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Cross flow microfiltration of ovine whey derived from the manufacture of Feta and Gruyere-type cheese: Effect on chemical composition and microflora

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Introduction

Membrane technology has been applied to the dairy industry over the last 30 years and is a cost-effective solution to separate or concentrate milk components. In addition, this technology is applied on whey, the by-product of cheesemaking with environmental challenge, to produce whey proteins concentrates. The aim of this research work was to study the effect of cross-flow microfiltration (CFMF) on ovine whey derived from soft and hard cheese manufacture.

Materials and Methods

Whey from Gruyere-type cheesemaking, hard cheese, (sample GW) and from Feta cheesemaking, soft cheese, (sample FW) were processed by CFMF on a pilot microfiltration module (PALL Italia s.r.l, MILANO, Italy) under the following conditions: constant transmembrane pressure (TMP) 1.5 bar at 50°C, ceramic membrane P19-40 (Membralox®) of 1.4 μm pore size, with length 1020 mm and area 0.24m2. Filtration duration was 15 min with constant flux at 162.03 ± 24.77 L.m^{-2}.h^{-1} for the permeate of GW (sample GWP) and 175,46 ± 13.31 L.m^{-2}.h^{-1} for the permeate of FW (sample FWP). Chemical composition was determined by FTIR (Milkoscan, Foss, Denmark), minerals by atomic absorption spectrometry (IDF, 2007), whey proteins by RP-HPLC (Moatsou et al., 2005) and carbohydrates by HPLC. pH, acidity and microflora counts were also determined. Apart from initial whey and permeates, the retentates were also analyzed (samples GWR and FWR). The obtained data were subjected to statistical analysis by comparing the means using the Least Significant Difference test (LSD, $P < 0.05$).

The microfiltration unit which was used

Main Results

- The whey obtained from the manufacture of the hard cheese (GW) was significantly (P<0.05) richer in fat, protein, calcium and total solids content than the whey obtained from the soft cheese (FW) (Fig. 1,2).
- Fat and total solids contents of both, FW and GW were decreased significantly by CFMF. As for fat, a reduction of 1.65% to 0.14% was achieved for GW and from 0.45% to 0.06% for FW.
- pH and acidity of retentates differed significantly between GWR and FWR (Table 1).
- No significant effect on whey proteins was observed (Fig. 3).
- Neither the lactic acid contents nor the main carbohydrates, such as lactose, glucose and galactose were they affected (Fig. 4).
- The population of total mesophilic flora, thermophilic lactococci and lactobacilli were reduced by 3-5 log cycles, while no yeasts, fungi and coliforms were observed in the permeates (Fig. 5).

Table 1. pH and acidity (mean of 3 trials ± SD) of whey (GW and FW), whey permeate (GWP and FWP) and whey retentate (GWR and FWR) derived from Graviera (G) or Feta (F) cheesemaking

	Whey from Gruyere-type cheesemaking			Whey from Feta cheesemaking		
	GW	GWP	GWR	FW	FWP	FWR
pH	6.36±0.52^{b*}	6.09±0,56 ^{a,b}	5.47±0.59^{a}	6.27±0.28^{b}	6.32±0.31^{b}	6.32±0.30 ^{b}
Acidity	0.10±0.01^{a}	0.12±0.03 ^{a}	0.18±0.05^{b}	0.11±0.02^{a}	0.10±0.02^{a}	0.10±0.02 ^{a}

*Means with different superscript letters in the same row differ significantly *(P<0.05)*

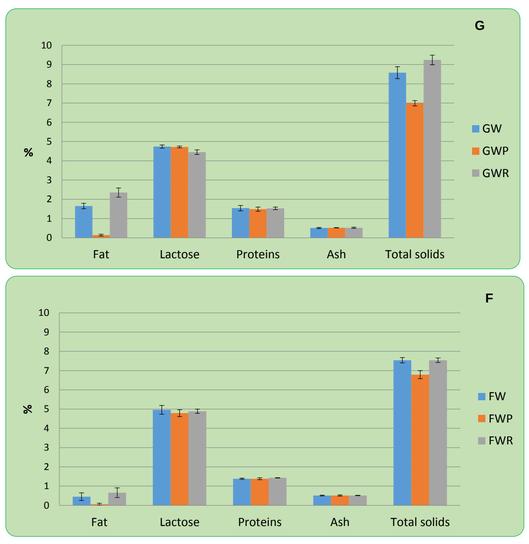

Fig. 1. Chemical composition of whey (GW and FW), whey permeate (GWP and FWP) and whey retentate (GWR and FWR) derived from Graviera (G) or Feta (F) cheesemaking

