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SHORT COMMUNICATION

Effect of fat on quality characteristics of whey obtained from manufacture of Ricotta cheese

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Abstract: The Ricotta cheese whey (RCW) is obtained during the manufacturing of Ricotta cheese as byproduct. It is highly nutritious and can be utilized in the manufacture of whey-based beverages. In the present study, RCW was analyzed for its sensory and physico-chemical properties obtained during the manufacture of Ricotta cheese from mixture of Mozzarella cheese whey and milk (80:20) with different fat levels (0.1%, 1.5%, 3.0% and 4.5% in milk). The results indicated that an increase in the fat content of milk used in the manufacturing of Ricotta cheese has a significant effect on the composition of RCW. The fat content of RCW increased with the increase in the fat content of milk used in the manufacture of Ricotta. The protein content was reported to be highest in the RCW prepared from milk with no-fat. The L* value of the sample increased while a* and b* values of the sample decreased with increase in the fat content of RCW. Sensory results revealed that RCW with higher fat content showed the highest acceptability as compared with the other samples.

Keywords: Ricotta cheese, Ricotta cheese whey, Sensory properties, Physico-chemical properties

Ricotta is a soft Italian unripened whey cheese. It is popular in Italy and Ibero-American countries such as Argentina. Ricotta cheese is obtained by direct acidification of cheese whey or mixtures of cheese whey and milk using citric acid at 90°C (Martins et al. 2010; Ruble et al. 2019; Gautam et al. 2023). After coagulation and precipitation of protein, the curd was then separated from greenish-tinged liquid usually called ricotta cheese whey (RCW) or scotta, which is considered a byproduct of the cheese industry. RCW is highly nutritious and can be utilized in the preparation of whey-based beverages. It is usually discarded by the cheese industries, but discarding whey contributes to environmental pollution due to its high BOD and COD values of about 50 and 80 g/L, respectively, and leads to a big loss for the cheese industries (Sansonetti et al. 2009; Maragkoudakis et al. 2016; Cortellino and Rizzolo, 2018; Pires et al. 2021).

Nowadays, consumers want nutritionally rich food that is low in calories, thus, fat reduction is the best option to reduce the calories of any food as well as beverages. In the present study attempts have been made to evaluate the sensory and physico-chemical characteristics of RCW obtained from Ricotta cheeses prepared by addition of milk with different fat levels to the Mozzarella cheese whey. This study also evaluated the effect of fat on the composition and suitability of RCW for the preparation of whey-based beverages varying in fat content.

Mozzarella cheese whey (7% solids, 0.78% fat and 0.9% protein) was collected during Mozzarella cheese preparation from the Experimental Dairy Plant (EDP) of the College of Dairy Science and Technology, Ludhiana. Raw mixed milk (5.0% fat and 8.5% non-fat solids) was also obtained from EDP of the college to prepare a milk with different fat content viz. 0.1% (no-fat milk, NFM), 1.5% (low-fat milk, LFM), 3.0% (medium-fat milk, MFM) and 4.5% (full-fat milk, FFM). Citric acid was obtained from the local market.

Ricotta cheese was prepared as per the mechanized method described by Gautam et al. (2023) using basket centrifuge (Deepali United Manufacturing Pvt. Ltd., Mumbai, India). Ricotta cheese was prepared using mixture of whey and milk in the ratio 80:20. Sweet Mozzarella cheese whey was heated to 50°C to stop the growth of starter culture followed by addition of mixed milk varying in fat content (0.1%, 1.5%, 3.0% and 4.5%). The whey/milk mixture was heated to 90°C and citric acid (5%, w/v) was added to bring down the pH to 5.4 of the mixture. The flocculated

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protein rises to the surface and the curd along with whey was allowed to rest for 20 minutes to complete the coagulation process. Later, the curd was separated from whey using basket centrifuge (5000 rpm for 5 min). Four varieties of RCW produced (NFM-, LFM-, MFM and FFM-RCW) were thus collected and stored at 4°C until further analysis.

