The Interaction of Oil Body and Protein in Soymilk Making

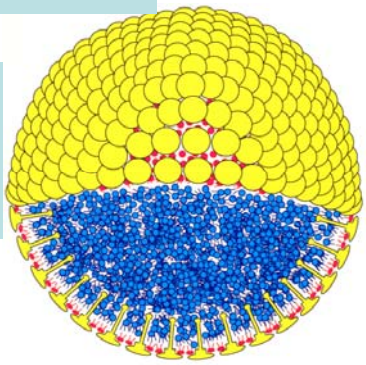
The Lab of Food Chemistry
Iwate University
Yeming Chen; Tomotada Ono

Oil Body (Huang)

Blue: lipid

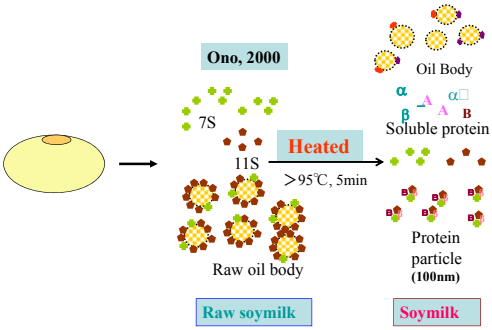
Red: Phospholipid

Yellow: Oleosin



(1) Large Lipid Core; (2) Oleosin Protein Surface.

Soymilk Preparation



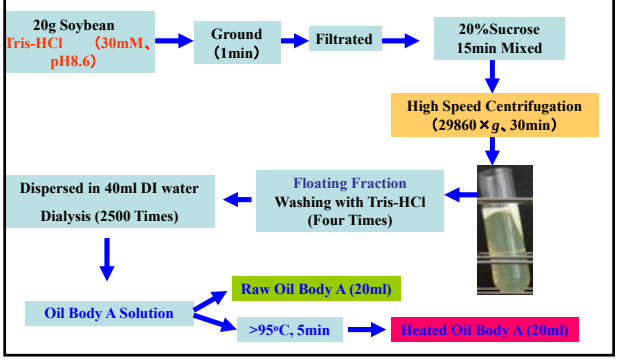
The Aim

- (1) The effect of **heating treatment** on **oil body** and **protein**, respectively?
- (2) What is the **intermolecular force** between oil body and protein in **raw soymilk**?

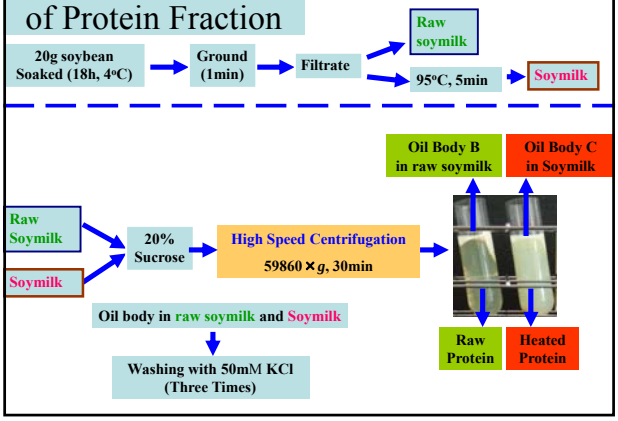
Materials and Methods

- Materials
  - (1) Tosan 205 (11S deficiency),
  - (2) Yumeminori (α', α deficiency)
- The Effect of **Heating** on Oil Body and Protein
  - (1) The interaction of oil body and protein
  - (2) The size
  - (3) The effect of $CaCl_2$
  - (4) The effect of pH
  - (5) The hydrophobicity

