# NEW FOOD PROCESSING DEVELOPMENTS*

WILLIAM P. RATCHFORD

*Eastern Utilization Research and Development Division, Agricultural Research Service, United States Department of Agriculture, Philadelphia 18, Pennsylvania*

In the limited space at our disposal it will be possible only to skim over some of the food processing developments recently completed or still under study at the Eastern Utilization Research & Development Division. The three other Utilization Research Divisions and other Federal laboratories conduct research on food; also, the food industry, which is the largest in the United States, does much research to develop new food products; hence this paper presents only a glimpse of the food products to which consumers can look forward in the next ten or twenty years and which may at some time present problems to regulatory officials.

One development of ours which has been available to consumers for a few years is potato flakes, which is one of the two principal kinds of high-quality dehydrated mashed potatoes. The other kind, potato granules, was developed by industry prior to the potato flake development. There are now 13 manufacturers of potato flakes with a plant capacity totaling 60 million pounds of flakes per year. The process for making them is essentially simple (Figure 1). The dehydrated sheet of mashed potatoes is taken from the drug drier and broken up for packaging. The development of potato flakes and potato granules and the many other processed forms of potatoes has been helpful to potato growers throughout the United States. We feel that it is largely responsible for the leveling off in the per capita consumption of potatoes, which had been declining steadily for more than 50 years.

However, good as potato flakes and potato granules are, not every one would want to eat mashed potatoes every day. We are accordingly developing a product called instant potato pieces which can be reconstituted with hot water in about five minutes, compared with the considerably

* Presented at the 47th Annual Meeting of the Central Atlantic States Association of Food and Drug Officials, May 27, 1963, Philadelphia, Pennsylvania.

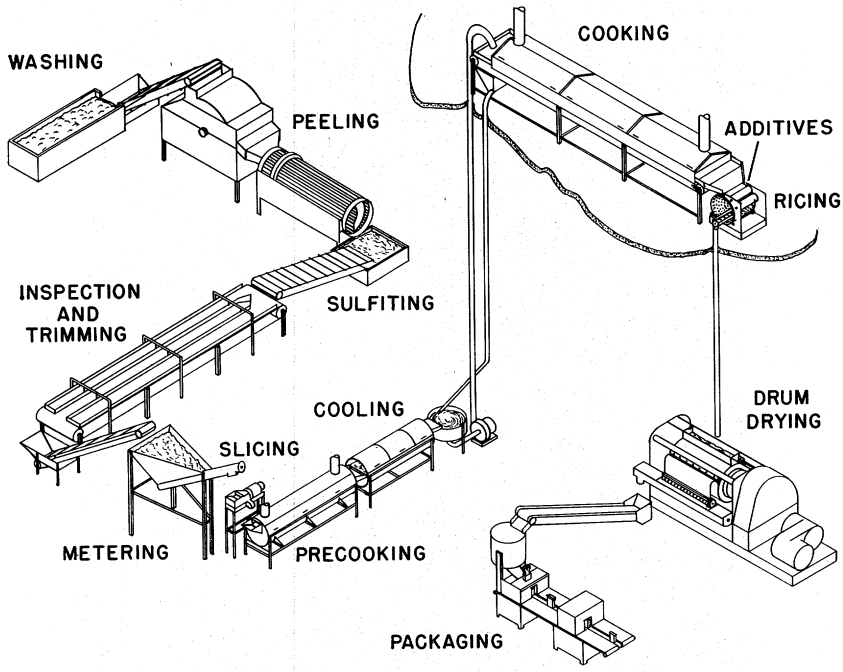


FIG. 1. Flow sheet of potato flake manufacture

longer times—up to 30 minutes—required for conventional potato pieces. The process starts with fresh potatoes cut up into dice one-half inch or three-eighth inch on an edge. These dice are then dehydrated part way to a moisture content of about 35 %. The partially dried pieces are then charged into a pressure "gun" (Figure 2). The lid is closed and the vessel is quickly heated while rotating. As the temperature rises, the pressure of water vapor within the vessel increases and finally reaches a point where the water within the dice is superheated with respect to atmospheric pressure. At the right temperature the lid of the vessel is quickly opened. A small percentage of the water within the pieces immediately flashes to vapor and as it does so creates a number of tiny channels leading from the interior of the piece to a surface. These channels or pores then permit relatively rapid (and hence inexpensive) dehydration to final dryness. Furthermore, the channels permit quick rehydration in hot water. This is the key to the rapid reconstitution properties of the potato pieces. This process, which we call "explosive puffing," works on other vegetables as well as potatoes and we have tried it successfully with diced carrots, beets, rutabagas, and sweet potatoes. It also works well on pieces of apple and whole blueberries.

