Whey Ricotta Cheese Manufactured from Fluid and Condensed Whey

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ABSTRACT

Twenty-four different supplies of fresh Mozzarella cheese whey were pasteurized. Twenty-one were evaporated into seven condensed whey (CWP) categories; three were not evaporated. Each whey and whey product was subsequently manufactured into Ricotta cheese. Average total solids (TS) content ranged from 6.70 to 35.90%. The Ricotta cheeses manufactured from five of the eight categories were judged to be acceptable for the market. Average TS (o/o) of the acceptable categories were 6.70, 10.31, 14.87, 18.02 and 20.86. Ricotta cheeses manufactured with CWP of average TS contents of 25.10, 28.67 and 35.90% were not acceptable. Flavor defects for Ricotta cheeses that were unacceptable included coarse, unnatural and unclean; body and texture defects included gritty and mealy. We recommend the manufacture of whey Ricotta cheese with approximately 21% CWP. Yields based on total weight for CWP with 20.86% TS averaged 21.32%, more than four times greater than the noncondensed whey. Ricotta cheese from CWP of 20.86% TS tested 69.75% moisture, 7.55% protein, 13.37% lactose, 4.30% fat and 0.72% salt. Large amounts of protein and lactose remained in the Ricotta cheese whey and must be handled properly to prevent pollution.

An estimated 29.5 billion pounds of liquid whey were produced as a byproduct of the cheese industry in 1975, and 81% of that total was sweet whey (6). Strict antipollution requirements (5) and the realization that whey contains protein of excellent nutritional quality (11,14), used in many food products (7,9), mandate continued research to improve whey utilization. Manufacture of Ricotta cheese (4,12) is one possible method for reclaiming protein in whey. Currently, this is unattractive to industry because of low yields and high labor costs (12). If yields could be improved significantly and the quality of the Ricotta maintained, the dairy industry might take a closer look at its manufacture from whey. This study was designed to determine the feasibility of manufacturing an acceptable Ricotta cheese from concentrated whey.

MATERIALS AND METHODS

Whey

Fresh Mozzarella whey was obtained from a local cheese plant. Each of 24 different lots was pasteurized at 63°C for 30 min on arrival at the University Dairy Plant and 21 of these were condensed.

Condensed whey

Whey concentrates of varied solids content were manufactured in a Rogers single-effect vacuum evaporator. The evaporator was operated at 54°C with a vacuum of 660-686 mm. Following concentration to the desired total solids (TS), the condensed whey product (CWP) was stored at 4.4°C until it was manufactured into Ricotta cheese. Average TS content (o/o) of the CWP for three trials were: 6.70 (non-condensed), 10.31, 14.87, 18.02, 20.86, 25.10, 28.67 and 35.90.

Manufacture of Ricotta cheese

Each whey supply (three noncondensed and 21 CWPs) was manufactured into Ricotta cheese by the following procedure: (a) One-hundred and fifty-nine kg of whey was placed in a cheese vat equipped with a direct steam injector. (b) The whey was standardized to pH 6.35-6.55 with sodium bicarbonate, then heated to 16-21°C and held 10 min. (c) Heating was continued to 44°C, then 454 g of salt added. (d) Whey was heated to a final temperature of 88°C over a period of 45 min. (e) Emulsion Sag 10 defoamer was added as required to control foaming (Union Carbide, Hamlet and Hayes Co., Colonial Road, Salem, MA). Granular citric acid dissolved in 2.5 l of hot water was dispersed throughout the whey in amounts necessary to lower the pH of the whey at coagulation to 4.8-5.0. (f) The steam valve was closed slowly when precipitate first appeared (0.5-1.0 min). Jacket steam in the cheese vat was turned on for 5 min. (g) After an additional 15-20 min, whey was drained from the vat through cheese cloth placed over the outlet to prevent curd loss. (h) Remaining curd and whey were stirred and drained into a sanitized plastic bucket. The contents of the bucket were then emptied into perforated plastic containers lined with disposable polyethylene cheese press wraps. (i) Card was drained for an additional 15 min, covered, then drained overnight at 4.4°C.

Collection of samples

Samples of whey before precipitation were taken directly from the cheese vat after salt had been added. Also, whey samples after precipitation were taken when the vat was partially drained. All whey samples were collected in both 177- and 532-ml Whirl-Pak bags. Cheese samples were collected aseptically in 532-ml bags and in 454-g cardboard containers.

Laboratory analyses

Whey. The pH and titratable acidity of the whey (8) were recorded three times: upon arrival at the plant, before precipitation and again after precipitation in the cheese vat. Samples collected before and after precipitation were analyzed also for TS (7), protein (2), fat (6), and lactose (10).

Ricotta cheese. Chemical tests made on the cheese samples were pH (8), moisture (3), protein (2), fat (8), salt (13) and lactose (10). Microbiological tests (1) were Standard Plate Count, Coliform, Psychrotrophic and Yeast and Mold Counts.

