MILK PROCESSING

IMPACT OF BATCH THERMOSONICATION ON PLASMIN ACTIVITY IN STORED SKIM MILK: TIME-AMPLITUDE EFFECTS

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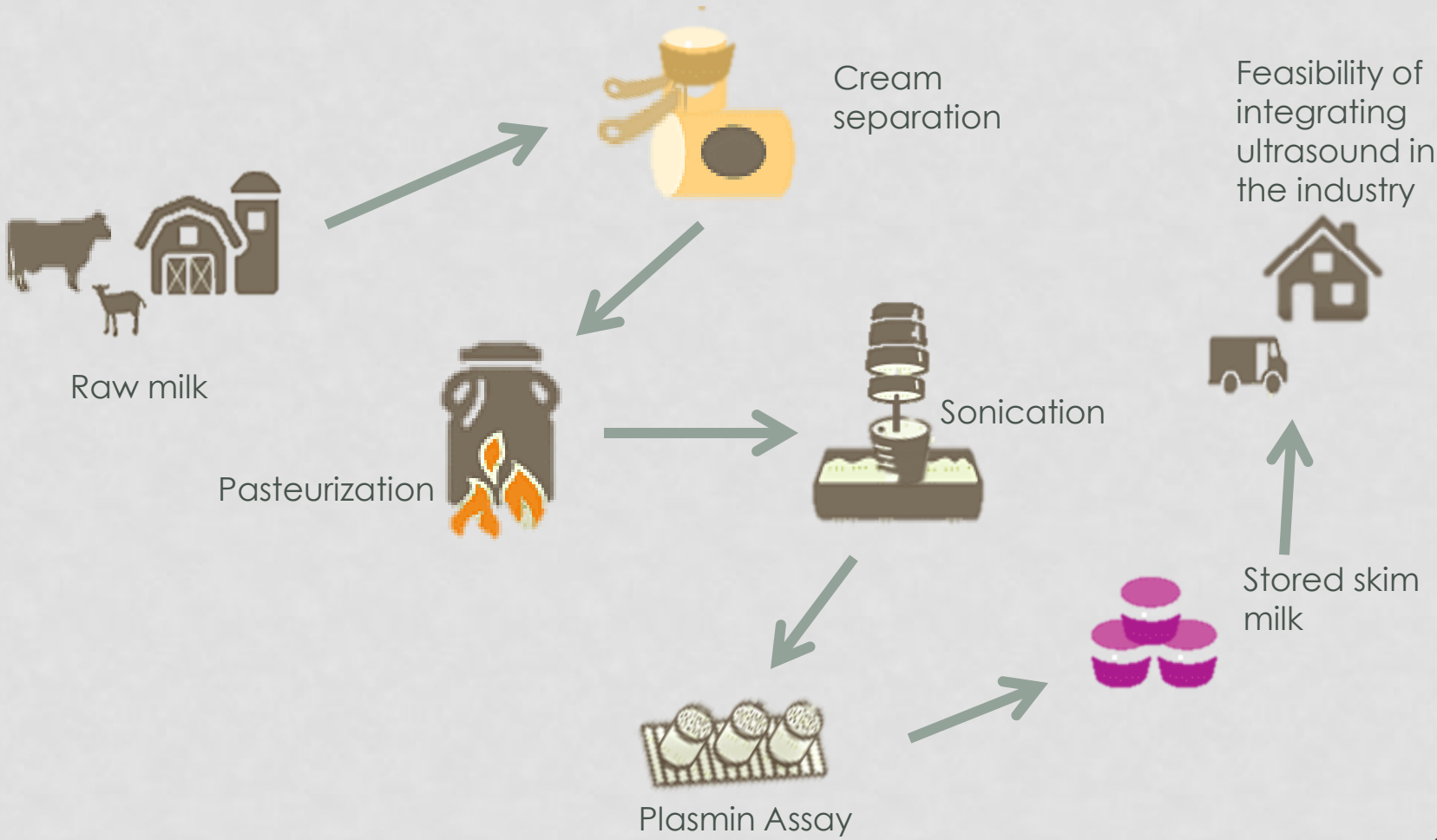
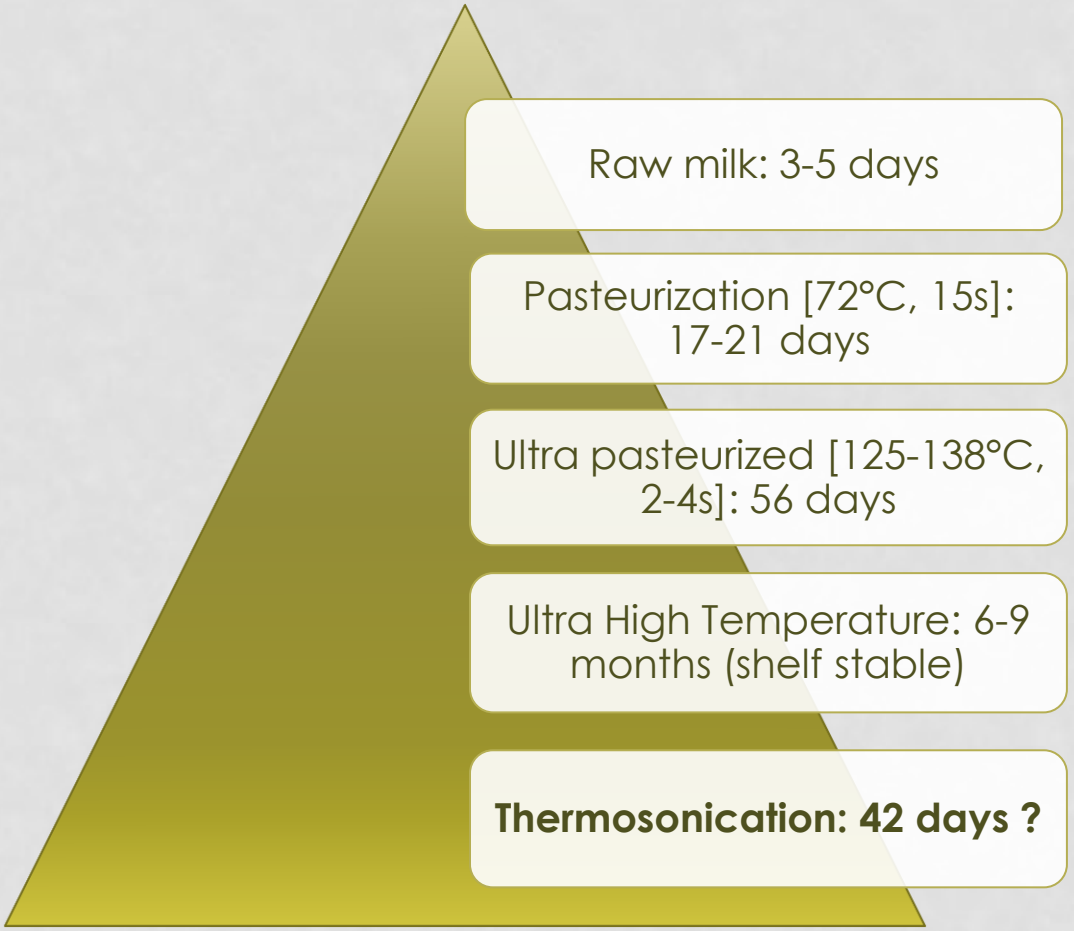
OVERVIEW


