THE RELATION BETWEEN SPECIFIC GRAVITY AND SOLID CONTENT OF RECONSTITUTED SKIM MILK

J. Babad and A. Shenhay-Hetman

Dairy Research Laboratory, Agricultural Research Station, Rehovot, Israel.

It was found that there is a linear relationship between the specific gravity of reconstituted skim milk and its total solids content, in total solids concentrations ranging between 7-30%. On this basis a formula is given for calculating the total solids content of reconstituted skim milk with an accuracy of ±4%.

INTRODUCTION

The specific gravity of milk depends on two variables: the dissolved solids-not-fat content which raises the specific gravity, and the fat content which lowers it. When determining the specific gravity of skim milk, the problem is simplified since the fat factor is virtually eliminated.

The determination of the specific gravity is very simple in practice, requiring no complicated apparatus and little time. It may be determined by means of a hydrometer calibrated for milk—the lactometer, by means of the Westphal balance, or with the specific gravity bottle—the pycnometer, the latter giving the most accurate results. However, since the lactometer is more convenient, it is generally used by dairymen, and its accuracy is sufficient for most industrial and commercial purposes.

The practical importance of specific gravity determinations lies in its wide application in extended research in this field. Several lactometers were designed with modifications of scale and range to accommodate variations in temperature and concentration of total solids. The most widely used are those of Quevenne, Soxhlet, Vieth, and Gerber. Average room temperature was assumed to be 15.5°C (60°F), and most lactometers are calibrated to this temperature. Special tables were prepared for calculating the specific gravity of milk at 15.5°C from measurements taken at other temperatures.

About forty formulae for calculating the relation between the specific gravity, fat, and solids-not-fat of milk, have been published during the last century. Richmond's formula with some modification by Hebner is generally applied today.

The milk shortage in Israel led to the increased use of milk powders for drinking and cheese-making. Therefore the specific gravity determination of reconstituted milk, both in concentrations approximating that of fluid milk and in more concentrated preparations, became particularly significant. The literature concerning milk powders and reconstituted milk cites but two papers on this subject.

Evenson and Ferris, working on the viscosity of reconstituted milk as compared with that of fluid milk, mention specific gravity determination (with Quevenne lactometer) in relation to total solids, without giving any details.

In another paper by Palmer and Dahle, dealing with the chemical and physical properties of reconstituted milk, the variations of its specific gravity were found to be of the same order as those of fluid milk. Numerical data, however, were not given.

The present work was undertaken to provide data on the relationship between the specific gravity and the total solids in reconstituted skim milk, in concentrations ranging from that of skim milk (about 8%) to double the normal total solids content of whole milk (about 26%). Determinations were therefore made in aqueous solutions containing 7-30% skim milk powder, in order to cover the whole practical range. This was necessary in order to standardize the composite milk and the cheese milk used in Israel since 1950. The experiments in the upper range of total solids were important as it was intended at first to distribute twice-normal concentrations of composite milk, permitting the housewives to dilute them themselves.

EXPERIMENTAL

Skimmilk powder was weighed on an analytical balance, reconstituted in a small volume of water in a Waring Blender, and diluted to 500 ml in a volumetric flask. In making percentage calculations the moisture content of the milk powder was considered (usually 5 to 6 percent moisture). In order to avoid the formation of air bubbles and foam (and perhaps the Recknagel phenomenon) the sample was heated to 68°C for 30 minutes. (Usually a drop or two of capryl alcohol (secondary octyl alcohol) was added to aid in foam prevention.) This also provided pasteurization when the measurements had to be postponed to the next day.

A standard Sprengel-Ostwald pycnometer was used for the specific gravity determinations, by the generally accepted procedure. All measurements were made at 15.5°C, in triplicate.

RESULTS

The results obtained are shown in figure 1, where the lactometer de-
degrees L°, calculated from pycnometer measurements at 15.5°C, are plotted against the percentage of skim milk powder in the reconstituted milk. Each value given in the graph represents nine determinations of reconstituted skim milk each of three milk powders. It may be seen that the graph is linear.

The following formula was derived from the values shown in figure 1.

I. \[ L = 4.25 \text{T.S.} - 1.25 \]

or

II. \[ \text{T.S.} = 0.235 L + 0.294 \]

where \( L \) stands for lactometer degrees and T. S. for % of total solids.

There was full agreement between the experimental values and those calculated from the formula, with due consideration for the standard deviation.

Table 1 presents the reproducibility of the results.

\[
\begin{align*}
\text{Standard deviation} &= \pm \sqrt{\frac{\sum d^2}{n-1}} \\
&= \text{deviation from average} \\
&= \text{number of determinations}
\end{align*}
\]

The differences between the various milk powders are not large, as may be seen from table 1, and they are of the same order of magnitude as those encountered in fluid milk.

Similar results are given by Lawrence, who determined the relation between the specific gravity and total solids of whey.

It seems evident, therefore, that for practical purposes the total solids content of reconstituted skim milk may easily be calculated from its specific gravity, with the aid of an appropriate hydrometer the formula given above.

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**REFERENCES**


**ODIORNE IS NAMED MANAGER OF CANCO PLANT AT LEMOYNE**

Raymond J. Odiorne of Baltimore, Md., has been named manager of American Can Company's new can-making plant at Lemoyne, Pa. B. Thompson, manager of manufacture for the container-making firm's Atlantic Division, announced.

Odiorne already has assumed his duties at the new plant. The Lemoyne plant is one of 58 operated by Canco in the United States, Canada and Hawaii. When in full operation, it is expected to employ 450 to 475 persons.

The new plant manager went to work for Canco as a foreman in the Hudson factory at Jersey City, N. J. in July of 1930. He spent the next 18 years there, serving successively as assistant foreman, foreman, assistant general foreman, assistant to the plant manager, and general foreman.

Odiorne has been assistant manager of the company's Maryland factory at Baltimore for the past two years.