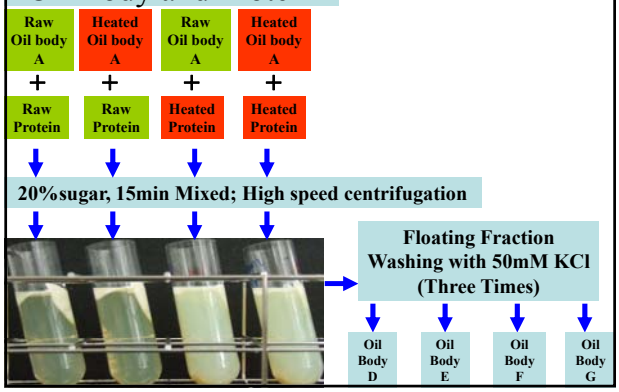
The Purification of Oil Body



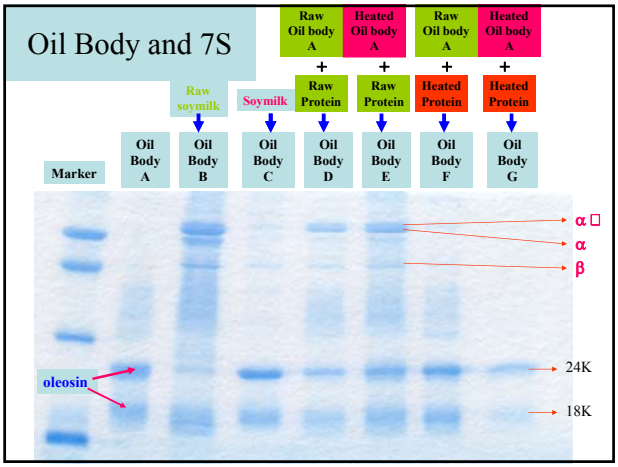
The Preparation of Protein Fraction



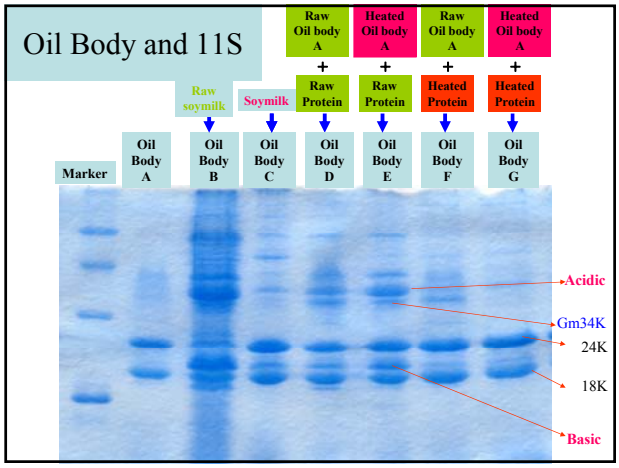
The Interaction of Oil Body and Protein



Oil Body and 7S



Oil Body and 11S



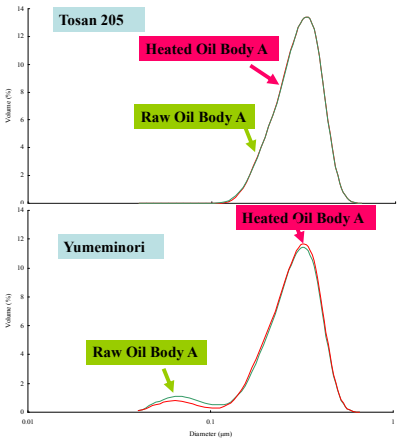
Conclusion 1

- (1) The protein-binding property (7S and 11S) of oil body do not change by heating;
- (2)Native 7S and 11S can bind with oil body but denatured ones can not bind with oil body whether it is heated or not.

