THE EFFECT OF DIFFERENT SUCROSE CONCENTRATIONS ON THE RHEOLOGICAL AND FUNCTIONAL PROPERTIES OF FROZEN-THAWED LIQUID EGG YOLK

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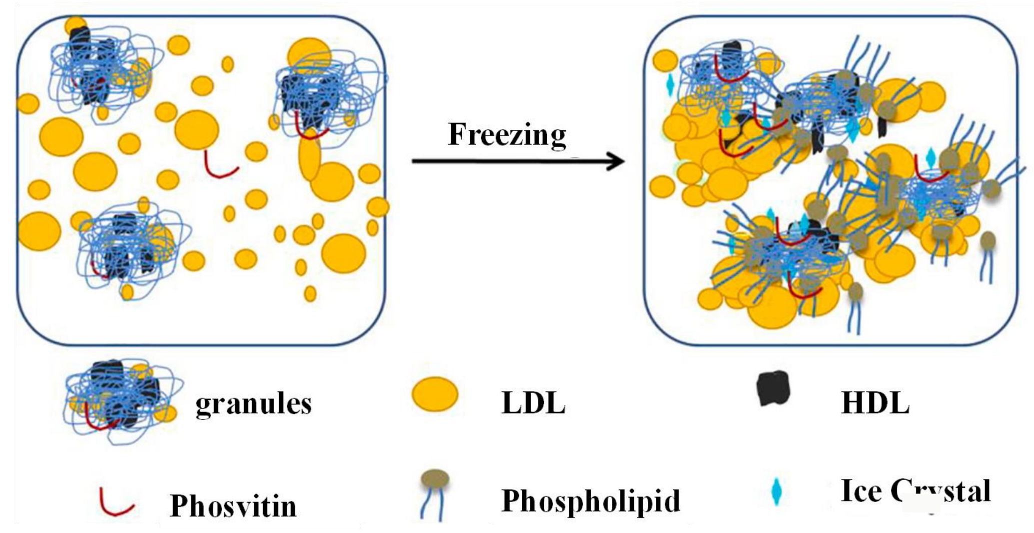
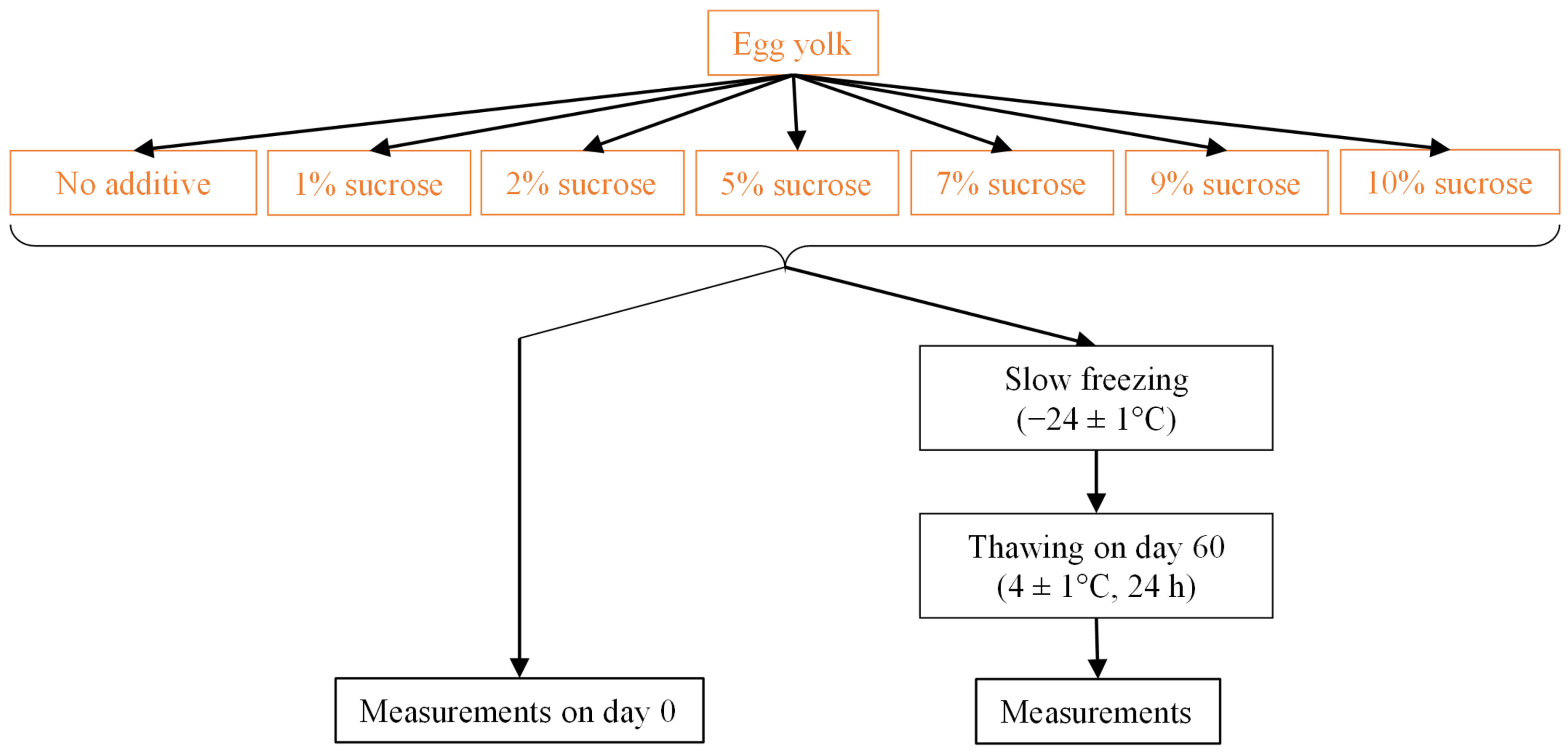
INTRODUCTION