Cream separation
Feasibility of integrating ultrasound in the industry
Raw milk
Pasteurization
Sonication
Stored skim milk
Plasmin Assay

SHELF LIFE



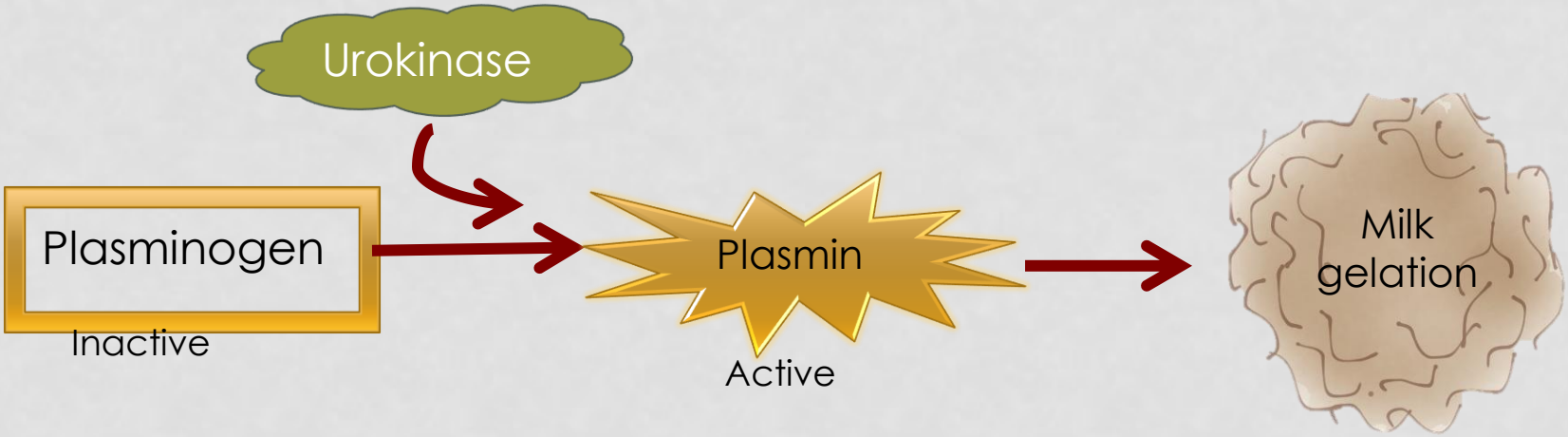
(USDA FSIS)

WHAT LIMITS MILK'S SHELF LIFE?

- Microorganisms
  - Pasteurization kills all vegetative cells of spoilage microorganisms
  - *Pseudomonas* spp., *Bacillus* spp. could also activate spoilage enzymes
- Processing and storage conditions
  - storage time and temperature
  - post-processing contamination
- Enzymes

SPOILAGE ENZYMES

- Native milk enzymes (proteases) degrade the milk protein structure
- Plasmin system is the major milk protease system and able to recover upon storage



ULTRASOUND & ENZYME INACTIVATION

- Inactivation of enzymes (Villamiel and deJong, 2000)
- Previous work at ISU
  - Long sonication times (1-3 minutes) in batch setting
  - Effective reduction in Total Aerobic Count and plasmin activity up to 30 days of refrigerated storage (Vijayakumar, 2012)
- Current work

