Starters for Cheese Whey Fermentation

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Story in Brief

Three different methods of starter storage were investigated on a laboratory scale for the growth of *K. fragilis* yeast starters in cottage cheese whey. Starters were frozen, stored at refrigerator temperatures, and propagated using a "progressive transfer technique" which involved saving a small portion of the fermented whey each time yeasts were grown, to use as a starter in the next batch. This progressive transfer appeared to have the most possibilities for use on the laboratory scale. Frozen starter can be used up to about four weeks, after which it loses some of its vitality. The refrigerated starter was the poorest technique of the three, and could only be used to store starters for two weeks.

Introduction

The food processor has problems when disposing of his wastes. It must be disposed of in such a manner that the Environmental Protection Agency's standards, as well as those of the local government are met. Food wastes are quite concentrated as compared to the sewage normally in the city sewers. Thus, a large food plant can dump enough waste solids into the sewer system to overload the city's treatment facilities. Many cities in Oklahoma and elsewhere, will not allow such large amounts of waste in their sewers. Even if they do, an extra sewer tax for each increment of solids is often added to the plant's cost. The standards set by the Environmental Protection Agency last January, are fairly severe. For example, the dairy industry can only put 0.1% of the solids in the sewer which originally entered the plant. This makes a tremendous problem of controlling what goes down the sewer. Although the regulations have not all been written yet, we're told that similar standards may face the meat industry and other food processors in the near future.

Pretreating food wastes to remove the Biological Oxygen Demand (BOD) before dumping the waste in the sewer can cost a great deal of

money. For example, one filtering apparatus used by some large dairy plants costs over $500,000. The filtered material from the unit goes down the drain and often, nothing is recovered—and the money spent on it is a "dead loss."

It would be of great benefit to the food processor, as well as the consuming public, if usable nutrients could be recovered from these food wastes before they are put in the drain. In the past this has not been considered economically practical, since food wastes are quite dilute and other sources of food and feed were plentiful. Now, however, the situation is different. The price of animal feed has risen tremendously, as has the price of human food. Whole new industries have grown up around the idea of finding substitute proteins or fats for human foods. It appears that we will shortly have to look for substitute sources of protein and fat in animal feeds if current methods of handling domestic animals are to continue. One such source might be from food wastes, since these contain "high quality" proteins. In addition to being cheaper than existing sources of animal protein, the recovery of these nutrients could be a great help to the food processor in offsetting the cost of pretreating his waste materials.

Previous work at OSU has shown that fermentation techniques can solve the waste disposal problem for cottage cheese whey. On the laboratory scale, fermentation removes 99+ percent of the BOD after 24 hours fermentation. The same principle applied to cheese whey could easily be applied to other food wastes, i.e., those from slaughter houses, packing plants, milk bottling operations, etc. The procedure already is in comcercial use with cheese whey at one location in California. Another multimillion dollar operation is being built to handle petroleum wastes in the United States. This procedure also is used to handle wastes from large petroleum and paper industries in England and France. The particular contribution of OSU work is that it can be applied to food plants of any size, large or small, whereas other techniques are applicable only to multimillion dollar installations. The OSU process is now ready to be "scaled up" to pilot plant size to determine what difficulties exist on a larger scale that were not anticipated in the laboratory. One of the first problems was that some new method of handling the initial yeast inocula (starter) would be desirable. In the laboratory a 30 percent starter inoculation (by volume) had been used. When fermenting 1,000 gallons of whey in the pilot plant, however, this required a starter volume of 300 gallons—a sizeable operation in itself. Thus, the first problem, which was solved last fall, was to develop a method of concentrating starters.