The composition and structure of egg yolk are complex and varied, with a natural protein-lipid supramolecular structure. Under certain conditions, such as heating and salting, this structure breaks down, and the protein conformation changes, resulting in different yolk gels. The main proteins and molecular forces involved in the gel formation process differ in different processes, resulting in different types of yolk gel structures. Although the freezing point of egg yolk is −0.65°C, an irreversible change in its fluidity occurs at −6°C. At this temperature or lower, egg yolks become paste-like, which makes them difficult to handle, for example during transport and mixing. The most common explanation for this gelation during freezing is that the large ice crystals concentrate the components of the yolk, which results in the accumulation of plasma LDL. Gelation during freezing can be prevented or reduced by the addition of various cryoprotective agents such as sucrose.

The gelation mechanism of egg yolk



MATERIALS AND METHODS



Rheological properties (20°C)
MCR 92 rheometer (Anton Paar, Les Ulis, France)
rotational mode (concentric cilinder)
Shear rate (10-1000 1/s, then 1000-10 1/s)
Evaluation: Flow curve, Herschel-Bulkley model:

$$\tau = \tau_0 + K\left(\frac{d\gamma}{dt}\right)^n$$

where τ is shear stress (Pa), τ_0 is the yield stress (Pa), γ is the shear rate (1/s), K is the consistency coefficient (Pa·s^n) and n is the flow behaviour index (dimensionless).