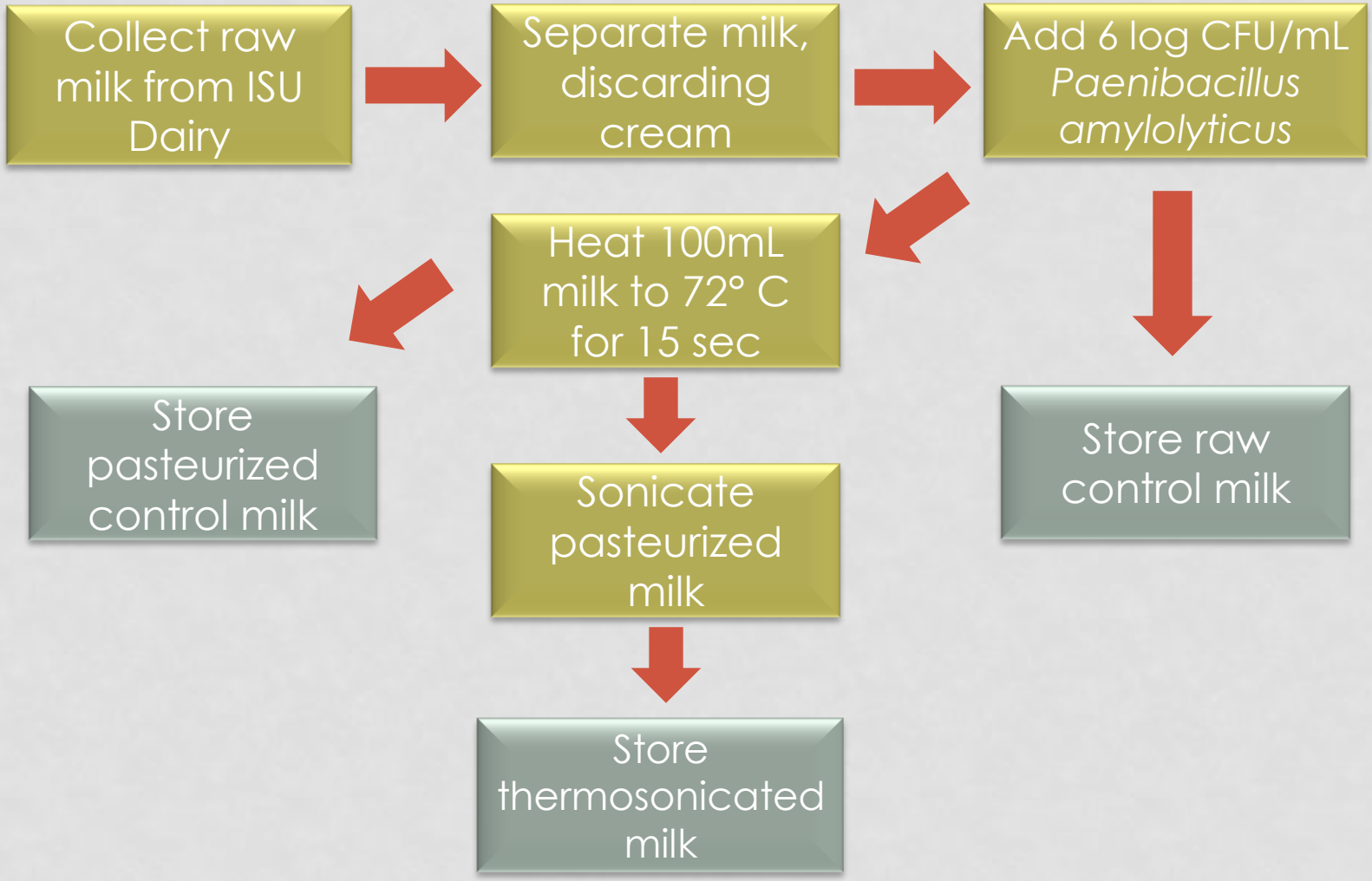
HYPOTHESES

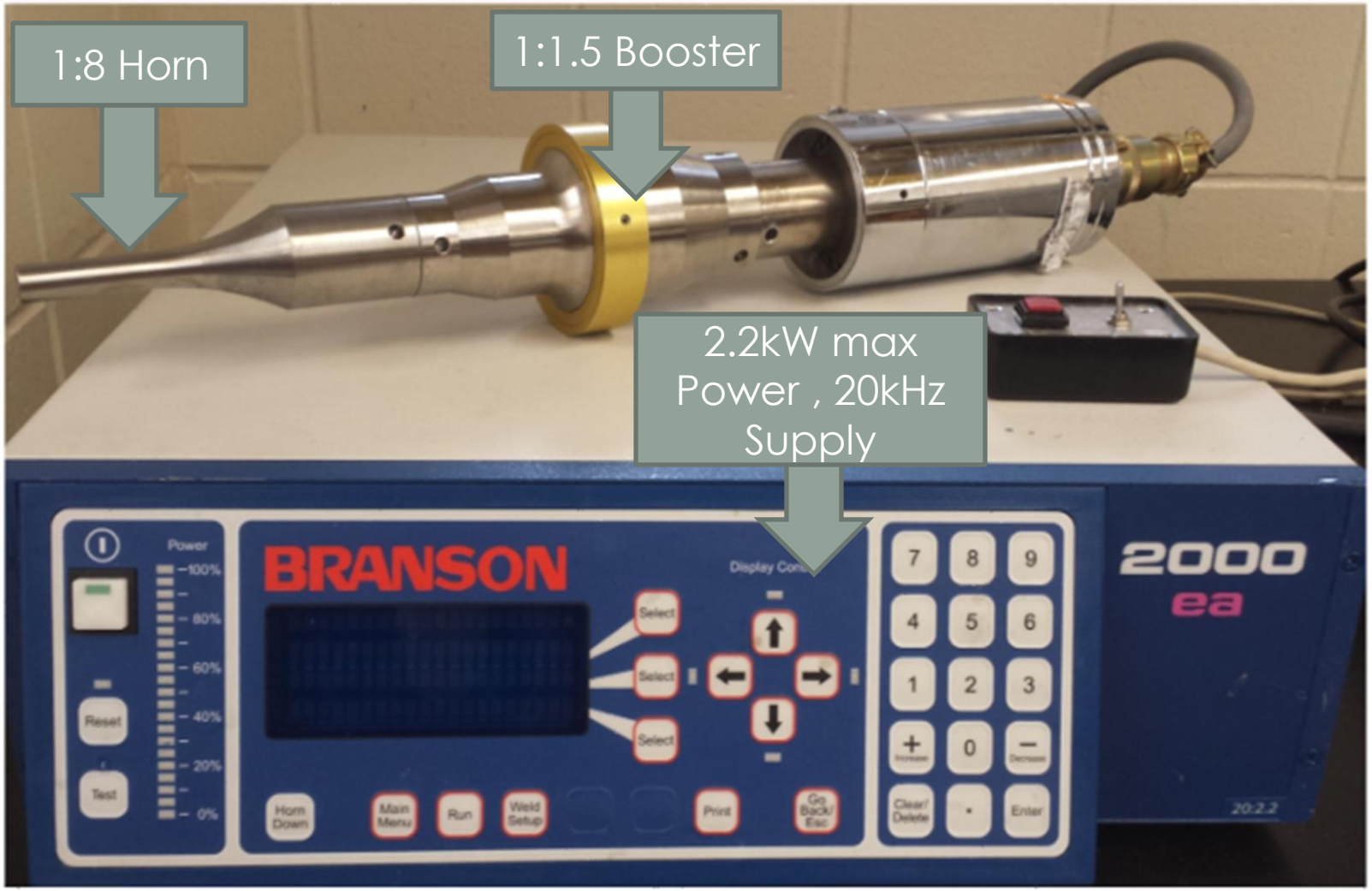
Thermosonicated (TS) milk vs. Pasteurized milk

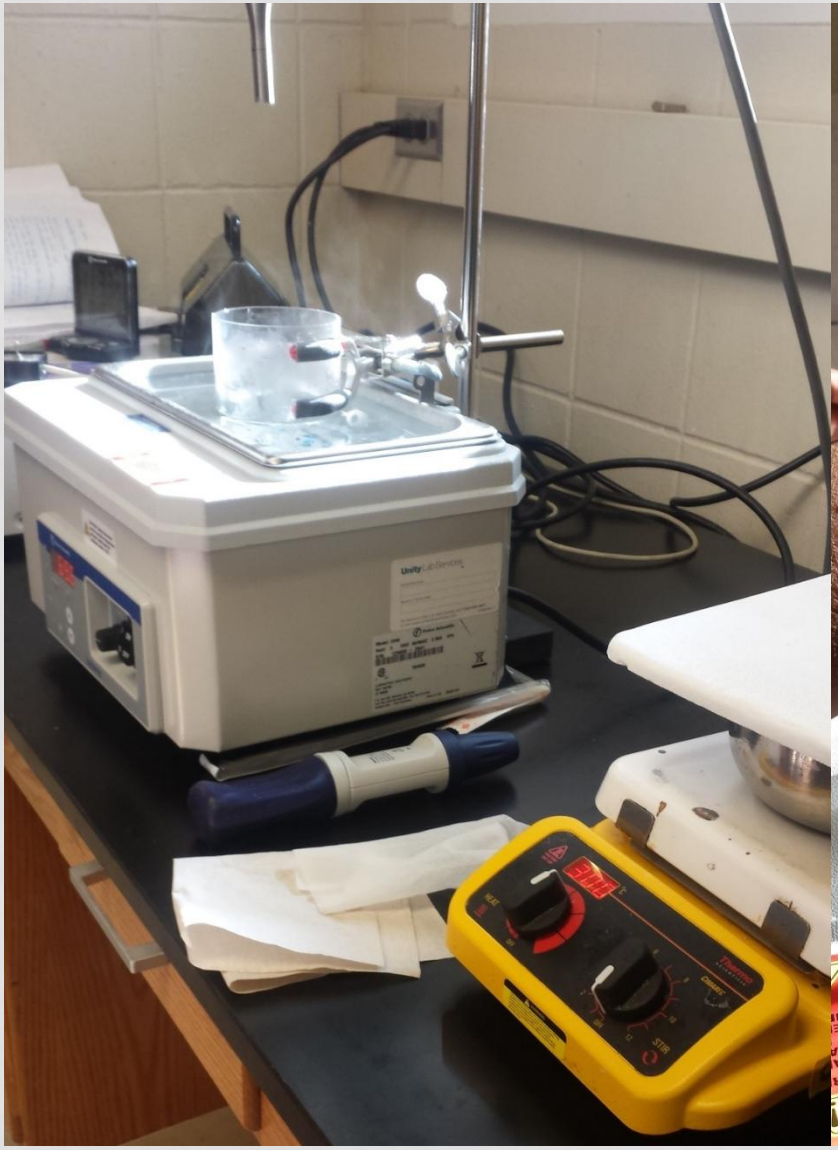
- TS reduces ***total plasmin activity*** in milk to maintain standard viscosity
- TS reduces total aerobic bacteria content (TAC) of milk – *Lily Benner (Clark Lab)*
- TS does not affect the aroma quality of milk

