

Effects of adding silky fowl egg albumen in breadmaking

Toshiyuki Toyosaki

Department of Foods and Nutrition, Koran Women's Junior College, Fukuoka, 811-1311, Japan

***Corresponding Author:** Toshiyuki Toyosaki, Department of Foods and Nutrition, Koran Women's Junior College, Fukuoka, 811-1311, Japan.

Tel: +81-925811538E-mail: toyosaki@koran.ac.jp

Citation: Toshiyuki Toyosaki (2017) Effects of adding silky fowl egg albumen in breadmaking. Int J Nutr Sci & Food Tech 3:2, 32-36

Copyright: © Toshiyuki Toyosaki. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Received May 05, 2017; **Accepted** May 17, 2017; **Published** May 29, 2017.

Abstract

In order to elucidate the sitological functional properties of silky fowl egg albumen during bread making, we examined the effects of albumen on gluten formation from various perspectives, comparing them with domestic fowl albumen. The lubricious texture of gluten extracted from silky fowl egg albumen fraction-added dough was not observed in gluten extracted from domestic fowl albumen fraction-added dough. With regard to the hardness and adhesion while the dough is baking, the degree of hardness tended to increase over time, while the adhesion tended to decrease in the silky fowl egg albumen fraction-added dough, as compared to the hen's egg albumen fraction-added dough. The dough rising rate during fermentation tended to be higher in the silky fowl egg albumen fraction-added dough, as compared to the hen's egg albumen fraction-added dough, revealing a positive correlation between added albumen and both hardness and adhesion. Polymerization of gluten during fermentation was triggered more readily in silky fowl egg albumen fraction-added dough than in hen's egg albumen fraction-added dough.

Keywords: Silky fowl egg, Dough, Egg albumen, Hardness, Adhesion, Breadmaking

Introduction

Silky fowl are a breed of chicken that have been designated a natural treasure in Japan. Each hen lays only about 40 eggs per year, making the eggs highly valued. Throughout the Asian continent, silky fowl and their eggs are used in medicinal cooking. From an academic viewpoint, a modern scientific approach has only recently been applied to determine their medicinal, chemical, and biochemical components [1-6]. Almost no sitological or nutritional studies have been conducted on silky fowl eggs.

We previously studied silky fowl eggs from a sitology perspective, examining a variety of phenomena induced during bread fermentation and baking, and reported new findings based on these studies [7-12]. Most of the studies focused on fat as the main nutritional ingredient, and the sitological functional properties of silky fowl egg albumen have yet to be determined.

The purpose of the present study was to examine silky fowl egg albumen and to clarify its sitological functional properties. We therefore thought it would be preferable to examine sitological phenomena throughout the entire breadmaking process for basic research materials. As a first step, we studied the sitological effects of Silky fowl egg whites on various aspects of breadmaking. We

herein report our findings.

Materials and Methods

Materials:

Flour was purchased from Nippon Suisan (Tokyo, Japan). The contents of protein, ash, lipid and water were 13.1% (Kjeldahl, N x 6.25), 0.4%, 1.8% and 15.0%, respectively. More than 95% of the flour granules were sifted through the sieve of 132- μ m mesh.

Eggs of silky fowl and hen's were a kind gift from Canaly 21 (Co., Ltd., Gifu, Japan). Each fresh egg fraction was obtained from the eggs collected within a day after laying and immediately used for these experiments. Eggs were collected from flocks of 20 silky fowls and 20 hens. A total of 10 dough were made, two eggs being included in each dough. The same feed was given to the silky fowls and hen's and they were kept under the same environmental conditions.

Preparation of egg albumen of silky fowl and hen' eggs

Crude egg albumen was adjusted according to the following method; it was separated egg albumen from 20 eggs. The separated egg albumen was acid-modified and thermal denaturation.

Adjustment of the acid-modified protein was prepared by the following method. A 0.1M acetic acid solution 30ml in addition to separate egg white proteins 60ml. In the case of thermal metamorphism egg white proteins, take the egg white proteins 60ml into a beaker of 100ml, was heated for 5 min. at 70 °C of hot water bath. The denatured egg white proteins was powdered by using a freeze-dryer.

Measurement of the amount of egg whites proteins

The amount of egg albumen was measured by the Lowry et al., method [13].

