

# NUTRITION & NEUTRONS

## THE EFFECT OF CITRATE ON CASEIN MICELLES

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### WHY STUDY CALCIUM IN CITRATE?

I'M A CHEESE GUY!



HOW TO MAKE A BETTER CHEESE MIX FOR MAC & CHEESE?



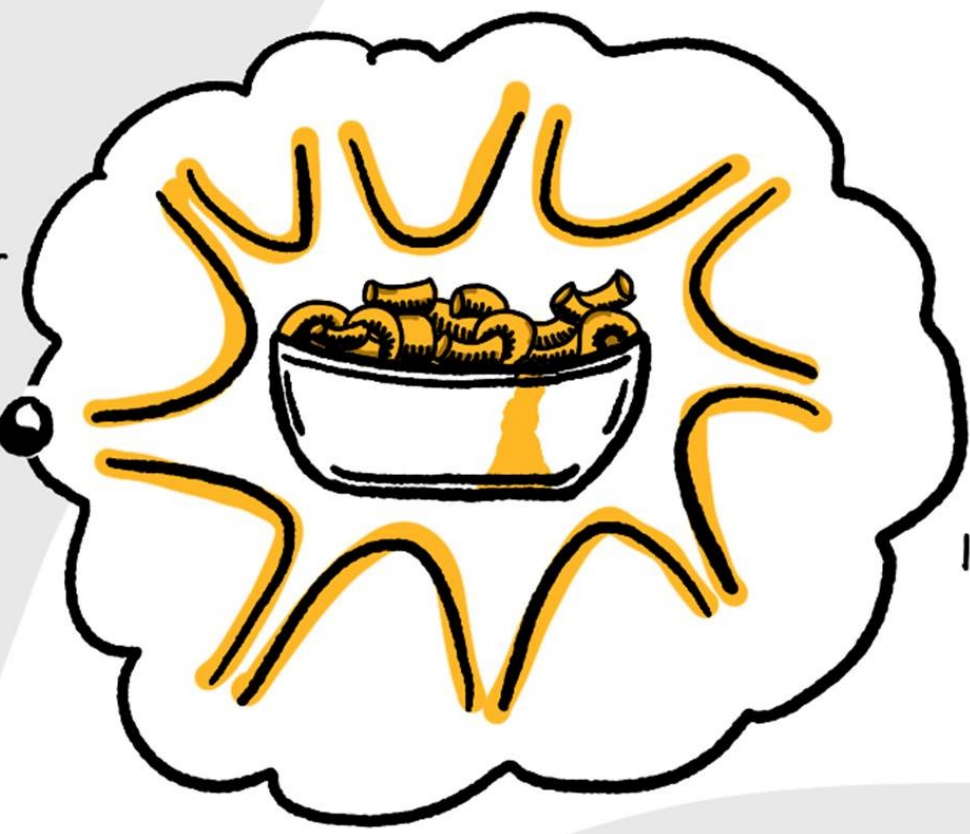
HEAT 11g SODIUM CITRATE IN 265g OF SKIM MILK (160 mM SODIUM CITRATE)

WHEN HOT AND CITRATE DISSOLVED ADD 285 g CHEESE



BUT SOMETHING HAPPENED WHILE STIRRING... TRANSPARENT FLASHES IN THE LIQUID!

HE USED THIS TO MODEL THE INQUIRY PROCESS FOR HIS STUDENTS



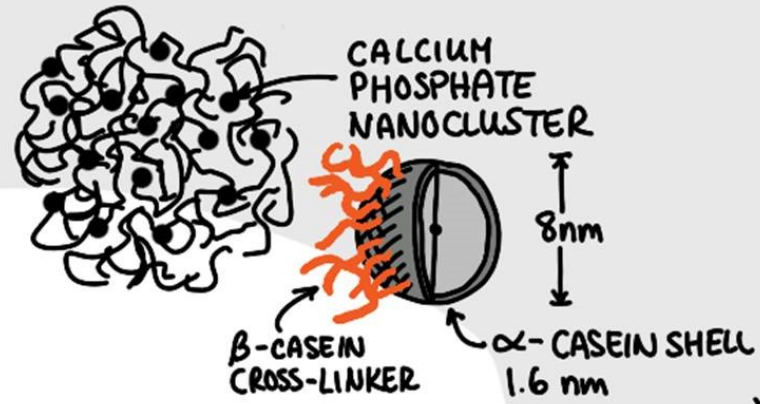
### CASEIN MICELLES

MAJORITY OF MILK PROTEIN (82%)  
COLLOIDAL STRUCTURE THAT SCATTERS LIGHT



? UNKNOWN INTERNAL STRUCTURE?

NANOCUSTER MODEL (THERE ARE DIFFERENT MODELS!)

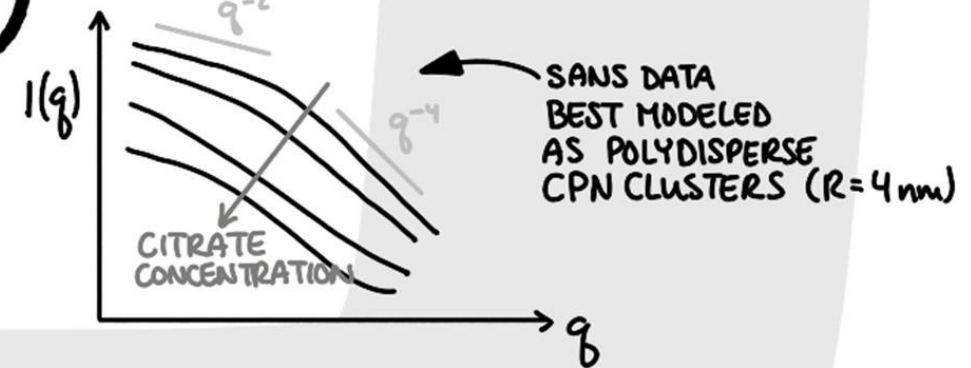


NEUTRON SCATTERING!

### EXPERIMENTAL APPROACH

- USE SIMULATED MILK ULTRA FILTRATE (SMUF)
- DISSOLVE NIST SRM1549a WHOLE MILK POWDER IN SMUF
- SKIM THE MILK VIA ULTRACENTRIFUGE
- RE-SUSPEND IN SMUF
- ALTER SMUF W/ CITRATE
- ANALYZE WITH DLS, SANS, USANS

OPACITY CHANGED WITH INCREASING SODIUM CITRATE CONC



### CONCLUSIONS

BOTH CITRATE & CONTRAST MATCHING HAVE SAME EFFECT ON SANS PROFILE  
→ CALCIUM PHOSPHATE CLUSTERS

CITRATE DOESN'T CHANGE  $R_g$   
CITRATE INCREASES  $R_h$

NOT LIKELY DISAGGREGATION OF CASEIN IN PRESENCE OF CALCIUM CHELATORS (AS DISCUSSED IN LITERATURE)

ARE PROTEIN CONCENTRATIONS TOO HIGH?

FUTURE EXPTS SHOULD USE MORE CONCENTRATED CITRATE; PURIFY CASEIN MICELLES; OTHER TECHNIQUES SENSITIVE TO LARGER PARTICLES

CITRATE CONC	$R_g$ (USANS)	$R_h$ (DLS)
10 mM	218 ± 14 nm	154 ± 8 nm
20 mM	214 ± 22 nm	204 ± 11 nm
30 mM	214 ± 16 nm	218 ± 16 nm
60 mM	212 ± 19 nm	219 ± 9 nm