

THE DAIRY.

The Cause and Prevention of Fishy Flavors in Stored Butter.

An address given by Dr. F. C. Harrison, to the Western Ontario Dairyman's Convention.

RESUME OF LITERATURE ON FISHY-FLAVORED BUTTER

The fishy flavor of butter has been known for a number of years, and in some of the more recent text books on dairying there are references to this particular taste. It is said to have been common in Denmark before the era of pasteurization, but, so far as I can ascertain, the first reference of importance occurs in the Colonial Dairy Review, compiled and published by W. Weddell, of London, England. About 1900 it is stated that much Australian butter sent to England had a pronounced fishy flavor that was very objectionable and which caused considerable depreciation in price. In 1901 the New South Wales dairy expert, M. A. O'Callaghan, found that the fishiness of Australian butter was due to a mould—*Oidium lactis*. By inoculating milk with this organism, fishy-flavored butter was produced, while the control portion of the milk produced butter of good flavor. By pasteurizing a portion of milk containing the mould, the pasteurized milk produced butter of good flavor, while the control transmitted the fishy flavor. O'Callaghan, therefore, recommended pasteurization at 168 degrees F., as that temperature readily destroyed the organism. Clearliness in and about the dairy was urged to prevent the inoculation of the butter during the manipulation of the milk.

DuRo, however, writing in the *Milch Zeitung*, found that pasteurizing at a temperature of 158 degrees F. did not always control the fishy taste in butter.

In 1901 there were several discussions as to the cause of fishy butter in the creamery journals, notably one by H. G. Piffard, who attributed the flavor to algae (low form of aquatic life), commonly found in stagnant fish-flavored water.

In 1903 appeared a bulletin on studies upon the keeping quality of butter by L. A. Rogers, of the U. S. Dept. of Agriculture. Rogers took two lots of freshly canned butter, kept them at room temperature and examined them at frequent intervals as regards condition, bacterial content, etc., and in from 250 to 300 days the samples showed a disagreeable fishy flavor. An increase in acidity accompanied the change in flavor, and both changes in acidity and flavor progressed steadily after the disappearance of the micro-organisms, showing that the changes were not due to direct action of the living cells. Rogers thought that it was reasonable to suppose that enzymes of the milk, acting alone or in conjunction with the yeasts and the resulting enzymes were responsible for the so-called fishy flavor in butter packed in large but unsealed vessels.

Later, in 1909, L. A. Rogers, of the United States Department of Agriculture, published a bulletin on Fishy Flavor in Butter, in which he states that the trouble is widespread in occurrence, but most noticeable in newer dairy sections. It occurred at times in fresh butter made during the summer months, but usually appeared in cold-storage butter after it had been held over some time in cold storage, and even low temperatures did not prevent the development of the fishy flavor. He could not produce the fishy flavor by inoculation with the mould *Oidium lactis*. He did not try the variety with which O'Callaghan worked. No species or group of bacteria could be found peculiar to creameries having trouble with fishy flavor; the only peculiarity of the cream from farms producing fishy butter was the presence of very active lactic-acid bacteria. The experimental butters which became fishy were all made from high-acid cream. Overworking the butter made from sour cream at times produced fishy flavor. In the opinion of this author, fishy flavor is caused by a slow, spontaneous chemical change by which acid is developed and which is favored by small amounts of oxygen. As a means of prevention, he advocated making butter from pasteurized sweet cream, and butter made from pasteurized sweet cream with a starter, without ripening, seldom, if ever, becomes fishy.

These seem the principal references to fishy flavor in butter, except one or two which occur in dairy text books, which are as follows: Lafar, in his text book on Technical Mycology, published in 1904, states that fishy butter is due, or is found to appear, when in certain regions pastures are flooded by salt water and the grass or hay therefrom is covered by small crustacea. The use of common salt made from sea water, or salt which contains much magnesium, imparts a fishy flavor to butter, and there are numerous in-

stances in which the presence of too much salt has resulted in fishiness. A fourth cause is due to micro-organisms.