The palatability of each Ricotta sample was evaluated by two experienced cheese-flavor specialists. Flavor, body and texture were each rated on separate scales from 1.00-5.00. A score of 5.00 points for flavor as well as for body and texture indicated an excellent sample. Deductions in units of 0.25 points were used to rate the severity of criticism. Ricotta cheese with an average score of 4.00 and above for flavor as well as body and texture was established as acceptable for the market.
RESULTS AND DISCUSSION

Fat was not separated from the 24 fresh Mozzarella whey supplies that were received at the University Dairy Plant. Each supply was obtained from a local cheese plant on 24 different days and was used as received without standardization or fortification. Additional processing was not desirable because we did not want to increase the cost of Ricotta cheese manufacture. Consequently, variations in major constituents for whey, condensed whey products (CWP), and manufactured Ricotta were expected and evident. Data presented here are average values of three trials for each of the eight whey products.

Quality of Ricotta

Most nutritionists would agree that the proteins, minerals and vitamins in whey Ricotta cheese are excellent quality nutrients. However, if the cheese is not palatable, nutritional value will not be used. Thus, subjective analysis of the finished products was considered first. Data in Table 1 show Ricotta cheeses manufactured from 6.70 (non-condensed) to 20.86% TS are acceptable for the market. CWP of 25.10, 28.67 and 35.90% TS were not acceptable. Flavor defects for the unacceptable Ricotta cheeses included coarse, unclean, and unnatural; body and texture defects included mealy and grainy. These sensory defects were associated with increased lactose and decreased fat and moisture contents. Ricotta, manufactured with CWP of 20.86% TS content, had a pleasantly sweet taste, and possessed neither a foretaste nor aftertaste other than its natural flavor. It had a firm body and a smooth and velvety texture. We recommend the manufacture of whey Ricotta cheese from CWP having approximately 21% TS.

Consumer acceptance for this product would depend greatly on its shelf-life. However, this study was not designed to examine the shelf-life of Ricotta cheese. Microbiological data of the 24 Ricotta cheeses indicated they were not grossly contaminated. The cheese manufactured from 20.86% TS contained less than 8,000 organisms per g, less than 10 coliform and psychrotrophic bacteria, and less than 1 yeast and mold. These data suggest that manufacturing Ricotta cheese by the above-described method can produce a product with acceptable shelf-life.

Yield and composition of Ricotta cheese

Yield of Ricotta cheese was calculated as a percentage based on the total weight of solids recovered from 45.36 kg of whey and CWP. These values are presented in Table 2, column 2. Yield from noncondensed whey was 5.25% and compared to a 6.0% value reported by True (12). As %TS of CWP increased, yield increased correspondingly. Obvious reasons for these increases were higher %TS of the CWP and recovery of more than these TS in the Ricotta cheeses. As seen in Table 2, yield for the 20.86% CWP averaged 21.32%, more than four times greater than for the noncondensed whey (6.7%).

Federal standards of identity have not been established for Ricotta cheese. Data in Table 2 show that as the yield of Ricotta cheese increased, there was a corresponding rise in percentages of lactose and salt; moisture content decreased uniformly, while levels of protein and fat were variable. Actual percent composition for each of the major constituents in the marketable Ricotta cheeses are shown in Table 2. Ricotta, manufactured from 20.86% CWP, contained the following composition: 69.75% moisture, 7.55% protein, 13.37% lactose, 4.30%fat and 0.72% salt.

Composition of Ricotta Cheese whey

Percent protein, lactose, and fat that remained in the Ricotta cheese whey is reported to show the efficiency of the precipitation process. As seen in Table 3, when the %TS of the CWP increased, percentages of protein, lactose, and fat were variable. The reason for such variability is thought to be caused by the difficulty of controlling an exact make procedure from batch to batch. This variability is further emphasized by looking at the recoveries of the same solids concentration in cheese from whey containing varied solids concentration.

### Table 1. Flavor scores of whey Ricotta cheese manufactured from fluid and condensed whey products (CWP).

<table>
<thead>
<tr>
<th>Total solids of CWP (%)</th>
<th>Flavored categories²</th>
<th>Average score b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flavor</td>
<td>Body and texture</td>
</tr>
<tr>
<td>6.70 noncondensed</td>
<td>4.42</td>
<td>4.25</td>
</tr>
<tr>
<td>10.31</td>
<td>4.83</td>
<td>4.58</td>
</tr>
<tr>
<td>14.87</td>
<td>4.33</td>
<td>4.42</td>
</tr>
<tr>
<td>18.02</td>
<td>4.33</td>
<td>3.83</td>
</tr>
<tr>
<td>20.86</td>
<td>3.75</td>
<td>4.25</td>
</tr>
<tr>
<td>25.10</td>
<td>3.83</td>
<td>3.50</td>
</tr>
<tr>
<td>28.67</td>
<td>2.83</td>
<td>4.33</td>
</tr>
<tr>
<td>35.90</td>
<td>2.17</td>
<td>3.17</td>
</tr>
</tbody>
</table>

²Samples judged by 2 experienced cheese-flavor specialists on a graduated scale from 1 to 5 for both flavor and for body and texture (5 was excellent quality). Average values for 3 trials.

