much;
If you can fill the unforgiving minute
With sixty seconds worth of distance run,
Yours is the earth and everything that's in it,
And which is more, (paraphrasing) you can run a farm, my son!"

A long silence, then Mary said "That's a wonderful poem, Fred. Let's work thru our Farm Bureau to correct all the wrongs that can be corrected, and then apply the thoughts of that poem to the rest. Our critics are fast discrediting themselves in the minds of the public. They can't fool all the people all the time. Meantime, we have work to do."

They turned in at the gate, and up toward the house.

The farmer had been to town.

UTILIZATION AND DISPOSAL OF CITRUS PROCESSING RESIDUES (1)

ROBERT S. INGOLS, Research Fellow,
Florida Citrus Commission, U. S. Products Station (2)
Winter Haven

The development of byproducts in any industry is either the outgrowth of pressure to relieve unsanitary conditions created by the wastes or the result of the need to find more avenues of income as circumstances reduce profits per unit of production. The citrus canning industry is able to use only about 40 percent of the whole fruit; the rest is "wasted" from the food standpoint. As the canning industry expanded, some means of reducing the cost of disposing of solid wastes was required. The citrus pulp-feed industry has been the principal answer to this need.

Residue from Citrus Pulp Manufacture

New ideas and developments are essential in the life of any industry and the citrus pulp industry is still young. Most of you are aware that the present dried citrus pulp is not a complete feed, for it is low in protein. This means that some high-protein feed must be used in conjunction with the citrus pulp for proper nourishment of cattle. There are several possible methods of increasing the protein content of citrus pulp. Recently, patents have been obtained by the Quaker Oats Company for increasing the nitrogen content of the feed by the direct addition of ammonia gas under pressure. Nitrogen in the form of ammonia gas is not directly available to animals, but it is indirectly available to the cow because ammoniated material remains in the stomach long enough for micro-organisms to grow on it and produce proteins, which are later assimilated in the cow.

The Kuder Citrus Pulp Company has been working with the Quaker Oats Company on the possible use of its process as one method of increasing the nitrogen content of citrus pulp feed. It is hoped that data from this interesting new development may be reported at the next meeting of the Society. This development will not increase the

1/ Agricultural Chemical Research Division Contribution No. 142.

2/ One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

capacity of the feed plant, but should insure an expanding market that will keep it operating at capacity at all times.

It is generally true that the cattle-feed plants have an excessive supply of raw material. The capacity of their dryers is limited, so in order to operate their plants most economically the largest possible amount of water must be removed mechanically from the peel before it is fed to the dryers. Thus, they handle the raw pulp in such a way as to produce the maximum quantity of press liquor, even though it contains 25 to 40 percent of the solids in their raw material. The large amount of solid material in the press liquor is not all going to waste, as you have already heard from the previous speaker, but some of it is. (See page 54).

Just let me give you an idea of the amount of material that is being wasted in one of these plants by estimating the size of a city that would produce an equivalent amount of waste. Let us assume that one of the feed plants is producing 7000 gallons of waste press liquor per hour for 24 hours a day, and that this waste averages 8 percent solids. This amounts to more than 110,000 pounds of solids per day, which is equivalent to the weight of volatile material in the sewage from a city of more than a half-million people on the basis of an average of 0.2 pound of solids per person per day. Adequate sewage treatment for an inland city of this size would cost at least two million dollars for the plant plus the expense of operation. It is small wonder that these feed plants are not interested in the treatment of the liquid wastes on a sanitary basis. The development of salable byproducts by these plants is most certainly the best answer to their disposal problem.

Citrus molasses, for use in feeds, is such a salable byproduct. There is no waste in its production and so it is ideal from the sanitary point of view. Alcohol production does not solve the problem completely, since the distillery slop does contain yeast and some of the unfermented raw material. Distillery slop is evaporated to dryness by some of the grain-using distilleries and sold as cattle feed because of its high nitrogen and vitamin contents. Wet slop from some of the smaller plants is fed directly to hogs. Some use for the waste from distilleries fermenting citrus press liquor is highly desirable.

When press liquor is used for the production of alcohol, less than 25 percent of the energy originally in the sugar is lost. More than 75 percent of it is still present in the alcohol. This is why alcohol can be used as a fuel. The total amount of yeast that grows in a mash is dependent upon the amount of energy which it is able to obtain from the nutrients in the mash. Excessive yeast growth is of no special importance in the production of alcohol, but a good price can be obtained for yeast itself because it is a high-protein feed. Therefore considerable study is being given by the Government and by industry to the problem of producing yeast for supplementing citrus-pulp feed, as another method for providing a balanced ration for cattle.

To produce yeast in maximum quantity, one must pass air through the liquid culture medium. In practice, the press liquor is first pasteurized. Then it is diluted with water and inoculated with a desirable strain of yeast, after which large volumes of air are bubbled through the solution for 8 to 10 hours. At the end of this time all the sugar should be gone and no substance of high energy content, except yeast, should remain. About half of the sugar will have "been completely burned up," that is, converted to carbon dioxide and the rest used by the yeast for making more yeast cells.