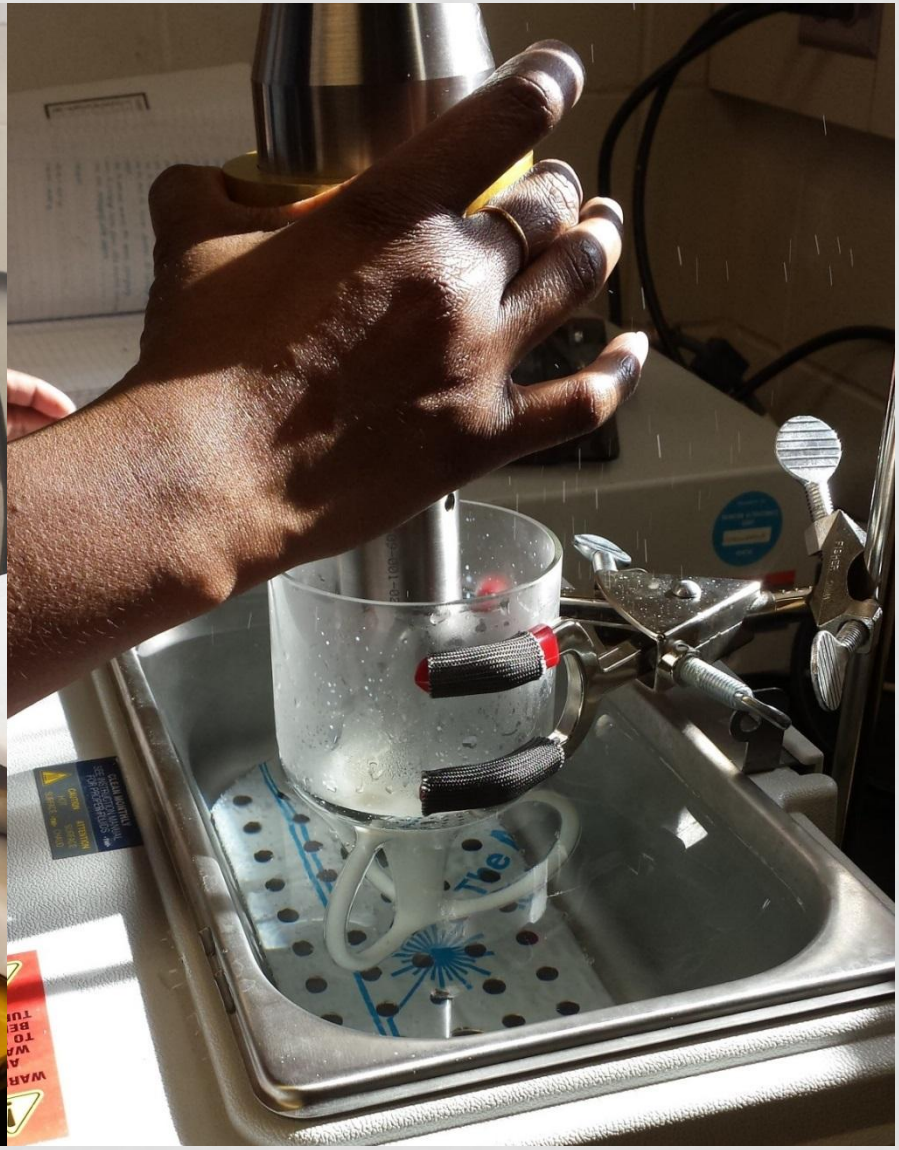
TS= Thermosonication

PROCEDURES


Collect raw milk from ISU Dairy
Separate milk, discarding cream
Add 6 log CFU/mL *Paenibacillus amylolyticus*
Heat 100mL milk to 72° C for 15 sec
Store pasteurized control milk
Sonicate pasteurized milk
Store raw control milk
Store thermosonicated milk


1:8 Horn
1:1.5 Booster
2.2kW max Power , 20kHz Supply
BRANSON
2000
ea
Power
100%
80%
60%
40%
20%
0%
Reset
Test
Select
Select
Select
Horn Down
Main Menu
Run
Weld Setup
Print
Clear/ Delete
Enter





TREATMENTS

Amplitude (μm)	Time (sec)	Average Energy Density (kJ/L)
170	10	14
	30	41
	60	84

- Each treatment will be repeated at least three times
- Treatments selected based on micro. and plasmin results from preliminary study using commercially pasteurized skim milk

