FOOD PRESERVATION QUARTERLY

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Editor :
W. A. EMPEY

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COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
HOMEBUSH, NEW SOUTH WALES, AUSTRALIA

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The Training of Professional Food Technologists at Sydney Technical College

By

F. H. REUTER, Ph.D., F.A.C.I.*

It is generally recognized that the Australian food processing industries experienced certain difficulties when trying to meet the demands of the Armed Forces during World War II. Some of these were due to the lack of the right kind of equipment. Others could be traced to the lack of sufficient skilled personnel. Technical staff in the industry had been recruited from professional schools of chemistry, chemical engineering or engineering. None of these, however, was aiming at preparing men especially for the food processing industries. In this Australia was in line with the rest of the world except the United States. There, food technology had so developed as a profession that in 1937 an " Institute of Food Technologists " was formed. This proved to be a great stimulus to progress and to the further development of food technology. From four or five courses of instruction in existence at that time about two hundred now have been instituted at universities and colleges right through the States.

Looking at the many professional courses offered in the United States, one is struck by the variety of approaches to the problem " How to Train a Food Technologist ". There seem to be two extremes ; one course is designed to train a biologist with some engineering for good measure, whereas the other one aims to produce a designing chemical engineer with enough biology included in the work to fit him for the food industry. Moreover historical and geographical influences have left their mark on the planning of the course. Those originated at agricultural colleges stressed technology and application rather than fundamentals. Others developed in institutions where professional courses in chemical engineering and chemistry were established emphasized the basic sciences.

The type of course in any particular institution, of course, was also influenced by the regional requirements ; an area where the processing of fruit was an important industry favoured a course strong in processing techniques and the agricultural aspects of food technology. A highly industrialized area developed a course more on the academic side with less application.

Planning of the Diploma course in Food Technology at the Sydney Technical College was commenced in 1944 and it was officially put into operation in 1947. The course has been designed to meet the special needs of the Australian food processing industries. It had to take into account that the industries can absorb only a limited number of professional food technologists and, therefore, a balance had to be struck between the special requirements of its various branches.

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The developmental stages of the planning coincided with the increasing appreciation in New South Wales of the urgent need for the teaching of food technology. It commenced with the Australian Chemical Institute taking the very practical step of founding the " Food Technology Group ", of which Mr. F. S. Bradhurst was the first chairman. It soon was able to demonstrate that there is great demand for instruction in food technology and co-operated closely with the Sydney Technical College in the organization of several short courses both on the graduate and foreman-manager levels.

The next phase of this development opened with the foundation of the Food Technology Association of New South Wales, which was conceived independently by Col. G. I. Adcock and Mr. W. J. Collings, and started off in collaboration with the Food Technology Group of the Australian Chemical Institute. The Association made education one of its main planks. Thus the objects of the Food Technology Association include

(*a*) to promote and advance the scientific and technical aspects of the food processing, manufacturing and distributing industries of Australian and other industries closely related thereto ;

(*b*) to improve the standard of knowledge and status of technologists employed in the food industries ;

(*c*) to promote lectures, discussions, exhibitions, courses of instruction . . . for the dissemination of technical and scientific knowledge regarding the food industries ;

(*d*) to establish bursaries and scholarships for educational purposes and to award competitive prizes in matters tending to forward the interests of the technical aspects of the food industry, and to assist in establishing or conducting technical and scientific museums, colleges, laboratories, or other organizations for technical and scientific research, relating to the food industry.

Diploma courses at the Sydney Technical College are designed for students who are employed in an allied industry while taking the courses. The importance assigned to industrial experience in the training of professional men is indicated by the fact that students must show satisfactory industrial experience before being issued with a Diploma of Associateship of the Sydney Technical College. The demand on a student doing a professional course is rather severe if he is forced to do all his college work in his own time and in the evening. The general trend in the last few years fortunately has been for industry to be co-operative and to allow time off to their employees who are diploma students at the College. Practically all students of the Chemistry Department, Sydney Technical College, now have one afternoon or morning given off by their employers, and about one-quarter are given two half days. This materially assists students, since diploma courses require four teaching sessions of about three hours per week, which must be taken in the evening unless time is given off by the employer. A student with two half days off in the employer's time is certainly in a much better position to do justice to the firm and to the course of studies than the one who must attend four nights a week. This has been acknowledged by the industry, who realize the benefit coming to them by the student's endeavour to go through a professional course of studies.

