

Ref. 16

Standardization of Milk using Cold Ultrafiltration Retentates for the
Manufacture of Swiss Cheese

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Two types of cheesemilks were prepared; control and milk standardized with whole milk UF retentate. The CONTROL cheesemilk was standardized by cream removal to an average of 2.84% (2.50% CN) solids with a mean CN: fat ratio of ~0.88. The UF Swiss cheesemilk was prepared by blending the whole milk UF retentate with partly-skimmed milk (2.55% fat) to obtain WUF milk with 13.56% solids (3.33% CN) with a mean CN:fat ratio of 0.86 (Table 1). The composition of the blended milks are shown below in Table 2. The day after membrane processing, Swiss cheese were manufactured from each of two cheesemilks (CONTROL and WUF) by a licensed cheesemaker in the University of Wisconsin-Madison dairy processing pilot plant using a traditional Swiss manufacturing protocol. The composition of the drain whey, press whey and cheese are shown in Table 2.

Table 1. Average weights and composition of the different milk and retentate used in the preparation of the UF standardized cheesemilk

Treatments	Weight of milk used in blending (%)	Total Solids (%)	Casein (%)	Total Protein (%)	Milk Fat (%)
UF Swiss, prepared by blending:					
a) WUF ¹ retentates	16.0 ± 2.5	26.58 ± 0.16	7.76 ± 0.20	9.70 ± 0.27	11.47 ± 0.07
b) Part skim milk	84.0 ± 2.5	11.54 ± 0.24	2.54 ± 0.03	3.28 ± 0.08	2.55 ± 0.01

¹WUF = Whole Milk Retentate

Table 2. Compositions of standardized cheesemilk, whey, press whey and cheese

Component	Control	UF Swiss	P-value
Standardized Cheesemilk			
Total Solids, %	11.55 ^b	13.56 ^a	<0.0001
Milk Fat, %	2.84 ^b	3.87 ^a	<0.0001
Total Protein ¹ , %	3.29 ^b	4.24 ^a	<0.0001
True Protein ² , %	3.05 ^b	4.06 ^a	<0.0001
Casein ³ , %	2.50 ^b	3.33 ^a	<0.0001
Non-protein Nitrogen, %	0.031 ^a	0.029 ^b	<0.01
Casein to Total Protein, %	77.35 ^b	78.33 ^a	<0.01
Casein to True Protein, %	81.93 ^a	81.95 ^a	<0.01
Whey Protein ⁴ , %	0.18 ^b	0.19 ^a	<0.01
Whey Protein in Serum Phase ⁶ , %	0.19 ^b	0.20 ^a	<0.01
Lactose, %	4.40	4.36	NS ⁵
Lactose in Serum Phase ⁷ , %	4.65	4.70	NS
Casein:Fat ratio	0.88	0.86	NS
Drain Whey			
Total Solids, %	5.98	6.08	NS
Milk Fat, %	0.27 ^b	0.39 ^a	<0.0001
Total Protein, %	0.79 ^b	0.99 ^a	<0.0001
True Protein, %	0.60 ^b	0.79 ^a	<0.0001
Lactose, %	4.21 ^a	4.03 ^b	<0.01
Press Whey			
Total Solids, %	5.95 ^a	6.06 ^a	0.02
Milk Fat, %	0.28 ^a	0.30 ^a	0.02
Total Protein, %	0.85 ^b	1.04 ^a	<0.0001
True Protein, %	0.66 ^b	0.84 ^a	<0.0001
Lactose, %	4.05	4.00	NS
Cheese			
Moisture, %	38.59 ^a	38.35 ^a	<0.01
Fat, %	29.64 ^a	29.92 ^a	<0.0001
Total Protein ⁸ , %	27.51	27.37	NS
Salt, %	0.73	0.66	NS
MNFS ⁹ , %	54.84 ^a	54.71 ^a	0.02
FDM ¹⁰ , %	48.25 ^a	48.53 ^a	<0.01
SM ¹¹ , %	1.88 ^a	1.72 ^a	0.03