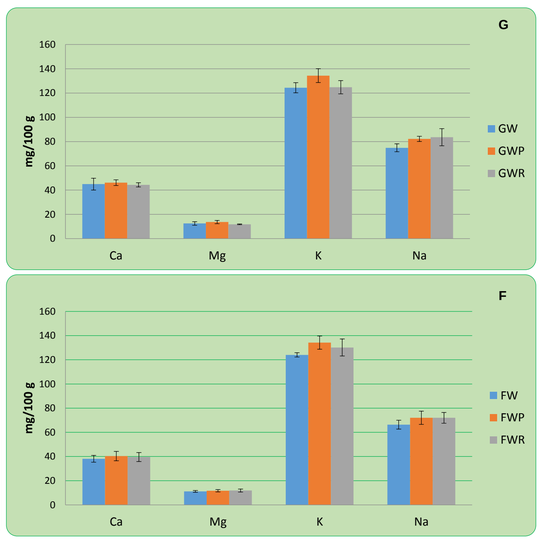

Fig. 2. Inorganic elements of whey (GW and FW), whey permeate (GWP and FWP) and whey retentate (GWR and FWR) derived from Graviera (G) or Feta (F) cheesemaking

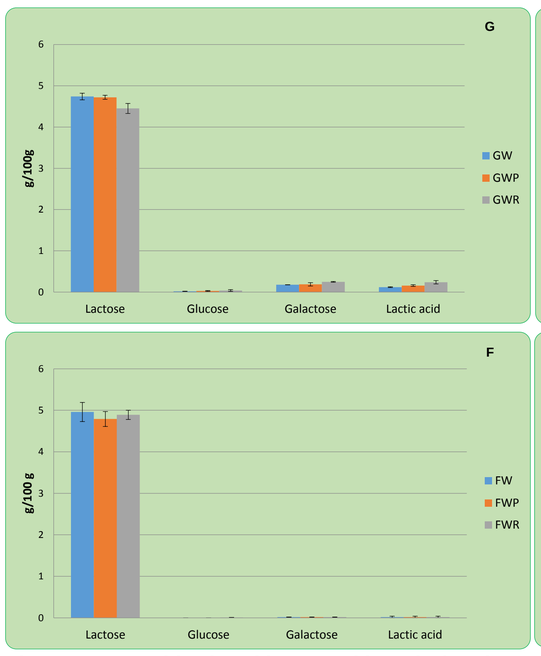

Fig. 4. Sugar and lactic acid composition of whey (GW and FW), whey permeate (GWP and FWP) and whey retentate (GWR and FWR) derived from Graviera (G) or Feta (F) cheesemaking

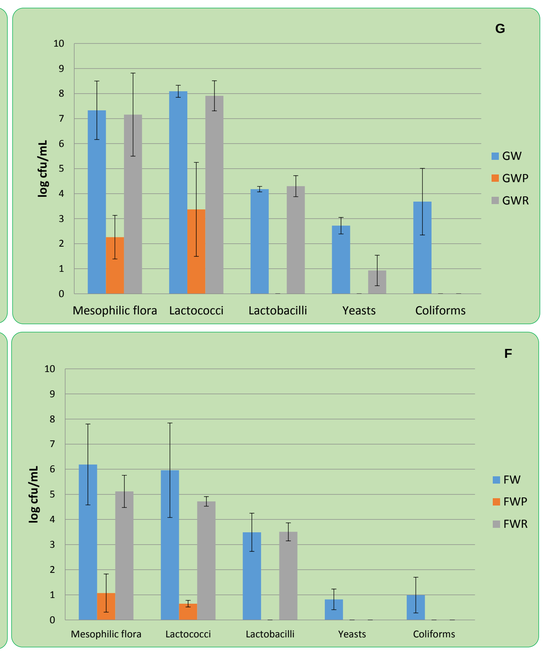

Fig. 5. Microbial counts of whey (GW and FW), whey permeate (GWP and FWP) and whey retentate (GWR and FWR) derived from Graviera (G) or Feta (F) cheesemaking

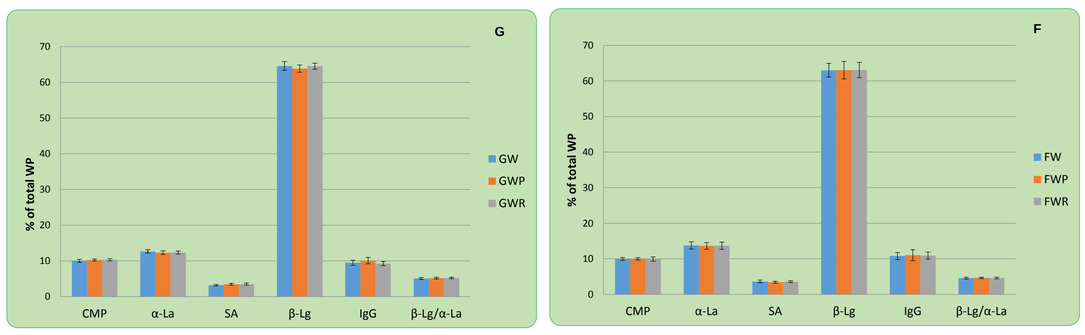

Fig. 3. Protein composition of whey (GW and FW), whey permeate (GWP and FWP) and whey retentate (GWR and FWR) derived from Graviera (G) or Feta (F) cheesemaking

Conclusion

Under the studied conditions, the cross flow microfiltration of whey from different cheeses affected significantly the fat content as well as the microbial load in the same way, i.e. no matter of the whey origin.

Acknowledgements

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