PLASMIN ASSAY METHOD

Centrifuge 100 000 x *g* for 1hr

Milk buffer discarded

Buffer with Trizma, **ε-aminocaproic acid**, NaCl added

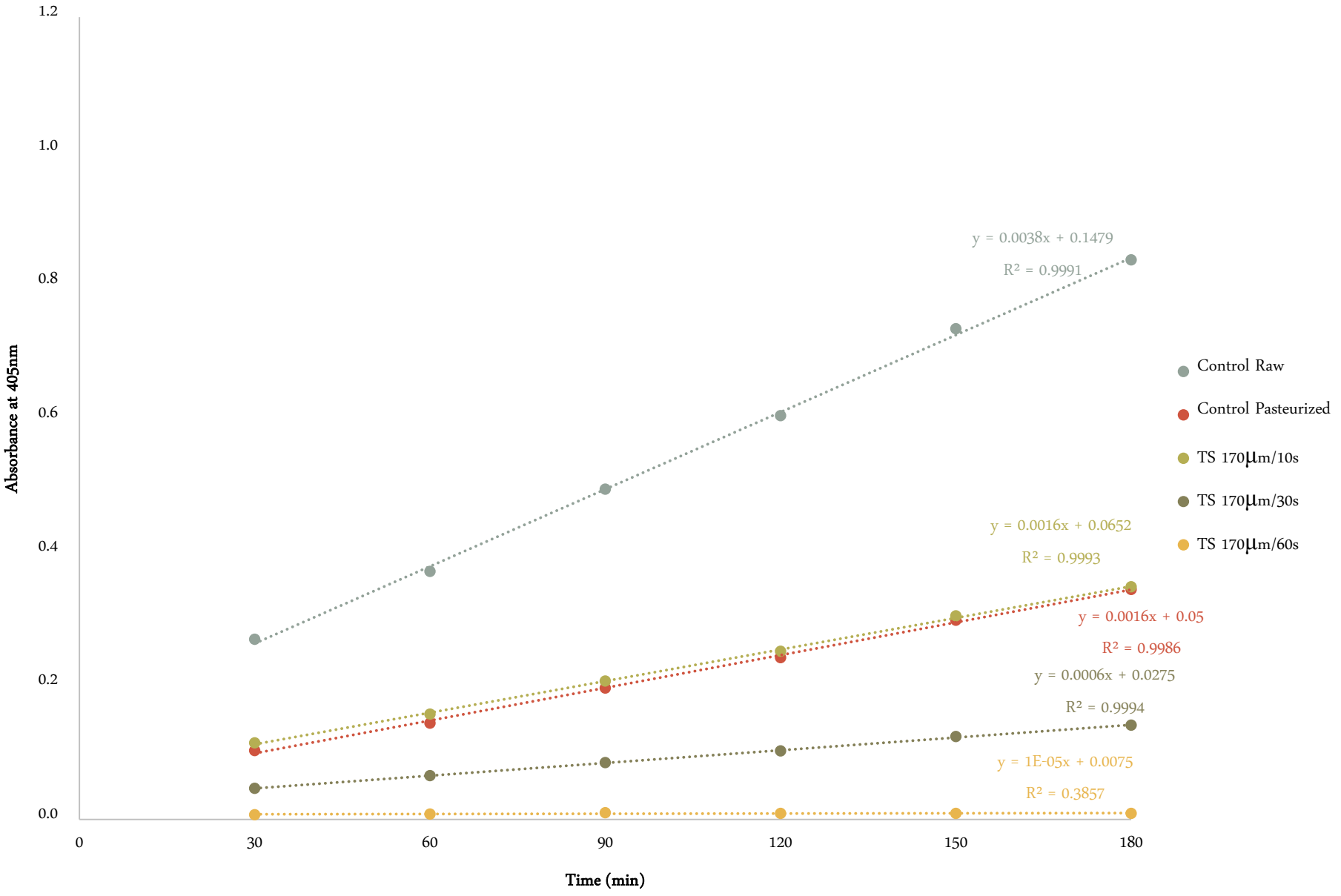
Casein is resuspended

Incubate for 2hrs & then centrifuge at 100 000 x *g* for 1hr

