DRIED FRUIT RESEARCH

By The
Western Utilization Research and Development Division of
Agricultural Research Service
U.S.Department of Agriculture

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Although a number of specific studies had been made by the Western Regional Research Laboratory from time-to-time in response to requests from various persons in the dried fruit industry, the genesis of the present concerted program dates only from 1957. It followed by about a year the allocation of funds to develop means for coating raisins so as to prevent their hardening due to loss of moisture when packaged with dry cereals. The broader studies, touching many of the industry's problems, were initiated following conclusion on November 1, 1957 of an agreement by the Department jointly with the California Raisin Advisory Board, the Dried Fig Advisory Board, the California Prune Advisory Board, and the Dried Fruit Association of California. The agreement provided for formation of a Dried Fruit Industry Research Advisory Committee, comprising representatives of the cooperating organizations and the Western Utilization Research and Development Division, to plan and execute the details of the cooperative work, and to hold quarterly meetings for that purpose. The cooperators agreed to make available to the Department funds for the salary of a full-time Chemist-Food Technologist, who would work with personnel assigned by the Department to conduct an agreed-upon program of research, and apply scientific knowledge to the improvement of dried fruit processes and products. Conferences between the Department and the Committee resulted in agreement on the following three fields for initial investigation:

1) Determine the stability of the various dried fruits, as it is affected by the temperature, the moisture content, and, where applicable, the sulfur dioxide content of the products.

2) Evaluate the various methods for determining the moisture content of dried fruits.

3) Develop new products from dried fruits.

During the five and one-half years this agreement has been in force not only have many of the original objectives been achieved, but the continuing work has broadened into a number of other needed investigations. Progress has been reported at meetings of the Research Advisory Committee and annual meetings of the participating dried fruit industry associations and managing boards. Some 17 technical papers have been published and distributed to all interested parties. Some of the specific accomplishments are described in the following paragraphs.

1) Information developed on stability of processed dried fruits.

Long-time changes in the properties and characteristics of dried fruits were determined over a broad range of temperatures and humidities. The resulting basic information can be applied to establishment of specifications for storage and marketing. For example, commercial storage at 50°F., rather than 34° to 40°F., can be employed without incurring quality loss above normal trade practice. Use of the higher temperature has prevented the sugaring of certain dried fruits. The information on rate of sulfur dioxide disappearance should enable operators to apply just the amount of sulfur dioxide required, and hence, in general, to reduce the amount used. The data on effect of temperature make it possible to control temperature of dried fruits in overseas distribution channels so as to meet quality specifications in foreign markets. Observations of adverse changes in flavor during the long-term storage have been related specifically to moisture content and temperature, and have thereby assisted the industry to avoid serious quality losses.

2) Explanation of disappearance of sulfur dioxide.

The reason for the gradual disappearance of sulfur dioxide from dried fruits in storage, never hitherto fully understood, has been traced to atmospheric oxidation to sulfuric acid or a sulfate, and this in turn has led to demonstration of a way, by means of a more protective type of packaging, to significantly reduce the rate of loss of sulfur dioxide. The sulfite level could

then be so low that some otherwise closed markets might be open to such fruit. However, the procedure involves some elements of increased cost, namely packaging in an oxygen-impermeable film such as Saran, and insertion of an "oxygen-scavenger" packet in the package. Invention of the latter was one of the byproducts of the investigation; it will be described later in the program by Dr. William Stanley. A scientific advance was also made when improved analytical methods for determination of elemental sulfur, sulfur dioxide, and sulfate were worked out as a necessary preliminary to tracing the fate of sulfur dioxide stored for a time in contact with dried fruit.

3) Improved method for hydrating dried fruit.

A possible improvement over the methods used in the trade to hydrate dried fruits intended for remanufacture or for distribution as "tenderized" fruits was developed. The characteristic feature is an immediate immersion of the fruit in cold water while it is still hot from a treatment with steam or hot water. Either steam or hot water is satisfactory to produce the effect in raisins, but hot water gives the better results in prunes and figs.

4) Control of raisin paste consistency.

A process of treating raisin paste so that it will not set to a hard solid upon standing was developed. The treatment, which involves only a controlled heating and holding of the paste, opens up a substantial new outlet for raisins in a variety of food products. A more detailed discussion of this extremely important development will be given later in the program by Mr. Fred Nury.

5) Dry-blanch-dry method of processing fruits.

This method, developed in the course of an intensive search for some way to dehydrate such cut fruits as apricots, peaches, and pears, and yet produce the attractive bright, translucent appearance of sun-dried fruit, has been thought by industry observers to have real promise. A raisin product somewhat like golden bleached raisins was also made by steam blanching

before dehydrating. These DBD (dry-blanch-dry) fruits appear to require less final sulfur dioxide than the sun-dried fruit does, and the natural flavor and vitamin A content are better preserved.

