The effect of ultra-high temperature and retort processing on ready-to-drink coffee latte quality

Uyen Phan and Anuradha Prakash

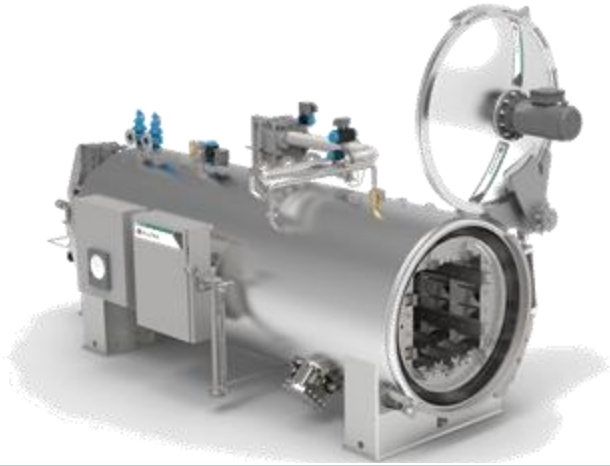
CHAPMAN UNIVERSITY

CHAPMAN UNIVERSITY

RTD Coffee lattes

CHAPMAN UNIVERSITY

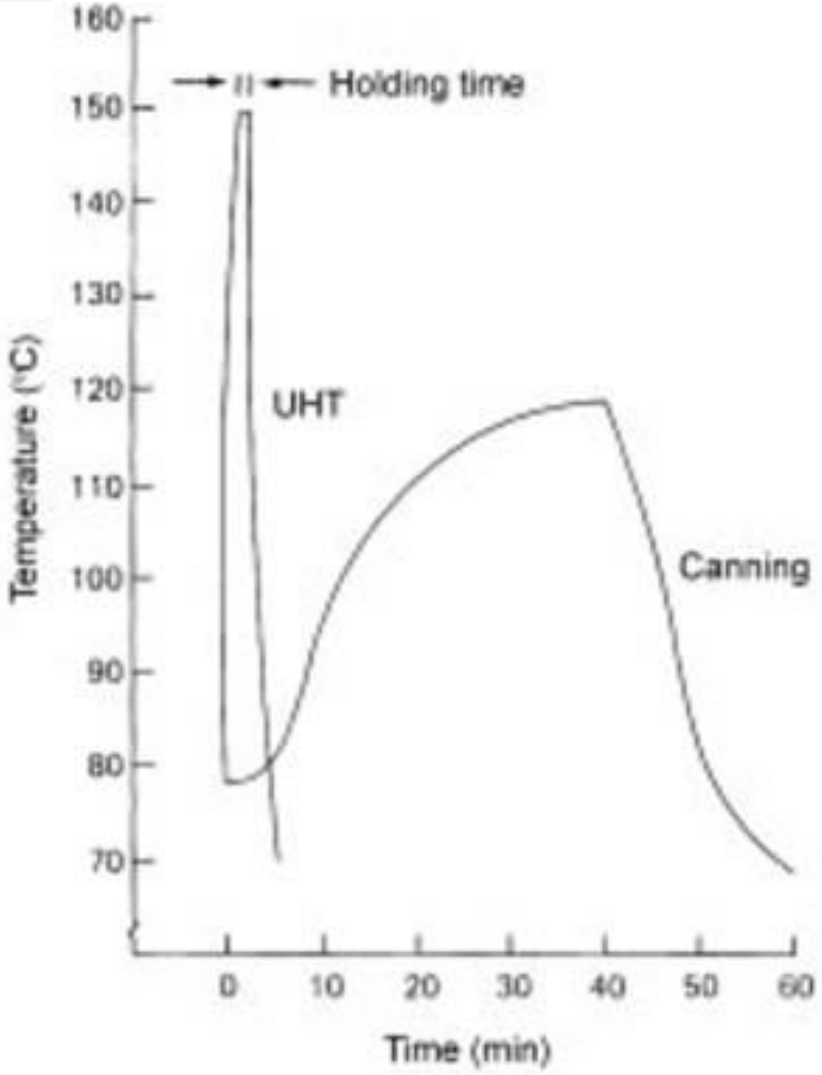
Sterilization techniques



	UHT	Retort
Temperature	135-150°C	115-130°C
Time	2-8 seconds	20-40 minutes
Packaging	Aseptic (bottles or Tetrapak)	In-container (usually cans and bottles)

CHAPMAN UNIVERSITY

Similar microbial reduction, but major differences in quality



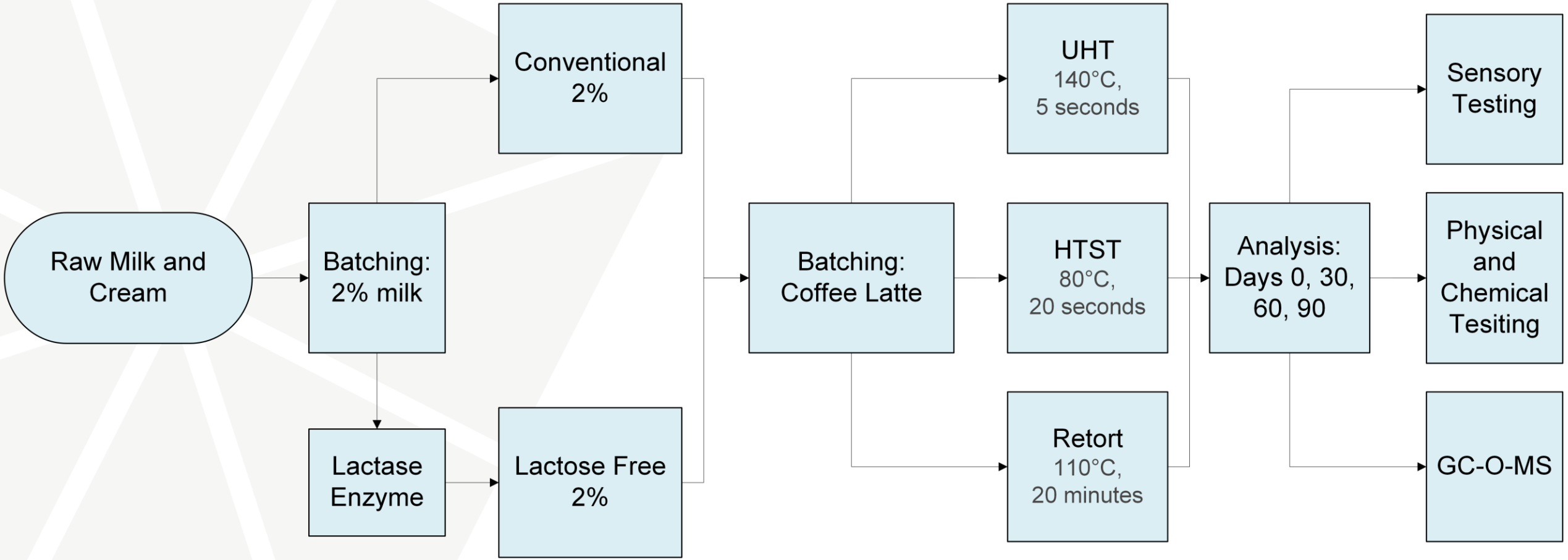
CHAPMAN UNIVERSITY

Objective

To compare the effects of UHT and retort sterilization on the physical, chemical, and sensory properties of RTD coffee lattes after heating and during storage