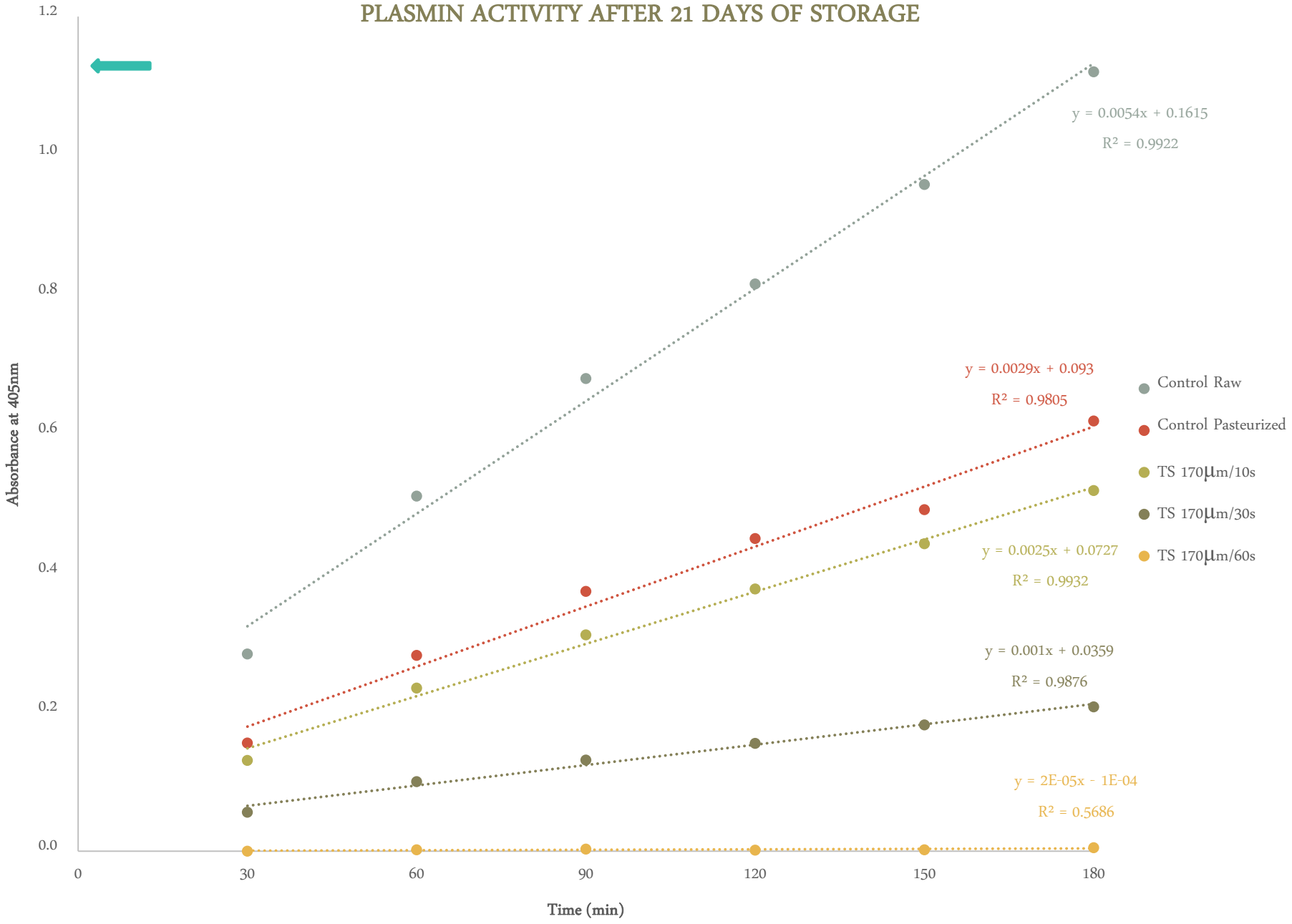
Buffer is added to urokinase and the absorbance is analyzed at 405nm for 3hrs

RESULTS

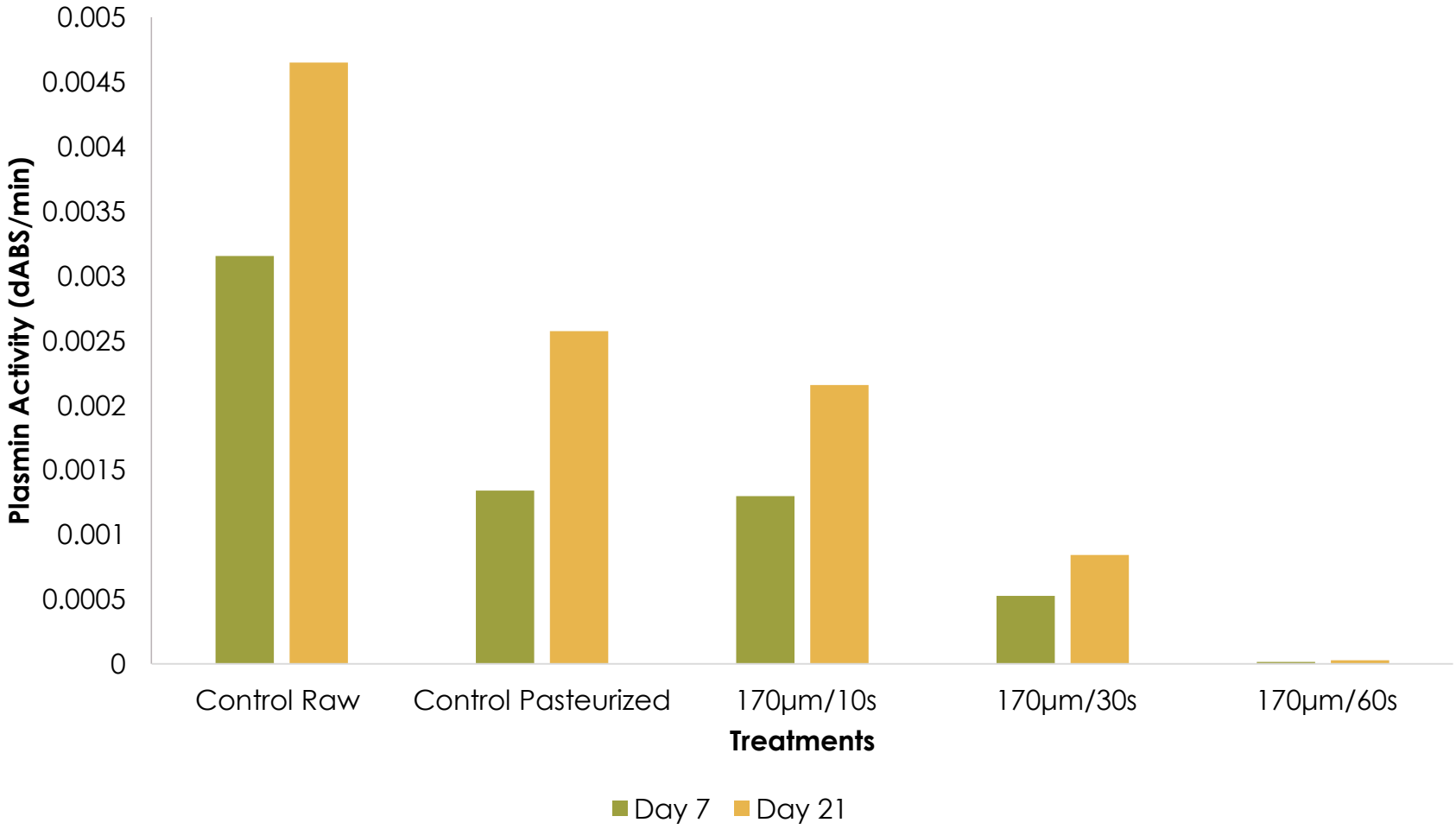
PLASMIN ACTIVITY AFTER 7 DAYS OF STORAGE



