# PHYS-010 The effect of Sucrose Fatty Acid Esters for fat bloom

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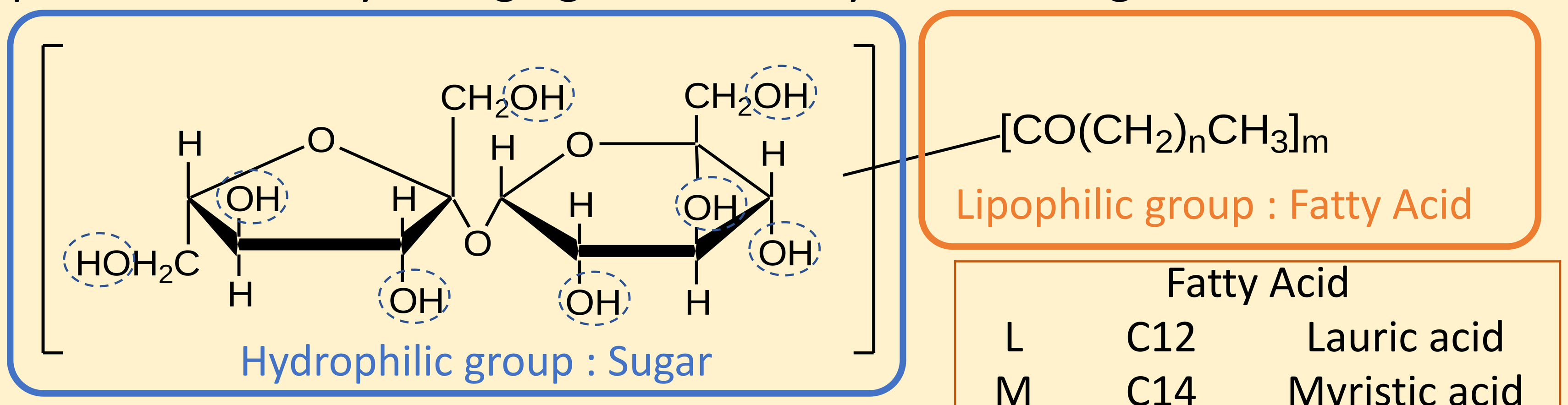
## INTRODUCTION

Sucrose Fatty Acid Esters (SE's) are food emulsifiers that are manufactured from sucrose and fatty acid methyl esters, have a wide range of hydrophilic and lipophilic balance (HLB), because fatty acids can bond with eight hydroxyl groups of sucrose. The experiment was conducted using SE's as RYOTO™ Sugar Ester (POS-135 (HLB1, palmitic-oleic-stearic mixed fatty acid), S-570 (HLB5, stearic fatty acid), P-170 (HLB1, palmitic fatty acid) and S-170 (HLB1, stearic fatty acid)). Chocolate during storage, fat bloom phenomenon happens that dulling or whitening on the surface. This problem affects texture and quality of chocolate. The mechanisms of fat bloom are caused by composition of fats, manufacturing process and storage conditions. In this research, we found that SE's have function to delay fat bloom appear in the chocolate and also SE's controlled the polymorphic transformation of the cocoa butter (CB).

## MATERIALS

Wide variety of "Sucrose Fatty Acid Esters (SEs)". SEs are possible to modify the properties in food by changing kinds of fatty acids or degree of esterification.




| | Fatty Acid | |
|---|---|---|
| L | C12 | Lauric acid |
| M | C14 | Myristic acid |
| P | C16 | Palmitic acid |
| S | C18 | Stearic acid |
| O | C18:1 | Oleic acid |
| POS | | Mixed acid |

