Preliminary studies on heat stability of high protein dairy beverages containing modified milk protein concentrate

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Abstract # T93

Abstract

Milk protein concentrates (MPC) are becoming a preferred source of protein in ready-to-drink dairy beverages. Calcium-mediated aggregation of proteins during storage is one of the main reasons for the failure of these beverages. In the current study, two batches of each MPC85 (control), 20%-calcium reduced (MPC-20%), and 30%-Calcium reduced (MPC-30%) were evaluated in two phases and in duplicate. MPC-30% and MPC-20% exhibited the highest HCT of ~ 32 min at all levels of SHMP addition while MPC85-Control has the least HCT time of ~ 21-25 min at 0 and 0.15% SHMP. HCT of control (28.06 min) at 0.25% SHMP and HCT of MPC-30% (32.79 min) and MPC-20% (30.96 min) at 0% SHMP were not significantly different ($p>0.05$). In phase II, MPCs were reconstituted in a model dairy beverage formulation consisting, 10.26% of a mixture of gums (gellan gum, carrageenan, cellulose gel, and microcrystalline cellulose), maltodextrin, and sugar along with, 0.12% potassium citrate. Formulations were homogenized and treated with three concentrations of SHMP after adjusting pH to 7. It was found that the presence gums and sugar adversely impacted the HCT of formulated model beverage. Control at 0% SHMP and MPC-20% at 0% SHMP exhibited the highest HCT of 8.86 and 8.37 min, respectively and the HCT is not statistically different ($p>0.05$). This study shows the possibility of reduced levels of phosphate addition by using calcium reduced MPCs.

Introduction

- Milk protein concentrate powders (MPC) are high protein ingredients with caseins to whey proteins ratio same as milk.
- Minerals retained during ultrafiltration effect the storage stability and functionality of MPC due to mineral-protein interactions.
- Research suggested that reducing the calcium also increased the solubility of the MPC powders.
- The objective of this study was focused on application of calcium modified MPC in formulating a high protein dairy beverage.

Table 1. Compositions of the MPC powders used to formulate the high protein dairy beverage

MPC	Total solids (%)	Protein (%)	Calcium (%)
Control	94.73±0.18	80.77±0.02	2.21±0.04
MPC-20%	95.13±0.89	80.77±0.55	1.73±0.02
MPC-30%	94.70±0.17	80.02±0.14	1.47±0.02

Materials and Methods

- Two batches of each MPC85 (control), 20%-calcium reduced (MPC-20%), and 30%-calcium reduced (MPC-30%) were evaluated in two phases and in duplicate.

Phase I

- MPC powders were reconstituted to 8% protein in distilled water
- Adjusted pH to 7.0 and divided into three equal parts
- Sodium hexametaphosphate (SHMP) was added at three levels (0, 0.15, and 0.25%)
- Homogenized and heat stability was determined by measuring heat coagulation time (HCT) at 140°C

Phase II

- MPC powders were reconstituted to 8% protein solutions in distilled water along with model high protein dairy beverage formulation
- Model high protein dairy beverage formulation constituting 10.26% of mixture of gums, maltodextrin, sugar, and 0.12% potassium citrate was added to the solution
- pH of solution was adjusted to 7.0 and divided into three parts
- Sodium hexametaphosphate (SHMP) was added in 0, 0.15, and 0.25%
- Solutions were homogenized and heat stability was determined by measuring heat coagulation time (HCT) at 140°C

Results and Discussion

Table 2. Heat coagulation time (HCT) of the 8% protein solutions prepared in Phase I and Phase II

MPC	SHMP (%)	Phase I HCT (min)	Phase II HCT (min)
Control	0	20.95 ± 0.02^{c}	7.14 ± 0.04^{ab}
	0.15	25.29 ± 1.54^{bc}	8.86 ± 0.01^{a}
	0.25	28.06 ± 0.22^{ba}	3.81 ± 0.82^{c}
20% Ca reduced	0	30.955 ± 0.33^{ba}	8.37 ± 1.35^{a}
	0.15	32.27 ± 1.17^{a}	4.85 ± 0.39^{bc}
	0.25	32.65 ± 0.7^{a}	5.65 ± 0.05^{bc}
30% Ca reduced	0	32.79 ± 3.43^{a}	5.21 ± 1.42^{bc}
	0.15	32.43 ± 2.82^{a}	4.95 ± 1.98^{bc}
	0.25	32.15 ± 2.41^{a}	5.2 ± 0.11^{bc}

Values with same superscript are not significantly different ($p>0.05$). HCT values were compared within phases.

- In Phase I, 20 and 30% Ca reduced MPC formulations exhibited the highest heat stability. This increase was because of the increased stability in casein micelles with decreased calcium.
- However, In Phase II, MPC-20% with 0% SHMP and control with 0 and 0.15% SHMP exhibited high heat stability.
- Reduced heat stability in 20 and 30% Ca reduced MPC formulations in Phase II was attributed to chelation of colloidal calcium phosphate to a critical level which resulted in disruption of micellar structure integrity.
- Reduced heat stability was also attributed due to the presence of 0.12% citrate in the formulation along with SHMP.

Conclusions

- In Phase I as calcium reduced, heat stability increased, where as in Phase II the addition of sugars and gums along with citrate (chelating agent) decreased heat stability in beverage formulations with calcium modified MPC.
- High protein dairy beverages formulated in Phase II from MPC-20% and in the presence of no phosphates exhibited high heat stability.
- This study shows the possibility of reduced levels of phosphate addition when calcium reduced MPC were used.

References

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