Weigmann, in his text book on the Mycology of Milk, published in 1911, gives the same causes.

Siedel found that a cause of fishy flavor in butter made from pasteurized cream was due to the washing of the pasteurizing apparatus with soda solution, which, in spite of repeated washing and rinsing with water, left a grayish deposit on the metal, which seemed to impart a fishy taste to the butter.

OPINIONS OF PRODUCE DEALERS.

In this connection I wrote to several large exporters of butter in Montreal, asking them if they had had any experience of this defect in Canadian butter, and, if so, to what extent, and to what degree it depreciated the value of the article. I received a number of instructive replies, which I may summarize as follows:

1.—"There have been many theories as to the cause of 'Fishy Flavor' in butter. Formerly, 'Fish' was given as a reason, then 'Salt,' then 'Salt That Had Been Near Fish,' then 'Salt Stowed In Vessels Crossing The Ocean,' but more recently the fault has been attributed to 'Dirt' in various forms, the flavor being taken in through the milk or cream, or through the salt. Probably the fault comes more frequently through the 'Salt' than in any other way, but we are satisfied that there are other causes."

2.—"We have met with this flavor in butter quite frequently, and fishy-flavor butter usually sells at one to two cents per pound under the price of finest, the depreciation, of course, depending upon market conditions. It has been our experience that fishy flavor is not often met

chants it seems pertinent to inquire if the term "fishy" accurately describes the flavor or trouble complained of. I have noted often that expert judges seldom agree in their description of a specific flavor, and it is certainly necessary to have a standard for comparison. Shall we define fishy flavor, as a peculiar oily taste, suggestive of certain parts of a fish, such as salmon or cod, or shall we enlarge the definition and apply it to any kind of an oily taste present in butter? You will note that a Montreal exporter goes even further and states that he thinks it is only an exaggerated term for staleness. The matter is more important from the biological than from the buyers standpoint, because we may have a number of different living agents producing the different shades or degrees of bad flavor. For example, the casual agent of 'staleness' may be entirely different from the casual agent of a true fishy taste.

I think it is reasonable to assume that fishy flavor may be imparted to butter by poor salt, probably of sea origin, and by certain small crustacea, but we may set these reasons aside, for under our conditions these are seldom, if ever, met with. Let us discuss, therefore, those most likely to occur under Ontario conditions.

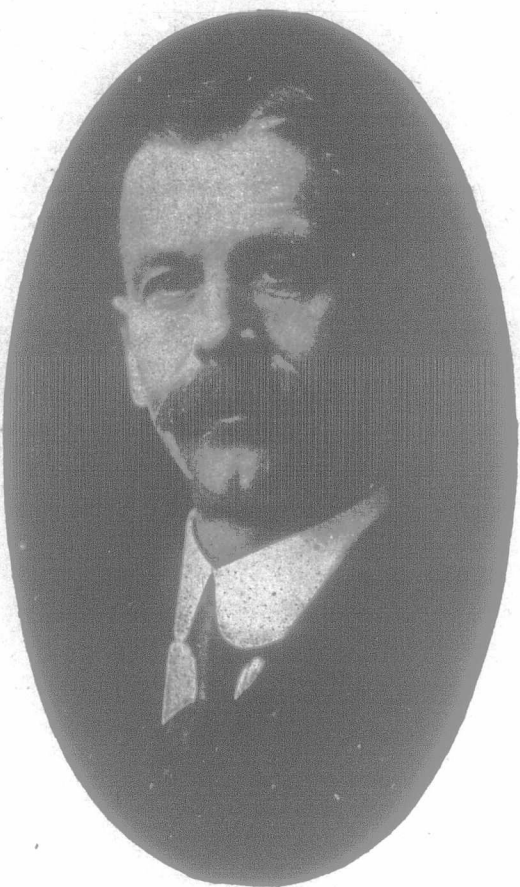
I think most makers who have to make butter from gathered cream will agree with me that during the hot weather the cream received at the factory is over-ripe. It has quite a high degree of acidity, and in many cases a secondary fermentation is commencing. The task of the maker to produce a first-rate article from such raw materials becomes at once a very difficult one, for the control of the acid fermentation is beyond his control, and secondary products are being formed in the butter by a variety of organisms. Even pasteurization of stale cream would not bring the best results, for many of the changes go on without the organisms, but through the agency of enzymes elaborated by them.