Our food processing research has stressed the removal of water from

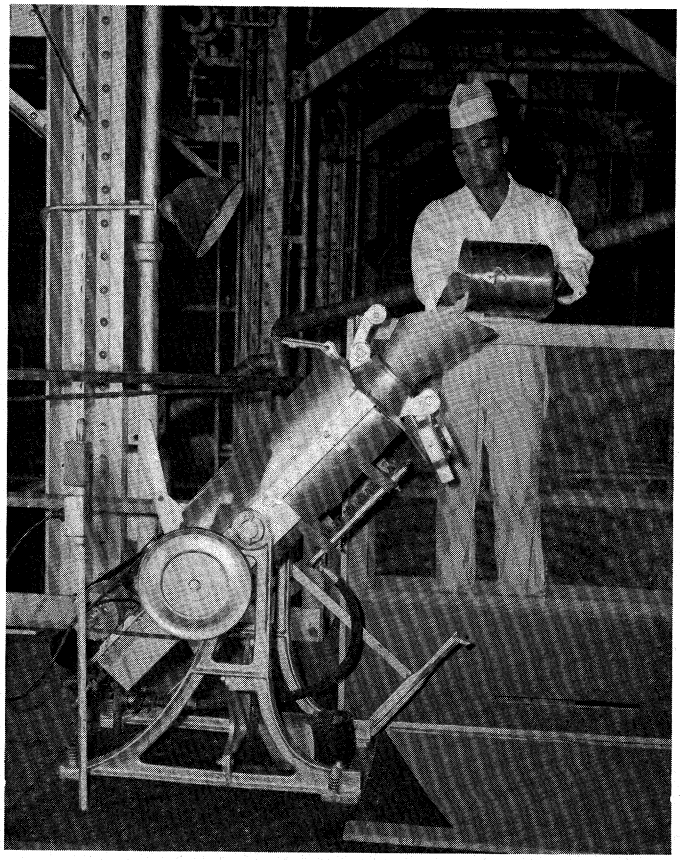

FIG. 2. Puffing gun used to make quick-cooking dehydrated vegetable pieces

foods for many years. One of our earliest developments was a seven-fold concentrate of apple juice and other fruit juices. The Agricultural Marketing Service conducted a market test in Fort Wayne, Indiana, on a full-flavored seven-fold apple juice concentrate packaged in a 4.6-ounce can, enough to reconstitute to one quart of apple juice. The results of this market test were very favorable. The key to the success of the test is the high quality of the juice, which is based on processing to recover and concentrate the true apple flavor or "essence," which is subsequently restored to the concentrated stripped juice.

After developing the liquid concentrate we turned our attention to a still drier material and devised a means for making powdered juice products. The process for doing this is shown in figure 3. Although essence is volatile and the material coming from the vacuum evaporator is a hot sirup, the