### Table 2. Yield and composition of marketable Ricotta cheese manufactured from fluid and condensed whey products (CWP).

<table>
<thead>
<tr>
<th>Total solids of CWP (%)</th>
<th>Yield b</th>
<th>Composition (%)</th>
<th>Percent protein c</th>
<th>Percent fat d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moisture</td>
<td>Protein</td>
<td>Lactose</td>
<td>Fat</td>
</tr>
<tr>
<td>6.70 ⁶</td>
<td>5.25</td>
<td>79.24</td>
<td>9.29</td>
<td>4.46</td>
</tr>
<tr>
<td>10.31 ⁶</td>
<td>9.88</td>
<td>78.03</td>
<td>7.67</td>
<td>7.13</td>
</tr>
<tr>
<td>14.87 ⁶</td>
<td>15.69</td>
<td>75.21</td>
<td>8.10</td>
<td>9.50</td>
</tr>
<tr>
<td>18.02 ⁹</td>
<td>16.85</td>
<td>71.81</td>
<td>9.06</td>
<td>12.31</td>
</tr>
<tr>
<td>20.86 ⁹</td>
<td>21.32</td>
<td>69.75</td>
<td>7.55</td>
<td>13.37</td>
</tr>
</tbody>
</table>

³Average values for 3 trials.

⁴Values calculated as percentage of total weight of beginning product.

⁵Percent protein recovered in cheese from whey containing varied solids concentration.

⁶Percent fat recovered in cheese from whey containing varied solids concentration.

⁷Noncondensed.
TABLE 3. Percentage of protein, lactose, and fat remaining in the whey after precipitation of the curd for manufacture of marketable Ricotta cheese.

<table>
<thead>
<tr>
<th>Total solids of whey (%)</th>
<th>Protein</th>
<th>Lactose</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.70</td>
<td>52.71</td>
<td>89.49</td>
<td>10.32</td>
</tr>
<tr>
<td>10.31</td>
<td>42.92</td>
<td>80.64</td>
<td>8.03</td>
</tr>
<tr>
<td>14.87</td>
<td>38.45</td>
<td>71.81</td>
<td>3.40</td>
</tr>
<tr>
<td>18.02</td>
<td>36.87</td>
<td>82.15</td>
<td>10.53</td>
</tr>
<tr>
<td>20.86</td>
<td>37.38</td>
<td>69.89</td>
<td>3.63</td>
</tr>
</tbody>
</table>

aAverage values for 3 trials.
bPercentage of each constituent calculated by the following equation: 
\[
\frac{\text{Kg of constituent in whey after precipitation}}{\text{Kg of constituent in whey before precipitation}} \times 100
\]
cCondensed whey products.

In conclusion, Ricotta cheese of marketable quality was manufactured successfully from Mozzarella whey that was condensed to a TS content of 20.86%. A four-fold increase in yield, when compared to results obtained from noncondensed whey (6.7%), should make this procedure attractive to the cheese industry.

ACKNOWLEDGMENTS

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REFERENCES


Coming Events,

con't. from p. 609

Oct. 14-17--24th ANNUAL ATLANTIC FISHERIES TECHNOLOGISTS CONFERENCE. Danvers, MA. Contact: Fred J. King, 1979 AFTC Secretary, Gloucester Laboratory, Northeast Fisheries Center, National Marine Fisheries Service, Emerson Ave., Gloucester, MA 01930, 617-281-3600, ext. 296.


Nov. 3-6--1979 AMERICAN MEAT INSTITUTE CONVENTION. McCormick Place and The Conrad Hilton, Chicago. Contact: Jodi Winslow, American Meat Institute, P.O. Box 3536, Washington, D.C. 20007, 703-841-2431.


Nov. 27-29--INTERNATIONAL CONFERENCE ON UHT PROCESSING AND ASEPTIC PACKAGING OF MILK AND MILK PRODUCTS. North Carolina State University, Raleigh, NC 27650. Contact: W. M. Roberts, Dept. of Food Science, NCSU, Raleigh, NC, 27650.

Dec. 3-8, 10-15--DAIRY DAYS. Sponsored by University of Nebraska-Lincoln Institute of Agriculture and Natural Resources, Nebraska State Dept. of Agriculture, and Nebraska milk marketing outlets. Cooperating organizations are Nebraska Veterinary Medical Association and Dairy Women of Nebraska. Two programs, one week apart, will be held in the following locations: Columbus, NB--Dec. 3, 10; Beemer, NB--4, 11; Hartington, NB--5, 12; O'Neili, NB--6, 13; Ravenna, NB--7, 14; Beatrice, NB--8, 15. Contact: Nebraska Dairy Women, plant fieldmen, or county extension agents for advance registration.

Mar. 26, 1980--ONTARIO FOOD PROTECTION ASSOCIATION, Annual Meeting, Holiday Inn, 970 Dixon Road, Toronto.