¹Total % N × 6.35

²(Total % N - % Non Protein N) × 6.35

³(Total % N - % Non Casein N) × 6.36

⁴True Protein - Casein

⁵Nonsignificant (F test for full statistical model $P > 0.05$)

⁶Whey protein in serum phase = % Whey protein / (100% - % Fat - % CN)

⁷Lactose in Serum Phase = % Lactose/(100% - % Fat - % CN)

⁸Total % N × 6.31

⁹Moisture in the nonfat substance of the cheese

¹⁰Fat content on a dry weight basis

¹¹Salt in the moisture phase of the cheese

^{a,b,c}Means within the same row not sharing a common superscript differ ($P < 0.05$)

Changes in pH During Ripening of Swiss Cheese

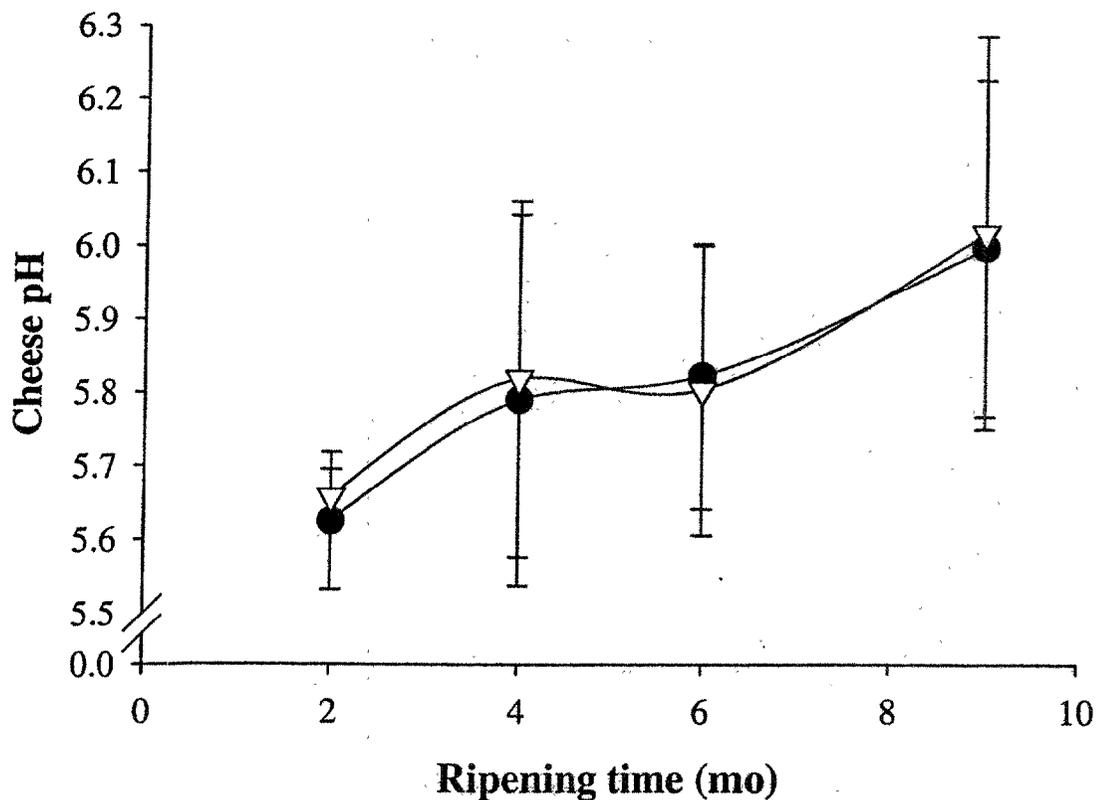


Figure 1. pH for control cheese (●), and UF retentate standardized Swiss cheeses (▽) during 9 months of ripening of Swiss cheeses at 7°C. Vertical bars represent standard deviations.