CHAPMAN UNIVERSITY

Experimental Design



CHAPMAN UNIVERSITY

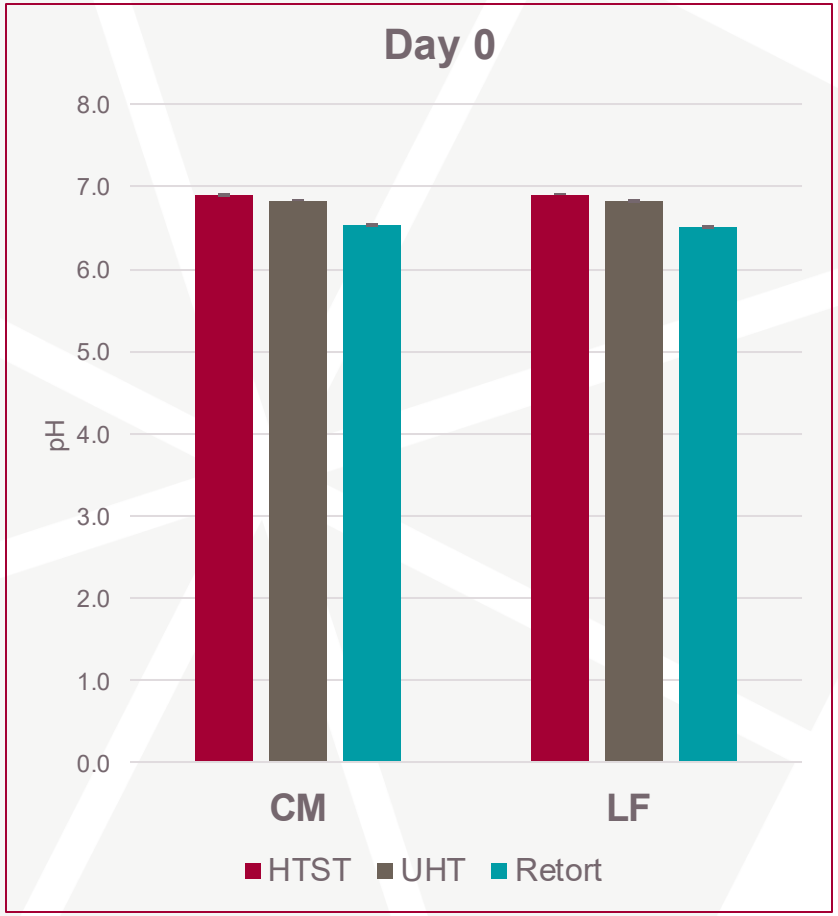
Ingredient (g)	Conventional Milk %	Lactose-Free %
2% milk	60.00	60.00
Water	31.30	30.93
Sugar	7.00	7.00
Soluble robusta coffee	1.50	1.50
Dipotassium phosphate	0.20	0.20
Tripotassium phosphate	0.10	0.10
Lactase	0.00	0.27
Total weight	100.00	100.00

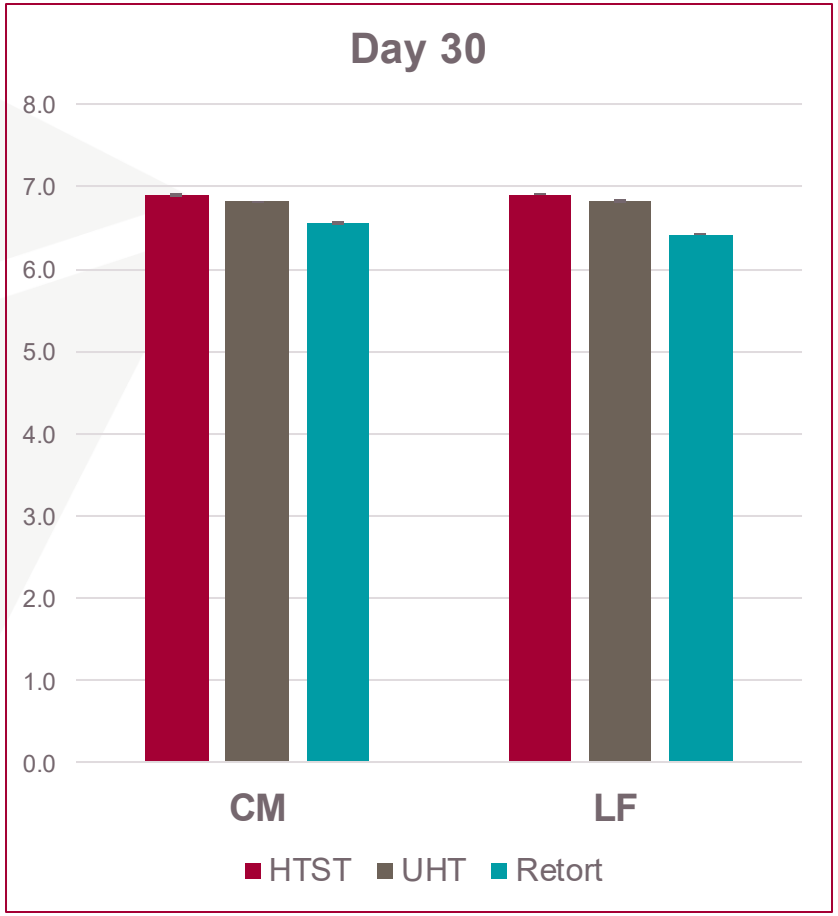
Effect of Heat Treatment on Color of RTD Coffee Latte

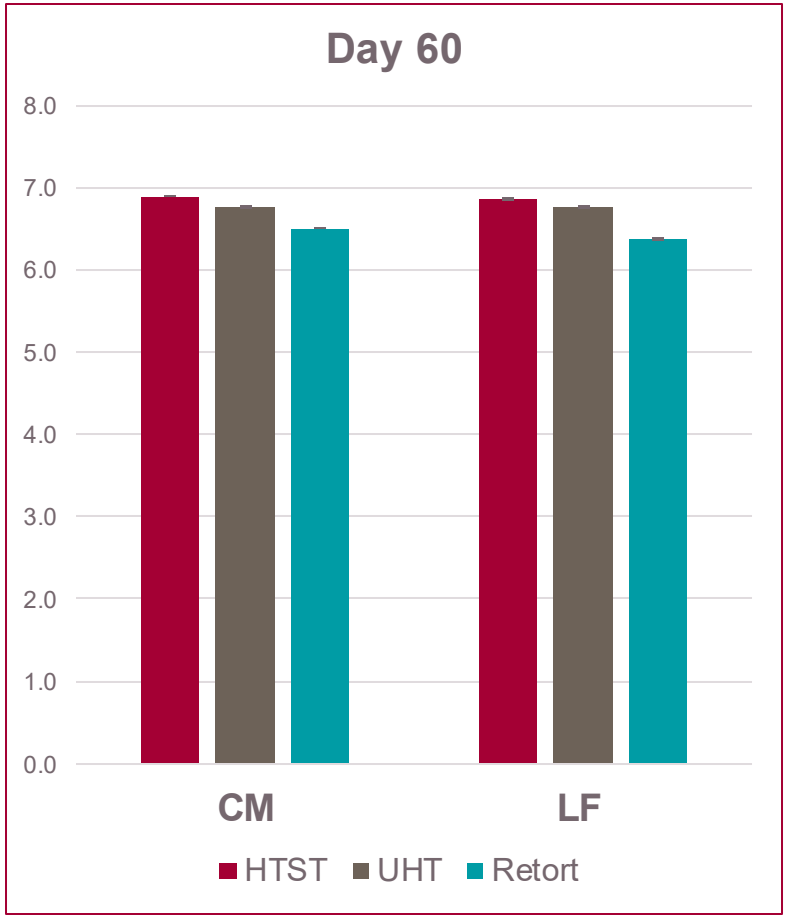
Milk	Day 0		Day 30		Day 60	
	UHT	Retort	UHT	Retort	UHT	Retort
Conventional (2%)						
Lactose Free						