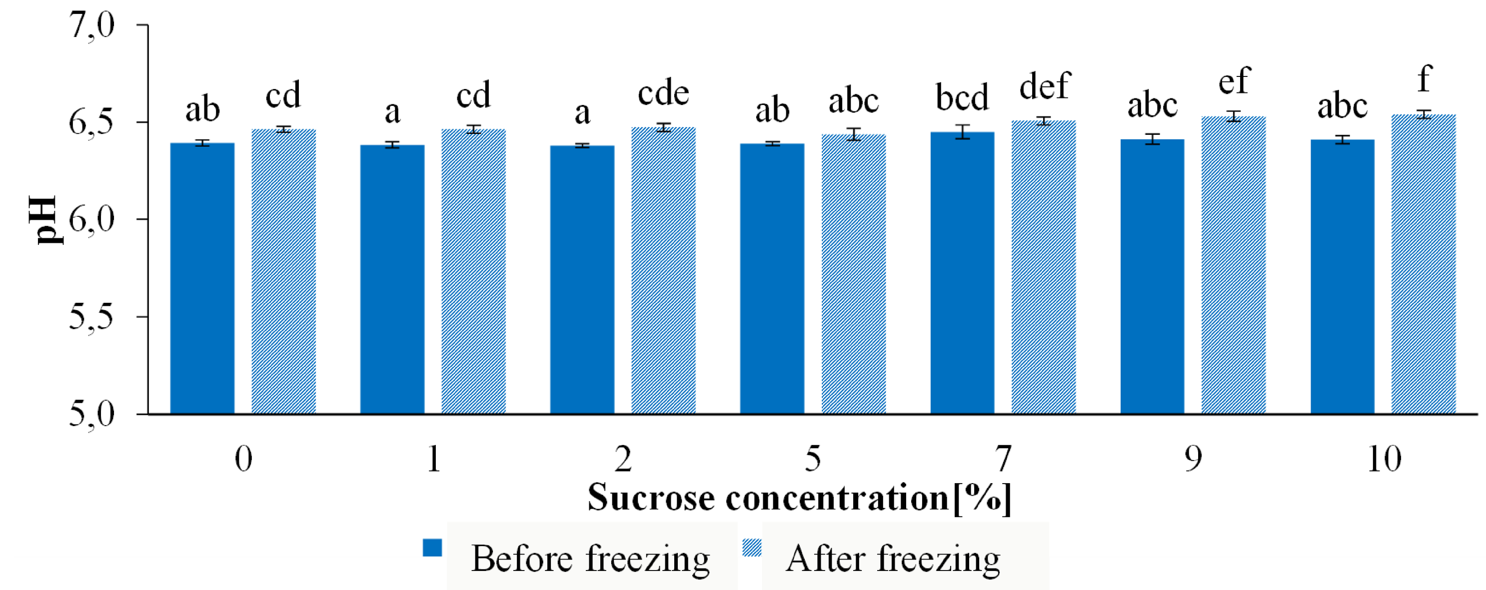
pH (4°C)
Digital pH meter (Testo 206-pH2, Testo SE & Co. KGaA, Titisee-Neustadt, Germany)

Colour
CR400 (Konica Minolta Sensing Inc., Osaka, Japan)
L* (lightness)
a* red(+)/green(–) colour attribute
b* yellow(+)/blue(–) colour attribute