The Effect of Heating on Oil Body

- (1)The size
- (2)The $CaCl_2$
- (3)The pH
- (4)Hydrophobicity

The Size of Oil Body

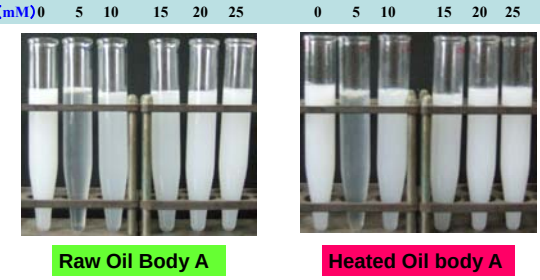


After being heated:

Oil bodies might **aggregate** because of its protein surface;

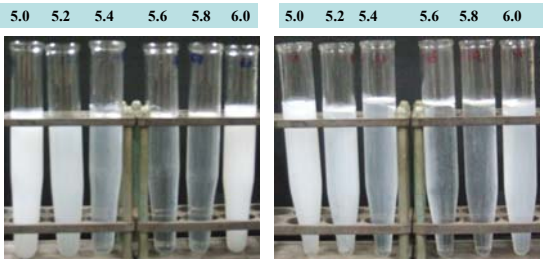
They also might **coalesce** into larger ones because of their large lipid core.

The Effect of $CaCl_2$



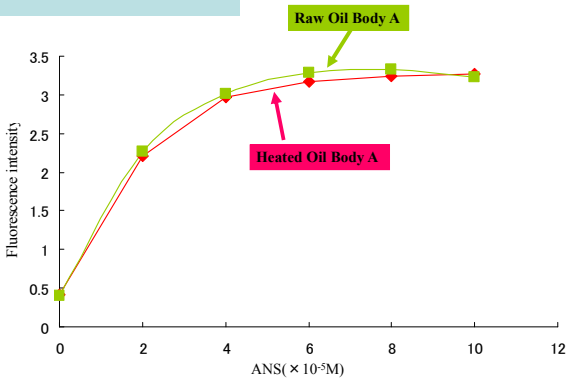
1600×*g*、20min

The Effect of pH

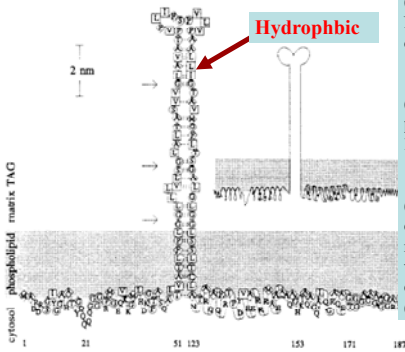


400×*g*、10min

Hydrophobicity



The Structure of Oleosin (Huang, 1992)



(1)Simple structure: N-terminal, central domain, C-terminal;

(2)Central domain penetrates into the lipid core;

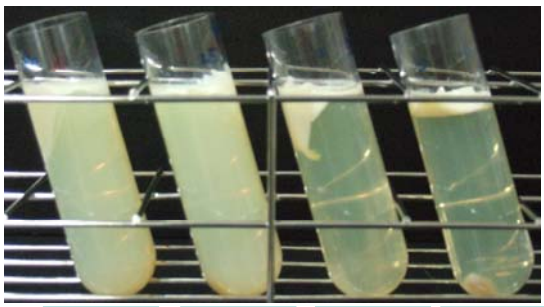
(3)The positively charged amino acid residues binds strongly with negatively charged lipids (phospholipid or TAG).

The Effect of Heating on Protein

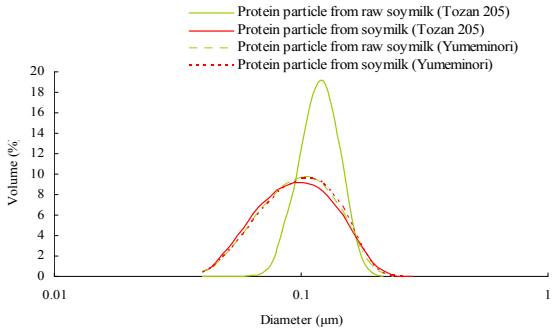
- (1)The existing state and size
- (2)The $CaCl_2$
- (3)The pH
- (4)Hydrophobicity

The Existing State and Size of Protein

20% Sucrose



Tozan 205 soymilk | Yumeminori soymilk | Tozan 205 raw soymilk | Yumeminori raw soymilk