CHAPMAN UNIVERSITY

Effect of Heat Treatment on pH post-processing

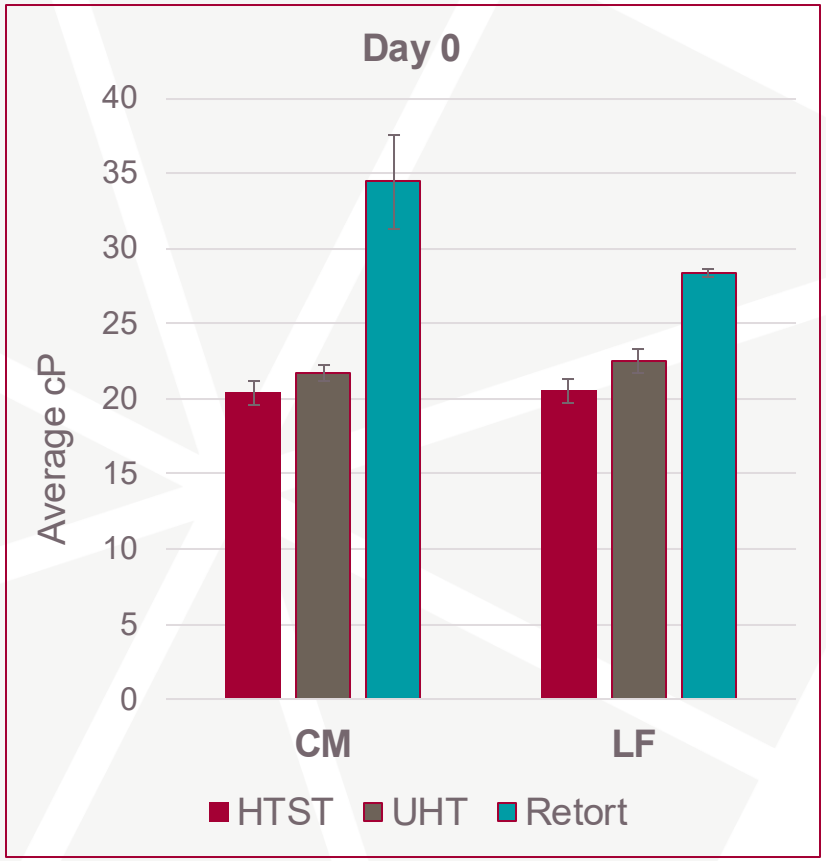


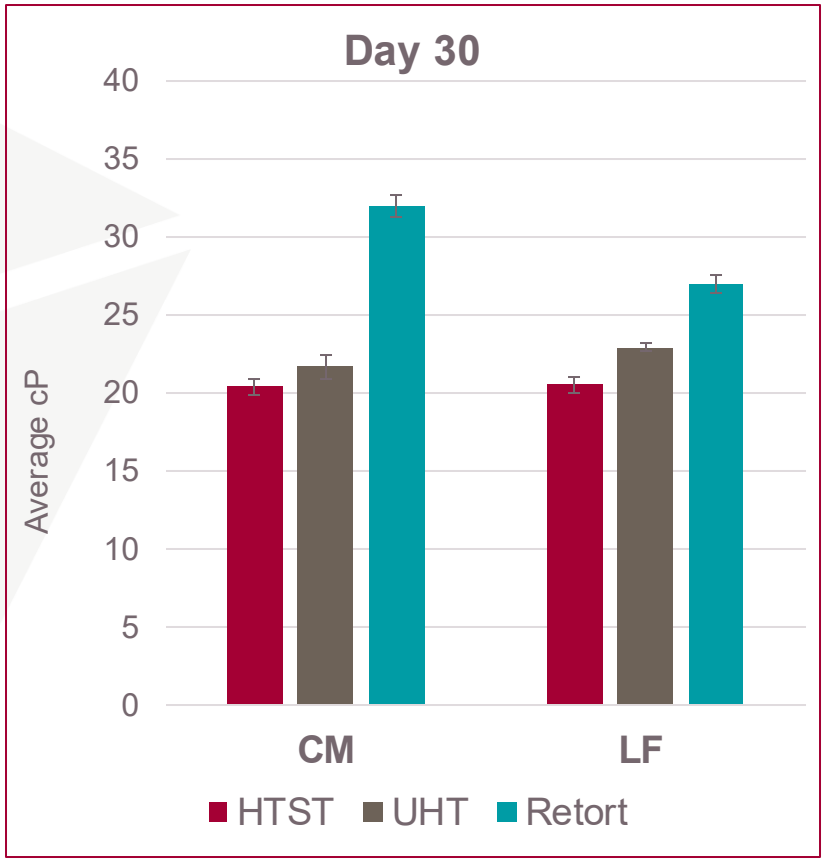


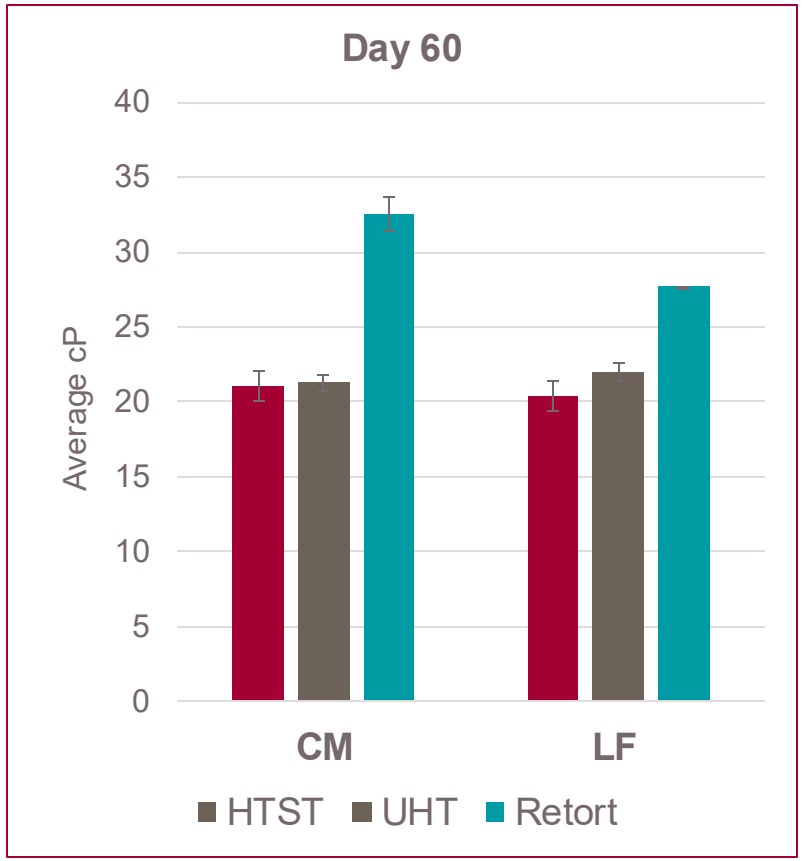


CHAPMAN UNIVERSITY

Effect of Heat Treatment on Viscosity (cP)