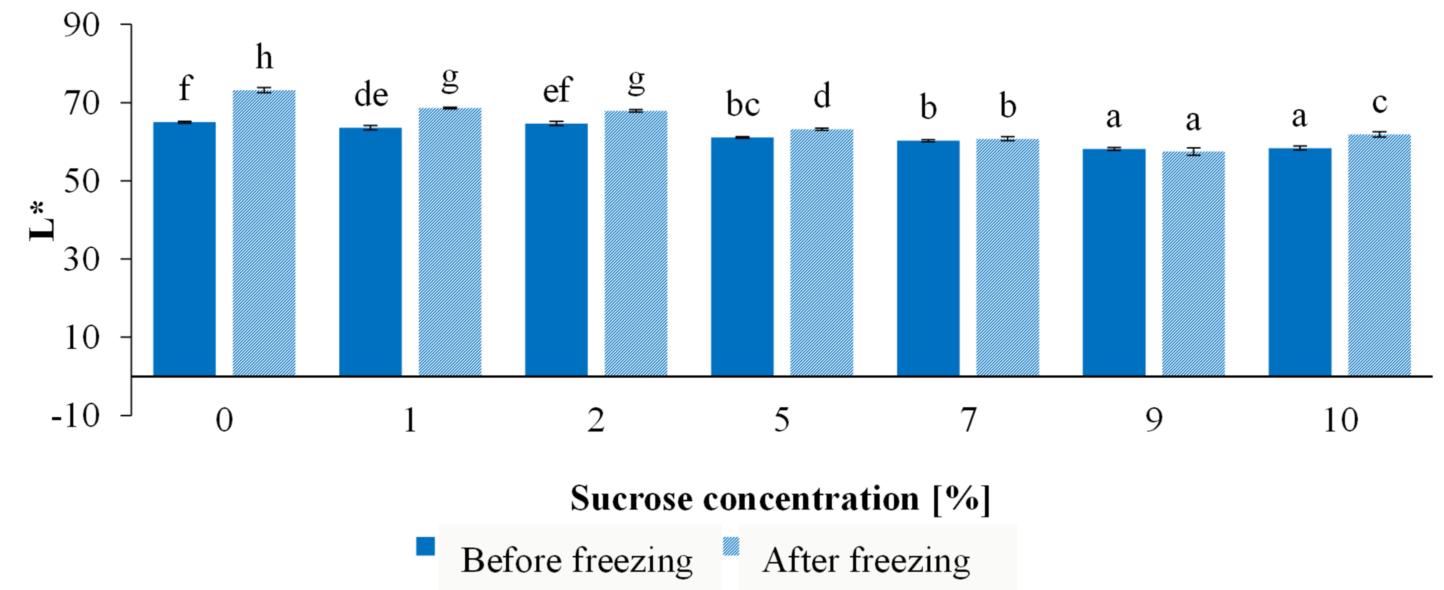
Turbidity
Dispersion in 10% NaCl solution (1:100 dilution)
Measurement of the absorbance at a wavelenght of 660 nm
U-2900 spectrophotometer (Hitachi, Tokyo, Japan)