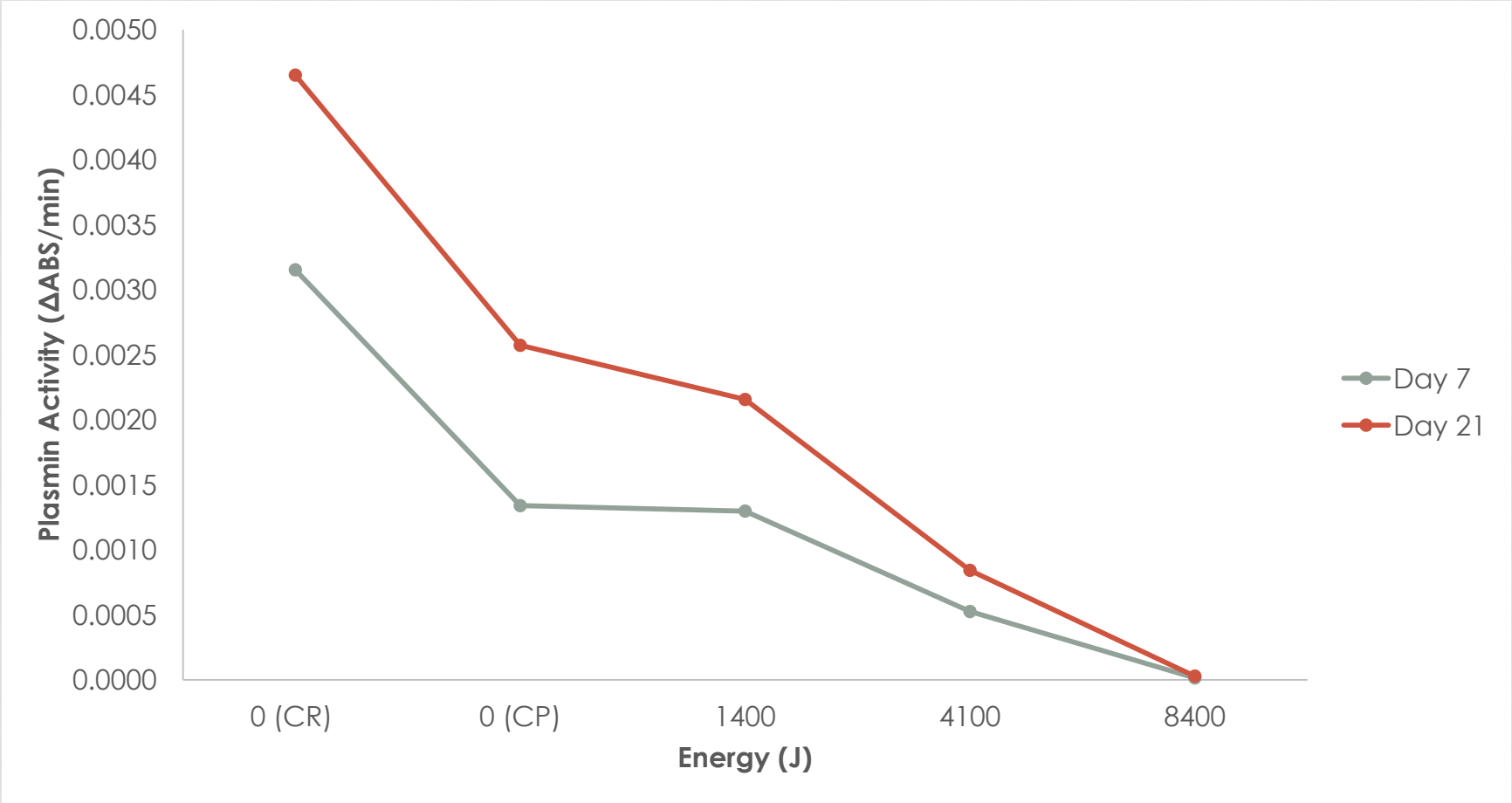
PLASMIN ACTIVITY AFTER 21 DAYS OF STORAGE



SPECIFIC PLASMIN ACTIVITY DAY 7 VS. DAY 21



SPECIFIC PLASMIN ACTIVITY VS ENERGY



CR= Control Raw
CP= Control Pasteurized

CONCLUSIONS

- Ultrasound may be an effective adjunct to milk pasteurization
  - Thermosonication reduced plasmin activity at 170μm/30s and 170μm/60s
- Incorporation of ultrasound into the dairy industry requires shorter processing time