Preparation of bread dough samples

Bread dough was prepared using commercially available ingredients for preparing bread dough and by employing the straight dough method. More specifically, dough was prepared using ingredients for preparing a loaf of bread, i.e., lipid, strong flour, live yeast, water, sugar, salt and skimmed milk powder. The added egg albumen was 0-30%. Dough temperature at the completion of mixing was 26 °C, and the dough was fermented for 90 min at a temperature of 28 to 30 °C. The dough was then molded, and the molded pieces were subjected to final fermentation for 60 to 70 min at a temperature of 36 °C and a humidity of 75%, followed by baking for 35 to 40 min at temperatures of 230 °C (top of oven) to 210 °C (bottom of oven). Dough subjected to only primary fermentation was also used in this experiment. For each type of bird egg, 5 replicate bread dough were prepared. Each bread dough was made from two eggs, which had been laid different birds.

Preparation of gluten samples

Gluten was separated from bread dough samples as follow; bread dough was then removed in a sieve and washed with distilled water for 20 min by hand until the gluten was obtained. After washing, the gluten was frozen in liquid nitrogen and freeze-dried. The freeze-dried gluten was ground and sieved using a 250 um sieve. This sample (100g) was defatted (four times) with 500 ml of chloroform under magnetic stirring for 20 min, filtered under vacuum, then dried in an air cupboard overnight.

Determination of rheological properties

Hardness and adhesion of dough were measured using a rheometer (TPU-2S, YAMADEN Co., Ltd., Japan). A dough set into a rheometer cell of 42 mm across and 16 mm high. The cylinder type plunger of a diameter of 15 mm compressed into the bread in the cell at 5 mm intervals and at a compression rate of 1 mm a second. Quarterly does it mean four trials on trials on each sample were carried out within 5 minutes of each other. Each value represents the mean \pm standard deviation.

Measurement of the rate of dough expansion

For the rate of dough expansion with fermentation, a fixed amount of dough was placed in a graduated cylinder and fermented in an incubator (temperature 30°C, humidity 75%), and the rate of expansion in a fixed time was measured.

SDS-polyacrylamide gel electrophoresis (PAGE)

Measurement was in accordance with the method of automated electrophoresis (Phast System; Pharmacia LKB, Biotechnology AB, Uppsala, Sweden) equipment was used. After electrophoresis, gels were stained using Coomassie brilliant blue-R250

Statistical analysis

All data are given as means \pm standard deviations. Statistical analysis was performed using the unpaired student's t-test (KaleidaGraph, Ver. 4.0, Synergy software, PA, USA). Difference in the mean values among groups were assessed using the Tukey-Kramer multiple comparisons test (Instat Ver. 3.0, GraphPad software, Inc., CA, USA). The level of significance was set at $p < 0.05$ for all statistical tests.

Results and Discussion

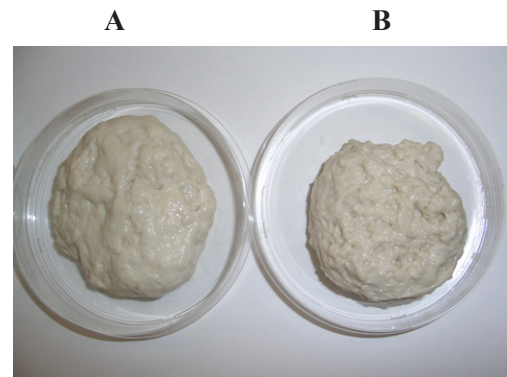


Fig. 1. Characteristics of gluten extracted from bread dough. A: Silky fowl egg albumen; B: Hen's egg albumen

Characteristics of gluten extracted from bread dough

A set amount of albumen fraction harvested from each type of egg was added to dough during mixing. One example of only crude gluten extracted from bread dough is shown in Fig 1. A different crude gluten consistency was observed between the two types of egg. Specifically, silky fowl egg albumen fraction-added gluten (A) had a prominently more lubricious surface than hen's egg albumen fraction-added gluten (B). This suggests that the type of albumen added had a very large effect on the bread dough and potentially a large effect on the characteristics of the bread while baking and on the finished baked product.

Differences in hardness of albumen fraction added dough during baking

We baked bread from dough with a set amount of albumen fraction separated from eggs added to the dough and measured the hardness over time. The results are shown in Fig. 2. Although the hardness tended to increase from two minutes of baking in both types of albumen fraction added dough, the degree of hardness tended to increase more with baking time in the hen's egg albumen fraction-added dough than in the silky fowl egg albumen fraction-added dough, and the hardness was about three times greater in the former than in the latter after ten minutes of baking.

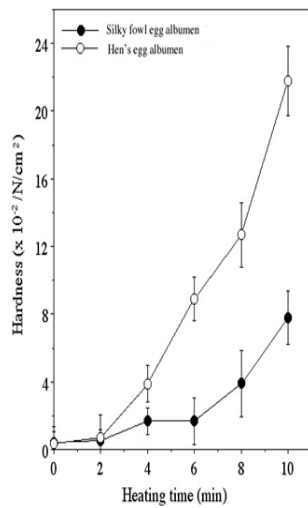


Fig. 2. Effects of hardness of egg albumen fraction added dough during baking.