The pH values of the cheeses were not significantly different during ripening (Figure 1)

The pH increased from 5.6 to about 6.0 during the 9 months of ripening.

Changes in 12% TCA soluble nitrogen as a percentage of total nitrogen during ripening of Swiss Cheese

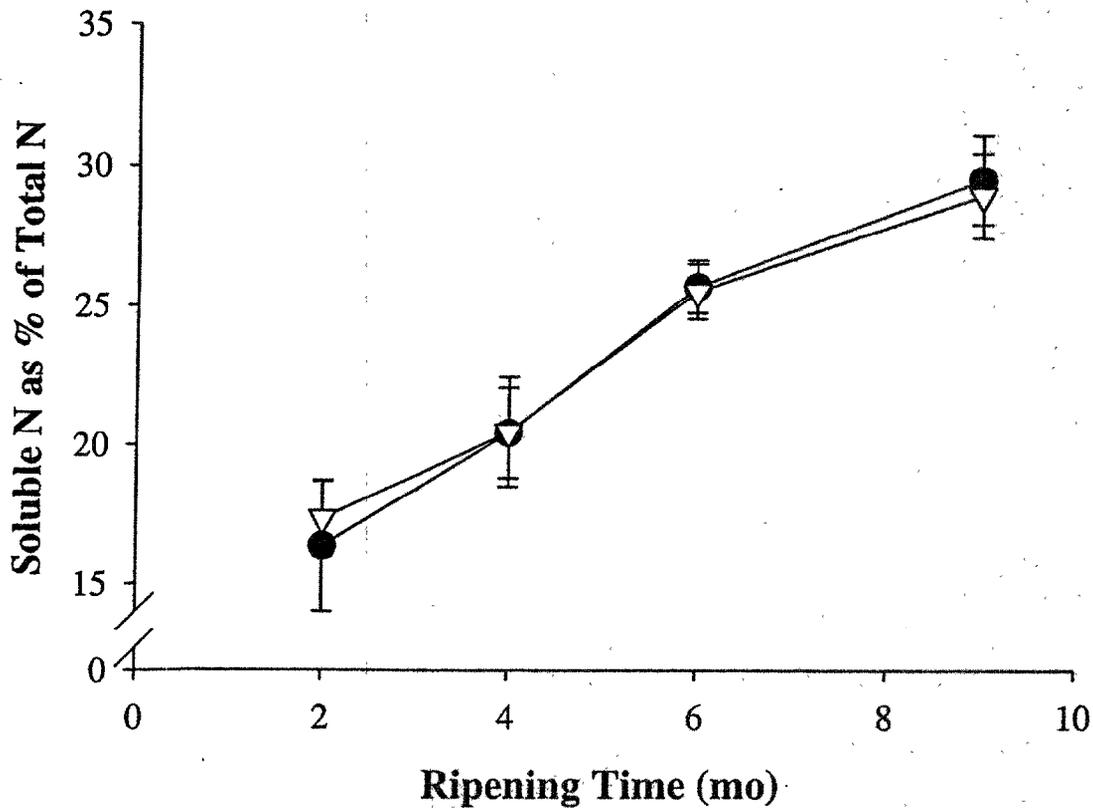


Figure 2. 12% TCA soluble nitrogen as a percentage of total nitrogen for control cheese (●), and UF retentate standardized Swiss cheeses (▽) during 9 months of ripening of Swiss cheeses at 7°C. Vertical bars represent standard deviations.

The use of higher solids milks did not result in any significant difference in the formation of 12% TCA soluble N during cheese ripening (Figure 2). As expected, age had a significant effect on 12% TCA soluble N production.

Informal Sensory Results

Informal sensory analysis by three experienced Swiss graders did not notice any obvious differences between the cheeses during ripening.