is the most tenable explanation, although there may also have been beneficial effects from the agitation which the yeasts were subjected to by aeration. These data indicate that the incubation of cultures of yeasts under certain conditions and in vessels of certain shapes, which allow different amounts of oxygen to enter, may greatly influence the crop.

3008

Effect of sodium benzoate upon certain yeasts.

FRED W. TANNER and LUELLA B. STRAUCH.

[*From the Department of Bacteriology, University of Illinois, Urbana, Ill.*]

The data collected under the conditions of these experiments indicate a marked difference in resistance of pure yeasts to sodium benzoate. On dextrose agar and in dextrose broth even in the presence of 0.40 per cent of sodium benzoate, growth was appreciable. *Torula communis* did not grow after the concentration of the benzoate in the broth had reached 0.15 per cent. One strain of *Sacch. ellipsoideus* was also inhibited at this concentration. Another strain showed a greater resistance; it grew in the presence of even 1 per cent but the growth was slower and less abundant. The fungi used seemed to be able to tolerate the sodium benzoate better when growing on a solid medium containing it than when growing in a liquid medium. This is probably explained by the fact that on the solid medium the organisms may use up the disinfectant during the early stages of growth so that the cells which develop later in the history of the culture do not have to endure such a high concentration as in the beginning. In liquid media such as dextrose broth, the sodium benzoate is in solution and therefore may come into closer contact with the cells. Two of the strains of budding fungi, *Mycoderma vini* and a pure culture from vinegar (No. 18) were able to grow apparently as well in the presence of one per cent of sodium benzoate as in the controls.

In sterilized apple juice the results were more striking. The

sterile apple juice was almost as good a medium for the yeasts as the sterile dextrose broth since in the control tubes without any preservative the growth was abundant. However, when sodium benzoate was added the growth was markedly inhibited since none of the fungi grew after 0.01 per cent had been added. The same was also true for the amount of alcohol formed. These results agree with those of Scott and Will.[2]

Attempts were also made to study the preserving effect of sodium benzoate in catsup. No growth of the yeasts could be secured even in control tubes containing no sodium benzoate.

The above data were collected by means of pure cultures under laboratory conditions. The most important fact brought out, perhaps, is the marked difference among yeasts in resistance to sodium benzoate; also, the fact that the chemical constitution of the material to be preserved has great influence is indicated. This probably explains the greater preserving action of sodium benzoate in apple juice than in broth. It is also reasonble to assume that the species of apple from which the juice has been prepared would have considerable influence.

Preservation of apple juice with sodium benzoate seems to be a relative matter anyway. Sodium benzoate is not an absolute preservative. It may delay the fermentation for a time and in conjunction with low temperatures may exhibit a moderate efficiency. However, fresh apple juice to which sodium benzoate has been added to the extent of 0.1 per cent, according to law, will ferment. Satisfactory vinegar has been made from such apple juice. Rice and Markley[1] stated that when the yeast has had a start or if the cider is not cooled, as much as 0.5 per cent of sodium benzoate would be necessary. Scott and Will,[2] who worked with unsterilized apple juice reported that sodium benzoate in amounts as low as 0.02 per cent prevented the formation of an appreciable amount of alcohol. This statement is in accordance with the results secured on commercial apple juice which had been treated with 0.1 per cent (1½ oz. to 10 gallons) of the preservative.

---

[1] Rice, F. E., and Markley, A. L., *Bull. Ag. Exp. Sta.*, Cornell Univ., 1921, xliv, 1-23.

[2] Scott, R. C., and Will, E. G., *J. Indus. Eng. Chem.*, 1921, xiii, 1141-1143.