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学 位 論 文 要 旨
Dissertation Abstract

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学位論文題目：
Title of Dissertation

Effect of D-Ketohexoses on Rheological Properties of Chicken Gel Products
(鶏肉および鶏卵のゲル状食品の物性に及ぼすD−ケトヘキソースの添加効果とその機構に関する研究)

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Sucrose (Suc) is the most popular sugar in food processing, because it gives comfortable sweetness to foods, improves the rheological properties of processed foods, and sometimes suppresses the growth of bacteria in foods. But excessive consumption of Suc and other conventional sugars, such as D-glucose (Glc) and D-fructose (Fru), increases the risk of developing lifestyle disease, *e.g.* diabetes. Rare sugar, monosaccharides and their derivatives being rarely in nature, may reduce the risk, because some of rare sugars, *e.g.* D-allulose (Alu), are non-calorie and suppress postprandial blood sugar elevation and body fat accumulation. Chicken meat and chicken egg are popular food materials and they are extensively used in producing gelling foods, such as sausage and scramble eggs, in many countries.

The main objective of this thesis was to investigate the effects of rare ketohexoses (Alu, D-tagatose/Tag, and D-sorbose/Sor) on the rheological properties of chicken gel products and to compare the effects of rare ketohexoses on frozen storage of chicken gel products with Glc, Suc, and trehalose (Tre).

Chapter 3 shows the effect of Alu as sugar substitute on rheological properties of chicken breast sausage. The total amount of Suc used was 2.5% of the weight of minced chicken breast meat. The results show that substitution of Suc with Alu did not affect breaking stress, breaking strain, and elasticity modulus of chicken breast sausage, but 100% substitution with Alu caused a 10% decrease in viscosity and 31% decrease in expressible water. The deterioration in the physical properties (elasticity, viscosity, water-holding capacity, and elastic recovery) of chicken breast sausage that are caused by frozen storage were greatly suppressed by the substitution of Suc with Alu. Thus, Alu was shown to confer resistance to freezing-related damage in sausage. In particular, the suppression of the quality deterioration of frozen-stored sausage demonstrates the feasibility and benefit of application of Alu to frozen foods.

Chapter 4 shows the application of D-ketohexoses to egg white (EW) gel. The aim of this chapter was to examine the rheological properties of chicken EW gels containing D-ketohexose (Alu, Tag, Sor and Fru) and to compare the effects of D-ketohexoses on freeze-thawing of EW gels. The results shows that D-ketohexoses can improve the rheological properties and water holding capacity of EW gels compared with Suc, Glu, and Tre. Furthermore, D-ketohexoses appreciably reduced the deterioration in the rheological properties of EW gels by freeze-thawing and possessed higher water-holding capacity against freeze-thawing than the other sugars. Thus, D-ketohexoses are useful to enhance storage stability of frozen gel-type foods containing EW.

Chapter 5 shows the application of D-ketohexoses to whole egg (WE) gel. WE gel with D-ketohexose showed similar viscoelastic properties to a WE gel with Glc, Suc, or Tre. But the breaking strength of ketohexose-gels was higher than that of the other sugar-gels suggesting that D-ketohexoses confer fracture resistance to WE gel. Furthermore, Alu was superior to all the other sugars (Tag, Sor, Fru, Glc, Suc, and Tre) in terms of the suppression of viscosity change of WE gel by freeze-thawing. Fru-gel also had a similar effect, but the suppression effect was restrictive only in the first freeze-thaw cycle. In addition, ketohexose-gels, especially Alu-gel, retained higher breaking stress value than Glc-, Suc-, and Tre-gel did.

Chapter 6 shows the mass transfer phenomena and diffusion coefficient of Alu into potato. In both Alu and control sugar Suc, uptake into potato in the immersion period of 0-2 h was higher than that in the immersion period of 6-8 h. The value of Alu and Suc content in potato were 2.81% and 1.75%, respectively. Diffusion coefficient of Alu was $6.43 \times 10^{-10} m^2 s^{-1}$ which is much higher than that of Suc ($2.83 \times 10^{-10} m^2 s^{-1}$), suggesting that Alu has the higher penetration rate into potato than Suc. The acceleration movement of Alu into food material may be useful in food processing and preservation such as curing process of meat and fish.

In conclusion, substitution of Suc with rare ketohexoses can improve the rheological properties of chicken gel products. Also, rare ketohexoses are useful to enhance storage stability of frozen chicken gel products. The application of rare ketohexoses to frozen foods will contribute to improvement of texture, suppression of quality deterioration, and reduction of the risk of developing lifestyle diseases.