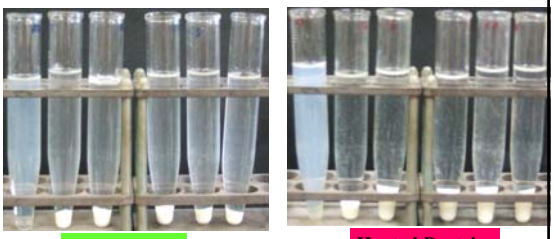


In raw soymilk, 7S and 11S mainly exist as 7S trimers and 11S hexamers because the supernatant fractions of raw soymilks are considerably transparent;

After being heated, 7S trimers and 11S hexamers are destroyed and form more large protein particles (about 100nm) which cause the supernatant fractions of soymilk opaque.

The Effect of $CaCl_2$ (Tosan205)

$CaCl_2$(mM) 0 5 10 15 20 25 0 5 10 15 20 25

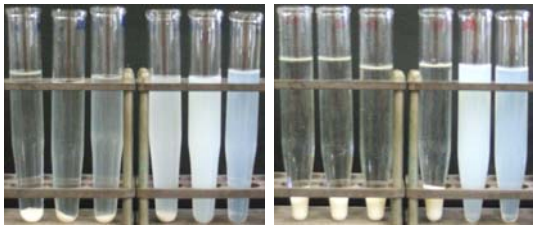


Raw Protein | Heated Protein

400×*g*、10**min**

The Effect of pH (Tosan 205)

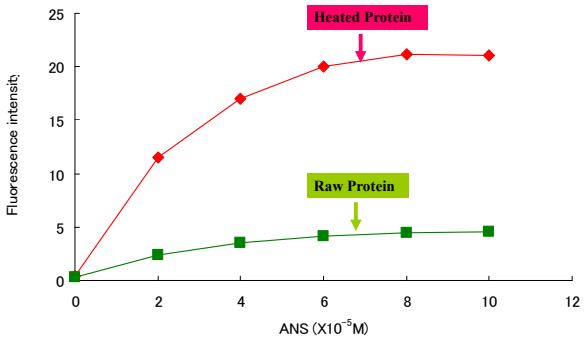
pH 4.8 5.0 5.2 5.4 5.6 5.8 4.8 5.0 5.2 5.4 5.6 5.8



Raw Protein | Heated Protein

400×*g*、10**min**

Hydrophobicity (Tosan 205)



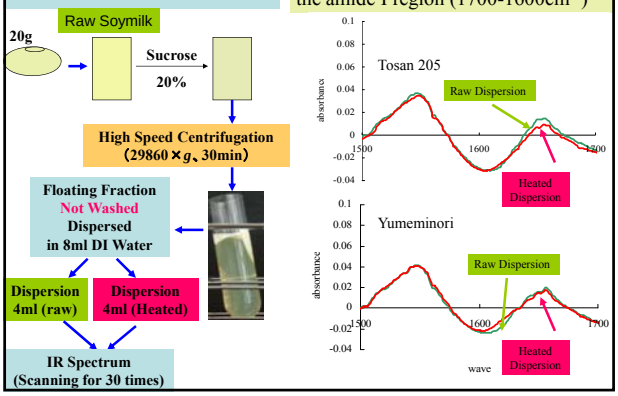
Electrostatic Interaction

The intermolecular force between oil body and protein in raw soymilk

- (1)The possibility of hydrophobic interaction is low;
- (2)Oil body could be purified by alkaline washing method (30mM Tris-HCl, pH8.6);
- (3)7S trimers and 11S hexamers have compact structures which would cause surface charge dense; after being heated, 7S trimers and 11S hexamers would be destroyed and the structures would become loose which would cause the surface charge thin.

? Hydrogen Bond

The **hydrogen bond destruction** could cause the **ir frequency shift** at the amide I region (1700-1600cm^{-1})



Conclusion 2

- (1)Oil body is very stable to heating treatment;
- (2)Many large protein particles become into being by heating treatment;
- (3) Protein binds to oil body via electrostatic interaction in raw soymilk