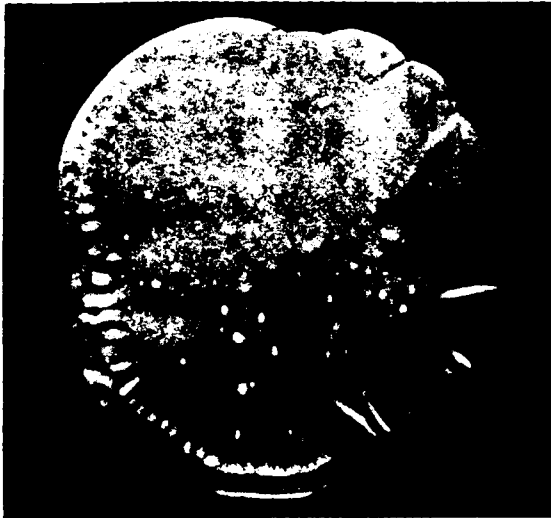


BRIGANDS IN BRINE

The formation of bloaters (hollow cucumbers) during the pickle brining process causes an estimated loss of about a million dollars annually. Here's what U.S.D.A. and North Carolina scientists have learned about the problem.

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UNLESS HE CAN REMEMBER Mom's potato-water culture for leavening bread, the average person has almost no acquaintance with the vast family of fungi known as yeasts. Actually, yeasts perform a vital role in the processing or preservation of many different food products. However, in pickle fermentations they apparently do more damage than good.

Since North Carolina is one of the major pickle-producing states, the role of yeasts in pickle manufacture is more than a matter of curiosity to many Tar Heels. Yeasts are involved in the fer-

mentation of all the major types of pickles excepting the relatively new pasteurized products.

Among the many different yeast species involved in the brine curing process, there are some thought to be undesirable because of their possible connection with certain types of pickle spoilage. The North Carolina Agricultural Experiment Station and the United States Department of Agriculture have been cooperating during the past few years in a study to discover the causes of pickle spoilage and means for its correction.

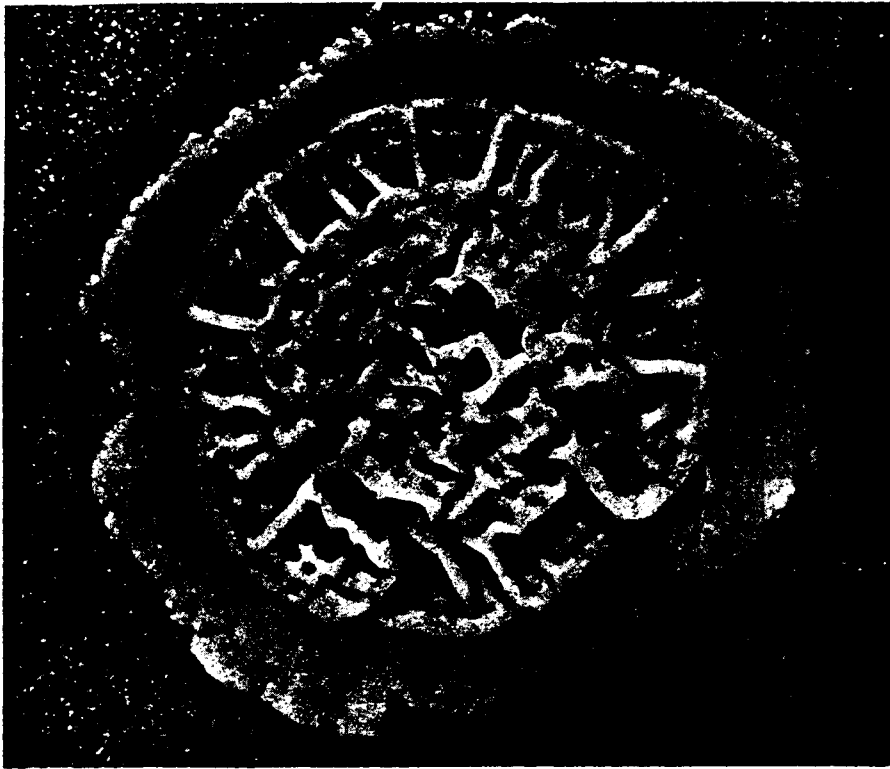
The Brining Process

A review of the pickle brining process will be helpful in understanding the spoilage problem. The green cucumbers, either graded to size or as field-run stock, are placed in wooden vats ranging in capacity from 200 to 1,200 bushels. A wooden cover made of loose fitting boards is placed over the cucumbers at a level about six inches from the top of the vat. Then the vat is filled with 6 to 8 per cent salt brine to a level a few inches above the cover.

