

SALTING OF CUCUMBERS

Influence of Brine Salinity on Acid Formation

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THE commercial manufacture of cucumber pickles generally involves two principal processes. The first is the production of salt stock by curing or salting fresh cucumbers in sodium chloride brines of suitable concentration. The second is the processing of salt stock to form the finished pickle. Spoilage of salt stock during the curing period or subsequently while it is in storage prior to processing is a loss frequently encountered by commercial manufacturers.

The use of sodium chloride or the brine of this salt in the household or in the commercial preparation of cucumber pickles has long been practiced. In spite of the established nature of this processing method, only a limited amount of exact information concerning the reactions involved has been obtained.

Rahn (8), Hasbrouck (4), Campbell (2), Brown (1), Fabian, Bryan, and Etchells (3), and others have made valuable contribution to our knowledge of the processes involved in the salting of cucumbers for the manufacture of pickles.

These investigators have shown that, in the preservation of green cucumbers by sodium chloride, certain salt-tolerant microorganisms are responsible for the disintegration of various organic fractions of the cucumber fruits. Chemical changes are reflected in the fermentation of soluble carbohydrates to form organic acids, principally lactic, and in some cases in the deterioration of the structure of the cucumber.

Microbiological activity is decidedly influenced by environmental temperature. Climatic conditions current in North Carolina at the time cucumbers are salted are decidedly different than those which prevail during the corresponding season in the more northern cucumber-growing areas where most of the previous investigational work has been carried on. In this state cucumbers are normally harvested from early June to late July. Therefore, salting begins and the curing process takes place during a period of high temperatures.

The view is commonly held, particularly in the South, that these different climatic conditions which prevail during the curing season require salting practices different from those followed in the northern sections of the country. It is believed that, under southern conditions, cucumbers must be cured in brines of relatively high salt content in order to prevent spoilage losses during the curing or storage periods.

In view of the more common use of brines of higher salt content in the southern than in the northern regions, it seemed important to study more thoroughly the influence of salt concentration of brines on the composition of such brines during the curing process, and on the physical nature and keeping quality of the salt stock produced under such conditions.

Commercial Salting Procedure

The salting procedure followed at commercial pickle plants is outlined briefly as follows: Barrels or vats are nearly filled with recently harvested cucumbers, a false head is fitted to the container (to keep cucumbers well submerged), and the container is filled with brine of the desired salt concentration.

Salting may be done in unsheltered vats, as is more common in the South, or in vats under a roof or within a building.

The curing process commences immediately after the cucumbers are brined and continues for 3 or 4 months. During this period numerous microbiological, chemical, and physical changes take place. The cucumber tissue is killed by the salt, and the soluble cellular constituents diffuse into the brine. These organic constituents dissolve in the brine and serve as nutrients for salt-tolerant microorganisms. Large numbers of soil-borne microorganisms are carried on the cucumbers. Many of these are more or less salt tolerant. As a result an active fermentation commences in the brine almost immediately. This fermentation continues, under southern climatic conditions, for 2 to 6 weeks, depending upon the salting procedure. The fermentation is evidenced by the development of brine turbidity, the formation of an appreciable quantity of lactic acid, and the evolution of a considerable volume of gas.

The significance of the numerous changes occurring during the fermentation process has not been established. Most pickle manufacturers, however, consider that acid formation is both desirable and essential for the satisfactory production and subsequent storage of salt stock.

Previous Studies

Numerous investigators (2, 3, 4, 7) have stressed the importance of carefully controlled salt concentrations of the brine involved in salt stock production.

Hasbrouck (4) recommended an initial brine concentration of 30° if the weather was cool and 32-33° if the days were warm. Salt concentration is expressed as degrees salometer (per cent saturation). The range 0-100° salometer represents 0-100 per cent saturation with respect to sodium chloride. A saturated solution contains 26.4 per cent sodium chloride by weight at 60° F.

Campbell (2) observed that a low or weak brine favored rapid fermentation whereas a high or strong brine checked or retarded fermentation.

Fabian, Bryan, and Etchells (3) investigated the influence of low-salt curing and high-salt curing on the fermentation process and salt stock quality. With the low-salt treatment (30° initially) brine acidity developed more rapidly and attained a higher value than with the high-salt treatment (40° initially). However, these authors point out that "after about a month's time there is very little difference between the total acidity of the two brines".

Le Fevre (7), on the other hand, reported appreciably greater acid formation in moderately strong brines (32-40°) than in weak brines (20-28°).

Present Studies

This report is based on studies made during 1934, 1935, and 1936. Salting was done in 45-gallon barrels. All treatments were salted in duplicate. More than 200 barrels of cucumbers were involved in this study. The experiments were carried on