Of the diploma courses conducted by the Chemistry Department of the Sydney Technical College chemistry and science take five years, whereas chemical engineering, metallurgy and food technology require six years. The teaching year is thirty-seven weeks.

The Food Technology course at the Sydney Technical College, in the first three years, gives a good foundation in Chemistry, Physics, and Engineering. Students take Mathematics I and II, Diploma Physics I, Inorganic Chemistry I and II, Quantitative Analysis, Organic Chemistry I and II, Physical Chemistry I and II, Mechanical Engineering I and II, Engineering Drawing and Descriptive Geometry, Materials and Structures, Workshop Practice. The specialized instruction of Stages 4 to 6 includes Microbiology I, II and III, Chemistry and Analysis of Foodstuffs, Industrial Biochemistry, Food Technology I and II, Food Engineering I and II, Principles of Plant Design and Construction, Nutrition and Dietetics, and a term each of Industrial Botany, Industrial Zoology and Sanitation.

Practically none of the advanced subjects have been previously taught in the Commonwealth. The problem of having to secure staff has been solved by having a team of experts from industry, the University and government institutions, as part-time lecturers. The task of setting up a new course of instruction is naturally a formidable one, and the lecturing staff merit high praise in taking on the task of pioneering the new subjects.

The course is conducted in the Chemistry Department, adding its weight to the already heavily overloaded accommodation. This, however, was not allowed to interfere with the initiation of the course. As Stages 1 to 3 are common with the chemical engineering course, the start could be made in 1947 with Stage 4. Stage 5 is run for the first time in 1948, and Stage 6 will follow in 1949.

Plans to provide a special food technology laboratory with all facilities have been prepared, but the implementation has been delayed for well-known reasons. It is projected to set up a 2,500 sq. ft. unit of lecture room and teaching laboratory. It is to take a wide range of equipment, together with the necessary testing facilities. All machines will be adaptable to a variety of purposes and will thus allow a wide range to be covered in the teaching, as well as offering opportunity for developmental and research work.

It was clear from the beginning that the necessary equipment could not be purchased in time for the commencement of instruction in the advanced subjects. The Food Technology Association stepped into the breach and undertook to canvass the food industries to procure on loan the equipment necessary for the teaching in 1948. This appeal was very successful. In addition some firms permitted the use of their pilot plant and test laboratories for teaching purposes and some classes have actually been held on factory premises. The experience gained with the use of loaned equipment will be most valuable when new units are ordered, because it must be realized that there is practically no published matter available on experimentation in the teaching of food technology and food engineering. All experiments, therefore, have to be designed especially for the course, a condition that is rather unusual with academic courses.

In conclusion a table is given showing a comparison of the Sydney Technical College Diploma Course in Food Technology with two American ones (Massachusetts Institute of Technology and Oregon State College).

and the only one in the British Isles that possibly could be compared with it, the course in Applied Chemistry (Foodstuffs) at Manchester University.

The comparison is made on the basis of hours of instruction, and shows how the various courses place emphasis on fundamental, engineering and biological subjects and the humanities.

Hours of Instruction

Subject	S.T.C. Food Technology Diploma Course 6 Years.	M.I.T. Food Technology Degree Course 3 Years.	Oregon State College (Corvallis). Food Technology. Degree Course 3 Years.	Manchester University. App. Chem. (Foodstuffs). Degree Course 3 Years.
Mathematics	162	180	—	192
Physics	91	330	132	247
Chemistry	1017	930	264	1435
Engineering	519	420	33	338
Food Technology . .	222	870	418	497
Biological Sciences . .	512	—	512	
Agricultural Sciences . .	—	—	209	—
Economics, Business Administration.	—	—	440	
Electives	—	90	286	—
Thesis	—	150	—	—
Humanities	—	360	132	—
Total	2523	3330	2426	2709

Whereas the hours of instruction of the Sydney Technical College course compare favourably with those quoted, the Sydney student in addition gains practical experience. If one does not count the first three years as junior ones and takes the last three years of the course as 48 weeks per year with 32 working hours per week, a student at graduation will have around 4,600 hours' experience to his credit.