There are problems, however, in making dried yeast commercially. The laboratory (1) has demonstrated the possibility of growing yeast but plant-scale equipment for drying yeast must be selected or designed. How well will a standard yeast centrifuge work in concentrating the yeast grown in press liquor? How will the dried

yeast taste? What will be the best method of drying the concentrated yeast slurry? Will it be necessary to use low evaporation temperatures to protect the vitamins or will the ordinary temperature of boiling water be satisfactory? The Dr. Phillips Company of Orlando has been working on this problem and may have a pilot plant in operation next year. Pasco Packing Association at Dade City is expecting to install a complete commercial plant by next year. The U. S. Citrus Products Station in Winter Haven is experimenting with a strain of yeast that is employed by the British government for the production of feed yeast in their tropical colonies. Due to the warm climate of Florida, it may be desirable to use a yeast that can grow at higher temperatures than those generally used. Our particular strain has a large-sized cell that may separate from the press liquor more readily than others.

Canning Plant Residues

The liquid wastes from canning plants are produced because of the application of sanitary measures in the plant. Flies must be kept away from the fruit; so fruit-handling rooms and machines are kept cleaned to keep down mold and yeast counts in the final product. Water is the best cleaning agent for this purpose, so it is used in fairly large quantities. Moreover, the need for cooling the canned materials quickly to prevent loss of quality requires the use of large amounts of cooling water. When all of these liquid wastes are mixed together the concentration of polluting material runs about 0.1 percent, or only a little more than in domestic wastes. Several agencies (2) of this State investigated the treatment of these wastes and found that this liquid can be handled well by the conventional method of biological treatment on a trickling filter. Even though the equivalant solids population load is not high, this method is expensive because there is a high initial cost of constructing the filters; therefore it has not been adopted.

During the past canning season a pilot plant has been operated for the treatment of the canning wastes from the Polk Company at Haines City. During the early part of the season all of the liquid wastes were discharged together. Later in the season the cooling water was eliminated. The canning of sections was carried out during the day shift while the canning of juice was a continuous process. By studying the flow of waste water for a continuous 24-hour period, it was possible to get a comparison of the strength and volume of the wastes from the juicing operation alone and from both juicing and sectionizing.

The waste from the juicing operation was much lower in volume and higher in concentration than that from the sectionizing operation, and its low volume, with relatively high concentration, made it similar to the wastes from two nearby juicing plants. This means that a small tank can be built to retain the wastes from 24 to 30 hours, during which micro-organisms should destroy about three-fourths of the organic matter, according to the results of our pilot-plant studies. This small biological-reaction tank is not as effective as a trickling filter, but it is much less expensive and may provide the necessary reduction in concentration. If necessary, a trickling filter could follow this tank and be much smaller than without it.

You may wonder if there would be any byproduct from this treatment of the juicing plant wastes. Some solid material would settle out in the reaction tank, but the daily amount would be so small that no commercial application is anticipated.

The sectionizing plant wastes are diluted with much more water, but may be strong enough to cause trouble in the receiving body of water. At present there is no good method that can be recommended for treating these wastes. The retention of a large volume of waste for the necessary hours of biological treatment requires large tanks which are expensive. Some new developments in industrial waste equipment have been announced this year. It is hoped

that a small model of these devices may be loaned to us for working with these wastes next season.

Summary

The development of byproducts is highly desirable in the growth of a new industry. The use of citrus pulp for making cattle feed has solved the solid wastes problem of the canning plants, but the manufacture of the cattle feed requires the disposal of a liquid waste that is a byproduct challenge. Some plants are now making citrus molasses as a byproduct, and an alcohol plant is ready for production. Feed yeast is another promising byproduct. A simple biological method for decreasing the organic matter in low-volume, high-concentration wastes from juicing plants is recommended. No economical method for treating the wastes from sectionizing plants before disposal is known.

Bibliography

1. Nolte, A. J., von Loesecke, H. W. and Pulley, G. N., "Feed Yeast and Industrial Alcohol from Citrus Waste Press Juice," **Ind. & Eng. Chem. 34,** 670 (1942.)
2. von Loesecke, H. W., Pulley, G. N., Nolte A. J., and Goresline, H. E., "Experimental Treatment of Citrus Cannery Effluent in Florida." **Sew. Works Journal 13,** 115, (1941.)

TRENDS IN THE PROCESSING OF FLORIDA CITRUS FRUITS AND THEIR INFLUENCE ON RETURNS TO PRODUCERS

ROBERT C. EVANS, Secretary-Manager
Florida Citrus Commission, Lakeland

Recently I received a letter from one of the officials of a large citrus cooperative in California in which three questions were asked relating to citrus processing operations in Florida in the past and in the post-war period. I think that they are truly "sixty-four dollar" questions. And they are questions that our neighbors should not have to ask us—they are questions that we should have asked long ago and should today be asking ourselves and seeking the answers. Yet, I doubt that many of us have done much serious thinking concerning the answers.

The questions were as follows:

1. Will the amount of canned citrus juices and canned citrus sections (including both oranges and grapefruit) continue to increase? Will the increase, if any, absorb a larger percentage of the total production than in the past?

2. What has been the effect of canned juices and sections on the fresh fruit market with reference to **prices** and **volume of sales?**

3. During the post-war period when the government is no longer a purchaser or at least a small factor, will the returns to producers for their entire citrus crop be greater or less because of canning outlets?

I am going to discuss with you today my own views on these questions. There probably will be few who will agree with all of my conclusions, some of which are supported by little or no concrete evidence. I hope that you don't agree with me entirely because the more we disagree on the answers the more we are likely to carry on discussion and research to determine the true