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Canning Cheese.

By E. F. PERNOT.

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CANNING CHEESE.

BY E. F. PERNOT.

The making of first-class cheese of a standard flavor is attended with many difficulties and uncertainties, although made with material from the same source, and under the same conditions. All of these difficulties have not yet been overcome, and are repeated from time to time, causing more or less serious loss.

As cheese is found on the market at present, there is a striking difference in flavor, consistency, and structure; varying from a tough, waxy, sour curd which is both unpalatable and indigestible, to a crumbling, pungent material bordering upon rankness.

It is almost impossible to purchase two samples of cheese of the same character, and there is far more inferior cheese on the market than that which is first-class. Many people cannot eat the ordinary cheese because of its indigestible qualities. These conditions have had a tendency to diminish the consumption of this nutritious article of food.

Butter makers had struggled through many trials and difficulties to produce butter of a standard flavor, until the introduction of the cream separator which has revolutionized that branch of dairying into one of our leading industries. Following the cream separator came the use of "starters" consisting of pure cultures of selected organisms, which places the power in the hands of dairymen to control the flavor of butter to such a degree of certainty, that now we have creameries producing butter of a standard flavor and quality throughout the year, stimulating an increased valuation and consumption of the article.

These results have been attained in making butter, by the control and proper use of organisms; and there is a possibility of attaining like results in making cheese, notwithstanding there are many more difficulties to overcome, owing to its being a more elaborate process requiring greater time, and consequently, additional opportunities for objectionable reactions to take place.

Milk is an ideal culture medium for a great many varieties of organisms, which, under favorable conditions, develop very rapidly. Feeding upon the material, they excrete products characteristic of their kind, and each of these chemical products reacts upon the different constituents of milk; some by a peptonizing action coagulate the casein, while others by their enzyme action may re-dissolve it again, forming still more complex chemical compounds. Those producing lactic acid have a tendency to increase at the expense of others.

A bacterial analysis of cheese reveals the presence of different organisms, each producing ptomaines in proportion to its activities, the predominating one exerting the greatest influence over the odor and flavor of the material in which it grows.

Hence, if fresh milk from which we desire to make cheese be inoculated with a pure culture of a selected organism, we may expect

it to be largely instrumental in producing a flavor and odor in the cheese peculiar to its action upon milk and curd.

One great difficulty which has been experienced in successfully controlling flavor in cheese is the prevention of other organisms, including mould, from entering during the process of curing. The first attempt to obviate this, was to coat the cheese with paraffin, which was a step in advance, yet not quite satisfactory owing to the scaling and cracking nature of paraffin, especially when handling the cheese. The next step was to can the curd in hermetically sealed tin cans, which is the subject of this bulletin, in which the success and failures met with will be recorded.

Making the Curd. The fresh milk as it was received at the dairy was weighed and placed in vats, and immediately inoculated with a pure culture of organisms which had previously been grown in sterile milk for twenty-four hours. When the proper acid reaction had taken place, rennet was added; after the curd was formed it was cut and heated in the usual manner until a proper acid reaction was reached, which was determined by the hot iron test. The whey was drawn off and the curd "matted" or "cheddared" at a temperature and for a time sufficient to develop the required acidity, again determined by the hot iron test. The matted curd was then cut with a "Harris" curd mill, then salted and packed into cans or hoops.

Preparing the Cans. Round cans made to contain one, two and one-half and five pounds each, were procured from a local tinner. They were well scrubbed with hot water and soda, thoroughly rinsed and dried; then, in order to protect the tin from the action of the salt and acid, the first cans used were lined with parchment butter paper, but as this was an annoyance in filling the cans and proved to be an imperfect protection to the tin, paraffining the can was adopted; this method consisted of placing some paraffin of a high melting point in the can, heating it very hot, then revolving the can and emptying out all that would not adhere into another can, and so on until all were coated; the covers were treated in a similar manner. When cooled, a thin film of paraffine was found covering the entire surface of tin which came in contact with the curd. Upon opening these cans six months after filling, they were as bright as new.