Total solids, fat, protein, lactose and ash content of RCW were determined as per the methods described for milk in IS: SP-18 (1981). pH of RCW was determined by using digital calibrated hand pH meter (pHep+, Hanna instruments) at 20°C. The titratable acidity of RCW was determined as per method for milk in IS: SP-18 (1981). Colour of RCW was determined by using a colorflex reflectance meter (Hunter lab, Reston, Virginia, USA). The instrument provides 3 parameters i.e., a* (greenness to redness), b* (blueness to yellowness) and L* (darkness to lightness) were recorded. All the measurements were carried out in triplicate.

Sensory evaluation of RCW samples was done using the 9-point hedonic scale (1 for disliked extremely and 9 for liked extremely) as per the method described in Indian standards (IS, 1971). Ten semi-trained panelists were served with 50 ml of sample each in glass beaker (100 ml), and panelists were asked to score for the attributes like flavour, sourness, colour and appearance and saltiness. Panel members, who were familiar with cheese whey and had a good knowledge on the sensory evaluation of dairy products and they were in the age group of 25 to 45 years.

Mean values and standard deviations (SD) of triplicate determinations were calculated using Microsoft Excel (Microsoft Office, 2010). All statistical analyses were performed using SPSS 16. A one-way analysis of variance (ANOVA) was used to determine differences among treatment means at the 95% confidence interval.

The physico-chemical analysis of RCW obtained after manufacturing Ricotta cheese with different fat content is given in Table 1. The total solids content of RCW samples ranged from 6.47 to 6.91% and did not differ significantly among all the treatments. Variation in the fat content (0.1-4.5%) of milk used for the preparation of Ricotta cheese resulted in significant difference in the fat content of the RCW varying from 0.07 to 0.11%. It was found to be highest in FFM-RCW while lowest in NFM-RCW. However, the protein content of LFM-RCW was found to be significantly higher ($P<0.05$) than other RCW samples, which might be due to the presence of more protein in the NFM and significant difference was not observed between LFM-, MFM- and FFM-RCW. The lactose and ash content did not differ significantly among all the treatments and found in the range of 5.51–6.01% and 0.46–0.51%, respectively, for all the samples. Cortellino and Rizzolo (2018) reported the chemical composition of RCW which comprised 5.39% total solids, 0.34% protein, 0.74% ash, and 3.76% lactose. Pisponen et al. (2013) showed similar results with respect to its compositional evaluation. They reported that the scotta has 5.43% dry matter, 0.26% fat, 0.5%

Table 1 Effect of fat on compositional and physico-chemical properties of Ricotta cheese whey (RCW)

Parameters	NFM-RCW	LFM-RCW	MFM-RCW	FFM-RCW
Total solids (%)	6.74±0.42^{a}	6.60±0.39^{a}	6.91±0.52^{a}	6.47±0.16^{a}
Fat (%)	0.07±0.05^{b}	0.09±0.17^{ab}	0.10±0.09^{a}	0.11±0.12^{a}
Protein (%)	0.59±0.14^{a}	0.38±0.11^{b}	0.37±0.06^{b}	0.36±0.09^{b}
Ash (%)	0.51±0.21^{a}	0.48±0.08^{a}	0.47±0.13^{a}	0.46±0.10^{a}
Lactose (%)	5.62±0.23^{a}	5.67±0.18^{a}	6.01±0.23^{a}	5.51±0.31^{a}
pH	5.51±0.05^{b}	5.54±0.02^{b}	5.42±0.01^{b}	5.74±0.09^{a}
Acidity (% lactic acid)	0.183±0.01^{a}	0.186±0.04^{a}	0.189±0.07^{a}	0.162±0.06^{b}
L*	28.98±0.12^{d}	31.29±0.07^{c}	32.44±0.18^{b}	35.03±0.01^{a}
a*	-3.50±0.01^{a}	-3.39±0.08^{b}	-3.23±0.07^{c}	-3.02±0.05^{d}
b*	-1.93±0.12^{a}	-1.11±0.04^{b}	-0.73±0.04^{c}	-0.50±0.03^{d}

Data are presented as Mean ± SD, n =3. Means with different lowercase superscripts (a, b, c, d) in each row are significantly different ($P < 0.05$) from each other.