Nomenclature for RYOTO™ Sugar Ester

S-170

- Percentage of Main Fatty Acid
- HLB
- Kinds of Fatty Acid

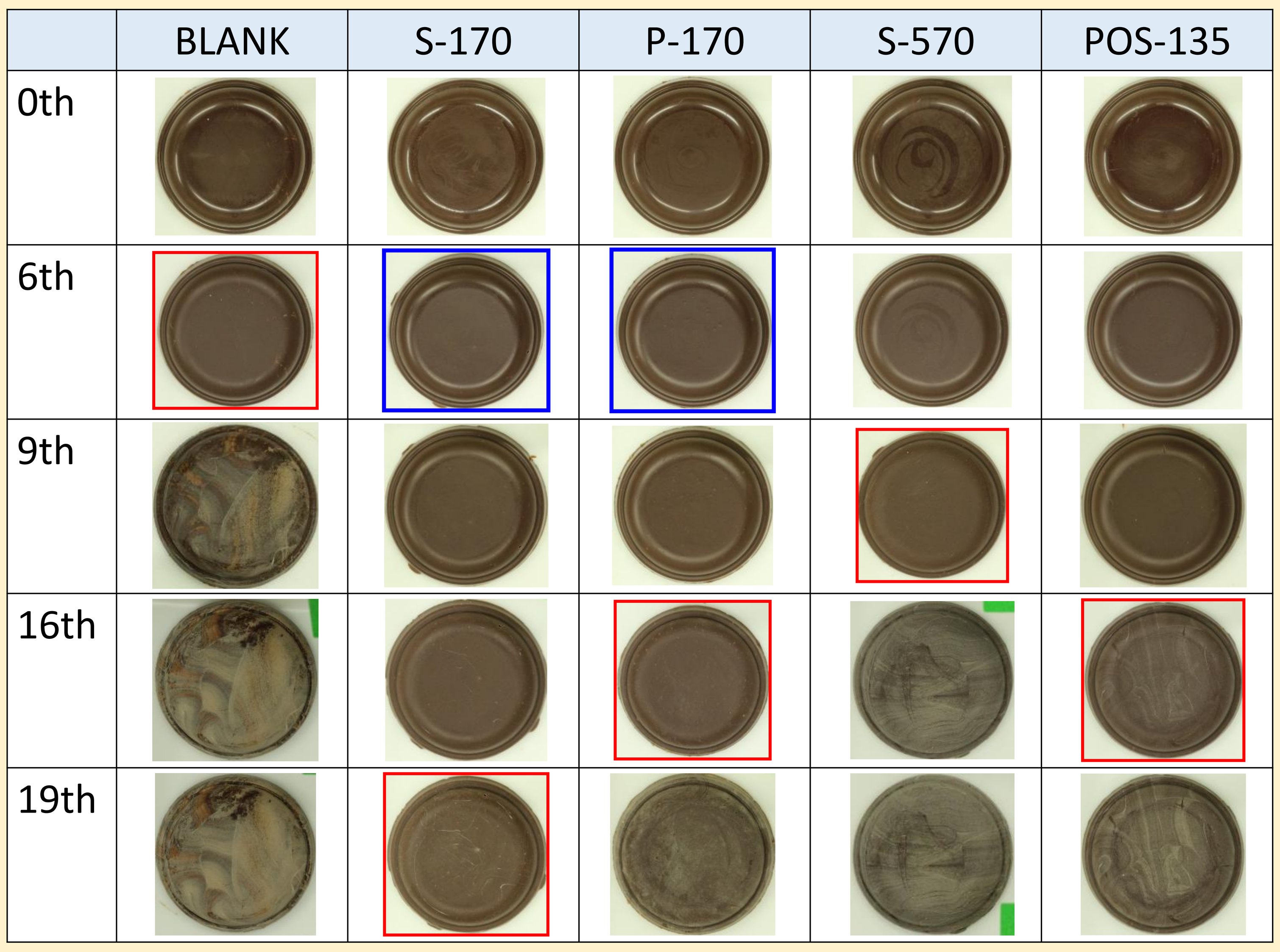
## Experiment1. Emulsifier addition effect to chocolate

**Process**

Dark Chocolate (NISSHIN KAKO Co.) → Warming 65°C → [Emulsifiers (0.5%)] → Cooling 30°C → [Seed (0.1%)] → Cooling 5°C 20min → Aging 20°C 4days → cycle storage condition (20 and 32°C , 12h each)

### Result1 Observation results of SE's-added chocolate

Fig.1 Observation results of chocolate with SE's on cycle condition




Red frame : bloom observed, Blue frame : grains observed

The chocolate with POS-135 was observed fat bloom from 16th, and S-570 appeared fat bloom from 9th whereas without emulsifiers occurred fat bloom from 6th. In addition, the chocolate with P-170 and S-170 observed grains from 6th, and appeared fat bloom after 16th.

