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**Pasteurization of Dairy  
By-Products**

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Coöperative investigations carried out by Mr. W. D. Dotterrer for the New York State Commission for the Investigation of Bovine Tuberculosis and the New York Agricultural Experiment Station have shown the following:

**Statement of problem.** At least 48 New York State cheese factories (24 cheddar, 13 Swiss, 9 Limburg, 2 brick) are pasteurizing whey and that at least 42 butter factories or skimming stations are pasteurizing skim milk. The 1915 list of the Department of Agriculture gives a total of 716 cheese factories, 234 butter and cheese factories, 290 butter factories and 29 skimming stations. Not all of these return by-products to their patrons but these are offset by milk stations which return skim milk or occasionally whey during the period of surplus milk.

Four states have laws compelling the pasteurization of dairy by-products. Pennsylvania requires by-products to be heated to 178 deg. F., Minnesota 180 deg. F., Iowa 185 deg. F., and Michigan 185 deg. F., or 145 deg. F., for 30 minutes. Compulsory laws are also in force in Denmark and parts of Germany.

The lowest temperatures permissible for proper pasteurization may be placed at 145 deg. F. for 30 minutes or 165 deg. F. for flash pasteurization. In order to have a safe margin it is better to heat to higher temperatures than these. The temperatures required by law are usually higher than this because hotter temperatures cause changes which are easily

detectable, thereby giving a ready means of detecting violations of the law.

The feeding value of whey and skim milk may be distinctly improved by proper methods of pasteurization. Three things contribute to this end. First, the germs which cause bovine tuberculosis, foot and mouth disease and other diseases are killed. This is probably the most important effect from the standpoint of the farmer's pocketbook but since the effect is a negative one, it is rarely appreciated. Second, pasteurization of whey causes the fat to remain suspended in it so that it does not rise to the top. Thus, it is saved and each farmer gets his share. Third, when pasteurization is properly carried out the skim milk and whey are returned in sweet condition and free from undesirable organisms.

It is usually reported by cheese makers that they have less trouble with "off-flavors" of cheese after the introduction of pasteurization. This is readily understandable as the pasteurized whey has been found to be undergoing a pure lactic acid fermentation as it is returned to the farmers. The organism concerned in the souring is not the ordinary lactic acid organism but the long rod form of lactic organism known as *Bacillus bulgaricus*. This organism is known to be essential in the making of Swiss cheese and has recently been

shown to play a part, together with the ordinary lactic acid organism, in the ripening of cheddar cheese (Wis. Agr. Exp. Sta.). The seeding of the farmers' cans with an almost pure culture of this desirable organism reduces the amount of trouble occasioned by the careless cleaning of cans.

Ordinary whey, poorly cared for, has been found to undergo mixed lactic, alcoholic and other fermentations in which yeasts play an important part. Such swill is poor feeding material and the putting of it into milk cans seeds them with undesirable organisms. Fruity and sweet flavors are usually regarded as being caused by yeasts which are probably the same as those which occur in this sour swill.

Unpasteurized whey has an acidity of 1 to 1.2 per cent. lactic acid as returned to the farmer. Pasteurized whey has an acidity between .3 and .4 per cent.

On two days out of the 20 on which bacteriological examinations were made of the whey at cheddar cheese factories, the predominant organism in the making vat was found to be *B. bulgaricus*. On the remaining days the predominant organism was undoubtedly the ordinary lactic acid organism. The significance of the discovery is not known.

The best and also the cheapest method of pasteurizing whey is to run a steam pipe from the boiler directly to the whey tank. The whey should be heated to at least 155 deg. F. Preliminary heating by jetting

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is frequently convenient. Separator slop or washings should not be added after the temperature is below 155 deg. F.

The cost of pasteurizing whey in this way is between  $\frac{1}{2}$  and 1 cent per 100 lbs. of whey.

### **Skim milk pasteurization.**

The problem of skim milk pasteurization differs from that of whey pasteurization. It is ordinarily the custom to return the skim milk immediately. This means that some flash system of pasteurization must be used. Commercial flash pasteurizers are frequently used for this purpose to good advantage or some system of jetting is used in which supplementary heating is provided for by forcing steam in the milk as it passes through the pipe or as it issues from the pipe. The forcing of steam directly into the milk adds from 6 to 10 lbs. of water per 100 lbs. of milk, thereby reducing the percentage of milk solids from an average of 9.6% to 8.9%. This reduction is negligible.

In any case the best results are obtained when the milk is turned into the farmer's can at a temperature which will remain above 145 deg. F. for 30 minutes or more. Under these conditions, the milk is pasteurized in the final container and does not sour for 24 to 36 hrs. or longer depending upon the treatment given it on the farm. If desired to keep it for some time it should be cooled as soon as the farmer reaches home. The system of holding pasteurization with subsequent cooling which is in use at several skimming stations permits the milk to be kept at the station for 24 hours without souring but is relatively

expensive. (Cost probably between five and 10 cents per 100 lbs. of milk). The milk is returned in excellent condition if the process is properly controlled.

Skim milk which is returned hot to the patrons undergoes a lactic acid fermentation largely due to *B. bulgaricus* and does not putrefy on standing.

**Conclusion.** Pasteurization of dairy by-products is highly desirable from the farmer's stand point as it greatly lessens the danger of the spread of bovine tuberculosis, foot and mouth disease and probably other troubles to his calves and pigs and so also to his herd. The gain to cheese makers, butter makers and milk dealers is an indirect one but is nevertheless a real one. This is so well appreciated in the regions where pasteurization has been introduced that no tendency was discovered at any place to give up pasteurization after it had once been adopted.