A PEA CANNERS' PROBLEM SOLVED.

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Popular Edition*

Of

Bulletin No. 249.

A Pêa Canners' Problem Solved.

F. H. Hall.

Most classes of food stuffs are subject to changes which impair or destroy their value as edibles. Why provisions fail to "keep." Fruits rot, milk sours, meat spoils and canned goods work, to the annoyance and loss of the housekeeper or the handler, and often to the perplexity of the one who has spent time and care in the effort to preserve the goods in wholesome condition. Yet these diverse changes are only manifestations of vital forces, very similar to those which have produced the foods themselves.

The decay of most animal and vegetable products is due to the activity of lower forms of life. The ordinary rots of fruit, mustiness in flour, mold on bread and cheese, and a few other troubles of food are caused by small plants, the molds, yeasts, fungi, etc.; but most of the fermentation, souring and spoiling of food is due to even simpler organisms, also classed as plants, each consisting of a single cell. These last are all bacteria, but they differ in species just as do higher plants, and manifest their presence in diverse activities so that they can be classified and studied.

* This is a brief review of Bulletin No. 249 of this Station on A Swelling of Canned Peas accompanied by a Malodorous Decomposition, by H. A. Harding and J. F. Nicholson. Any one specially interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete bulletin. The names of those who so request will be placed on the Station mailing list to receive future bulletins, popular or complete, as desired. Bulletins are issued at irregular intervals, as investigations are completed, not monthly.
It is usually their development that causes decay in foods, and thus brings trouble to the housekeeper, canner and provision preparer.

**Methods of preserving food.**

The preservation of food products, then, depends upon the control of these minute plants, and this may be accomplished in several ways: (1) The organisms which are present in the material and which would cause decay may be killed by heat and precautions taken to exclude other living germs; (2) the food may be kept at so low a temperature that growth of the little plants is checked; (3) the substance may be dried so that the water necessary to support the life of bacteria is driven off; (4) liquids containing sugar may be boiled down, or more sugar may be added, until the syrup becomes so concentrated that the bacteria can not live upon the sugar although this is one of the favorite foods of many common species; (5) some material may be added that is detrimental to the bacteria and prevents or checks their activity.

All these methods are in common use, as in canning fruit, keeping milk, drying beef, "boiling down" cider, and salting pork, respectively; and against none but the last is there any valid objection on the score of wholesomeness, and none against that except when such materials are added as have, or are thought to have, some injurious effect upon the human system. The knowledge, however, that salicylic and boracic acids, formalin, etc., have been used as preservatives has caused a widespread distrust of the use of chemicals in putting up foods, although many substances, like salt and saltpeter, are fatal to bacterial activity while harmless to the consumer as ordinarily used. This distrust of chemicals in food makes it advisable in all cases, where it is possible, to use some other means of preserving materials to be used as food.

Heat is one of the best agents, as it is the most common one, for sterilization of food products, since heating adds to the palatability of many foods, as well as causes the death of decay-inducing bacteria. Therefore, where it can be used without injury to the quality of the material, canning is the favored method for preserving foods; since proper heating kills the germs and sealing the cans excludes living ones.
But the conditions for securing perfect sterilization of different classes of foods are quite diverse. The intensity and length of heating which would prevent the spoiling of fruit are much less than those necessary to insure the keeping of vegetables; and the same fruit or vegetable may contain in some seasons the spores of certain decay-inducing bacteria which would survive the heating that destroys the germs ordinarily present. The germs that cause certain fermentations or decays, of very similar appearance, may themselves be of widely separated species and different in many characteristics, including the ability to withstand heat.

These methods and factors all had to be considered in the solution of a pea canners' problem that was brought to the attention of the Station in 1902. It was evident that this problem was well worth attention, for the value of peas canned in New York each year is about $1\frac{1}{2}$ million dollars, and the trouble is one which often causes great loss. It was also considered that the investigation came well within the scope of Station activity, since the canning factories, like creameries and cheese factories, take, directly, large quantities of farm products and often stand in a semi-cooperative relationship to the farmers of the State. Consequently the Bacteriologist began work upon the problem and has solved it satisfactorily.