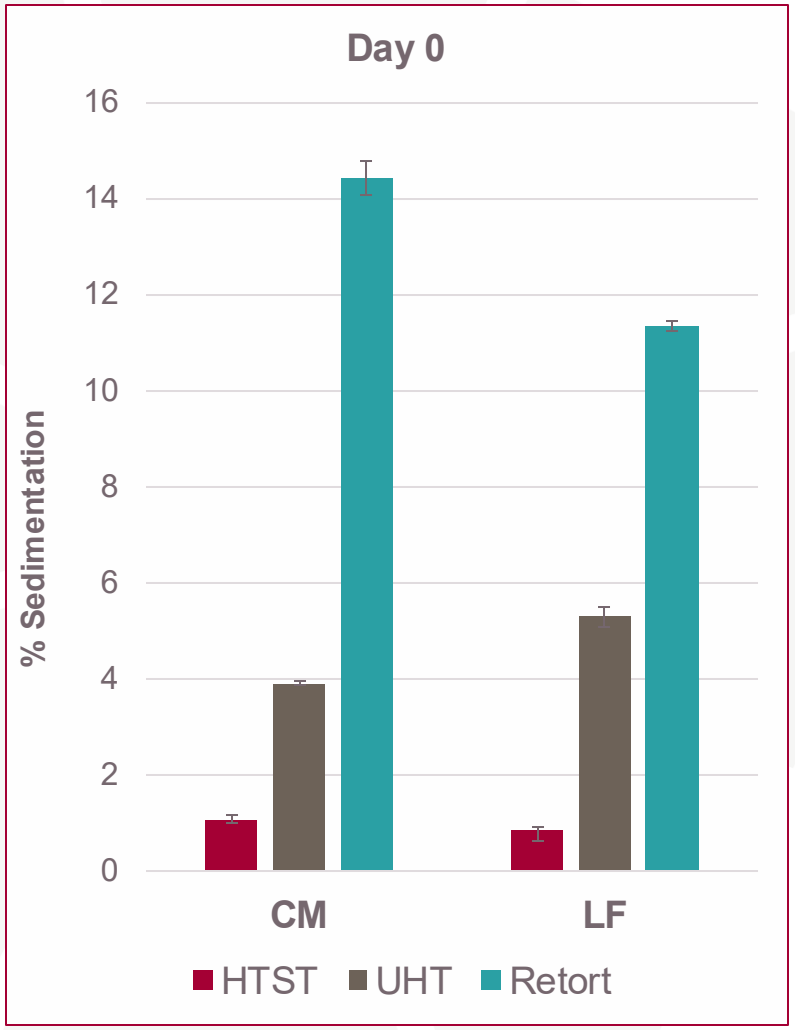


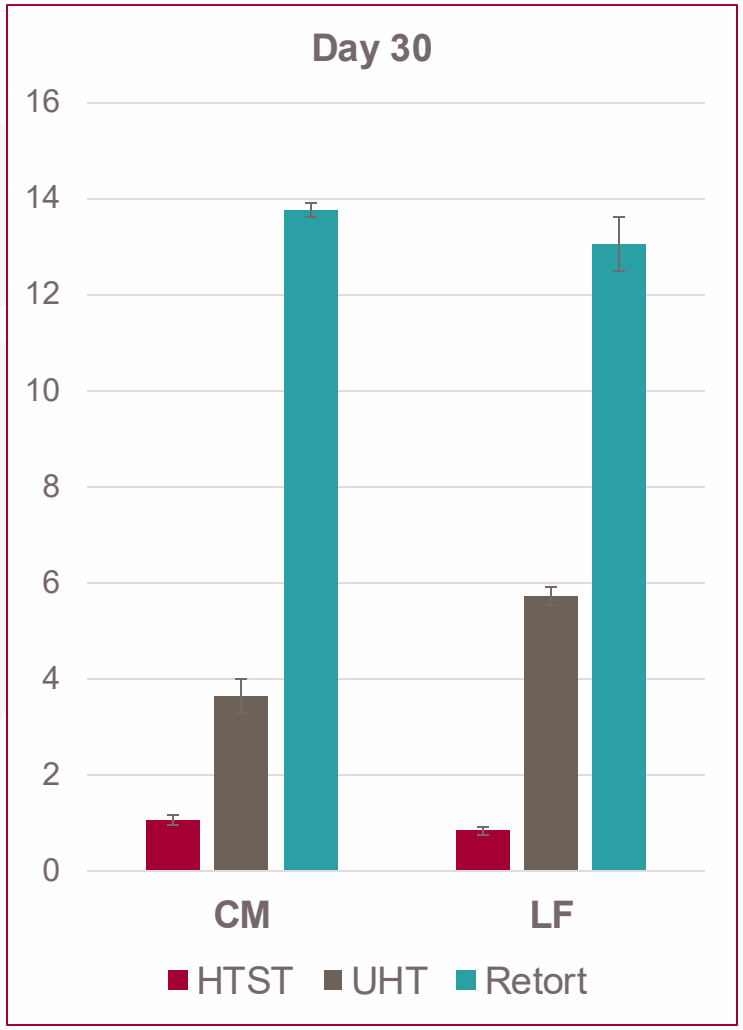


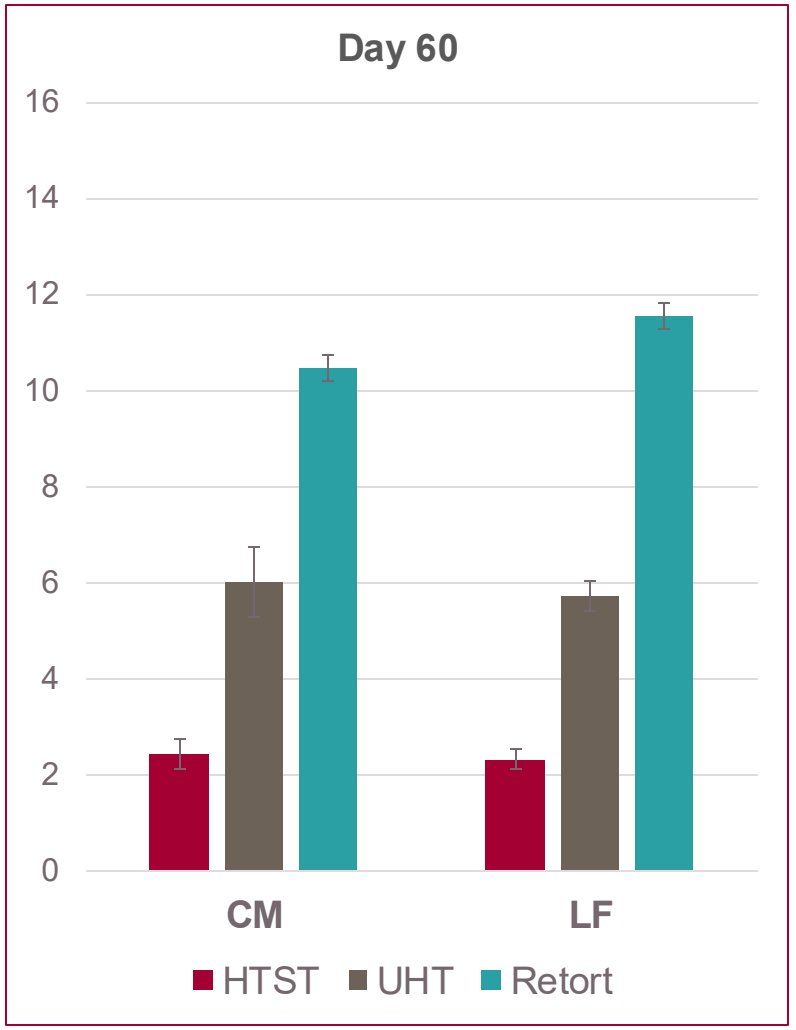


CHAPMAN UNIVERSITY

Effect of Heat Treatment on Sedimentation (%)