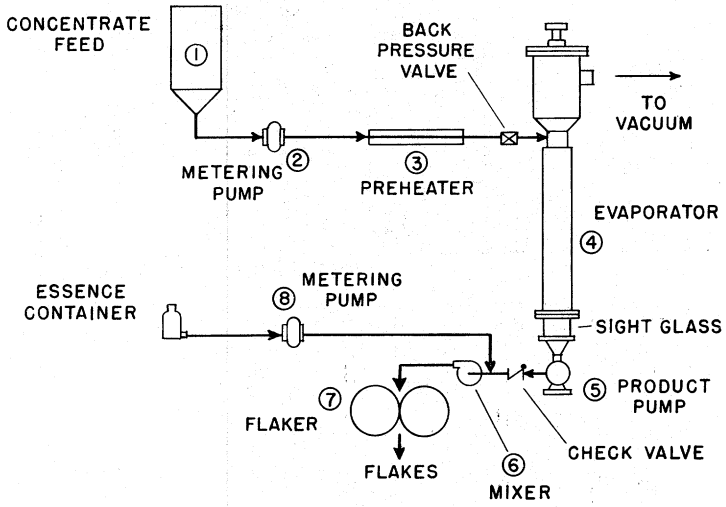


FIG. 3. Flow sheet of the process for dehydrating fruit juices

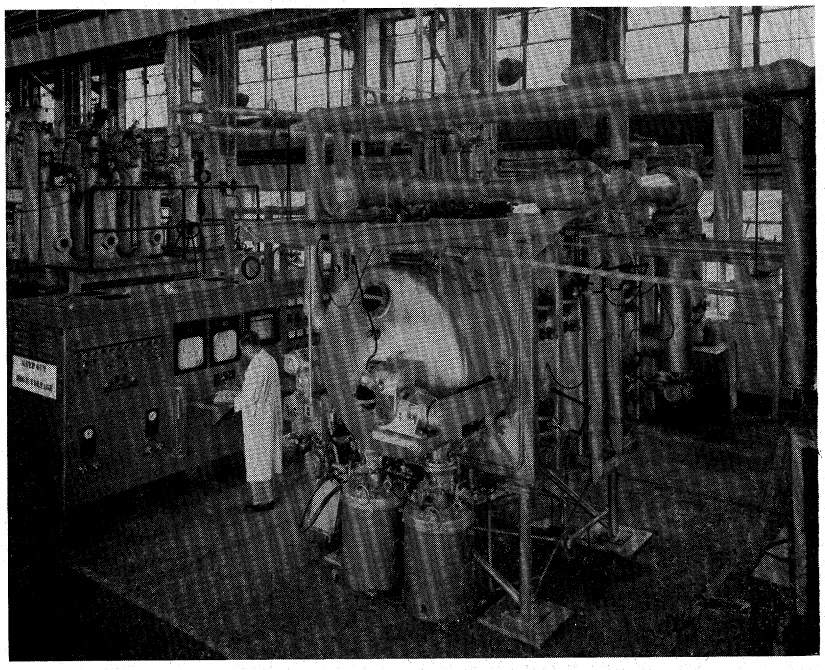

FIG. 4. Pilot plant scale continuous vacuum dryer used for making foam-dried whole milk, located at the Eastern Regional Research Laboratory, Wyndmoor, Pennsylvania.

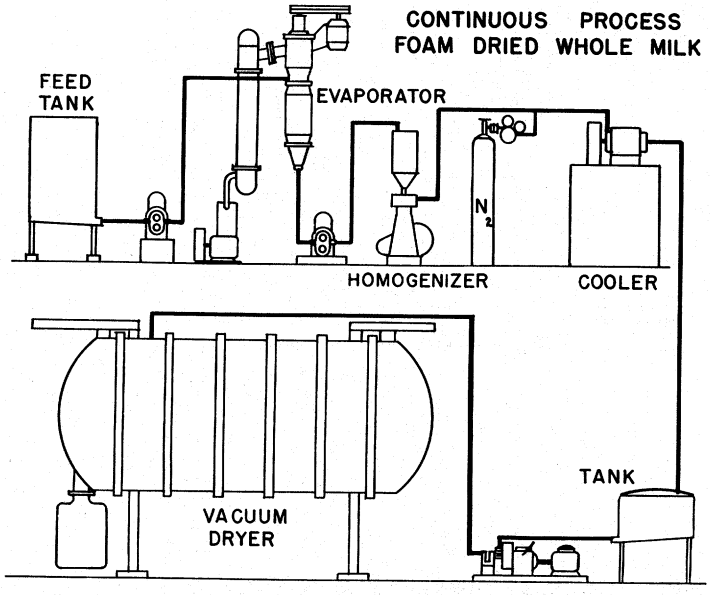


FIG. 5. Flow sheet of the process for foam-dried whole milk

sugars of this sirup appear to have an affinity for the essence so that it is not lost in the subsequent steps. These include the intimate mixing of the essence with the molten sirup, followed by chilling of the mass on the rolls of a flaker. The material congeals to a glassy substance which is subsequently crushed to make a flakey powder. This powder has greater storage stability than liquid concentrates and is accordingly of special interest to military supply agencies.

Our current work with dehydration involves mainly milk, for we are seeking to develop a high-quality dry whole milk. Our objective in this development is an increase in the consumption of milk. If we succeed in increasing the total consumption of milk by about 10%, the milk surplus problem should be solved. We are currently studying two methods for preparing dry whole milk. One of these is spray-drying, a process going forward under study by our Dairy Processing Laboratory in Washington, and vacuum foam-drying, under study by our engineering group in Wyndmoor (Figure 4). The two processes are outlined in figures 5 and 6. The interior of the vacuum dryer is shown in figure 7. In developing dry whole milk we have three goals. One goal is that the powder should be readily reconstituted with cold water. A second is that the reconstituted milk should taste like fresh milk. And the third is that the powder should taste like fresh milk after six months' storage at room temperature. Thus far we have at-

