Note on Fresh Egg Yolk in 50% Whole Wheat Bread[1]

R. E. W. BIRCH[2] and P. L. FINNEY[3]

Cereal Chem. 57(6):448-449

Bread-making potential is largely related to the quality and quantity of protein in the wheat (Finney 1978, 1979; Pomeranz 1979), but many surfactants increase loaf volume and develop crumb grain if properly formulated (Chung and Pomeranz 1977, Chung et al 1978, Knightly 1977). Egg yolk lipoproteins are known to interact with proteins and carbohydrates during many food preparations and may serve as surfactants to improve bread quality (Schultz and Forsythe 1967). Egg yolks and whole egg products are important ingredients in doughnuts, sponge cakes, custards, cookies, eclairs, and cream puffs; however they are rarely formulated in breads except in some sweet-dough recipes. Only a few published reports describe the effects of formulating egg products in yeast-fermented breads. Pelshenke and Hampel (1962) found that egg yolk decreased starch retrogradation after 24 hr and produced grain with superior compressibility. In that study, egg yolk reportedly increased loaf volume, but the authors provided no details of the experiments. A U. S. patent describes a simple procedure for isolating an egg yolk lipoprotein ("lecitho-vitelin") that improved loaf volume and crumb grain in straight-dough and sponge-dough breads. The addition of "lecitho-vitelin" to the formulation allowed production of acceptable breads from weaker soft wheat flours (Freilich and Frey 1941).

MATERIALS AND METHODS

Whole wheat meal prepared from a commercial Montana hard red winter wheat in a Hobart grinder was mixed 50:50 with a commercial straight grade baker's flour and used as the control flour. Protein contents of the whole wheat and straight grade baker's flours were determined by an AACC method (1962) to be 14.3 and 10.7%, respectively. Breads were formulated on a flour basis using 7.6% fresh baker's yeast, 4% nonfat dry milk solids, 1.5% salt, 0.6% water extract of malted barley (50 dextrinizing units per gram, 20° C), 75 ppm ascorbic acid, and optimum mixing time and water absorption (determined by the mixograph). In addition, 4% vital gluten, variable amounts of fresh yolk, or 3% Crisco shortening were formulated as indicated. Bread-making procedures were used as described by Finney et al (1977) and Magoffin et al (1977). Ten-gram mixograms were prepared as described by Shogren and Finney (1972).

RESULTS AND DISCUSSION

Egg yolk had no pronounced effect on physical dough properties reflected by the mixograph (Fig. 1). Shortening increased loaf volume of the control from 732 to 961 cc. Vital gluten was relatively ineffective in the control, increasing the leaf volume from 732 to 752 cc. With 3% Crisco shortening in the control, gluten only increased loaf volume from 961 to 1,005 cc (Fig. 2). Loaf volume increased without peaking with increasing levels of fresh egg yolk. Eleven percent yolk increased loaf volume from 732 to 1,118 cc, but with 4% gluten added, 7% yolk increased volume from 752 to 1,125 cc (Fig. 2). The 4% vital gluten was much more effective in combination with egg yolk than it was with shortening, increasing loaf volume about 100 cc at all levels tested (Fig. 2). Thus egg yolk is the most effective agent for producing bread structure that we have studied.

The major lipoprotein fractions of egg yolk have long been of interest to scientists because of their close relationship to the

[1]Scientific Paper 5672, College of Agricultural Research Center, Washington State University, Pullman.

[2]Graduate student, Department of Foods, Nutrition and Institutional Management, Washington State University, Pullman.

[3]Research food technologist, Western Wheat Quality Laboratory, Science and Education Administration, U.S. Department of Agriculture, Pullman, WA.

