Proceedings of the Iowa Academy of Science

Volume 46 | Annual Issue Article 40

1939

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SOME APPLICATIONS OF CHEMISTRY TO THE MANUFACTURE OF DAIRY PRODUCTS

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This discussion is in no way intended as an inclusive one relative to the application of chemistry to the dairy industry. It is intended rather as a brief resumé of certain problems that have been studied, at least in part, by the Dairy Industry Section of the Iowa Agricultural Experiment Station.

For ease of handling and for continuity the subjects might, without too great a stretch of imagination, be classed as applications of analytical chemistry, catlysis, surface chemistry, physical chemistry and enzyme chemistry to the manufacture of dairy products.

Two analytical chemical problems will be considered here, (1) Why is it that samples of ice cream made from mixes which contain legally required amounts of fat may be found illegal by regulatory laboratories? and (2) inasmuch as aggregate "fat" losses in churning represent large sums of money are the materials that are determined as fat really fats and are they worth incorporating into butter?

(1) A study of different steps in the assembly, manufacture and retail distribution of ice cream revealed that churning of melted samples of ice creams that had been previously chilled in the hardening room might yield faulty sampling and low fat tests. Sampling ice cream before melting gave analytical results that agreed well with those obtained for the companion mixes.

(2) Analyses of the fatty materials of buttermilk showed them to be approximately 75 percent fats, 22 percent phospholipins and 3 percent sterols. This indicates that attempts at greater butter yields are advisable since the phospholipins largely associate with the buttermilk.

One catalytic problem only will be considered *viz.*, The importance of copper as a catalyst in oxidative changes. A so-called oxidative change involving the occurrence of "metallic" and "tallowy" flavors in strawberry ice cream is important in the ice cream industry. Many agents have been studied to determine their rôle in its development. Oxidative enzymes are apparently unimportant, strawberries likewise seem not to be a contributory factor while

the presence of copper is important. Furthermore, the form in which copper exists seems to be important. It appears, as one would suspect, that copper combined with protein has relatively little effect in comparison to ionized or ionizable copper.

From a surface chemistry standpoint, the studies involving factors affecting churning losses are interesting. It has been shown that change in fat content of cream does not vary in the same ratio as the fat content of the buttermilk from that cream and that when losses are computed and comparisons are made they mean little unless both the fat content of the cream and that of the buttermilk are taken into consideration.

In addition these studies indicate that casein plays an important rôle in the protective systems at the fat-serum interfaces of the fat globules of milk and cream.

For physical, as distinct from surface chemistry, mention need be made only of the recent and rapidly expanding application of pH as a control method in the manufacture of butter from sour cream. The flavor defects that occur and are produced by chemical changes in this type of butter are alkaline, "metallic," "cheesy" and "fishy." The first rarely occurs if the pH of the butter is not higher than 7.5, metallic flavors begin to appear at pH values of approximately 6.6 and become progressively worse as the acidity increases, cheesy flavored butter seems usually to have pH values in the vicinity of 5.8 to 6.2 and fishy flavors occur at pH values below 6.0. In other words, optimum keeping quality from a chemical-deterioration standpoint seems to exist in the pH range 6.8 to 7.3.

Enzyme chemistry finds a unique application of popular interest in furnishing a control method for detecting faulty pasteurization of milk and cream. A number of enzymes have been studied in this connection but the phospho-monoesterases having an optimum activity in the vicinity of pH 9.0 seem the most suitable for pasteurization control of any that have been studied to date by the many investigators who have worked with them. The "phosphatase" test has been checked here only that assistance might be given to milk dealers, health laboratories, and milk sanitarians who have sought such assistance.

These brief remarks indicate that there is considerable diversity in applying chemistry to the dairy industry. The work is chiefly with biological fluids or modified biological fluids consisting chiefly of complex colloidal systems. As in other borderline fields the interdependence of the man trained in the applied field and the

one trained in chemistry cannot be questioned. Unlike some biofields but rather closely akin to many agricultural fields the economic consideration has directed the work toward the practical to a greater extent than toward the theoretical. In more recent years, however, a better balance has been established between the two, resulting largely from the fact that the dairy industry is becoming chemically minded.

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