Differences in adhesion of albumen fraction added dough during baking

We baked bread from dough with a set amount of albumen fraction added to the dough and measured the adhesion over time. The results are shown in Fig. 3. Adhesion tended to decrease with baking time in both types of dough, and no differences were observed in adhesion in the two types of dough after ten minutes of baking. However, a very marked difference in adhesion was observed between the two types of dough between 2 and 6 mins of baking, with adhesion being greater in the silky fowl egg albumen

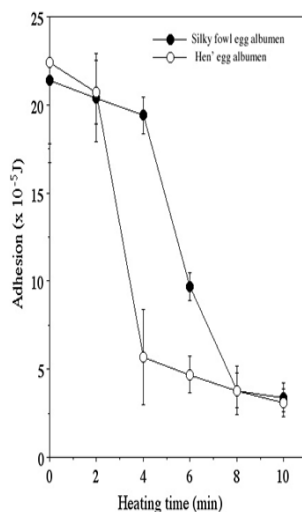


Fig. 3. Effects of adhesion of egg albumen fraction added dough during baking.

fraction-added dough than in the hen's egg albumen fraction added dough. This suggests that the added albumen had marked effects during that period.

Differences in rising rate between the two types of albumen fraction-added dough during fermentation

Differences in rising rate during fermentation of dough with the two types of albumen fraction added under various temperatures are shown in Fig. 4. The rising rate increased in both types of dough under higher temperatures. The change in rising rate differed between dough containing albumen fraction from silky

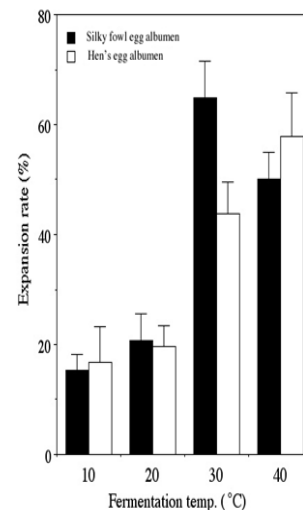


Fig. 4. Effects of expansion rate on the fermentation temperature added egg albumen in dough.

fowl and dough containing albumen fraction from domestic fowl. Specifically, a rising rate of about 20% was observed at fermentation temperatures of 10°C and 20°C, but the rising rate increased with fermentation temperatures of 30°C or higher. At 30°C, the rising rate was high in the silky fowl egg albumen fraction-added dough, at about 66%, but was only about 45% in dough containing albumen fraction extracted from hen's eggs. When the fermentation temperature was 40°C, the rising rate was about 50% in silky fowl egg albumen fraction-added dough and 57% in hen's egg albumen fraction-added dough, with the latter being higher. This suggests that the rising rate differs between the types of egg. This phenomenon may be a manifestation of differences in rising rate with the different chemical properties of the albumen components.

Effects of different ratios of albumen fraction added on dough rising rate

The effects of ratio of albumen fraction added on the rising rate are shown in Fig. 5. For silky fowl egg albumen fraction-added dough, increasing the volume added tended to increase the rising rate during dough fermentation. Although the rising rate also tended to increase in hen's egg albumen fraction-added dough during

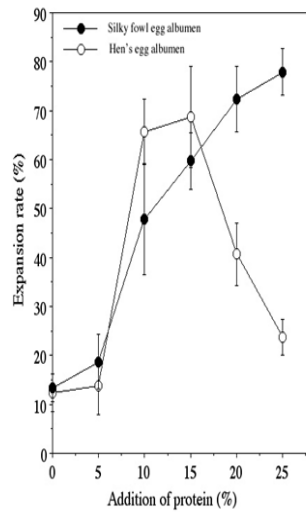


Fig. 5. Relationship between the concentration of added egg albumen and expansion rate of dough.

fermentation with a volume of up to 15% added, it tended to decrease with volumes of more than 15%. It is unclear whether this result is due to the different chemical properties of the hen's egg albumen or simply changes in the volume. Further investigation is needed to clarify this point.

Association between albumen fraction ratio and dough hardness

The results of tests on the association between different ratios of albumen fraction added and dough hardness and adhesiveness are shown in Figs. 6 and 7. The ratio of albumen fraction added correlated positively with both hardness and adhesiveness. This clarifies that ratio of added albumen fraction becomes a significant factor affecting hardness and adhesiveness as it increases.