RESULTS

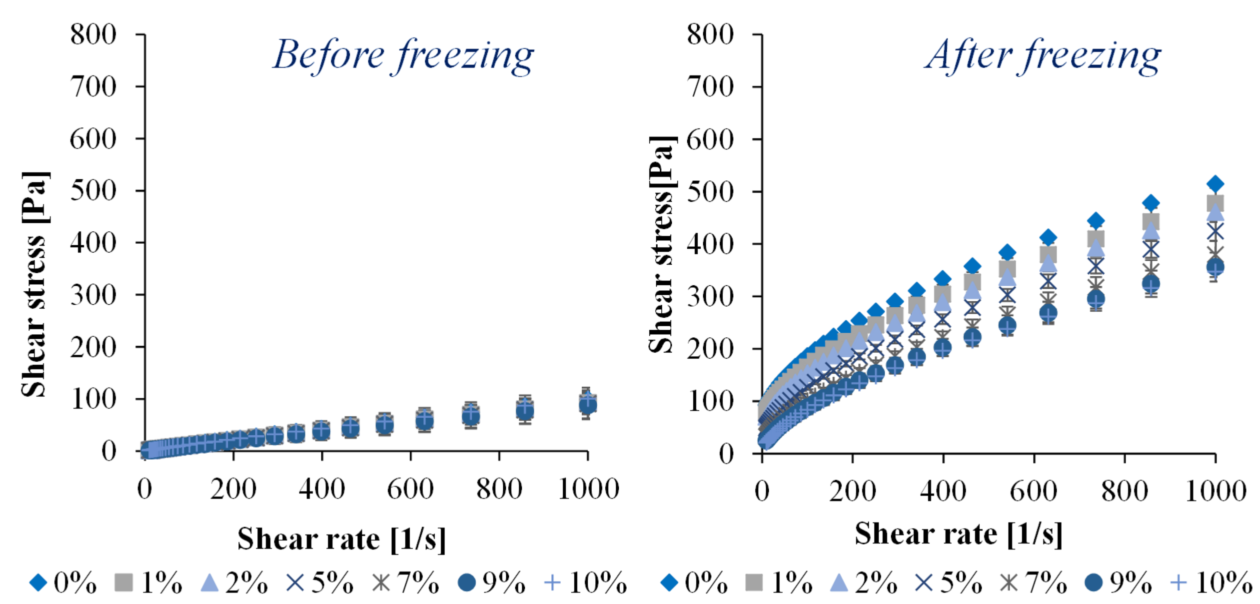
pH



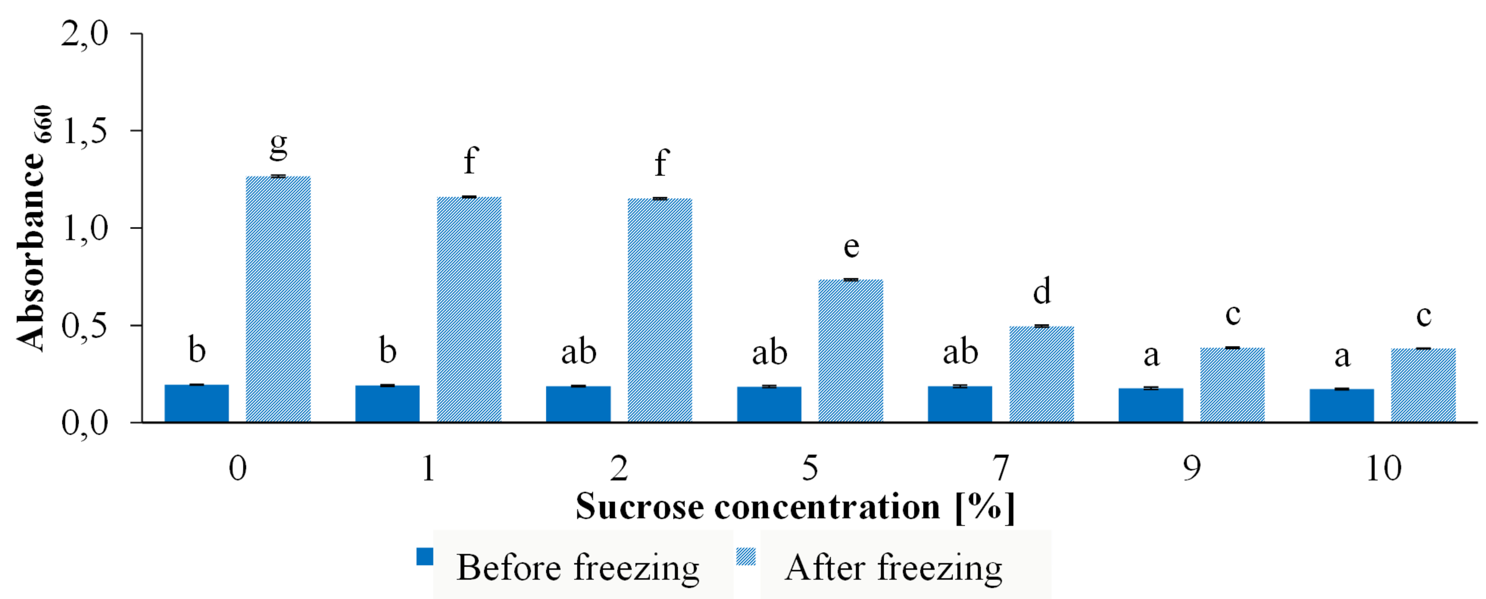
L*



Rheological properties



Turbidity



CONCLUSION

In our study, we found that the addition of sucrose did not result in a significant change in the pH of the samples, but the effect of freezing and thawing was significant. The samples became slightly darker at higher sucrose concentrations when it was added to the samples prior to freezing. However, samples became lighter after freezing and thawing. The addition of sucrose did not significantly change the rheological parameters of egg yolk samples. After freezing, a cryoprotective effect was observed. The lowest shear stress values were measured at 9-10% sucrose concentrations. The result of turbidity measurement also shows that the samples containing 9 and 10% sucrose have the lowest turbidity, so these samples have the best emulsion forming properties.

ACKNOWLEDGEMENTS

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