

is now definitely established that lactobacilli are the main agents responsible for the development of cheese flavours. The streptococci of the starter, however, prepare the ground for the lactobacilli, either by the particular degree of acidity which they produce, or by some other specific property. There are indications that the single-strain cultures sometimes yield cheese either lacking in flavour or even undesirable in flavour at maturity, possibly because they tend to suppress the growth of lactobacilli. There are three possible ways in which this difficulty may be overcome:—

- (a) By a modification in cheese-manufacturing technique when single-strain cultures are used.
- (b) By the use of a small proportion of a mixed culture in conjunction with the single strain.
- (c) By the addition of desirable types of lactobacilli to the cheese vat.

As is indicated in the section on cheese flavour, these possibilities are being investigated.

The main significance in the discovery of methods by which starters can be prevented from failing suddenly lies in the degree of control given to the cheesemaker over his manufacturing methods. Variability in starter activity has probably caused more spoilage of cheese than any other single factor. The active single strains form a basis on which cheese-manufacture can be built up from the stage of an art to something resembling a science.

(b) *Cheese-Ripening* (I. R. Sherwood).—In previous reports a description was given of investigations which showed that the active acid-forming strains of streptococci normally present in cheese starters do not play any direct role in the formation of cheese flavour, although they exert an indirect influence by reason of their effects on the composition of the cheese curd. It was concluded from these investigations that lactobacilli are the chief agents responsible for the development of flavour in Cheddar cheese. Different strains of lactobacilli added to cheese milk in relatively large numbers caused the development of a wide variety of good and bad flavours, characteristic of the individual strains.

An attempt was therefore made in the year under review to isolate strains of lactobacilli capable of producing desirable flavours in cheese, with the object of making a selection of suitable types that could be added to cheese milk to produce cheese of consistently attractive flavour. This problem is complicated by the facts that there is no satisfactory laboratory technique for recognizing desirable strains and that results need to be based on cheesemaking experiments which introduce unavoidable variables due to the composition and source of the milk. It is clear that changes brought about in cheese made from cleanly-produced milk inoculated with lactobacilli are governed to a large extent by the physical and chemical constitution of the green cheese, which, in turn, depends on the composition of the cheese milk and the manufacturing procedure. Unfortunately, the present state of knowledge of these is still too meagre to define their effects with precision. There is the added difficulty that inocula of certain strains of lactobacilli may not “swamp out” some types, already present in the milk, which readily multiply in cheese and mask the effects of the organisms under observation.

The addition of gross inocula of lactobacilli has been found to lead to premature proliferation of these organisms in cheese, resulting in the development of a peculiar acid flavour in the early stages of ripening and an undesirable flavour in the mature products. Good results, however, have been achieved by inoculating the milk with a much lighter dose of organisms, especially in the vicinity of the order of the bacterial count of the milk used. In particular, notable advances have been made by the isolation of organisms from prize-winning cheeses possessed of choice flavour, when mature. The light inoculation of cheese milk with many strains which are slow gas-formers and accordingly do not produce slit openness has yielded excellent results in numerous cheeses manufactured in the Dairy Research Institute factory. Similar results have recently been obtained by several factory managers in various localities who have added these organisms with starter to vats of milk. The cheeses made from inoculated milk have developed very satisfactory flavours which, in most instances, were definitely better than the flavours of those made from milk which had not been inoculated.

Unfortunately, the propagation of cultures of lactobacilli is too difficult to be practicable in commercial factories. Attempts are accordingly in progress to make these cultures available to factories by incorporating desirable types in the single-strain cultures developed by the Institute during the past few years.

The possible role of betacocci in imparting “bouquet” to cheese is also being studied.

(c) *Acidity in Cheesemaking* (Dr. R. M. Dolby).—The importance of acidity changes in the process of cheesemaking is realized by all cheesemakers. The use of the active single-strain starters developed at this Institute involves, in many factories, a change to lower acidities in the whey at the various stages in the process of cheesemaking, if cheese of the best quality is to be obtained. During the past year a study has been made of the factors affecting the pH and acidity of cheese. Comparisons have been made of different types of starter cultures and of various modifications of the manufacturing process, to determine their effect on the acidity of the cheese. With most of the starters examined it was found that in normal cheesemaking procedure the type of starter did not affect the acidity developed in the cheese when fourteen days old, although acidity at this age of the cheese was developed more slowly when less active starters were employed. It was observed, however, that the cheese produced by the use of one starter culture had a definitely low acidity, although the rate and degree of acid development in the cheesemaking process was normal.

The chief factor controlling acidity in the cheese appears to be the rate of acid development between “drying” and “milling.” With a given starter the rate is best controlled by adjustment of the “running acidity.” The time of setting appears to have little effect on the acidity developed in the cheese, but does have a considerable effect on the body of the cheese. If, as is well recognized by cheesemakers, the salting is delayed until too high an acidity has been reached, the cheese is likely to have a harsh acid type of body.