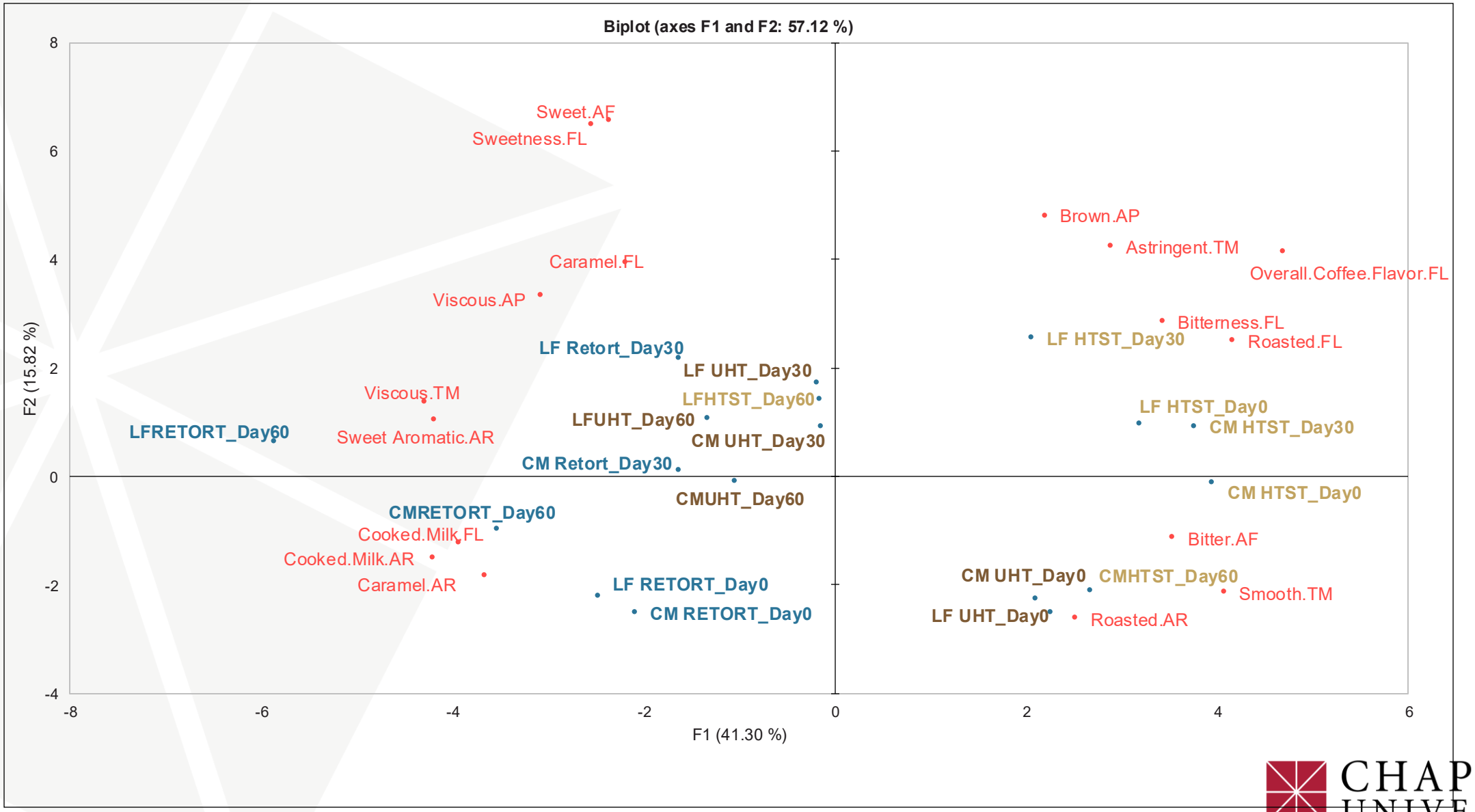






CHAPMAN UNIVERSITY

Effect of Heat Treatment on Sensory Quality



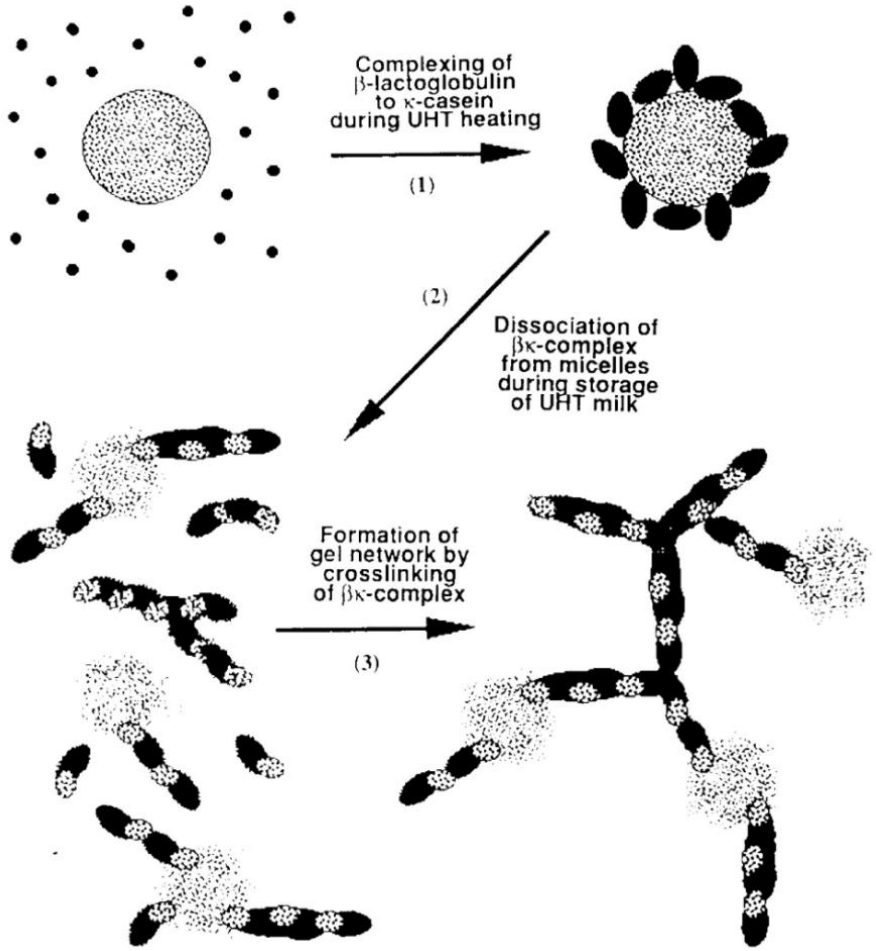
CHAPMAN UNIVERSITY

Heat induced protein-protein interactions

Interactions change protein size and conformation

Age gelation
- Increased viscosity

Sedimentation
- Layer of protein at bottom of container



Anema, S. G. (2019). Age Gelation, Sedimentation, and Creaming in UHT Milk: A Review. *Comprehensive Reviews in Food Science and Food Safety*, *18*(1), 140–166. https://doi.org/10.1111/1541-4337.12407

CHAPMAN UNIVERSITY

SDS-PAGE _ Day 0

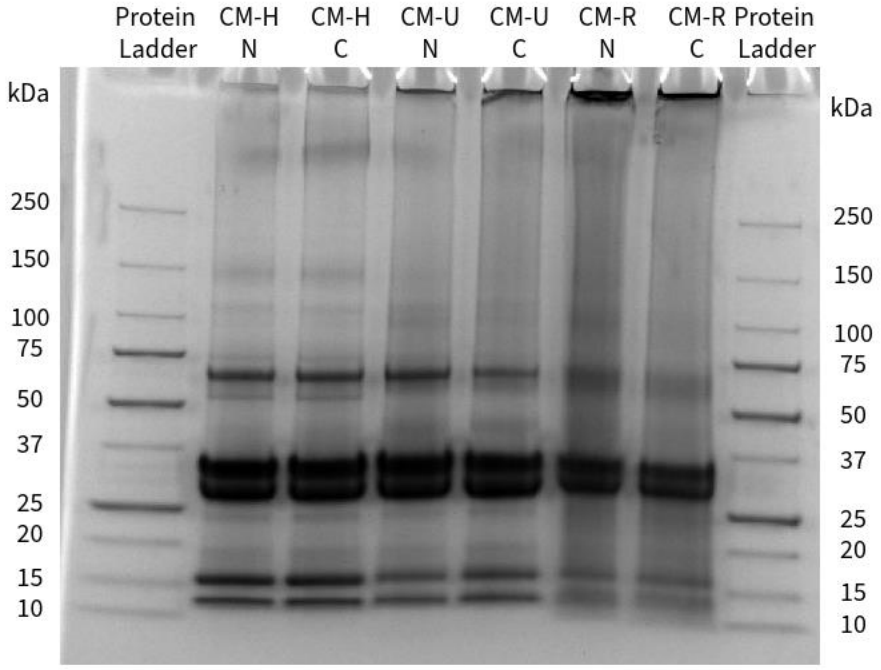


Figure 1. SDS-NR-PAGE of conventional milk (CM) lattes treated by HTST (H), UHT (U), or retort (R) processing and non-centrifuged (NC) or centrifuged (C).

Conventional milk

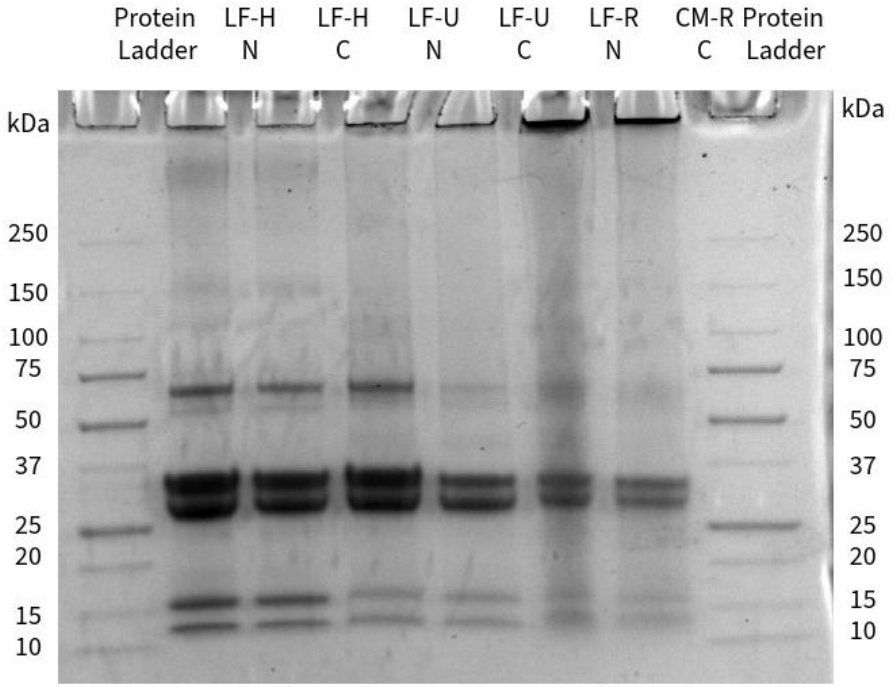
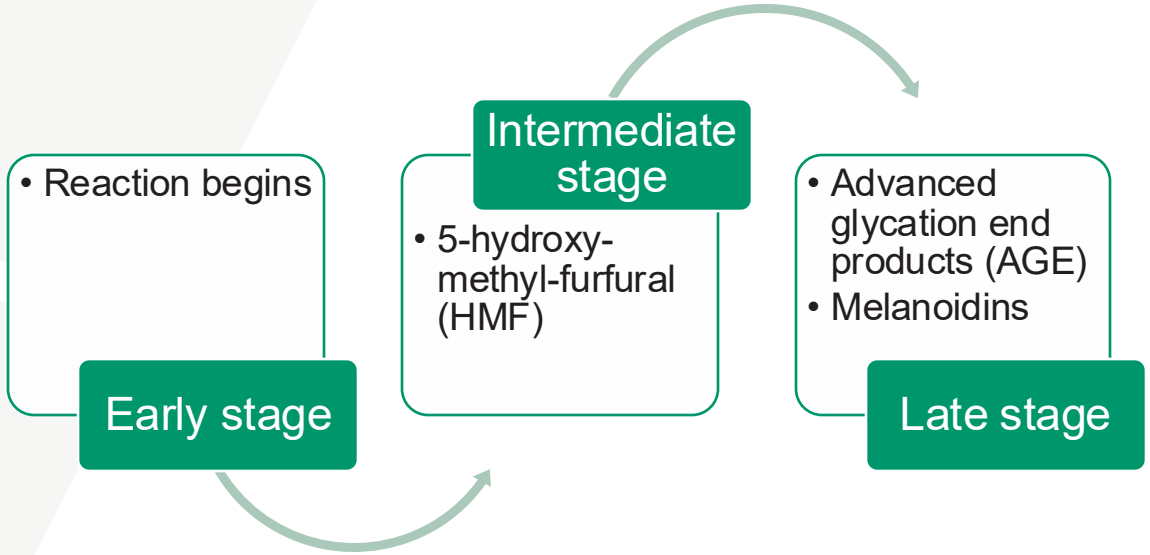


Figure 2. SDS-NR-PAGE of lactose-free (LF) milk lattes treated by HTST (H), UHT (U), or retort (R) processing and non-centrifuged (NC) or centrifuged (C).