This combination of academic studies and industrial experience promises that the men passing through the course will be of value to the Australian food processing industries where they should soon rise to take their places, ultimately, in the leading positions.

Trends in Packaging of Apples and Pears in U.S.A.

By

D. Martin*

While there is yet no substantial interest in any type of package other than the *north-west bulge box* for export, the position regarding domestic packs is much more fluid than is sometimes realized. There is considerable ferment within the trade, brought about by dissatisfaction with the amount of bruising and wastage caused by the use of a bulged pack with ripe fruit. There has been a tendency to market fruit at progressively riper stages over the past few years as the result of later harvesting allowed by the use of anti-drop sprays. Much of the fruit seen being packed during the 1947 season and in the wholesale markets was full eating ripe, and on Australian standards would be considered dangerously over-mature for such markets. The preference of the U.S. public for very large fruits is a powerful additional factor making for bruising and other packaging difficulties.

Also there are changes taking place in the buying and shopping habits of the public, and the bushel box or basket has certain disadvantages in catering for the newer requirements. Although the bulk of the trade is still carried out in the traditional containers, it is probable that a period of rapid evolution in packaging is at hand. While it is impossible to forecast the types of containers that will ultimately emerge, the N.W. apple box is meeting with serious criticism and competition.

The three main methods of marketing will be discussed under separate heads.

(a) Consumer Packages

The " Super mart " type of self-serve food store is now an accepted feature of American life even in quite small centres, and the critical selection of fruit from a bulk pile by the customer results in a rapid culling of the best fruit and serious bruise damage to the remainder, which then move slowly and often at reduced prices.

To counter this a flood of consumer packages has appeared, but a certain amount of natural selection has already taken place and the idea of consumer package has wide acceptance for fancy or better grades. (Persons seeking really cheap fruit usually buy lower grades.) Substantial proportions of oranges are already sold in mesh bags, and tomatoes in cardboard trays, while nearly all potatoes are sold in this way.

For fruit, the following types seem most likely to survive :

(1) *Mesh Bags*. These are widely used for oranges in 5 and 10 lb. sizes. These are filled automatically and placed in a frame and slot wirebound box of the *Friday* type (see page 10). Some packers are

* An Officer of C.S.I.R., Division of Plant Industry, who returned, late in 1948, from a visit to U.K. and U.S.A.

experimenting with mesh bags for apples and seem satisfied with results. One packer expressed himself as very satisfied with his experience of this pack. He uses eight 5 lb. paper or cotton mesh bags in a $12 \times 12 \times 20$ Friday crate. His total presentation costs are 73 cents per box, of which 37 cents is due to cost of bags. The cost above ordinary packaging is three-quarters of a cent per pound, but he expects to reduce this with more experience and increased production. He has not experienced greater bruising or rubbing with this type of pack, but is worried by the possibility of scald in the absence of oil wraps. A big advantage of this type of pack is that it can be done most readily at shipping point ; some other types are best done at terminal point for a really suitable type of master container has not appeared.

(2) *Fibreboard Trays.* Types are very numerous, but probably those similar to the " *Farmpak* " are most likely to survive. They are already widely used for tomatoes, where the extra protection given to the softer fruit more than compensates for the added cost. With apples they suffer from the disadvantage of all rigid types, namely the complicated adjustment of size of container and master container to cover the range of fruit size. This makes it difficult to package economically at shipping point. Probably the use of this type will be confined to fruit packed at terminal point or in situations such as are common in mid-western States, where the orchards are close to big centres of population and there are large sales direct to stores or from roadside stands.