The trouble referred to is the swelling of the cans of peas while they are in the store-room of the factory, upon the shelves of the dealer or in the hands of the consumer. Such swelled cans present the appearance shown by the two outer ones shown in the cover illustration, the ends being rounded or "bulged" as though pressed almost to bursting by some force within the can. Such, indeed, is the case, and the pressure sometimes becomes so great that the tops are blown off or the side seams split, scattering the contents far and wide. In such cases the contents of the cans emit a most vile odor, the peas themselves are mushy, and their skins inflated with gas like little balloons.
These outward manifestations indicate the work of bacteria; and after a long and rigid examination this has been proven to be the case and a particular species of bacteria identified as the cause of the trouble. In general terms, this species is rod-like in form, with one end of the rod swollen slightly.

The steps in proving the guilt of this particular species were as follows: Suspicion was cast upon it by finding this form present in large numbers in those swelled cans which on opening emitted the characteristic disagreeable odor; the liquor of these cans, after heating to destroy less resistant germs, was used to inoculate dishes of culture medium and colonies of this particular bacterium, free from all other species, obtained; from these pure cultures, material was taken to inoculate cans of sound peas and the original trouble was reproduced; then from cans thus made to swell by inoculation, the germ was again isolated and by comparing its behavior under various conditions with the behavior of the original species, the two were proven identical.

From experience at the factory it was found that the germ, whatever species it might be, could survive heating the cans to 230°F for 30 minutes. After the identity of the germ had been determined by the steps given above, the additional test was applied of subjecting cans artificially inoculated with pure cultures of the bacterium in question to the same degree and length of heating. The cans still swelled, showing that this germ, like the one causing the original trouble was not destroyed by such heating. This gave additional proof of the identity of the species.

In preliminary work, various temperatures and times of heating were tested to ascertain how resistant the spores of this bacteria were. The factory where the outbreak occurred had been "processing" peas in 2 lb. cans at 230°F for 30 minutes with good success for several seasons; but with the advent of this species of bacteria the number of swelled cans became so great as to threaten the loss of almost the entire output. The cans in stock after the discovery of trouble were reheated at 238°F for 35 minutes, which checked the swelling; and this temperature was used with good success throughout the
season. Some loss occurred, however, so arrangements were made to continue the investigation on a large scale. Accordingly in the season of 1903, through the courtesy of the Geneva Preserving Co., whose factory was conveniently located, the Station was enabled to can a ton of peas, under various conditions. From replies to a circular letter sent to canners throughout the State it was found that 240° was the most generally used temperature for processing. This was adopted as the degree of heat to be used, and lots of 150 cans each, of different kinds and sizes of peas, previously inoculated with pure cultures of the decay-producing bacteria, were subjected to this temperature for periods varying, by 5 minute increases, from 10 minutes to 45 minutes. When the heating was continued less than 30 minutes, the percentage of swelled cans was too large to count the processing successful; but heated 30 minutes, only one can out of 150 swelled and none swelled that were heated longer than this.

Effect on commercial quality. It is not enough, however, to know that a certain heating will destroy the germs;—it must do this without so affecting the quality of the goods as to hurt their sale. To test this point, competent judges were asked to sample the treated cans immediately after cooling and at the end of eight months. These examinations proved that heating the cans at 240° for 30 minutes left the peas in good condition. Heating 40 or 45 minutes caused a slight darkening of the color, especially in cans of large peas, and in some instances a slight scorched taste.

These defects, however, while noticeable at the first examination, had greatly diminished at the end of eight months, although the liquor in the cans of large peas was still somewhat dark. It is thought that this darkening might have been largely prevented by more thorough bleaching before the peas were put in the cans.

It seems safe, then, to recommend heating peas to 240° for 30 minutes, since this temperature and time suffice to destroy the spores of this particular germ, the most resistant so far known in pea canning, and do not effect the quality of the goods enough to hurt their sale.