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ETHANOL STABILITY

D.S. HORNE

21.1 INTRODUCTION

In the previous edition of Advanced Dairy Chemistry, Horne (1992) reviewed what was mainly his work and that of colleagues at the Hannah Research Institute on the effect of ethanol addition on the stability of the casein micelle system. These studies were part of the Institute’s wider programme on micellar stability, particularly on the effects of renneting or heating milk. In that context experiments were also carried out at sub-critical ethanol levels and contributed to the effective exploitation of the theories of steric stabilization as applied to the casein micelle, the so-called ‘hairy micelle’ model of Holt (1975) and Walstra (1979). Holt and Horne (1996) recently reviewed such work in this area. Models of internal micelle structure have also to be consistent with the observations of micellar behaviour in the presence of ethanol and here we ask how well the latest suggestions stand up to this test.

In this revised chapter, emphasis is placed on the role of milk composition and processing factors in controlling the alcohol stability of milk. The single-point alcohol stability test was used, and is still being used, as a test of the suitability of milk for processing. It is cheap and easy to apply, but it is also apparent that the possibilities of other causes of failure are either not understood or are being overlooked in the blanket application of this test, indicating the necessity for a further, alternative, confirmatory test before final condemnation of the milk.
21.2 ALCOHOL STABILITY TEST

21.2.1 Historical introduction

The earliest accounts of the alcohol stability test for milk appeared in the scientific literature almost a century ago. Particularly in central Europe, the test was often enshrined in city statutes or public health regulations and provided an objective assessment of the keeping quality of milk for retail sale. A review of this early work and the value of the test in this context is contained in a 1915 Bulletin of the United States Department of Agriculture (Ayers and Johnson, 1915).

Most people employed the simple unsophisticated single alcohol test. If a precipitate formed when an equal volume of ethanol solution, usually 70%, was added to a milk sample, the batch of milk was rejected. Dahlberg and Garner (1921) concluded that "the alcohol test shows good possibilities as a practical and reliable test for determining the quality of milk for condenseries making evaporated milk". Its use for this purpose continued until the 1930s, with such alcohol tests being accepted as indicators of whether the milk was going sour, or was mixed with colostrum or was contaminated with milk from a cow suffering from mastitis (Padmos, 1930). Thereafter, following a report of Ramsdell et al. (1931), who stated that no available test, including the alcohol test, was sufficiently "definite for advantageous use in grading milk to sterilization purpose", the alcohol test fell into disfavour and its usage declined in the USA and Europe. However, recent evidence suggests that the single-point alcohol test is still widely applied in Central and South America and in the Far East as a means of rapidly defining the acceptability of milk on arrival at the dairy plant (Guo et al., 1998; M.A.V.P. Brito, Personal Communication; P. Tangkawattana, Personal Communication).

21.2.2 Ethanol stability/pH profile

When the alcohol test first came into use, it was regarded largely as a measure of acidity, particularly acidity produced by bacterial fermentation. However, it was soon observed that fresh milk from individual cows frequently coagulated and that the test was dependent on factors other than acidity. In view of the fact that rejection of a farmer's milk output at the dairy can lead to a considerable drop in income, it is crucial that the potential causes of failure, other than bacterial contamination, are fully understood by the practitioners and advocates of the test. This information is available in the literature from the results of early studies and from the more recent developments.

The early major studies relating to the alcohol test concentrated on the role of the inorganic components of the milk serum. Sommer and Binney