Lactose-free milk

Heat-induced protein-reducing sugar reaction

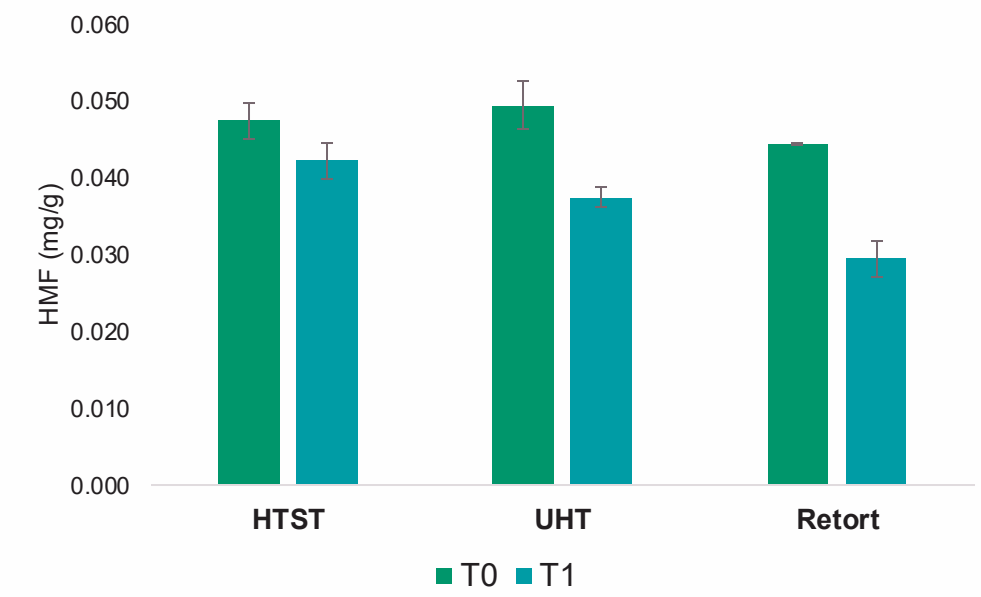
- **Maillard reaction:** Heat-induced browning that occurs between the carbonyl group of reducing sugar (lactose) and the amino group of amino acids (lysine)