Filling the Cans. When the curd was ready for pressing, it was placed in the cans in small quantities at a time and firmly pressed with an instrument similar to a wooden potato masher. As it was found impossible to fill the cans full enough to admit of further pressing, without leaving an air space between curd and cover, a loose tin band about two inches wide was inserted and filled in the same manner as the can, then a circular block of wood was placed on top and inside of the band, the cans were placed one behind another in the cheese press where they remained under fair pressure over night. In the morn-

ing the circular blocks and bands were removed, covers fitted on and soldered, hermetically sealing the can. It was found necessary to remove a small portion of the curd from immediately beneath where the cover was to be soldered, as the fat and moisture oozed out and interfered with soldering.

The Proper Time For Filling Cans. The proper condition of the curd at the time of filling the cans was a matter of experiment. In order to determine this, cans were filled at regular intervals of one hour from the time the whey was drawn off until one hour after milling and salting, and it was found later that in all cases, curd, milled and canned one-half hour after salting, gave the best results.

As there is no evaporation while curing, the curd must not be too wet or there will be unabsorbed whey when the can is opened. Less than the usual amount of salt must be added because it is all retained. In curing by the ordinary method there is a constant evaporation going on which brings the salt to the surface in solution where it crystallizes, diminishing the saltiness of the cheese. The latest experiment was to press the curd in hoops in the regular manner after which the bandage was removed and the green cheese slipped into cans which were made to fit, and covers immediately soldered on. Five-pound and twenty-three pound cheeses were made in this manner.

Curing the Cheese. A good feature of canned cheese is the curing, which obviates the constant care incident to the ordinary method, for after the cans are placed in the curing room they require no further attention other than to keep the temperature low and constant; humidity, dryness, vermin or mould cannot affect it.

In order to ascertain the progress in curing, lots of from six to fifteen cans were filled at a time, so that they might be opened at regular intervals, varying from six weeks to one year.

The first can was opened six weeks after being filled, and the cheese, for its age, was well ripened, of an excellent flavor and odor, the texture was friable, delicate and quite superior to that of any other cheese. Several cans were opened at each of the various times, and a gradual increase of the delicate flavor was noticeable, but even in a can one year old it did not become strong and rank. There seemed to be a limit reached in the ripening, after which it remained unchanged. Very naturally there was no rind, no mould, and no loss in weight through evaporation, a pound of curd produced a pound of cheese.

Effect of Temperature During Curing. The first lots of cheese canned were placed to cure in a small room adjoining the laboratory which was situated up stairs in a wooden building. The temperature of this room was kept at about 60°F until the summer months when it reached about 75°F. All the cheese cured under these conditions was good, but unfortunately one day

in early July the temperature suddenly rose to over 100°F, the consequence was that all the cheeses that were in different stages of curing, were ruined. Those which were three months old, or older, were not affected. The younger the curd, the more it was injured. Some cans sprung a leak, others swelled and even bursted, and most of the unripened curd turned bitter; in several cans of fresh curd the butter fat was found to have separated from the curd.

Another lot was selected to cure at a temperature of 62°F. One month after, the temperature rose to 80°F and the cheese turned bitter. In every case where there was a high temperature in curing, or a sudden change of temperature from low to high, the cheese was spoiled. After three months curing, change of temperature seemed to have no bad effect, but by far the most satisfactory results were obtained from cheese which was cured at a constant temperature of 60°F.

Testing Its Shipping Qualities. In order to test its shipping qualities, two one-pound cans of cheese which had been cured for three months, were sent by mail to U. S. Consul H. B. Miller at New Chwang, China, with directions to open one can for sampling, the other to be returned unopened, thus giving it twice the traveling distance. Mr. Miller found the cheese to be of a good quality and submitted it to a Russian cheese expert, who pronounced it of excellent flavor and structure. The cheese which was returned, was uninjured by the shipping.

Two one-pound cans were also sent to Rev. J. H. Kilpack, Sutton, Surrey, England; they were returned from the New York post office, on account of there being no parcel package mail system between America and England. They were again forwarded to the Department of Agriculture by mail and from thence to their destination by express. Mr. Kilpack submitted one can to an English cheese importer who pronounced it of the best quality of States cheese. The other can was returned, and the cheese found to be in excellent condition. Other cans were sent to various points in America with the same results.

Doctor True and Major Alvord, of the Department of Agriculture, pronounced it fine cheese, smooth and mild, with a pleasant flavor and especially suited for export trade.

It would seem as if these tests fairly demonstrated that shipping had no detrimental effect upon canned cheese, but it is to be remembered, however, that the cheese must be reasonably well cured before submitting it to the extreme changes of temperature incident to shipping long distances.