(3) *Cardboard Box with Window.* This is a very attractive package designed to hold 4 lb. apples and filled semi-automatically by means of a metal sleeve with the weighed apples. When closed, the weight of the fruit inside keeps it locked shut. The windows are of Pliofilm, which does not stem-puncture. These are made by the Ohio Boxboard Company, Rittman, Ohio, who quoted $4\frac{1}{3}$ cents each. It appears to be a good type of package for terminal packaging or for mid-western States, but the problem of the wastage of total space and that of the master container make it unsuitable for transporting any distance.

There are other consumer packs of great interest, but which seem to have use only for speciality or luxury trade. Of these the " hammock " pack is the most interesting. This consists of two flat pieces of cardboard each with circular Pliofilm covered holes slightly larger than the fruit. The Pliofilm is heat placticized and the two sheets brought together over the fruit, which is thus supported in the hole in the Pliofilm with half of the fruit projecting beyond either side of the cardboard. A handle is cut out of the cardboard for carrying. It has a very high novelty value but its ultimate practicability is not certain. Its assembly is slow and the master package problem has not been solved.

(b) Packer-to-Consumer Packaging

From small beginnings by Bear Creek Orchards, Medford, Oregon, the presentation of top quality fruit for distribution direct to consumer by express carriage service has grown to a tremendous business, and there are few big packing houses in Washington and Oregon which do not now participate.

The business was made possible by the prior existence of a highly efficient railway delivery company (Express Railway Agency, Inc.), which can reach most of the country sufficiently rapidly that there is little chance of the fruit arriving over-ripe. The packages are made up in refrigerated rail car lots and sent to main centres, from which they are distributed unrefrigerated. Rigid guarantees are given on delivery and condition and the initial cost includes all charges. The main use is for gifts, and they are regarded as being especially suitable for Christmas trade, though Bear Creek run a " fruit of the month " line. The absence of the necessary distributing agency makes a similar development unlikely in Australia, but the more open mind which is induced towards packaging generally will have a stimulating effect on the evolution of bulk packaging and increased appreciation of consumers towards quality in fruit will make them more critical of the faults of other types of package.

There are three main types:

(1) *Cartons.* Development seems to be selecting out two main types, single layer trays $8'' \times 11'' \times 3\frac{1}{4}''$ containing 10-14 fruits, and $14'' \times 10'' \times 3\frac{1}{4}''$ containing 18-24 fruits. Multi-layer trays are uncommon. These trays are made of corrugated fireboard either folded or stitched, in which the fruit, wrapped and unwrapped, mixed for decorative effect, are nestled in shredded coloured paper covered with a pad and the tray slipped into a corrugated fireboard envelope or covered with a full depth lid and wired. The fruit is packed in cool store, with rigid selection, and the packed cartons are placed in refrigerated trucks or returned to cool store immediately. Price approximately $3 and $4.50.

(2) *Boxes.* These are of four main types: trays containing 10-14 fruits, quarter-boxes, half-boxes and boxes, and vary in price according to the elaboration in presentation. Generally the timber is selected, sanded and varnished, but with some of the cheaper packs no special treatment is given. In the case of the quarter- and half-box, lighter wood is used and no wiring is necessary. Very little bulge is allowed.

The half-box with the light timber appeared to be a possibility for Australia, for the dimensions are sufficiently small for sliced hardwood to be satisfactory for all but the heads. Dimensions were $7\frac{5}{8}'' \times 8\frac{5}{8}'' \times 16''$ and the plain boxes were costing 20 cents.

(3) *Elaborate Baskets.* These are put up by Bear Creek Orchards only and, while of no practical interest to us, give an indication of the lengths to which it is possible to go with the packaging of fruit.

They consist of a shallow wicker basket with a high handle. On to the bottom of the basket is placed a papier-mâché form with moulded hollows to give the fruit a grip. The mound of fruit, etc., is built up on this form according to a fixed plan, dressed with trimming material, covered with cellophane, and then sewed into cotton mesh to hold it firm for travelling, and packed into a carton with bracing to keep the structure from touching the sides. These are assembled on mass production lines from materials made during the slack season. It is an overwhelming experience to see thousands of elaborate satin bows on racks waiting to surmount this edifice, the most costly of which sells for $16.

