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Effect of Salt on Chemical and Physical Properties of Egg Proteins

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Summary

1. Effect of the addition of sodium chloride on electrophoretic patterns of avian yolk proteins:

Effects of dilution with same weight of 0.9% saline or hypertonic (10%) saline on horizontal polyacrylamide gradient gel electrophoretograms of egg yolk of the Japanese quail(Coturnix coturnix japonica) and chicken (Gallus domesticus)were studied. Phosvitin preparations of quail and chicken egg yolk were obtained according to Mecham and Olcott(1949). The eletrophoretic mobility of the quail phosvitin bands were faster than those of the chicken phosvitin(Fig.2). After electrophoresis of egg yolk and phosvitin of quail and chicken, a new dense protein band in prealbumin zone on the gel was detected by CBBR staining of electrophoretograms of the quail and chicken egg yolk dissolved with the hypertonic saline(Fig. 1, Fig.2), having the same mobility as the major phosvitin band of quail and chicken.

Performic acid-oxidation of quail phosvitin was done as described by Van Eldric and Watterson(1981). A rabbit was injected with 300 ug performic acid-oxidized phosvitin seven times. Anti-phosvitin sera was obtained 7 days after the 7th injection (on Day 71). The serum showed immunoreactivity against quail phosvitin by ELISA. Serum had enough titers for detecting immunologic reactions(Tanabe et al., 1990).

Anti-quail phosvitin sera reacts to quail yolk phosvitin bands which appeared in quail egg yolk dissolved with the hypertonic saline, but does not react to chicken bands by Western blotting (Fig. 3).

2. Effects of composition of common sample salt on gelation of avian egg yolk in yolk memblane:

A common sample salt No.1 containing 99.64% NaCl and a common sample salt No.3 with admixture containing 96.54% NaCl, prepared by the Salt Science Rersearch Foundation, Tokyo, were used in the experiment(see Table 1). Sand (1000 um mesh filtrate), salt and water were mixed at a ratio of 50:6:10 (w/w/w) and were put in a small box. Indentations of 2cm diameter and 3cm depth were made in the mixture. Each fresh egg yolk with membrane was separated from albumen and put in an indentation and kept at 25 C. After 24 and 48 hrs, transparent yolk gels were obtained in every indentation.

The concentrations of sodium in the yolk gel maintained for 48 hrs with common sample salt No.1 and No.3 were 947+14 ppm and 824+50 ppm, respectively(Fig. 4). The creep curves were obtained from yolk gels (Fig. 5). The creep behaviour was analyzed with a six-element mechanical model. Retarded elastic modules (Ev2), retarded viscus modules (nv1) and Newtonian modules (nN) of yolk gels salted with Salt No.3 were much higher than those of yolk gels salted with Salt No. 1(Table 2).

3. Effects of salt on rheological properties and scanning electron micrographs of heat induced egg white gels:

The fresh eggs weighing about 60 g were collected from White Leghorn laying hens and stored in a box at 25 C for 6 days. Geletion of egg white was induced by incubation of shell eggs at the increasing temperatures from 20 C to 85 C for 55 min in deionized water or 20 % solution of a Common Salt No. 1 containing 99.64 % NaCl (prepared by Salt Research Foundation, Salt No. 1). Heat induced egg white gel samples were obtained from the incubated and shelled eggs.

In fresh eggs, the hardness of egg white gel made by incubation in deionized water and in 20 % solution of Salt No. 1 was 26 x 10^{4} dyne/cm^{2} and 35 x 10^{4} dyne/cm^{2}, respectively. The hardness of heat induced egg white gel of shell eggs stored for 6 days at 25 C was 10 x 10^{4} dyne/cm^{2}. The creep behavior of the heat induced egg white gel was analyzed with six element mechanical modules. Instataneous elastic modules (E0), retarded elastic modules of the first hook body (E1), retarded elastic modules of the second hook body (E2), retarded viscous modules of the first hook body (n1), retarded viscous modules of the second hook body (n2) and Newtonean viscous modules (nN) of fresh egg white gels made by incubation in 20 % solution of Salt No. 1 was 1.06 x 10^{5} dyne/cm^{2}, 4.16 x 10^{5} dyne/cm^{2}, 10.92 x 10^{5} dyne/cm^{2}, 3.45 x 10^{7} poise, 12.05 x 10^{6} poise and 2.84 x 10^{8} poise, respectively. All the scores above were much higher than those of heat induced fresh egg white gels made by incubation in deionized water. All of the scores of elastic modules and viscous modules of the egg white gels of shell eggs stored for four days were higher than those of gels of fresh eggs and shell eggs stored for six days. Electromicrographs of fresh egg white gels showed the presence of small and fine structured aggregates, which were formed into spindle-shaped clusters leaving regular void spaces. Salt caused larger aggregates in fresh shell eggs and smaller aggregates in stored shell eggs.