Methods and Results

After studying several possibilities, the procedure best adapted for our use was to obtain an initial batch of yeast starter, then concentrate the yeast organisms by gravity, filtration or centrifugal force. They then were stored in this concentrated form until used. It was found that in order to store *K. fragilis* yeast (the one used in this work) for any period of time, it was necessary to have a media which contained its growth requirements. However, the volume of that media could be greatly reduced. For example, starting with 300 pounds of starter, only four pounds of cells were obtained, after settling by gravity, or filtration. After trying

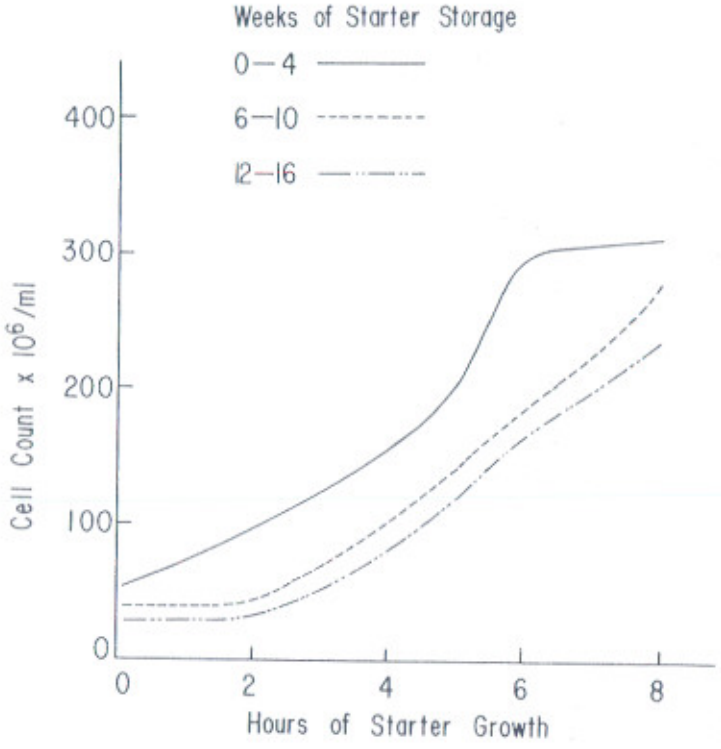

Figure 1. Growth of K. fragilis starter in cottage cheese whey at 35°C[1] after various periods of frozen storage[2]

[1]K. fragilis plated on yeast-malt extract agar after storage.
[2]Frozen storage at 0°F starter removed, grown in whey and counted every two weeks for 16 weeks. Each batch innoculated at the rate of 0.8% starter to whey.

several growth substances it was found that sucrose (table sugar) was as good a growth media for the yeasts as any other which was readily available. Thus, after obtaining the initial four pounds of yeast, they were stored in an equal volume of water containing 50 percent sucrose.

Three different types of storage were used. First, the cells were frozen (0°F). At each two week period a portion of the frozen cells were removed from storage and added to cheese whey. The growth curves showing the performance of these yeasts were then plotted by counting the numbers of yeasts using a yeast-malt agar obtained from the Northern Regional Research Laboratories in Peoria, Illinois. The results of this trial (Fig. 1) showed the starter organisms retained their original vigor for about four weeks, after which there was a considerable drop in their vitality which slowed the growth rate of the organisms in cheese whey. Even so, the frozen starter could be used for periods of up to 16 weeks of storage with no more than a 2-3 hour loss in time of reaching maximum growth during cheese whey fermentation.

The second technique was to take a similar sample of the *K. fragilis* yeasts and store them at refrigerator temperatures (38°F). In this case (Fig. 2) the yeasts lost a portion of their vitality within two weeks, but this reduced growing ability was maintained for eight weeks thereafter. After ten weeks, however, so many of the starter cells had died that they would have been of little practical value in the commercial fermentation of whey, since it took 4-6 hours for the yeasts to begin growing.

The third technique used in the laboratory was to obtain yeast organisms, as before, store them in the refrigerator at 38°F. for two weeks, then use them in fermenting a batch of whey. From this first fermentation then, a small portion was removed after five hours growth, when the cells were in their most rapid growing stage. These cells were rediluted in 50 percent sucrose solution, stored another two weeks, then used again to ferment another batch of whey. From this second batch of whey, a second portion of yeast was obtained after 5 hours growth, the cells concentrated, stored, and used again.

This technique (called progressive transfer) was continued for a period of 14 weeks with whey fermentation at two week intervals. Only two weeks of storage was involved and no loss of yeast vitality was noted in the starter (Fig. 3). At the end of 14 weeks the starters were growing just as fast as they had at the beginning. Thus, for rapid growth of starters this progressive transfer seemed to be the most applicable.