(c) Bulk Packages

Scarcity of timber and rising costs (35-38 cents) have made alternative containers competitive, and the interest in them is vital in areas where box timber is no longer available, such as Wenatchee (Washington), but quite real even in those where supplies still remain. The interest in other containers has opened the mind of the trade to the possibility of improvement in the box as a vehicle for carrying fruit.

In eastern and mid-west States the barrel has disappeared, and while the bushel basket still persists, supplies are very light and there is a big trade in secondhand baskets, boxes tend to replace them and there are three main types:

Virginia	$11'' \times 13'' \times 17''$
New England	$11'' \times 13\frac{5}{8}'' \times 16''$
Michigan	$11'' \times 12\frac{1}{2}'' \times 16''$

These are all packed without a bulge, often with a "face and fill" technique. Some of the larger growers, such as Senator Byrd of Virginia, went straight to the N.W. box.

In the western States the supremacy of the N.W. type box is no longer unchallenged, the reaction of the retail trade against the serious bruising now occurring in the fruit has caused a reaction against the bulge and in interest in "separated layer" packs and boxes without bulge.

The high cost of the box has led to experiments to cheapen it by using heavy cardboard bottoms and lids, but these have been unsuccessful. Substitutes for the N.W. box fall into four main types:

(1) Cartons.
(2) Cartons with separators.
(3) Oversize N.W. box.
(4) Wirebound crate with separators.

(1) *Cartons.* Plain cartons have found considerable acceptance for use for immediate distribution, but have been complete failures for cool storage or for long freight car hauls. No satisfactory waterproof type has yet been evolved, and under moist conditions the fibreboard softens and the lower cartons in a stack collapse. Strengthening with wood corner posts or plywood strips in the sides has not overcome the difficulty. Further research may evolve a moisture-resistant type.

Dimensions have not yet been standardized.

Ohio Boxboard Company, Rittman (Fig. 1).
2,200 cu. ins.
2,400 cu. ins. $17\frac{1}{2}'' \times 10\frac{1}{2}'' \times 14\frac{1}{2}''$ (external measurements).

Fort Wayne Apple Carton.
2,200 cu. ins. $13'' \times 13'' \times 13''$.
This type has a lid covering the full depth of the box.

Michigan Apple Carton.
Dimensions as in *Rittman* carton, but with 12 inner cartons each containing eight apples in three layers, each layer separated by cardboard and the four cartons of each layer separated by a cross shaped piece.

(2) *Cartons with Fruit Separators.* Ohio Boxboard Company peach box. In this box each of the four layers is separated by cardboard with holes cut in it for ventilation and each fruit of the layer in a separate cell. The holes coincide with the junctions of the cells to prevent the edge of the hole damaging the fruit. There are holes in the bottom and lid to allow ventilation.

The Seattle Boxboard Company carton is a larger one, approximately $20'' \times 12'' \times 14''$, with the layers separated by cardboard, and the fruit in cells. It is chiefly used as a speciality pack for large Golden Delicious.

The Ohio Boxboard Company put out a carton with soft tissue pads of *Kempack* to separate the layers.

The *Friday* pack is the most elaborate and probably the most satisfactory of the separated layer types. The fruit is nested in moulded separators made from re-pulped newsprint. Variations in fruit count are provided for by differences in contour of the separator moulds so that the box is completely filled. The principle of this pack appears to be most successful and its use has permitted the marketing of even very soft varieties such as MacIntosh. All users of this pack interviewed were agreed that it eliminated bruising. The only objections to it were

Fig. 1.—Ohio Boxboard Company Carton.
2,200 and 2,400 cubic inches. Used with plywood stiffeners in sides and ends when extra strength required. Fruit may be separated by tissue pads.

the increased cost (one packer estimated increase at 5 cents per box, others at 10 cents) and the possibility of scald as no experimental evidence was available as to whether oil-impregnated separators would control this as effectively as oil wraps. Surprisingly enough the increased size (12″ × 12″ × 20″) was not considered a disadvantage, because the same number as in the case of the N.W. box could be got into a freight car or on a pallet, and in cool stores it was no bigger in cross section than a bulged box and the 2″ extra length was not very apparent in the rather open method of stacking used. The claims of the inventor that there were savings in packing due to the practicability of using unskilled labour were discounted by users, for in no case was it possible to use the *Friday* pack only, and to avoid labour trouble in the sheds both were paid for at the same rate.