Study of the Organisms and Their Action. The most difficult feature of an experiment of this nature, is to determine the reaction of organisms in a material composed of animal matter, and the relation which they bear to the finished product, when one or more varieties are acting simultaneously forming chemicals of both a simple and a compound character.

When we attempt to understand fully the reaction of even a pure culture of one organism in milk and its products, it becomes a difficult problem; much more so is it, when several varieties are acting on the same material and the products of each other.

The continued action of organisms in material is in itself a minor factor in the ultimate results, but maintains which they produce continue their reaction long after the organisms have ceased their activities, consequently: if we inoculate fresh milk for cheese making with a pure culture of some selected germ, its ptomain will predominate, governing the odor and flavor of the finished product by its action upon some constituent of the curd while curing.

This was quite plainly demonstrated in the many instances in this experiment where pure cultures were used to inoculate fresh milk which was subsequently made into cheese. The peculiar flavor was so pronounced as to be undoubtedly due to the organism. Some produced a mild, delicate flavor, while others were sharp and acidulent.

Most of the pure cultures were obtained by making plate cultures from milk, and from samples of good cheese of both domestic and foreign makes. In selecting the germs, those were chosen which formed a firm curd without re-dissolving the casein when grown in sterile milk; then, before adopting them, they were tested for the flavor which they would produce.

A large number of cultures were necessarily handled to select even seven varieties; two of these gave the same flavor in the cheese, leaving six, one of these six gave a fishy odor to the curd in the vat so that it had to be rejected. Another formed too much gas, swelling the cans while curing, so that only four remained giving good results, although the first selection of seven reacted suitably in a milk culture.

Just before sealing the cans, a sample of the curd was taken from beneath the surface, and plate cultures made from it, to determine the organisms present at the time of canning.

It was found that cultures from curd which had been inoculated, contained a large number of the organisms used, and but few others.

When the cans were opened, cultures were again made as before, to determine whether the organisms had increased or diminished during the time of curing, and it was found that they had materially decreased in number per centigram of cheese, and some varieties which had found their way into the milk had disappeared.

The time will come when cheese will be made of a standard quality by the use of pure cultures as "starters," using organisms which possess economic value.

This experiment has covered a period of nearly two years, during which time a great many pounds of cheese were made under various conditions; it has demonstrated the possibility and practicability of controlling the flavor by the use of pure cultures. At every cheese making, where a culture was used, a check cheese

was cured in the ordinary manner, the flavors always corresponded with those which had been cured in cans, but to a much less marked degree.

The market now demands food to be in sealed packages and not so much in bulk as formerly; and the sale of cheese will be increased when it can be purchased in cans or packages upon which is marked its age and flavor, the latter being designated by letter or by name; this will be accomplished by the use of pure cultures and by curing the cheese in cans, or by some other means which will exclude the influence of other organisms.

It seems as though the present method of making cheese is not in keeping with the care exercised in making butter.

From the time milk is received at the dairy until the butter is wrapped in paper, the hands of a modern dairyman never come in contact with either material or product. In cheese making it is handled with the hands throughout the process, and it is not uncommon to see an operator bending over a vat with his hands and arms submerged nearly to the elbows, stirring the curd during the "cooking" and other parts of the operation. This would interfere to a more marked degree in the flavor of *cheese* made with a pure culture, than it would with *butter* if treated in the same manner, because the flavoring of cheese is a secondary reaction.

Means may yet be devised, by which the curd will be handled with fingered paddles, or other implements, doing the work of the hands, thus obviating the introduction of many objectionable germs.

As an article of food for export trade, or army use, **Conclusion.** cheese cured in cans would be very desirable, as it is condensed, nutritious, and in convenient form for transportation. There are others besides cheddar cheese, which could be made and cured in cans. A soft cheese having the consistency of thick cream, that could be spread upon bread, would likely find a ready market in the Orient. Some work was done in this line, but no definite results reached.

Several lots of cheese were canned without previously inoculating the milk, and they turned out very well. Inoculating the milk with pure cultures in other lots, was for the purpose of controlling the flavor, and proved successful.

Good results will only be attained either way, by dairymen who are competent to make first-class cheese, *as the curing in cans will not correct any error made in preparing the curd.*

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