Changes in gluten molecular weight with fermentation of

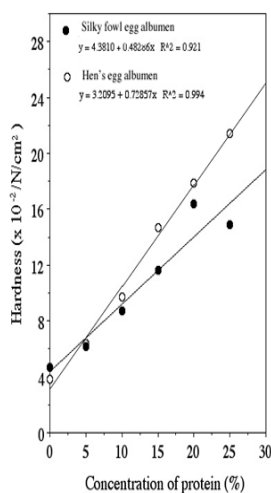


Fig. 6. Relationship between the concentration of added egg albumen and hardness of dough.

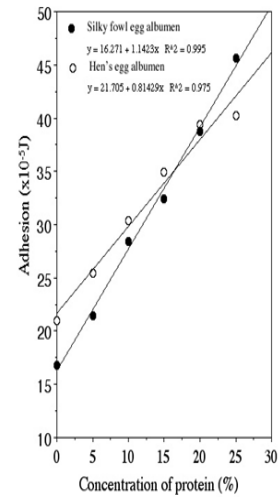


Fig. 7. Relationship between the concentration of added egg albumen and adhesion of dough.

albumen fraction added dough

In order to determine changes in gluten molecular weight with fermentation of albumen fraction-added dough, we extracted gluten during each fermentation and examined changes in molecular weight. The results are shown in Fig. 8. Polymerization of gluten progressed with fermentation time in silky fowl egg



Fig. 8. Changes of molecular weight of gluten on the fermentation of dough added egg albumen.

albumen fraction-added dough. Although gluten also polymerized with fermentation in the hen's egg albumen fraction-added dough, the changes were less pronounced.

This phenomenon suggests that, at the very least, different types of egg (proteins in particular) differently trigger polymerization caused by altering the gluten molecular weight.

Conclusion

The primary aim of this study was to examine the effects of albumen fraction on the chemical properties of bread dough. We determined that the type of egg added during bread baking greatly affected the distinctive color, flavor and texture of the bread. At the very least, these findings may be useful to the bread making industry for determining one aspect of the unique sitological functional properties of silky fowl eggs.

References

1. Nishimura S, Oshima I, Ono Y, Tabata S, Ishibashi A, & Iwamoto H (2006) Age-related changes in the intermuscular distribution of melanocytes in the Silky fowl. *Br. Poul. Sci.* 47: 426-432.
2. Sakakibara K, Tabata S, Shiba N, Gotoh T, Nishimura S, & Iwamoto H (2000) Myofibre composition and total collagen content in Miliotibialis lateralis and M. pectoralis of Silky and White Leghorn chickens. *Br. Poul. Sci.* 41: 570-574.
3. Ferrand R, & L'hermite A (1985) Experimental analysis of the extensive pigmentation in the Silky fowl embryo: evidence for an environmental regulatory process. *Experientia*, 41: 512-514.
4. Carefoot WC (1993) Further studies of linkage and mappings of the loci of genes in group 3 on chromosome 1 of the domestic fowl. *Br. Poul. Sci.*, 34: 205-209.
5. Shaobi TS, & Forbes JM (1987) Feeding responses to infusions of glucose solutions into the duodenum of cockereka and the influences of pre-fasting or vagotomy. *Br. Poul. Sci.* 28: 407-413.
6. Afanador G, & Roberts JR (1994) Effect of nephropathogenic infectious bronchitis viruses on renal function in young male broiler chickens. *Br. Poul. Sci.* 35: 445-456.
7. Toyosaki T, & Koketsu M (2004) Oxidative stability of silky fowl eggs. Comparison with hen eggs. *J. Agric. Food Chem.* 52: 1328-1330.
8. Toyosaki T, & Koketsu M. (2007) Antioxidant effects of the water-soluble fraction of baked sponge cake made with silky fowl egg: comparison with White Leghorn egg. *Br. Poul. Sci.* 48: 449-453.
9. Toyosaki T (2012) Partial purification of an antioxidizing component in silky fowl egg. *Adv. Food Sci. Technol.* 4: 34-38.
10. Toyosaki T, & Y. Sakane Y (2013A) Rheological properties and oxidative stability of baked sponge cake using silky fowl egg. *Adv. Food Sci. Technol.* 5: 1351-1354.
11. Toyosaki T & Sakane Y (2013B) Anti-browning effects on baked dough made using silky fowl egg. *Int. J. Agric. Food Res.* 2: 44-49.
12. Toyosaki T (2014) Recent findings about the silky fowl egg. *Curr. Res. Nutri. Food Sci.* 2: 51-55.
13. Toyosaki T (2016) Studies on physical properties of gluten, and bread dough with silky fowl egg. *Int. J. Nutri. Sci. Food Technol.* 2: 53-58.
14. Lowly OH, Rosebrough NJ, Far,r AL, & Randall RJ (1951) Protein measurement with the phenol reagent. *J. Biol. Chem.* 193: 263-275.