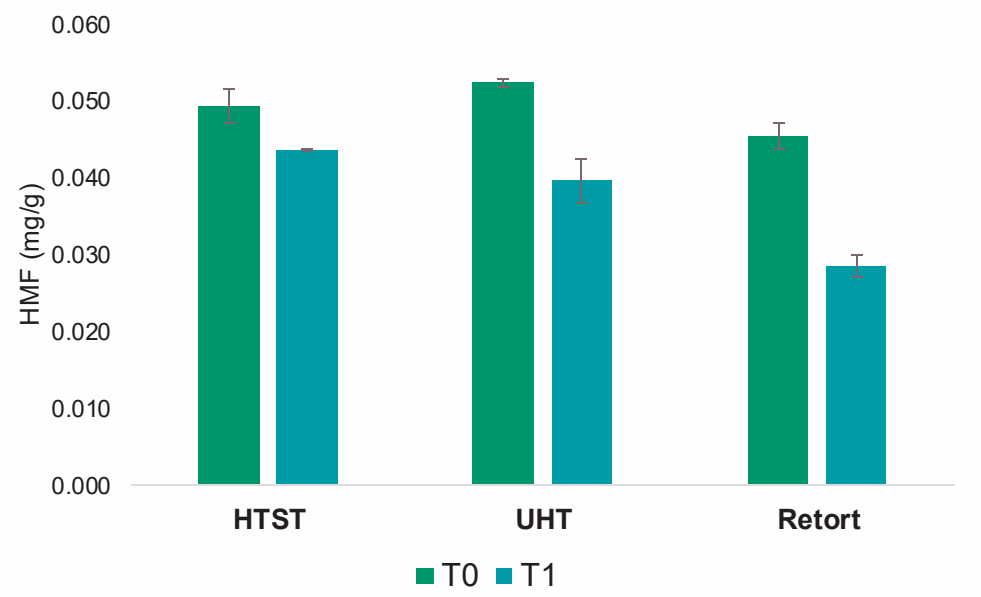
CHAPMAN UNIVERSITY

Maillard reaction products – HMF

Conventional Milk



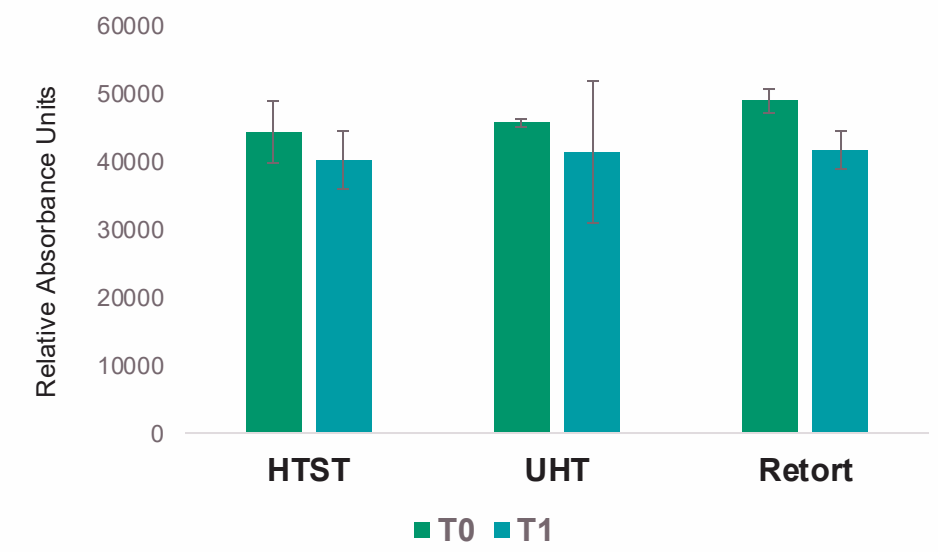
Lactose Free



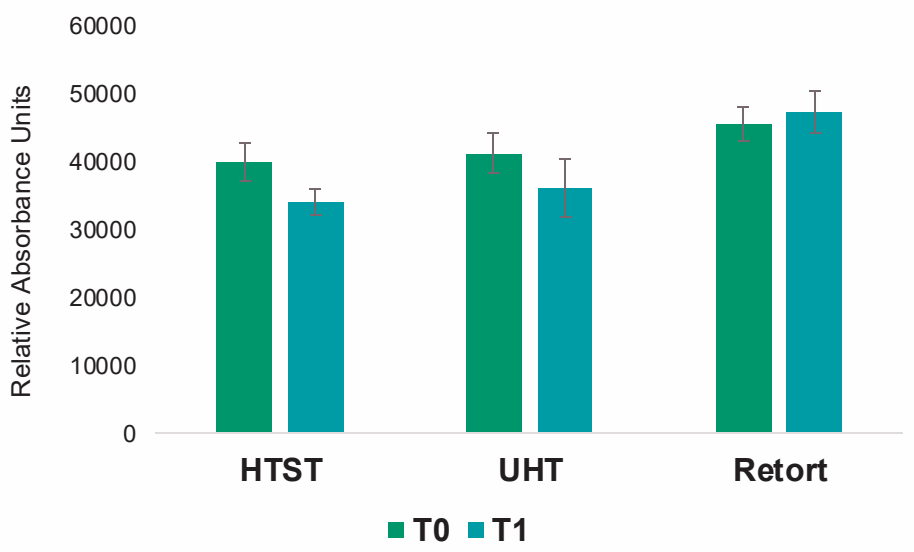
T0 = Day 0
T1 = Day 30

Maillard reaction products – Total AGEs

Conventional Milk



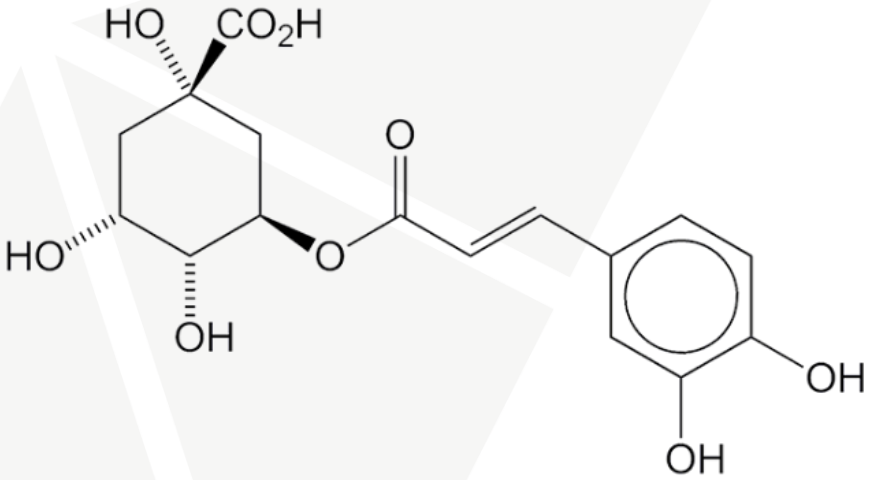
Lactose Free

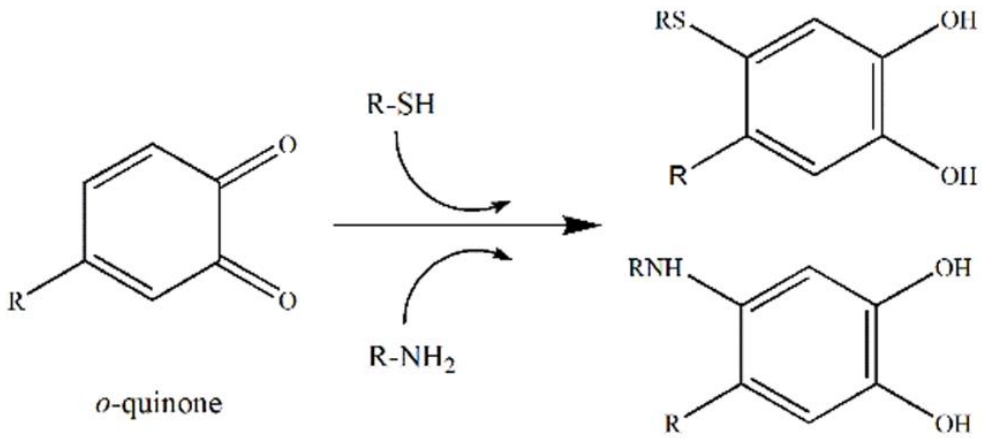


T0 = Day 0
T1 = Day 30

Heat-induced protein-phenolic interactions

- Phenolic compounds oxidize and form covalent bonds with proteins
  - Increase protein complex size
  - Decrease phenolic content/antioxidant capacity

