode at shear rates ranging from 21 to 144 1/s .

Measurement of Ricotta cheese viscosity:

Bohlin viscometer (Bohlin V88, Sweeden) equipped with a cone and plate system (CP 5.4/30) and attached to a worksttion loaded with V88 viscosity program was used. About 1-2 gm of the cheese sample with a flat surface was placed on the plat and allowing the cone to touch the surface of the cheese sample. The viscosity was measured at 25°C with shear rate of 33 1/s virsus time. A total of 6 measurements were carried out.

Cheese yield:

Cheese yield was calculated as kg of fresh cheese per kg of WPC mixture.

Organoleptic assessment:

Ricotta cheese samples were scored for organoleptic properties by a taste panel of 11 persons for National Research Centre staff as described by 15 Mahran et al., (1999). The panelists scored the cheese flavour (out of 40 points); body & texture (out of 50 points) and appearance (10 points).

3. Results and Discussion

Composition of WPC mixtures:

Table (1) shows the chemical composition of Edam cheese whey which used in the preparation of WPC mixtures.

Total solids content of WPC (control) was 13.95 % while in the other treatments increased from 15.65 in Tr.1 to 17.33 in Tr.2 and 18.93 % in Tr.3 this variations has been attributed to SMP addition, also protein content increased from 7.41 % in control WPC to 7.96 in Tr.1,to 8.51 in Tr.2 and 9.06 % in Tr.3. The same trend was noticed for lactose and ash contents.

Table (1) :Gross composition of Edam cheese whey, WPC and WPC mixtures used in Ricotta cheese manufacture (average of 3 replicates).

%	Whey	WPC	Tr. 1	Tr. 2	Tr. 3
Total solids	7.1	13.95	15.65	17.33	18.93
Protein	0.7	7.41	7.96	8.51	9.06
Ash	0.8	2.3	2.35	2.37	2.40
Lactose	4.8	4.1	5.11	6.13	7.15

Fat	-	0.1	0.1	0.1	0.1
Tr.1: WPC + 2% SMP					
Tr.2: WPC + 4% SMP					
Tr.3: WPC + 6% SMP					

The low fat content of WPC mixtures due to the separation of fat by high speed separator in the company before ultrafiltration process.

Viscosity of WPC mixtures:

Fig (1) and (2) shows the viscosity of WPC mixtures measured at 25°C at share rate ranging from 21 to 144 1/s. The lowest initial viscosity showed with WPC without SMP addition. The initial viscosity increased with the increasing addition of SMP. All treatments showed increasing in viscosity as share rate increase.

In general, viscosity of WPC mixtures acidified with Citric acid were higher than those acidified with GDL.

Gross composition of cheese:

Tables (2 and 3) shows that the total solids contents of Ricotta cheese increased with the increasing of SMP addition. Also, protein content increased, the same trend was observed for lactose and ash contents, the pH values also increased with SMP addition increased.

Total proteins, lactose and ash contents of Ricotta cheese made from WPC mixtures acidified by using 1.5 % GDL were higher than that made from WPC mixture acidified by using Citric acid while, its pH values were lower

Table (2): Composition of Ricotta cheese made from WPC mixtures acidified with 1.5 % GDL (average of 3 replicates).

%	Total solids	Protein	Lactose	Ash	pH value
WPC	25.34	17.55	3.78	2.46	5.35
Tr. 1	27.54	19.09	5.00	2.71	5.61
Tr. 2	29.92	20.67	5.50	3.03	5.80
Tr.3	31.08	21.30	5.90	3.31	5.90

Tr.1: WPC + 2% SMP

Tr.2: WPC + 4% SMP

Tr.3: WPC + 6% SMP

Table (3): Composition of Ricotta cheese made from WPC mixtures acidified with 0.14% Citric acid (average of 3 replicates).