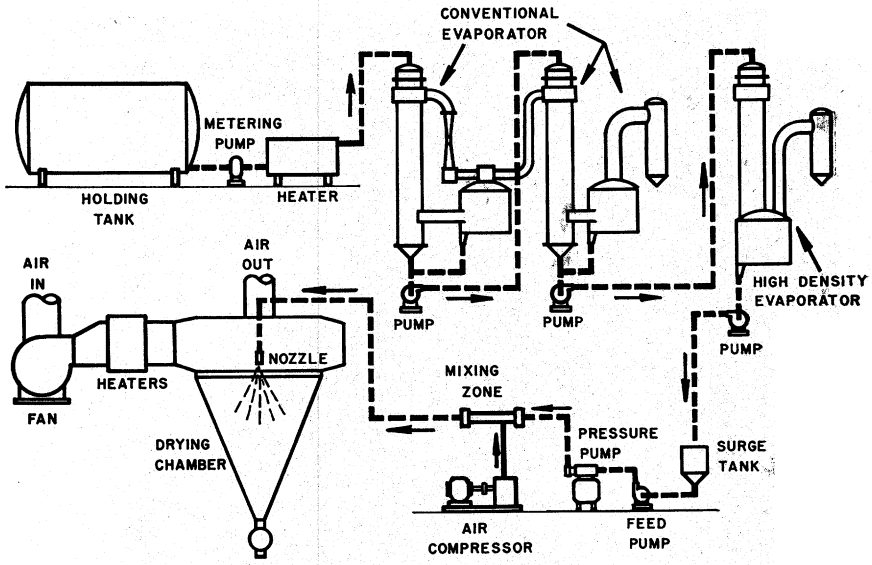


FIG. 6. Flow sheet of the process for spray-dried whole milk

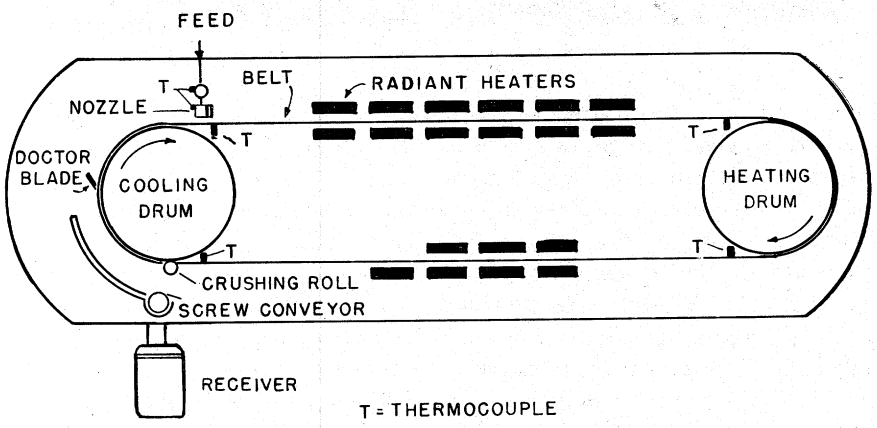


FIG. 7. Functional drawing of continuous vacuum dryer

tained only the first two goals. The freshly made powder mixes very quickly with ice water and tastes like fresh milk. However, after a few months' storage at room temperature the flavor of the reconstituted milk is no longer that of fresh milk. The reconstituted milk is wholesome and nutritious but it does not meet our standard of taste. How long it will take us to achieve our third goal is unknown.

Another area of recent development in food processing concerns an old

FIG. 8. Paraformaldehyde pellet used in maple tree tap holes

food product—maple sirup. In the maple sirup industry there is a virtual revolution taking place, due in part to research conducted in our laboratories and in part by the stimulus which our research has provided to others. One aspect of this revolution is the increasing use of plastic tubing to collect maple sap. The use of tubing permits better sanitation in handling the sap and the tree provides hydrostatic pressure to keep sap flowing to the collector. Another aspect of this revolution is the increasing use of central evaporating plants which for the first time provide a market for raw sap. The trend appears to be away from the processing of maple sap on the farms which produce it and toward a separation of sap production from sap processing. The raw sap is now being sold to processing plants like other farm crops.

For a long time it was thought that when a maple tree tap hole stopped flowing it was because the hole had "dried out." It was found however, that the stoppage of flow was instead caused by the growth of microorganisms adventitously introduced into the tap hole. The use of paraformaldehyde pellets inserted in the tap hole (Figure 8) inhibits the growth of these microorganisms and permits the taphole to flow until the sap becomes "buddy" and not suitable for processing into sirup. These para-

formaldehyde pellets were used extensively for the first time in the 1963 maple season and resulted in an increase in yields of 30 to 50%. The discoveries that sanitation was a key factor in improving both the quality and quantity of maple sirup has resulted in maple sirup production which has 80% of the product in the top two grades compared with perhaps 50% in the two top grades a few years ago. Newly developed maple products have included a maple fluff and a high-flavored maple sirup for the manufacture of maple-flavored sirups.

Before ending this paper I would like to remind you that we do considerable research on agricultural products that do not have a food value. The total list of agricultural products assigned to us for study include dairy products, meat, animal fats, hides and leather, eastern fruits and vegetables, tobacco, honey, maple products, new crops, and allergens of agricultural products.

At our Eastern Division we are always glad to have visitors. We are prepared to show you around if and when you drop in, and if you will give us a few days' notice of your intention to come we will make certain that the red carpet is rolled out.