VOL. 6 AUGUST, 1931 NO. 3

HILGARDIA

A Journal of Agricultural Science

PUBLISHED BY THE

California Agricultural Experiment Station

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UNIVERSITY OF CALIFORNIA PRINTING OFFICE
BERKELEY, CALIFORNIA

The titles of the Technical Papers of the California Agricultural Experiment Station, Nos. 1 to 20, which HILGARDIA replaces, and copies of which may be had on application to the Publication Secretary, Agricultural Experiment Station, Berkeley, are as follows:

4. Effect of Sodium Chlorid and Calcium Chlorid upon the Growth and Composition of Young Orange Trees, by H. S. Reed and A. R. C. Haas. April, 1923.

5. Citrus Blast and Black Pit, by H. S. Fawcett, W. T. Horne, and A. F. Camp. May, 1923.

6. A Study of Deciduous Fruit Tree Rootstocks with Special Reference to Their Identification, by Myer J. Heppner. June, 1923.

7. A Study of the Darkening of Apple Tissue, by E. L. Overholser and W. V. Cruess. June, 1923.

8. Effect of Salts on the Intake of Inorganic Elements and on the Buffer System of the Plant, by D. R. Hoagland and J. C. Martin. July, 1923.

9. Experiments on the Reclamation of Alkali Soils by Leaching with Water and Gypsum, by P. L. Hibbard. August, 1923.

10. The Seasonal Variation of the Soil Moisture in a Walnut Grove in Relation to Hygroscopic Coefficient, by L. D. Batchelor and H. S. Reed. September, 1923.

11. Studies on the Effects of Sodium, Potassium, and Calcium on Young Orange Trees, by H. S. Reed and A. R. C. Haas. October, 1923.

12. The Effect of the Plant on the Reaction of the Culture Solution, by D. R. Hoagland. November, 1923.

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17. Nutrient and Toxic Effects of Certain Ions on Citrus and Walnut Trees with Especial Reference to the Concentration and Ph of the Medium, by H. S. Reed and A. R. C. Haas. October, 1924.

18. Factors Influencing the Rate of Germination of Seed of Asparagus Officinalis, by H. A. Borthwick. March, 1925.

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HILGARDIA

A JOURNAL OF AGRICULTURAL SCIENCE

PUBLISHED BY THE

CALIFORNIA AGRICULTURAL EXPERIMENT STATION

VOL. 6 AUGUST, 1931 No. 3

DISTRIBUTION OF SOLID MATTER IN THICK AND THIN EGG WHITE[1]

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Stored eggs kept under optimum conditions of temperature and humidity and free from molds and putrefactive bacteria may, nevertheless, exhibit tendencies toward undesirable changes which cause the eggs to lose much of their original appearance and attractiveness.

One of the most prominent of these changes is the slow liquefaction of the firm, jelly-like white. As a result of this liquefaction the egg white appears watery. This condition is found very objectionable in the market egg and frequently results in a lowering of grade and price of the egg with a corresponding loss to the owner.

Up to the present time investigations of egg white have not differentiated between the thick and the thin varieties in kind studied or in results obtained. Accordingly, there has existed no experimental evidence which would serve as a basis for an explanation of the progressive liquefaction often encountered in stored eggs.

The results of investigation of thick and thin white can hardly be considered comparable until the amount of dry matter present in each of these substances is known and any variation in this dry matter is taken into account. To establish a basis of comparison of thick and thin white, as a first step in studies on watery whites, the distribution of dry matter in thick and thin white, and its possible variability in different eggs were investigated.

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METHODS

The method of determining total solids was that recommended by Hertwig (1925): A sample of 2 grams of liquid white was weighed into a covered aluminum dish which had previously been dried at 127–133° C, allowed to cool in a desiccator, and weighed soon after attaining room temperature. The dish was uncovered and, with contents and cover, dried in the oven at 127–133° C for one hour. The dish was then covered, transferred to desiccator to cool to room temperature, and weighed. The method has proved satisfactory and capable of very close checks.

Refractive index was measured with the Spencer Refractometer, Abbe type. The investigation included normal eggs up to 40 days of age from more than 30 birds. The eggs were stored under room conditions.

RESULTS

Without exception, the refractive index and total solids of thin white were found identical within experimental limits with those of thick white from the same egg in eggs more than 1 day old. Occasional small and random differences appeared in eggs less than 1 day old.