%	Total solids	Protein	Lactose	Ash	pH value
WPC	24.05	16.45	3.85	2.26	5.91
Tr. 1	26.38	18.05	4.85	2.45	5.96
Tr. 2	28.86	19.69	5.31	2.81	6.10
Tr.3	30.57	20.95	5.78	3.10	6.21

Tr.1: WPC + 2% SMP

Tr.2: WPC + 4% SMP

Tr.3: WPC + 6% SMP

Cheese yield:

Table (4), shows the fresh yield of Ricotta cheese made from different mixtures of WPC. WPC fortified with 6% SMP (Tr. 3) has the higher fresh yield followed by WPC fortified with 4% SMP (Tr. 2) and WPC fortified with 2% SMP (Tr. 1) compare to control treatment that made from WPC without SMP addition. The cheese yield increased with the increasing of SMP addition. These results are in agreement with those reported by Shahani, (1979) and Mathur & Shahani, (1981).

Also, the fresh yield of Ricotta cheese made from WPC mixtures acidified with Citric acid was higher than that made from WPC mixtures acidified with GDL

Table (4): Yield % of Ricotta cheese made from WPC mixtures (average of 3 replicates).

Treatment	Cheese from GDL	Cheese from Citric acid
WPC	20.11	23.56
Tr. 1	24.66	27.32
Tr, 2	29.09	30.18

Tr. 3 33.33 36.16

Tr.1: WPC + 2% SMP

Tr.2: WPC + 4% SMP

Tr.3: WPC + 6% SMP

Cheese viscosity:

Fig (3) and (4) Shows the rheogram for viscosity versus time for Ricotta cheese samples. The cheeses differed in their initial viscosities. The lowest initial viscosity was 12.12 Pas for cheese made from WPC acidified with 1.5% GDL, while the maximum was 25.31 Pas for cheese made from WPC fortified with 6% SMP and acidified with 0.14g/kg of Citric acid. All treatments showed a noticeable drop in viscosity at successive intervals. Generally, the cheese made from WPC acidified with 1.5% GDL were low viscosity than that made from acidified with 0.14 g/kg Citric acid.

Organoleptic assessment:

Table (5) shows the organoleptic evaluation of the different treatments of Ricotta cheese. Ricotta cheese made from WPC without SMP addition was ranked higher score than the other treatments followed by Tr. 1, Tr. 2 and Tr. 3 respectively.

Ricotta cheese made from WPC acidified with 0.14 g/kg of Citric acid was judged better than that made from WPC acidified with 1.5% GDL.

Ricotta cheese made from WPC without SMP addition had a good quality (soft and moist-griny texture). The quality of Ricotta cheese was decreased with SMP addition increased, beside the cheese made from WPC fortified with SMP had a sweet taste especially with Tr. 2 and Tr. 3.

The results indicate that the addition of SMP (not more than 2%) to WPC was enough to obtain Ricotta cheese with a good quality near to that made from WPC without SMP addition.

Table (5): Organoleptic properties of Ricotta cheese (average of three replicates).

	Cheese acidified with GDL				Cheese acidified with Citric acid			
	WPC	Tr.1	Tr.2	Tr.3	WPC	Tr.1	Tr.2	Tr.3
Appearance								
10	9.2	8.5	7.3	7.3	9.0	8.5	7.2	7.2
Flavour								
40	36.6	33.3	32.6	32.3	37.2	36.4	33.2	32.8
Body and texture								
50	46.6	43.6	40.0	39.3	47.3	45.8	42.8	40.6
Total								
100	92.4	85.4	79.9	78.8	93.5	90.7	83.2	80.6

Tr.1: WPC + 2% SMP

Tr.2: WPC + 4% SMP

Tr.3: WPC + 6% SMP

4. Conclusion

It can be concluded that it is possible to successively use whey protein concentrate (WPC) for Ricotta cheese with good flavour and a high acceptability specially with WPC without SMP.

Production of Ricotta cheese has been considered to be one of the economical way for the utilization of whey. So, the manufacture of Ricotta cheese could easily be undertaken as an additional source of income.

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