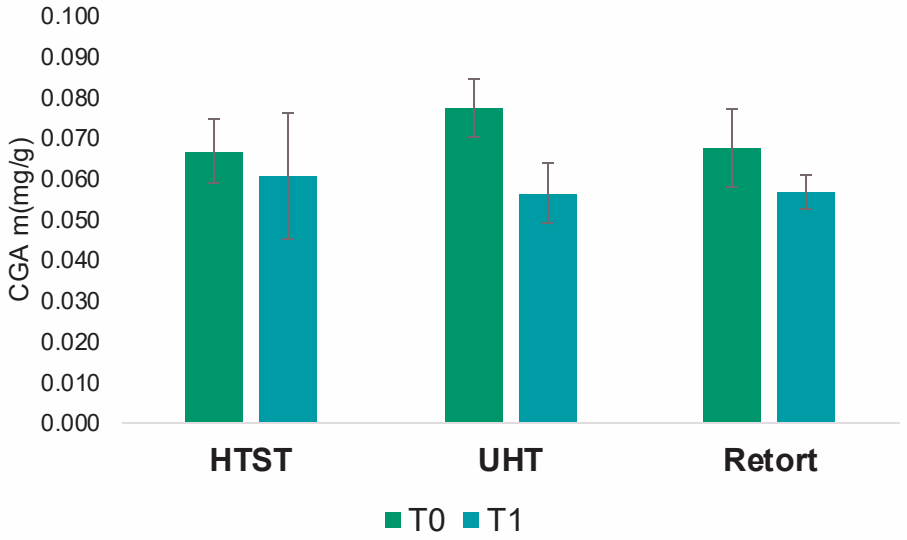




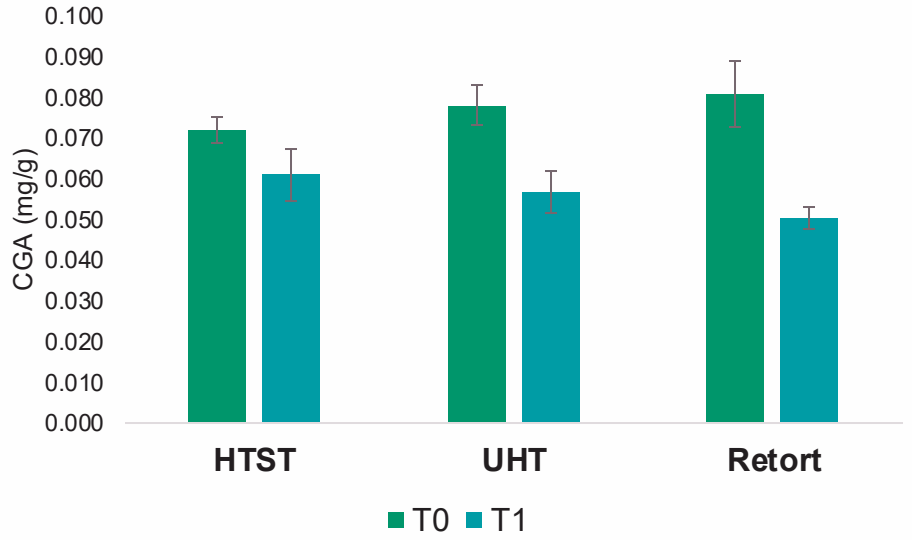
CHAPMAN UNIVERSITY

Phenolic compounds - CGA

Conventional Milk



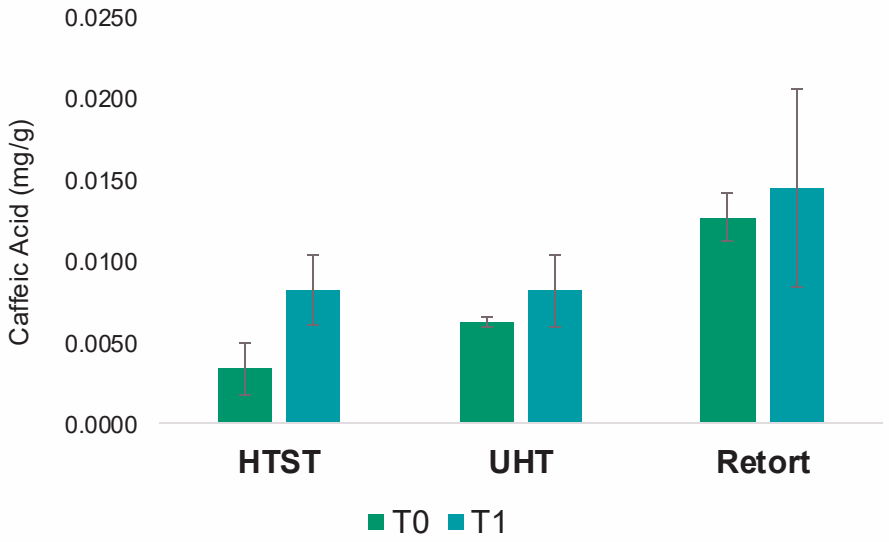
Lactose Free



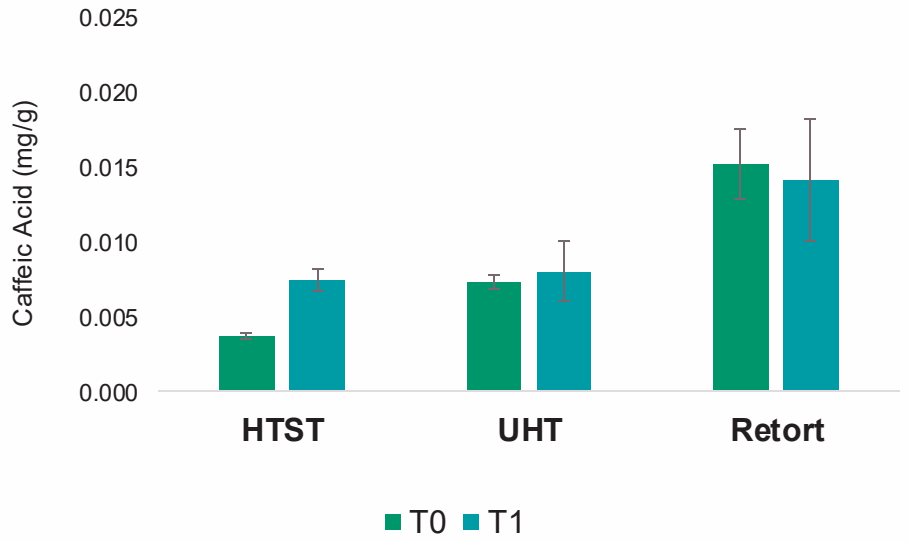
T0 = Day 0
T1 = Day 30

Phenolic compounds – Caffeic Acid

Conventional Milk



Lactose Free

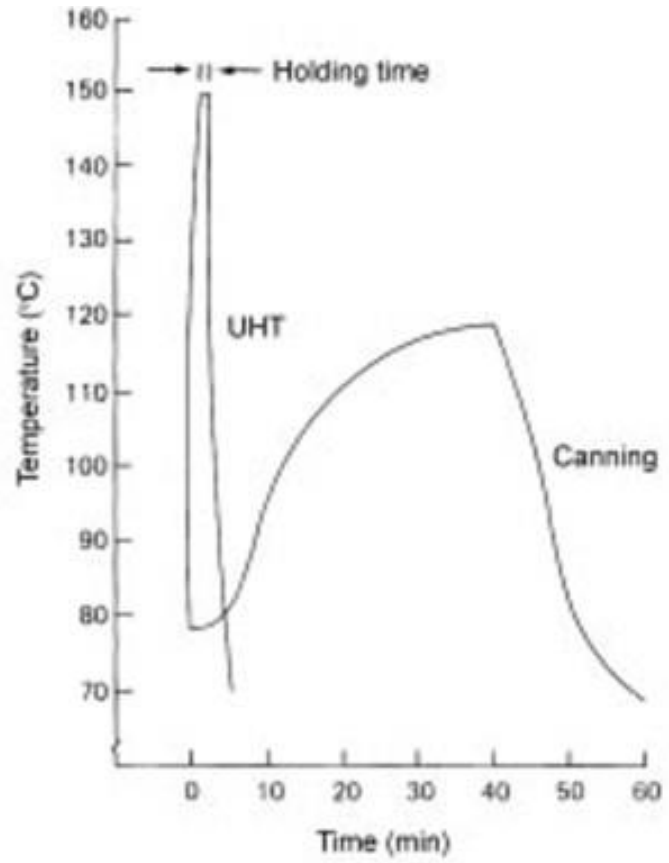


T0 = Day 0
T1 = Day 30

CHAPMAN UNIVERSITY

Summary

Quality	UHT	Retort
Physical	• Similar to HTST control	• More changes in color, sedimentation, and viscosity
Chemical	• Greater formation of intermediate stage MRPs • Fewer protein-protein and protein-phenolic interactions	• Greater formation of late stage MRPs • More protein-protein and protein-phenolic interactions
Sensory	• More well-rounded sensory perception	• Perceived cooked milk and sweetness aromas and viscous texture • Lowest coffee flavor perception



Final thoughts

Thank you!

CHAPMAN UNIVERSITY

RTD lattes

ORIGINAL BLEND
UCC
COFFEE
WITH MILK
Since 1969
NET 11.4 FL.OZ. (337mL)

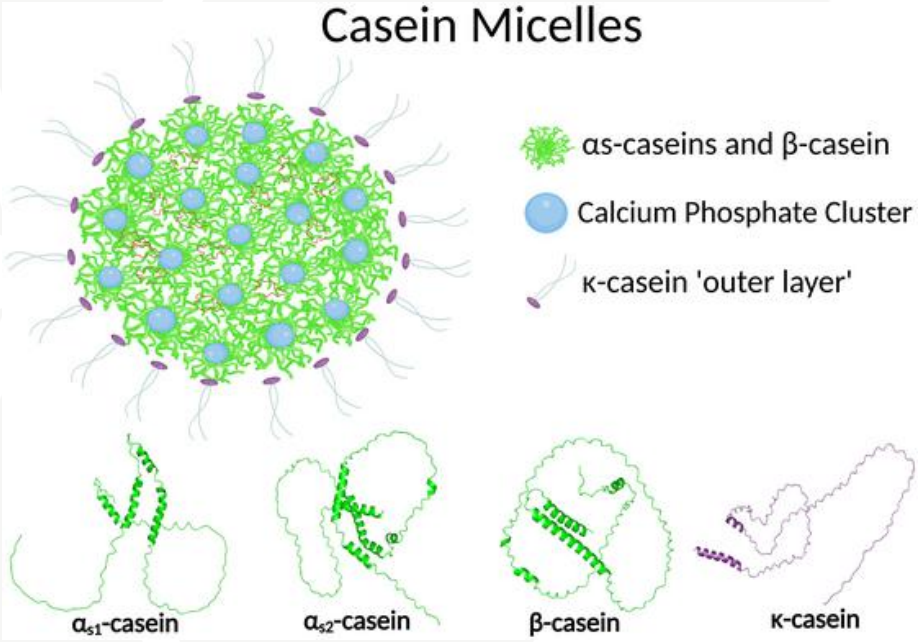
Coffee
STARBUCKS
frappuccino
280
13.7 FL OZ (405 mL)

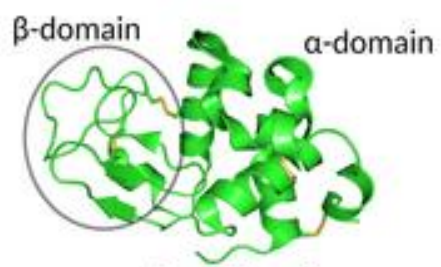
original
DUNKIN'
ICED COFFEE
RICH + SMOOTH
original
13.7 FL OZ (405 mL)

slate.
mocha
latte
high protein iced coffee
LACTOSE FREE ENERGY
20G
PROTEIN
+ CAFFEINE
1g sugar
110 calories
3g net carbs
made with ultra-filtered milk
naturally flavored coffee beverage
11 FL OZ (325ML)

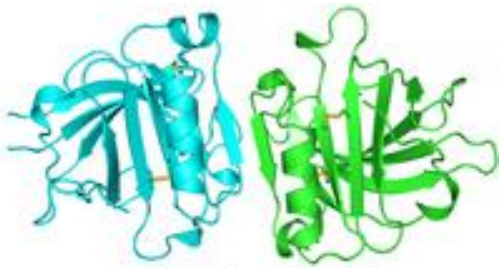
Changes in quality

Proteins from milk

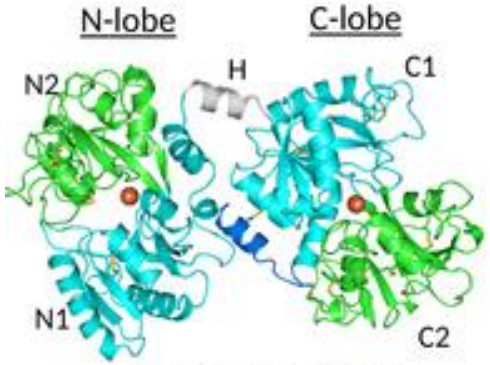




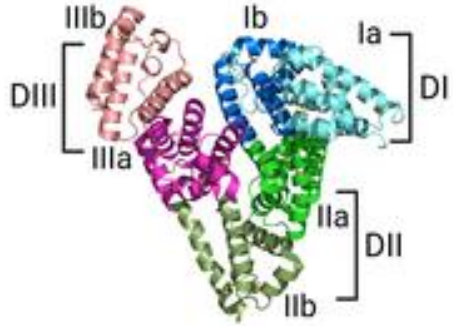
α-lactalbumin



β-lactoglobulin



Bovine lactoferrin



Bovine serum albumin

Almeida, C., Baião, D., Silva, D., Trindade, L., Pereira, P., Conte Junior, C., & Paschoalin, V. (2024). Dairy and nondairy proteins as nano-architecture structures for delivering phenolic compounds: Unraveling their molecular interactions to maximize health benefits. *Comprehensive Reviews in Food Science and Food Safety*, *23*. https://doi.org/10.1111/1541-4337.70053

CHAPMAN UNIVERSITY