Novel Microfiltration Process for the Manufacture of Soluble Casein Isolate from Acidified Milk

Yanjie Lu, Mike Molitor, and John A Lucey
Wisconsin Center for Dairy Research, University of Wisconsin-Madison

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Introduction

Caseinates are traditionally manufactured by acidifying skim milk to precipitate caseins, thoroughly washing the precipitate and then neutralizing the acid casein curd with alkali, which requires very specialized equipment. Sodium caseinates contain low residual concentrations of whey proteins, calcium and lactose. At neutral pH, caseinates are more soluble and less turbid than MPC, MPI and micellar casein.

Objectives

The objective of this study was to develop an innovative process utilizing spiral membrane microfiltration (MF) to produce a soluble casein isolate (caseinate) that could perform as a caseinate alternative.

Materials and Methods

Preparation of soluble casein isolate

Stable casein dispersions were prepared by sufficient acidification of pasteurized skim milk to solubilize the colloidal calcium phosphate (CCP), but avoid aggregating the caseins (Lucey, et al., 1997). The acidified skim milk was processed at ambient temperature using microfiltration /diafiltration to remove serum proteins, lactose, and the soluble minerals. Next the acid MF concentrate was neutralized with concentrated NaOH and spray dried (Figure 1).

Summary / Main Findings

- Moderate acidification solubilized the majority of CCP.
- It is critical to maintain a narrow pH range because pH < 5.2 would induce casein precipitation while pH > 5.5 reduces calcium solubility and decreases casein retention during microfiltration.
- Acidification of the diafiltration water helped to maintain the narrow target pH, which facilitated calcium depletion and casein retention.
- This innovative process can yield product meeting the codex standards for caseinates (Table 1).
- When rehydrated to a total solids content of 5% (w/v), our casein isolate was less turbid compared to commercial sodium caseinate.
- This novel process produces a soluble casein isolate that compares favorably against commercial sodium caseinate.

Acknowledgements

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Results

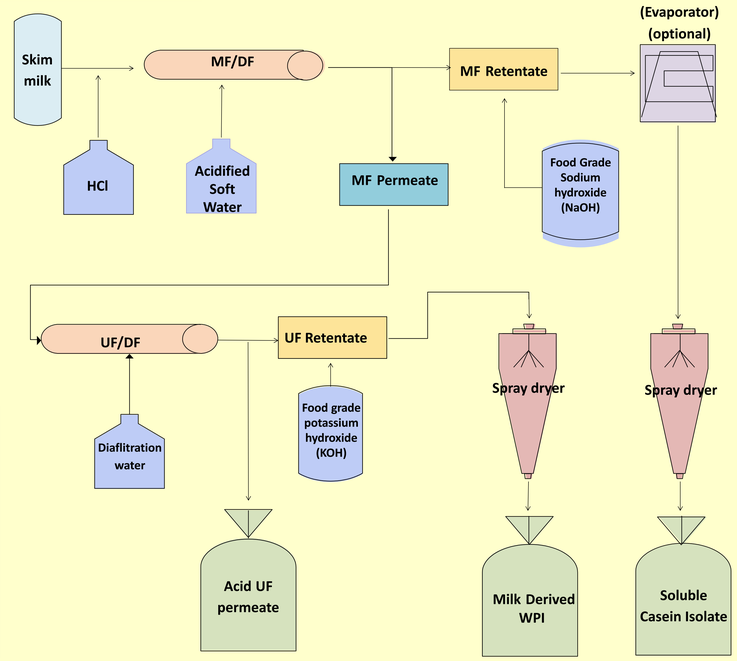

Figure 1. Flow chart for soluble casein isolate and by-products.

Table 1. Composition of soluble casein isolate (example)

	Soluble Casein Isolate	Codex Standard for edible casein products
Protein in dry matter (%)	93.3	≥ 88
Casein as a % of milk protein (%)	97.0	≥ 95
Moisture (%)	6.25	≤ 8
Fat (%)	1.60	≤ 2
Lactose (%)	0.37	≤ 1
Ash (%)	4.11	—
pH (10% solution)	7.29	≤ 8

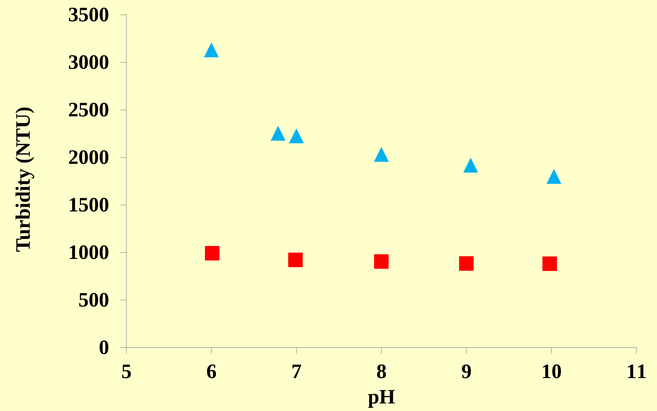

Figure 2. Turbidity of 5% caseinate solutions at different pH values. (■) soluble casein isolate, (▲) commercial sodium caseinate. NTU: Nephelometric turbidity units.

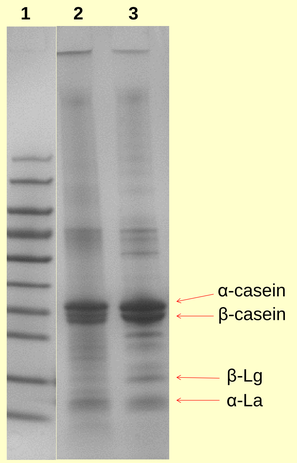

Figure 3. SDS-PAGE image of casein products. Lane 1, protein standards; Lane 2, commercial sodium caseinate; Lane 3, soluble casein isolate.

Figure 4. Comparison of the clarity of commercial sodium caseinate and soluble casein isolate solutions (5%, w/w).

References

Lucey, J. A. C. Dick, H. Singh and P. A. Munro. 1997. Dissociation of colloidal calcium phosphate-depleted casein particles as influenced by pH and concentration of calcium and phosphate. Milchwissenschaft 52: 603-606.
Codex standard for edible casein products. CODEX STAN 290-1995, Adopted in 1995. Revision 2001. Amendments 2010, 2013, 2014.