## Experiment2. Emulsifier addition effect to cocoa butter(CB)

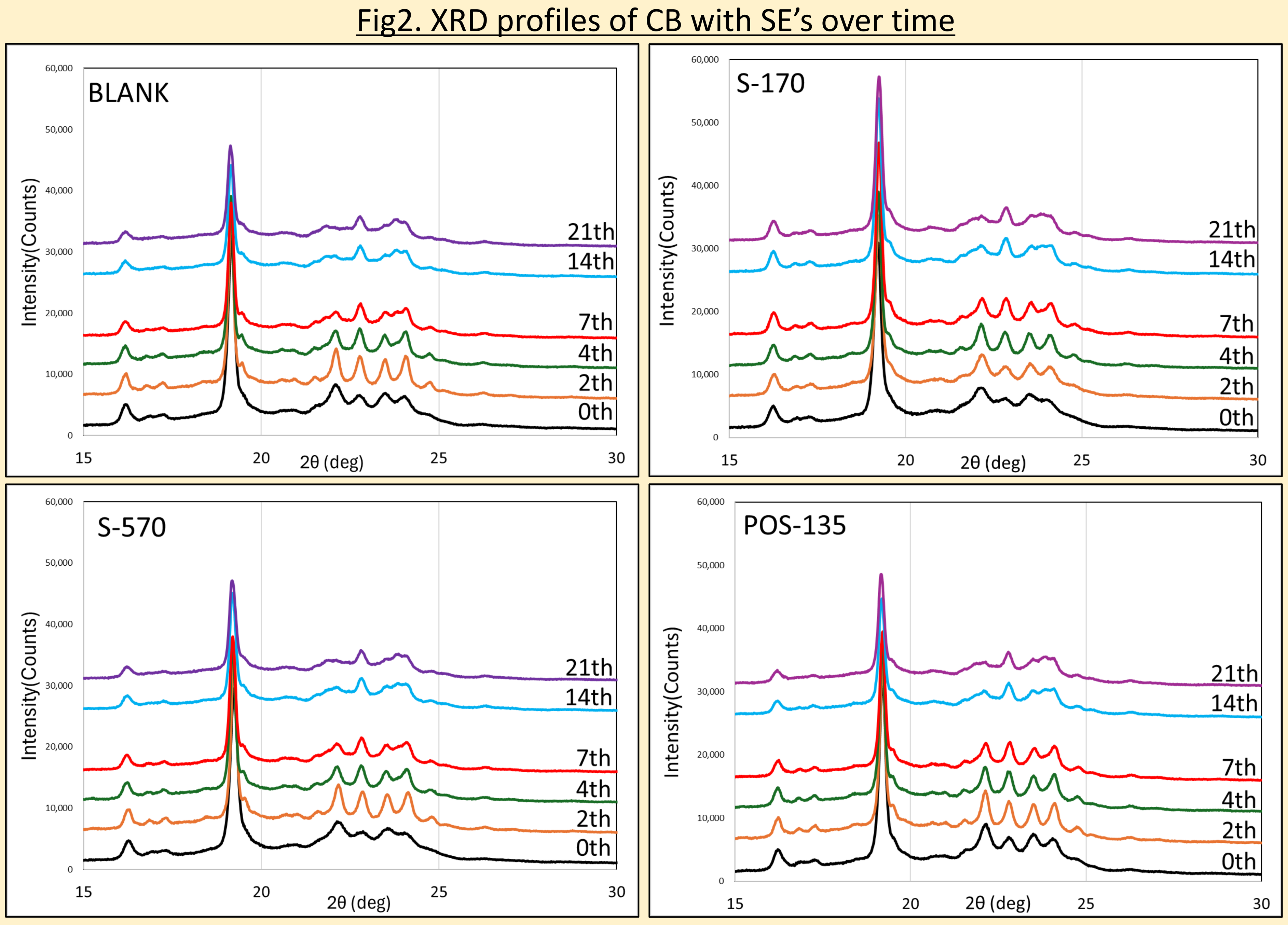
**Process**

Cocoa Butter (NISSHIN KAKO Co.) → Warming 65°C → [Emulsifiers (0.5%)] → Cooling 30°C → [Seed (0.1%)] → Cooling 5°C 20min → Aging 20°C 4days → cycle storage condition (20 and 32°C , 12h each)

### Result2-1 X-ray diffraction measurement(XRD)

Measuring how the sample changes into different crystal polymorphs over time.

Fig2. XRD profiles of CB with SE's over time




**Analysis**

To observe the time changes of the four peaks of β2, a comparison was made using the intensity ratios of A and B.