A minor objection to the back was voiced by one user that his conveyors, etc., were built for the shorter N.W. box and he had trouble with the longer *Friday* type.

(3) *Oversize N.W. Box.* The simplest move to overcome bruising in large forward apples, particularly Golden Delicious, was by using an oversize box 1″ deeper than normal. Each layer of fruit is separated by a sheet of heavy crepe paper and practically no bulge is put on the box. In addition to the ordinary corrugated strawboards, a pad of three layers of heavy crepe paper is put inside sufficiently long to form a double layer on the top of the box.

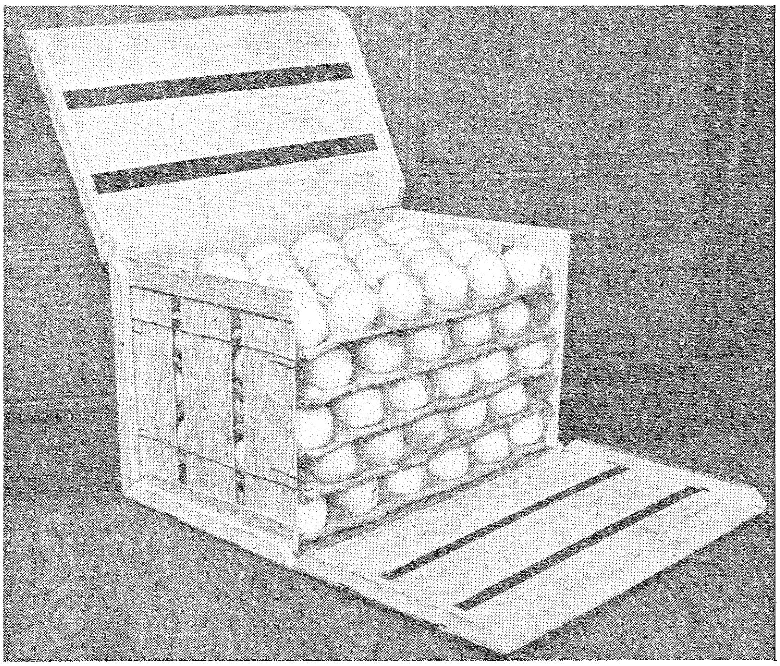

Fig. 2.—Wire Bound Apple Crate with Friday type moulded separators.

(4) *Wirebound Crate* (Fig. 2). This crate (internal dimensions $12'' \times 12'' \times 20''$) is of sliced wood stitched to a frame and bound with wire. It was evolved principally to overcome the objections to the carton for storage purposes. It is made to fold flat, the final securing being by means of wire ends through three wire loops so that no nailing is necessary, but for export security a further wire strapping would be necessary.

The final acceptance of the *Friday* type package depends on balancing the good features against the probable increased cost. There seems no reason to doubt that bruising is greatly reduced and that unskilled labour can pack it and no nailing up or fruit wraps are required. On the other hand, this saving in labour will probably not balance the increased cost. While the open nature of the package allows for a greatly increased rate of cooling, there is no data available to show whether this is sufficient to permit ships to dispense with dunnage, and unless this is so the increased length of the package would increase freights.

Reactions to Australian Dump Box

Objections voiced by the New York trade to the Australian dump box were all in the direction of appearance, with high weight of box and short weight of fruit of less importance. These objections would obviously become much more important under more competitive conditions. The New York market is abnormally sensitive to adverse factors. Strangley enough there was no objection to the type of box *per se*, and the opinion was expressed several times that given equal appearance and weight of fruit there would be no prejudice against it, particularly if it could compete in price, but it was stressed again and again that the appearance of both box and fruit was all-important.