6) Coating of raisins to control moisture loss in the package.

Extensive studies of various water-repellent compounds that showed promise as edible moisture barrier coatings on raisins disclosed a number which were effective. Beeswax was the best, but is relatively more expensive than others. Acetylated monoglycerides ("myvacet"), although not producing particularly good moisture barriers, did make the product free-flowing and therefore attractive for eating out of hand. A useful combination comprises 20% beeswax, 80% Myvacet. A high-speed machine capable of producing the thin, uniform film of such wax on raisins, was designed and built by the engineering staff of the Laboratory. It is now undergoing tests and development on a plant scale. This high-speed coating equipment may also find many other applications in the food industry.

7) Improvement of flavor in prune products.

The flavor of fresh-prune juice has been significantly improved by incorporating a small proportion of a water extract of ground prune pits. The possibilities will be further explored.

8) New products.

Gelled fruit sauces, made from prunes, figs, raisins, and golden raisins, are being investigated. An attractive gelled apple sauce is also being studied. Studies are continuing on methods of making dehydrated fruits of very low moisture content, and low-moisture fruit powders made from dried fruits.

Some other problems needing attention are: the effects of light on dried fruits; the use of ethylene diamine tetracetic acid (EDTA) to counteract the adverse catalytic effect of trace metals such as iron and copper on the color stability of cut dried fruits; and the storage stability of dried apples.

Safety of Food Additives

The Food Additives Amendment of 1958 to the Federal Food, Drug and Cosmetic Act required that the industry prove the safety of the additives that are used in the preservation of dried fruits. As a result of the industry's concern, the Department signed on July 1, 1960 an agreement with the Dried Fruit Association of California, representing also the Date Administrative Committee, the California Prune Advisory Board, the Dried Fig Advisory Board, the California Raisin Advisory Board, and Lyons-Magnus Company, representing the California Glaceed Fruit Industry. The Department agreed to:

a) Study the safety of the four most commonly used dried fruit preservatives, namely ethylene oxide, propylene oxide, methyl formate, and ethyl formate;

b) Adapt or develop, if needed, analytical methods for determination of these substances and their trace residues in dried fruits;

c) Develop substitute preserving agents in case any of the standard preservatives should prove to be unsafe.

Your industry agreed to furnish funds to pay an experienced pharmacologist and an assistant, to work on these problems in cooperation with members of the Western Regional Research Laboratory staff. Research on the four compounds mentioned above was quickly initiated at the laboratory. Excellent cooperation was given by the chemical manufacturers, who supplied data obtained in their laboratories. The combination of these data with information obtained by our staff made it possible to make early petitions to the Food and Drug Administration for clearance for use of propylene oxide, methyl formate, and ethyl formate. However, it proved to be necessary to conduct 2-year feeding studies with rats and dogs in order to ascertain whether ethylene oxide is safe. At the end of these studies a petition for clearance was presented to the Food and Drug Administration, even though an analytical method had not yet been developed. In contrast to experience with the other preservatives, this determination has proved to be

extraordinarily difficult. The Food and Drug Administration has refused to consider the request for clearance without a satisfactory analytical method; they have, however, agreed to extend permission for the use of ethylene oxide for one more year, which will end July 1, 1964. During that period of grace we plan to exert every effort to develop a satisfactory method.

The wisdom shown by the industry in requesting the development of preservatives or antimycotics that might substitute for ethylene oxide, the most active preserving agent, now becomes apparent. Paralleling the toxicity studies on ethylene oxide, we have actively sought new antimycotic agents, in cooperation with the Food Science and Technology Department of the University of California. Various measures for the control of molds and yeast in high-moisture dried fruits were investigated, and the highly successful sorbate treatment was the result. From 250 to 600 parts per million of potassium sorbate, depending upon the moisture content of the fruit, provides good protection, and because the compound is not volatile, the protection lasts through the whole distribution chain. Methods of application of the antimycotic were worked out and were demonstrated to the industry. Nearly all of the commercial production of high-moisture dried fruits is now sorbate-treated. The process is also being considered for use in the distribution of high-moisture dates. One of the byproducts of the research on this problem was development of a simple and rapid analytical method for determination of sorbate in dried fruits. The method is well adapted to use in a plant control laboratory.

In conclusion, we feel that the dried fruit industry would do well to prepare itself thoroughly against presently unforeseen problems that may spring out of the increasing public awareness and concern about this whole matter of food additives. The industry would indeed be well advised to keep up a diligent search for new and improved food processing methods, not alone because of the current emphasis on food safety, but even more because science and technology are not standing still, and he who would maintain his place in the procession must advance, too, or be left behind with a dwindling share in the American food dollar. Many

unorthodox ideas are being brought out, and some of them serve to emphasize how little we really know about great areas in food science. The dried fruit industry can make a prudent investment in its own long future if it goes after some of those disturbing areas of ignorance.

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(June 24, 1963)