Fig3. Analysis section of β2

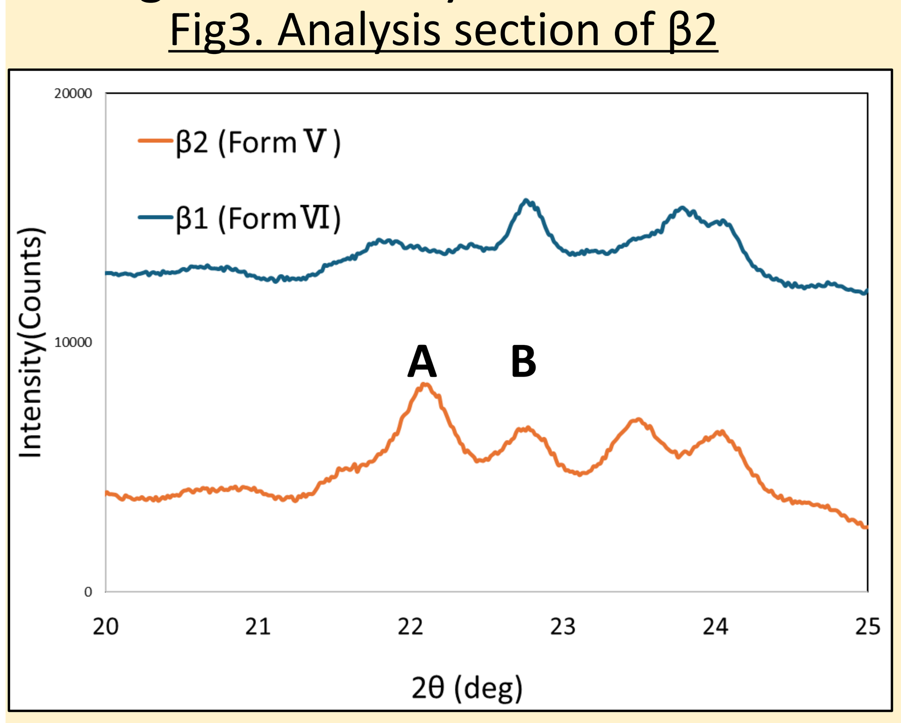
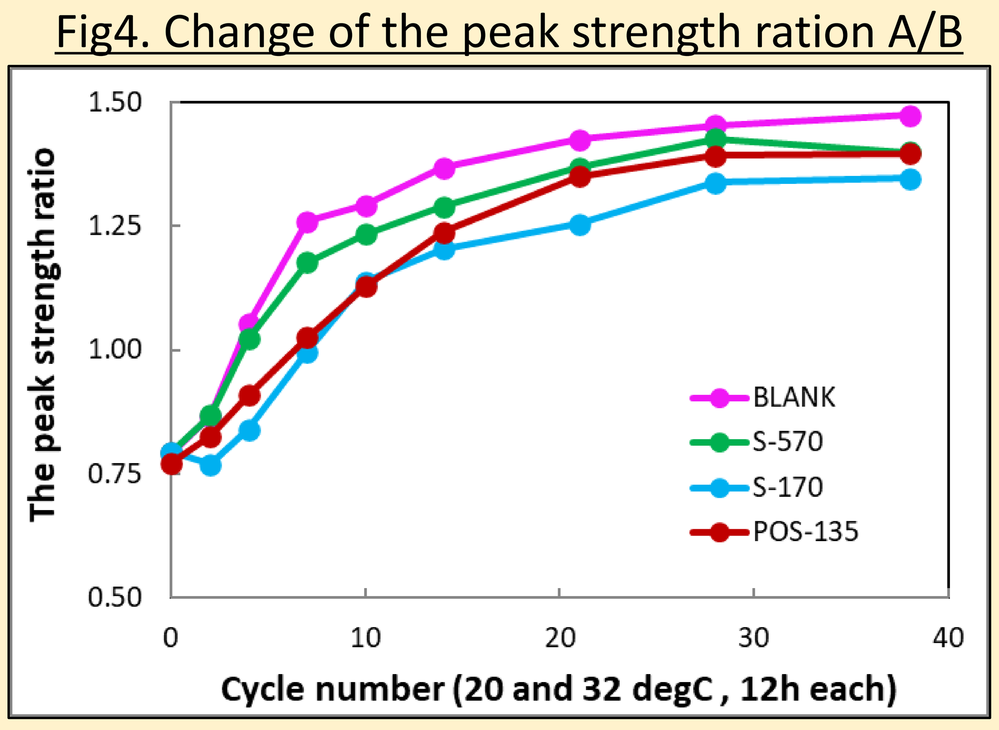



Fig4. Change of the peak strength ration A/B




Compared with BLANK, it was found that the initial bloom suppression was effective with S-170 and POS-135, while S-570 showed a consistent level of bloom suppression effect over time.