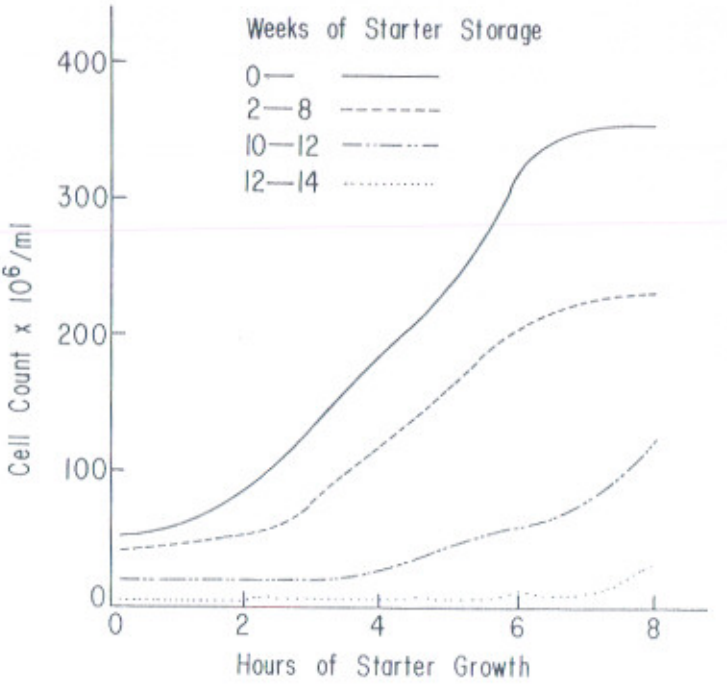

Figure 2. Growth of K. fragilis starter in cottage cheese whey at 35°C[1] after various periods of refrigerated storage[2]

[1]K. fragilis plate counts on yeast-malt extract agar.
[2]Storage at 38°F, removed, grown in whey and counted every two weeks for 14 weeks. Each batch innoculated at the rate of 0.8% starter to whey.

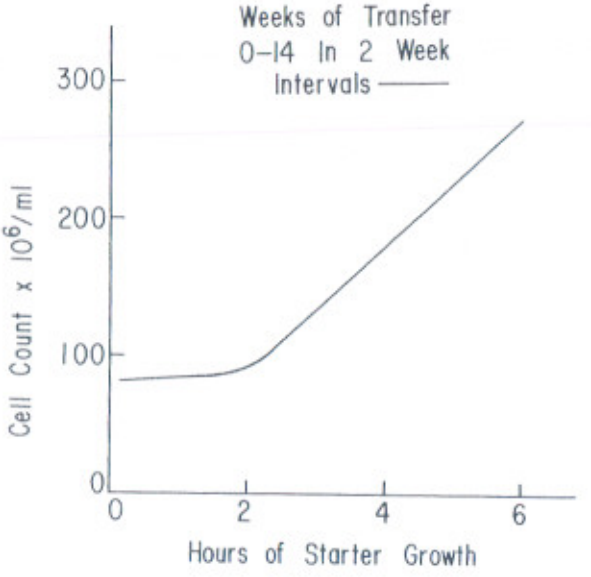

Figure 3. Growth of K. fragilis in cottage cheese whey at 35°C after progressive transfers[1]

[1]K. fragilis plate counts on yeast-malt extract agar. Starter organisms recovered after 4-5 hours from each whey growth. Stored at 38°F for two weeks then used to innoculate the next batch of whey.

A New Custard for the Elderly

J. B. Mickle, Olive Pryor and R. D. Morrison

Story in Brief

A new baked custard with fewer calories, higher protein, and a lower fat content was developed and tasted by a group of senior citizens. This custard was dried—when ready to serve, water was added and the custard was baked in the usual manner. The taste panel of senior citizens liked this dried custard just as well as the fresh product. They also preferred the custard which was approximately twice as sweet as normal, but preferred the normal texture as opposed to a thicker one which was more like a pudding.