FIRMING STRAWBERRIES BEFORE FREEZING

The possibilities of using various substances to increase the firmness and drained weight (thereby decreasing the amount of juice which drains away on defrosting) of thawed strawberries have been investigated by E. G. Grab, J. B. Wegener and B. H. Baer and reported by these authors in the *Food Packer*, vol. 29, no. 12, Nov. 1948. From results of trials with calcium salts, alginates and pectinates it was concluded that the use of low-methoxyl-pectinate in a concentration of 0·3% by weight of fruit would materially improve the texture, colour and appearance of the defrosted fruit.

ASCORBIC ACID IN FRUIT PROCESSING

Fruits with a low natural ascorbic acid content readily discolour or brown and change in flavour on thawing, due to the action of enzymes in conjunction with oxygen of the air. Blanching before freezing sufficient to heat-inactivate these enzymes results in a cooked flavour and deterioration of the natural colour of the fruit. These defects are avoided when protective treatments employing ascorbic acid are substituted for blanching. In reporting results of trials carried out by Hoffman-La Roche Inc. and outlined in *Food Manufacture*, vol. 23, no. 12, Dec. 1948, it was stated that the procedure was practicable for prunes, apricots, nectarines, peaches, bananas, pineapples and fruit purées, but that frozen berries and vegetables with fairly high natural ascorbic acid content were not noticeably improved by addition of ascorbic acid.

It was stated that, irrespective of amounts of citric or other acid used to inhibit enzyme activity, the amount of ascorbic acid needed for effective treatment against browning and loss of flavour should not be less than 150 milligrammes per pound of finished packs of apricots and peaches. The addition of ascorbic acid to syrups should be made at the rate of 150 to 200 milligrammes per pound of finished pack for most fruits. If heat is used to prepare a sugar syrup it should be cooled to 80° F. or lower before adding ascorbic acid and excessive agitation and long periods of stirring avoided. The use of iron or copper containers for solutions should be avoided.

New Uses For Citrus Fruits*

By

J. F. KEFFORD

During the war years Australian citrus growers enjoyed a series of profitable seasons, but present markets are much less favourable. Recent seasons have been particularly disastrous for lemon growers. Outlets in the fresh fruit markets and in the cordial industry are saturated and lemons are rotting on the trees in New South Wales coastal districts. With grapefruit, too, the market is glutted, and the price of oranges has fallen right away.

These conditions are closely analogous to those which confronted the Californian citrus industry about thirty years ago. At that time the California Fruit Growers' Exchange established two subsidiaries—the Exchange Orange Products Co. at Ontario and the Exchange Lemon Products Co. at Corona. To-day the Exchange is a gigantic co-operative organization and the two products companies are important units in its operations.

However, in California, greatest importance is attached to the marketing of the fresh fruit and the by-products factories are not regarded as profit-making ventures but as agencies assisting to stabilize fresh fruit prices. In Florida the trend is different. Growers there have found that they cannot match the quality of Californian fruit in the markets in the eastern States and so they have sought to dispose of a much larger proportion of the crop, for instance more than half of the orange crop, in the form of processed products.

The citrus products manufactured in greatest volume are the canned juices. In the last twelve years the American pack of grapefruit, orange and lemon juices has increased from one million to 63 million cases. In this country, canned citrus juice production was undertaken during the war years and as much as two million gallons was packed in a season. But the local demand is very small; we have not yet acquired the American habit of commencing almost every meal with a glass of fruit juice. So this wartime industry has not survived.

Even in America canned citrus juices receive uneven consumer acceptance. Grapefruit juice is generally acceptable and lemon juice, packed in small five-ounce cans, is popular with housewives, but orange juice has poor keeping qualities and quickly develops unattractive stale flavours. Because of this, recent interest in America is directed towards another form of packaged orange juice—frozen orange juice concentrate. Some of the water is evaporated from orange juice and the resulting concentrate is frozen in an ice-cream freezer and packed in cans. When it is reconstituted with about three times its bulk of water it gives an orange juice virtually indistinguishable from fresh juice in flavour and nutritive value.