### Result2-2 Differential Scanning Calorimetry(DSC)

A sample of about 10 mg was packed in an aluminum pan and the percentage change in polymorphic transition from β2 to β1 over time.

**Analysis**

According to the XRD results of blank samples, it has become β1 after 28 days. In the DSC analysis, peaks below 34degC are considered β2, while those above 34degC are considered β1, and the area ratio was analyzed.

Fig5. DSC analysis method and temperature program

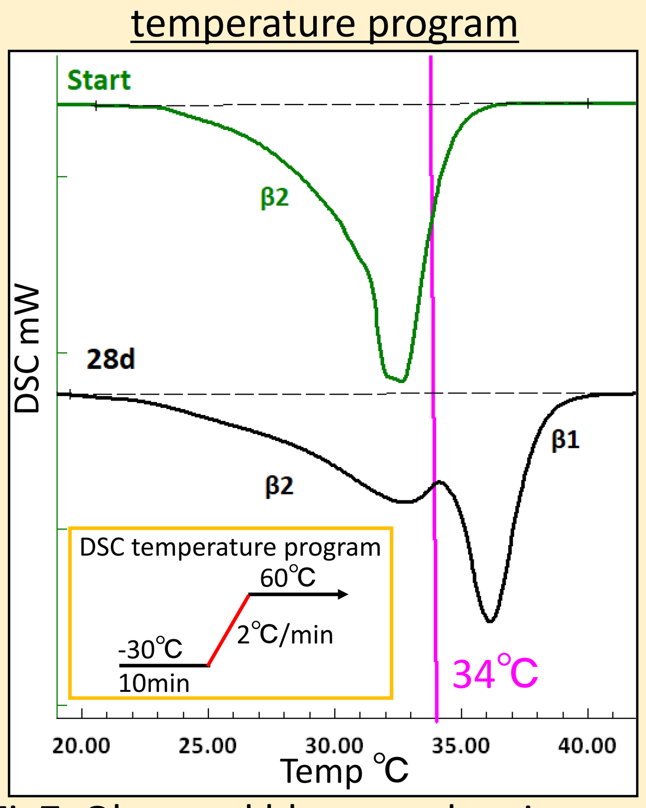



Fig6. Area ratio of β1 during cocoa butter melting peak

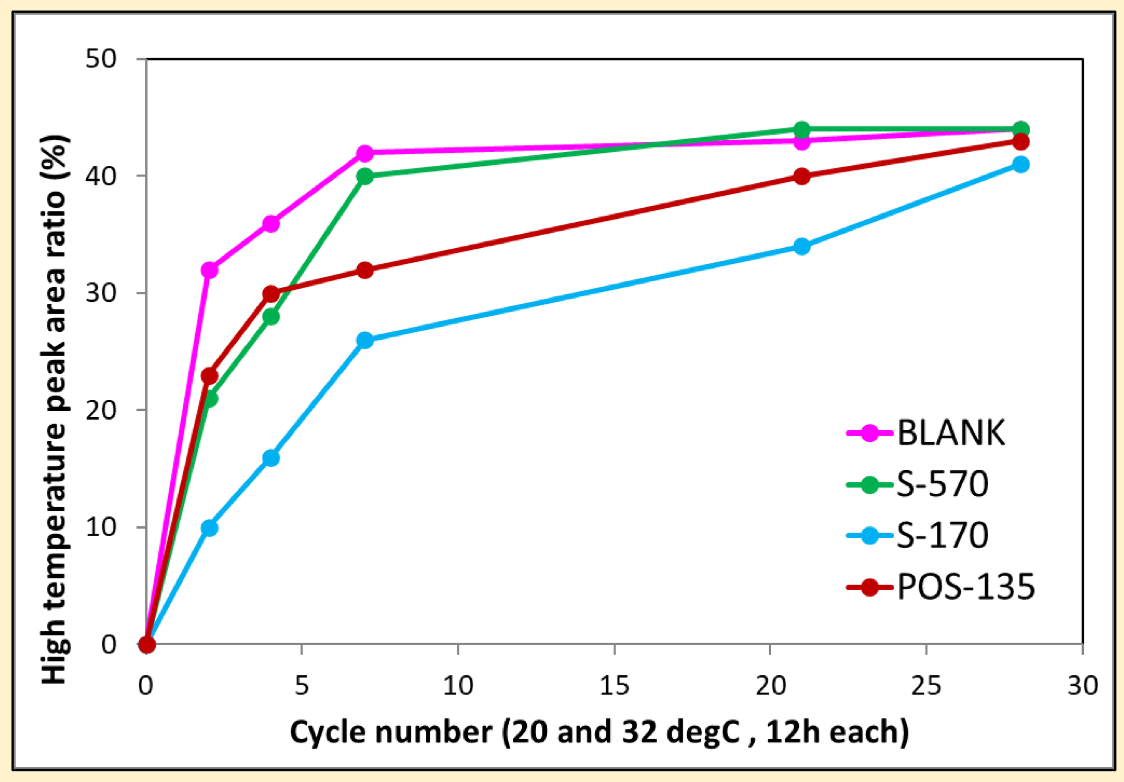
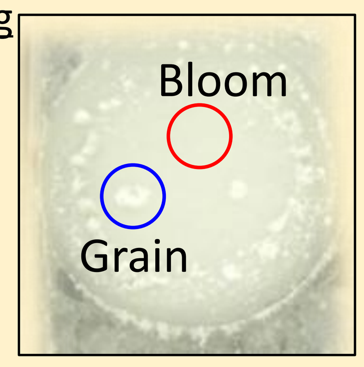
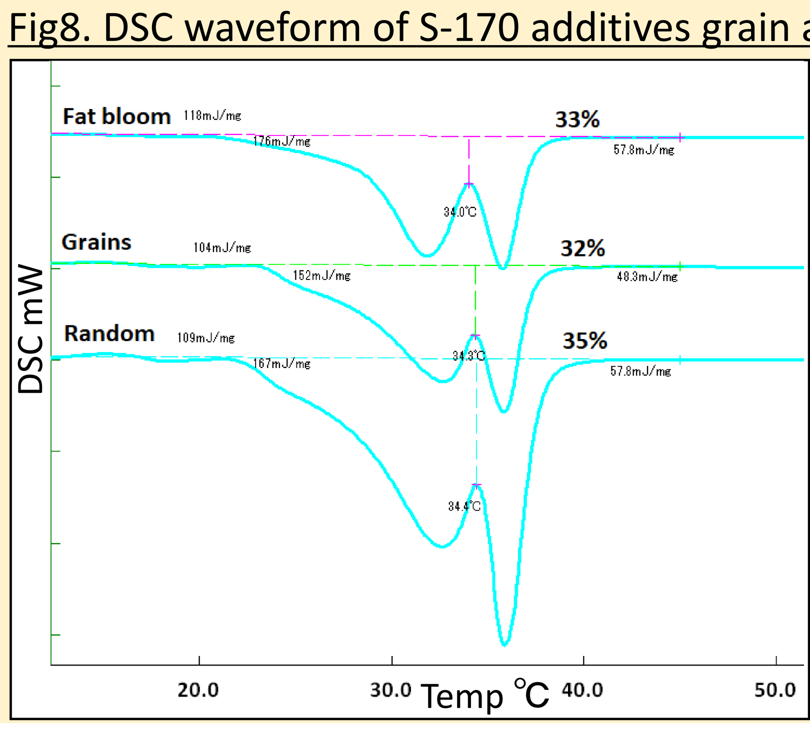



Fig7. Observed bloom and grain in s-170 adding




After the 21st cycle, grains and blooms were observed in the same chocolate with the S-170 additive.
Take them out and analyzed by DSC.
"Random" is a place without grain and bloom.

Fig8. DSC waveform of S-170 additives grain and bloom




By adding POS-135, S-570, and S-170 to BLANK, the occurrence of bloom is suppressed, especially with S-170 being the most effective. Furthermore, since there was variation in the measurements for the S-170, it is assumed to be due to the influence of the grain.

## Discussion

1. Through XRD and DSC measurements, we confirmed the transition suppression effect of POS-135 and S-170. For S-570, some effect was acknowledged, but it was similarly confirmed that its effect is smaller compared to POS-135 and S-170.
2. The reason for the grain formation in S-170 and P-170 considered to be due to the emulsifier acting as a nucleus, causing high-crystallinity fats in the chocolate to aggregate and form grains.