Next, dry salt is added on the cover



The four cucumbers on the left are specimens of "bloater" damage caused by yeasts. Compare them with the undamaged pickle (right).



A giant colony (enlarged 10 times) of the cucumber brine yeast, *Endomycopsis Ohmeri*, Var. *Minor*. Colony conformation varies when grown on different cultural material.

to maintain the initial brine concentration which would otherwise be diluted by the water from the cucumbers. The brine strength is gradually raised by adding enough dry salt to give a holding strength of 16 to 18 per cent at the end of four to six weeks.

Under these conditions, salt-tolerant micro-organisms grow for at least four months. The process of fermentation takes place as these organisms feed upon the soluble nutritive material such as sugars from the cucumber, and convert them into lactic and acetic acids, alcohols and gases. At the end of the curing process—about three months under southern conditions—the cucumbers have changed from a green, opaque, buoyant fruit to olive-colored, translucent, gas-free salt stock.

Types of Spoilage

Two main types of spoilage are encountered during the brining process. One of these is due to the formation of “bloaters” or hollow cucumbers resulting from gaseous fermentation.

Leaders of the pickle industry estimate the loss due to bloater formation to be about \$1,000,000 annually. This loss actually is in the reduced value of the cured stock since bloaters must be

used for less valuable items like cut pickle or relish.

What Causes Bloaters?

Cooperative pickle research at this Station has demonstrated that the brining schedule has considerable influence on the formation of bloaters. If the starting and early curing brine-strength is not high—for example, from 6 to 8 per cent salt—acid-forming bacteria will be active for a short period, followed by a slight to moderate yeast fermentation in which only small amounts of carbon dioxide gas are formed.

But if the early brine strengths are high—that is, from 12 to 15 per cent salt—then little acid will be formed, since the acid-forming bacteria do not thrive in high salt concentrations. As a result, large amounts of food will be left over for the salt tolerant yeasts to thrive upon and form large volumes of gas. This excess gaseous fermentation by yeasts is responsible for most of the bloaters, although the hydrogen-forming bacteria are also involved in certain brining seasons.

Which Yeasts Are Responsible?

Two general types of yeasts are associated with cucumber brines: those that grow beneath the surface of the

brine, and those that produce luxuriant films on the surface which are exposed to the air but sheltered from direct sunlight.

More than 1,400 cultures of sub-surface yeasts have been isolated and identified in extensive studies made at commercial brining stations in North Carolina. Two new species accounted for 88 per cent of the total number of cultures. These sub-surface yeasts are responsible for the gas formation and hence for most bloater spoilage.

Film-forming yeasts do not depend solely upon sugar for growth but can use the fermentation acids or alcohols in the brine. Studies have shown that at least four species produce films on commercial cucumber brines.

What Causes Softening?

A large number of organisms, including different genera of bacteria, yeasts and molds, have been reported as capable of producing the pectin-splitting enzymes that would destroy cucumber tissue. However, to date, no group of micro-organisms has been proved responsible for the softening of salt stock.

The studies have indicated that a pectin-destroying enzyme corresponding in chemical behavior to commercial pectinase is responsible for the loss in firmness of salt stock. But of the 143 sub-surface and film yeasts screened for their ability to produce the enzyme, none has been found to be a potential source of the softening enzyme. Four yeasts from sources other than cucumber brines were able to produce the enzyme.

The cucumber plant and its fruit have also been studied as possible sources of the softening enzyme. An enzyme very similar to that responsible for the spoilage has been found in dry cucumber seeds, male flowers, fertilized female flowers and also in ripe cucumbers. A second enzyme, known as pectase, has been found in various parts of the cucumber plant and fruit.

ON THE COVER: A photomicrograph (basic magnification, 1,700 times) showing the cells of one of the cucumber brine yeasts isolated during the study of the bloater problem. Several of the cells contain two or three round spores—their means of reproduction.

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