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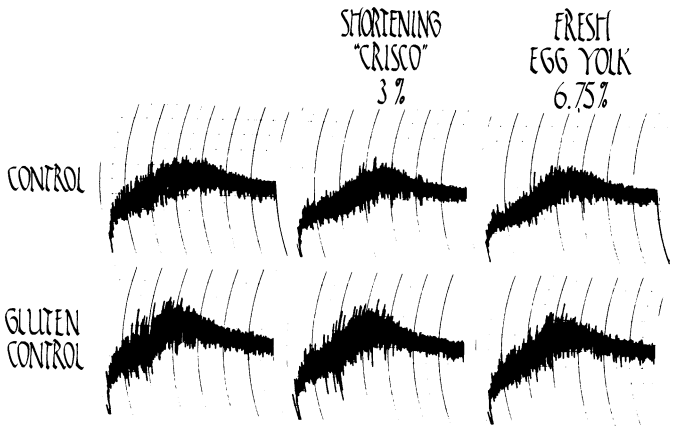

Fig. 1. Mixograms (10 g) showing effect of 3% shortening or 6.75% fresh egg yolk, with and without 4% vital gluten.

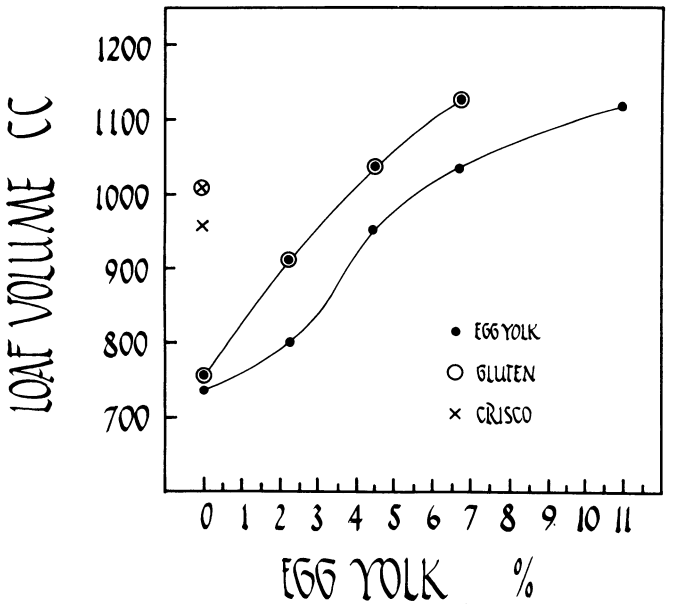

Fig. 2. Percent fresh egg yolk with or without 3% Crisco shortening or 4% vital gluten versus bread loaf volume.

developing avian embryo (Osborne and Campbell 1900). Because of the inherent difficulties in preparing, fractionating, and purifying egg yolk fractions, numerous references outline methods to isolate those fractions (Alderton and Fevold 1945, Blackwood and Wishart 1934, Calvery and White 1931, Chargaff 1942). Many more isolation methods have been well reviewed (Parkinson 1966, Powrie 1977).

Numerous workers extracted egg yolk with ethyl ether (Alderton and Fevold 1945; Evans and Bandemer 1957; Fevold and Lausten 1946; Lea and Hawk 1951, 1952; Vandegaer, Reichmann, and Cook 1956). Workers were later discouraged from using ethyl ether because it changed the solubilities of both the fat-rich lipovitellenin and the lipovitellin egg yolk fractions (Vandegaer et al 1956). Another ether extraction procedure altered lipoprotein electrophoretic behavior (Evans and Bandemer 1957). Freeze-drying of lipovitellin preparations altered extractability (Lea and Hawk 1952).

The "lecitho-vitelin" described by Freilich and Frey (1941) was extracted by ethyl ether and water and contained approximately 80% protein, with the remainder believed to be essentially phosphatidyl choline (lecithin). They found that the high protein fraction alone produced the loaf volume effect of the whole fresh egg yolk. In addition, those authors reported that the "lecitho-vitelin" and the liquid oil fraction separated in the ethyl ether fraction were more effective in combination than either formulated alone.

ACKNOWLEDGMENT

We thank Clint Keller, Holland Library, Washington State University, for his calligraphy in Figs. 1 and 2.

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[Received June 4, 1980. Accepted July 23, 1980]