Table 2 Effect of fat on sensory properties of Ricotta cheese whey (RCW)

Attributes	NFM-RCW	LFM-RCW	MFM-RCW	FFM-RCW
Flavour	6.06±0.42^{c}	6.49±0.39^{b}	6.42±0.52^{b}	7.12±0.16^{a}
Sourness	7.11±0.39^{a}	6.88±0.26^{a}	6.13±0.55^{b}	5.95 ±0.19^{b}
Colour and appearance	6.02±0.21^{b}	6.84±0.48^{a}	6.70±0.33^{a}	6.88±0.30^{a}
Saltiness	6.87±0.31^{a}	6.05±0.18^{b}	6.11±0.23^{b}	5.96±0.34^{b}

Data are presented as Mean ± SD, n =3. Means with different lowercase superscripts (a, b, c) in each row are significantly different ($P < 0.05$) from each other.

protein, and 4.14% lactose and ash content of unsalted and salted scotta was around 0.44% and 0.62%, respectively.

The pH values (at 20°C) of all RCW samples were in the range of 5.51 to 5.74. The pH value was found to be significantly higher ($P<0.05$) in FFM-RCW when compared to other treatments (Table 1). However, significant difference was not observed between NFM-, LFM- and MMF-RCW. High pH value in FFM-RCW might be due to the addition of FFM (contains 4.5% fat) which decreased the level of protein in the whey that is also a major contributor for pH in the milk. Maragkoudakis et al. (2016) reported that pH of scotta was in the range of 5.5 to 5.9. The titratable acidity values of RCW ranges from 0.162 to 0.189 % lactic acid, the highest value being observed for MFM-RCW and did not differ significantly from NFM- and LFM-RCW. The effect of colour profile on RCW is given in a Table 1. A L* value of RCW represents the brightness of the samples, which was in the range of 35.03–28.98. All the samples reported low brightness value because most of the casein has been removed from Scotta. The highest brightness value ($P<0.05$) was observed in FFM-RCW sample which might be due to the presence of a higher levels of fat when compared with other RCW samples. Results also showed that reducing the fat content in RCW has an inverse relationship with the L* value. The negative a* value represents greenness in the RCW samples due to the presence of riboflavin in whey, which ranges from -3.02 to -3.50. It was significantly higher ($P<0.05$) in LFM-RCW than the other treatments and lowest in FFM-RCW. The negative b* value represents the redness in the samples, which was in the range of -0.50 to -1.93. Results showed that there was a significant difference in b* value among RCW samples, which might be due to the varying fat and protein content in the samples. Reducing the fat content leads to lower carotene content and makes the sample less yellow in colour.

The sensory study has been done to check the acceptability score of the RCW as raw material which can be used for making beverages. The results of sensory evaluation of RCW samples are presented in the Table 2. The score for the flavour attribute was in the range of 6.06 to 7.12. The highest score observed in the FFM-RCW sample, which might be due to the presence of a higher levels of fat as compared with the other samples, as fat is a major contributor to the flavour of any product. As expected the lowest flavour score was observed for NFM-RCW sample. The sourness in the samples was mainly due to the addition of citric acid (5% w/v) during the preparation of Ricotta cheese. Sourness score for NFM-RCW was found to be highest among the treatments and differed significantly ($P<0.05$) from MFM- and FFM-RCW. Scores for colour and appearance did not differ significantly ($P>0.05$) among LFM-, MFM- and FFM-RCW samples while lower score was observed in the NFM-RCW. All the RCW samples were reported to have a salty taste, which might be due to the ash content in the samples. The score for saltiness of the NFM-RCW sample was reported to be the highest, which might be due to the combined effect of the higher amount of ash and protein content in the sample compared to other samples. However, significant difference ($P>0.05$) was not observed between LFM-, MFM- and FFM-RCW samples.

Conclusions

In the present investigation, effect of variation in the fat content of milk and whey mixture used in the manufacture of Ricotta cheese on physico-chemical and sensory properties of RCW was studied. FFM-RCW had higher fat, pH, L* value and lower protein, acidity, b* and a* values when compared to other RCW samples. Fat content of RCW positively influenced the flavour and colour scores and reduced the saltiness and sourness scores with increase in the fat content of RCW.

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