TABLE 1

Hen	Age of egg, days	White	Solids	Refractive index 20°C
D 512	1	thin	11.24	1 3551
		thick	11.26	1.3550
	2	thin	11 76	1.3559
		thick	11.72	1 3559
	3	thin	11.80	1.3561
		thick	11.84	1.3562
D 511	2	thin	12.25	1.3569
		thick	12.22	1.3568
	20	thin	13.08	1.3582
		thick	13.12	1.3582
	30	thin	14.71	1.3610
		thick	14.74	1.3610
	39	thin	15.26	1.3620
		thick	15.22	1.3620

Representative data are included in detail in table 1; all data secured are presented graphically in figure 1. The values for percentage solids in thick and thin white from the same egg have been plotted against the corresponding average refractive index, since these measurements seem to be the same for each kind of white. The relation is

practically linear regardless of the variation in age or composition of the white.

In the fresh eggs studied the egg-white solids were found to vary chiefly in the range 10.7 to 12.9 per cent, with a corresponding refractive index variation of 1.3540 to 1.3580. A few extremes were found outside of these limits, values as high as 13.5 per cent and as low as 9.6 per cent being observed.

Eggs from the same hen showed much less variation and in many cases a high degree of uniformity. The percentage of solids in the white of stored eggs tended to increase in proportion to an increase in refractive index; these changes were in general more pronounced in the eggs which showed greater shrinkage.

DISCUSSION

The refractive index shows a steady increase with age but maintains throughout the same relation to total solids, as demonstrated in figure 1. The increase in concentration of solids is undoubtedly due to the disappearance of water from the white. This loss may take place in two ways, namely, by escape of water vapor through the

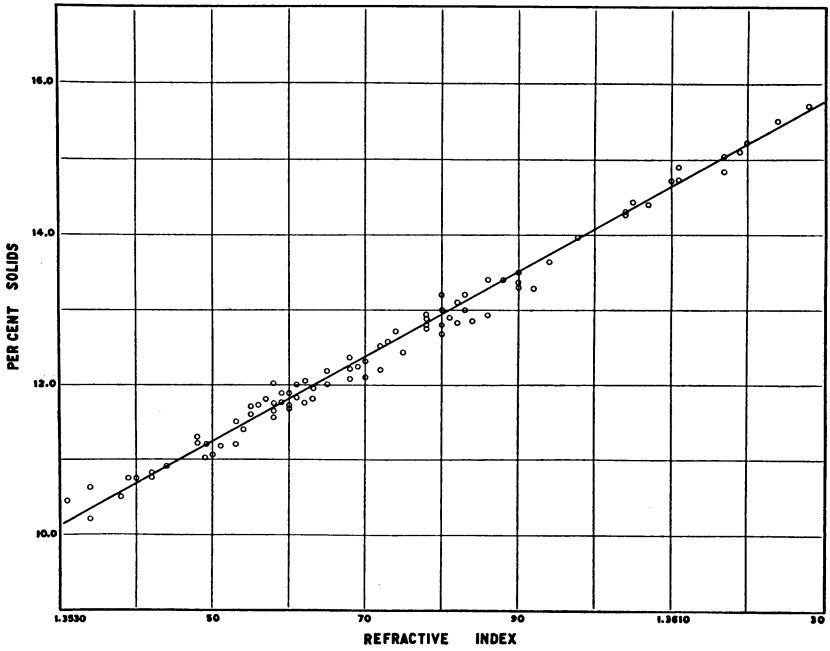

Fig. 1. The relation of the refractive index of egg white to its solids concentration.

shell and by diffusion of liquid water into the yolk. In order that equality of refractive index and total solids may persist, there must exist, between thick and thin white, a rapid equilibrium with respect to water. The loss of carbon dioxide and the gradual disappearance of thick white seem to have no bearing on this relation.

It is believed that the lack of complete agreement between refractive index and total solids shown in figure 1 is due chiefly to errors in determinations of solids, since any one set of determinations of solids, when plotted against refractive index, gave lines parallel to those of other sets. This suggests small variations in the drying treatment. A variation in the mineral constituents of the egg white solids may also account for part of the disagreement.

Romanoff (1929) has reported distinct differences in dry matter between the thick and thin white from the same egg. His results, which are based on the examination of only 5 eggs, most certainly do not agree with the results of our examinations. These, including a far greater number of eggs, show no exception, outside the limits of error, to the statements made above. The additional fact of equality in refractive index is conclusive support for the findings from determination of solids.

SUMMARY

The percentage of solids is the same in thick and thin white from the same egg, whether the egg is old or fresh. This conclusion is supported by the fact that the refractive indices are also the same.

The solids variation in fresh eggs was found generally in the range 10.7 to 12.9 per cent with extremes as low as 9.6 and as high as 13.5 per cent.

Refractive index measurements serve as a rapid means of estimating solids in egg white.

A rapid equilibrium with respect to water exists between thick and thin white in the same egg. The concentration of water remains the same in each regardless of losses to the yolk and through the shell.

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