Such organisms as varieties of *Oidium lactis*, moulds, such as *Penicillium glaucum* (the common blue-green mould), *Cladosporium butyri* are all fat splitters, and such commonly found organisms as *Bacillus fluorescens*, a common organism in water, *Bacillus mesentericus* or potato bacillus, *Streptothrix odorifera*, and many others belong to this fat splitting company and produce undesirable flavors in butter. Another factor which I believe gives a disagreeable, fishlike flavor, is a bacterial substance known as indol, and which is produced by a number of fecal bacteria, such as the *Colon bacillus*, *B. lactis aerogenes*, and many others.

Tri-methylamine, which has an odour of hering brine, undoubtedly gives a disagreeable flavor to butter, which may be termed fishy. Rogers denies the statement of O'Callaghan that this substance (tri-methylamine), which is produced by *Oidium lactis*, gives rise to a fishy flavor, but we must remember that under the name *Oidium lactis* are included a large variety of organisms, some of which undoubtedly produce poor flavor. I recall an instance of this.

Dr. Weigmann, the Director of the Dairy Experiment Station at Kiel, and one of the leading dairy authorities in the world, prepared and sold a starter for buttermakers which contained a lactic-acid organism, together with a variety of *oidium lactis*. The combination or mixed culture gave excellent results and a fine flavored butter, that, however, had a very limited keeping quality, which, Dr. Weigmann told me, was due to the action of the *Oidium* decomposing the butter fat, and giving rise to an undesirable flavor. Hence, he could not recommend this culture for the preparation of butter for export purposes, but only for butter which was quickly consumed. I had samples of this culture, and in some experimental work confirmed the conclusions of the German Expert.

Again, Rogers states that large quantities of tri-methylamine could be worked into butter without producing any trace of fishy flavor. I believe this statement true, but find that if minute quantities are employed, there is a decided fishy flavor. If one smells a bottle of 33 per cent. solution of tri-methylamine, no trace of fishy flavor can be noticed, but make a large dilution by adding a drop to a cupful of water and the smell is instantly noticed, even at a distance of several yards. Hence, any organism able to produce this substance (tri-methylamine) in butter may give rise to a fishy taste, and we know that many producing this substance are found frequently in butter. Recently a Japanese investigator, Tsujimoto, has found that the odor of fish oil is due almost entirely to clupanodonic acid. This acid, by the addition of more hydrogen atoms, becomes stearic or oleic acid, and it is possible that oxidation of stearic acid or stearin and oleic acid or olein might result in the formation of clupanodonic acid, and thus give a fishy flavor. This is merely an hypothesis, and may be the explanation of Roger's surmise, that "fishy flavor is caused by a slow, spontaneous chemical change



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with in new butter, but generally arises in butter that has been held in cold storage for some length of time. We have also noticed that when butter is very mild-salted, the fishy flavor does not seem to develop to the same extent as in higher-salted butter."

3.—"Re 'Fishy Flavored Butter.'—This is a common fault with all held butter, and we think only an exaggerated term for 'staleness'—at least, the two go hand-in-hand. It is a question of degree. The lower the temperature the slower the process. We think salt sometimes turns butter fishy. 'Saltless' butter is rarely fishy in low temperature."

"As to the value of these faulty flavored butters, it is a question of degree again. Personally, I would not have fishy butter on my table as a gift, but there are many people who seldom or never get anything else. Of course, they don't know as I do. Ordinarily, such butters have to be sold at one to four cents per pound under finest, mild, fresh flavored. Canadian tastes have changed very much the last few years as regards butter, and it is more difficult to sell low grades than formerly, even at the reduction. There is not so much fishy butter as formerly, because we think it goes into consumption more regularly than in former years."

From the results of former investigations and from the opinions of leading wholesale mer-