* From the script of a broadcast talk given in the Australian Broadcasting Commission's *Country News Magazine* on Sunday, October 10th, 1948.

When the juice is removed from citrus fruit, about half of the weight of the fruit is in the residue, most of which is peel. One use for this peel is familiar to you—the candied peel in fruit cakes and plum puddings. But it may surprise you to know that it also is the raw material for a branch of chemical industry producing a number of interesting materials.

In America considerable quantities of citrus peel are dried, in huge rotary kilns, to make a supplementary cattle food which finds a ready sale. In the pigmented layer of the peel, called the flavedo, there are countless tiny oil cells which yield orange, lemon and grapefruit oils for flavouring cordials and confectionery.

The white pithy part of the peel is called the albedo, and it contains an important constituent, pectin. Pectin is the substance that gives the *set* in marmalades and jellies. It is present in all fruits, usually in sufficient quantities to make a good jam in the hands of a skilful housewife. But commercial jam-makers like to make certain of a good *set* by adding pectin, which has been extracted from citrus peel and dried to a granulated powder that resembles gelatine.

By modifying the process of extraction it is possible to make several kinds of pectin—quick-set pectin and slow-set pectin, confectioner's pectin, and medical pectin, which is used as a substitute for serum in blood transfusions. But I think the most interesting of the pectin products is a material called low-methoxy-pectin which has the property of forming a jelly in water containing a little calcium. Quite a number of intriguing applications have been found for low-methoxy-pectin. It is used as a skin coating on candied fruit and on skinless sausages. It is the active ingredient in cold-water milk puddings, made from a prepared mix which is stirred for a few minutes with cold water to give a smooth and attractive blanc mange. And because low-methoxy-pectin forms a jelly that does not melt in boiling water, it is used to make jellied canned fruits which turn out of the can with the fruit already set in jelly.

What are the prospects of developing in Australia the production of citrus by-products such as those I have described?

Pectin manufacture has already commenced in Sydney, and in time we shall probably be independent of pectin from California which has been the chief supplier in the past. Britain also is anxious to find non-dollar sources of citrus products, particularly the orange juice concentrate which is distributed by the Ministry of Food as a source of Vitamin C for nursing mothers and children. Most of this concentrate has come from America, but Britain is encouraging production in Palestine and Jamaica, and supplies from Australia would be welcomed. But then, in addition to potential markets, a citrus products industry requires the active interest and participation of growers' organizations and, to quote a policy statement from the Exchange Lemon Products Co., "an aggressive research programme for the development of new products and improved manufacturing methods".

Answers to Inquiries

(1) STORAGE OF SHELL EGGS

An inquirer sought information on the best conditions for the storage of eggs in shell. The answer dealt with the following points:

Selection of Eggs. The eggs used for long storage should be unwashed and should, of course, be free from all visible defects of shell and contents as revealed by candling. The eggs should, as far as possible, be packed in new filling material and clean cases free from marked odour or mould attack. The moisture content of the case timbers should not exceed about 16% at the time of storage. Storage of the eggs should take place as soon as possible after laying and no eggs "older" than seven days should be cold stored.

Temperature and Air Flow. The temperature of storage should be 32-33° F. and the storage room should be fitted with some method of obtaining uniform forced air circulation. There are many ways in which this may be done but the main aim is to secure uniformity of air flow in all parts of the room. The quantity of air flow in changes per hour will, of course, vary according to the method by which the refrigeration is applied. Since the rate of evaporation of moisture from eggs is independent of the air speed passing over the cases, reasonably high air speeds can be used if such is found desirable from the point of view of maintaining the necessary low temperatures.

Relative Humidity. The relative humidity to be aimed at should be around 85%, measured in the air between the cases. This figure is generally attained in practice (under Melbourne conditions) using a moderate amount of insulation on the walls and the average amount of refrigeration pipe surface. For instance, a room insulated with six inches of cork board and the average amount of piping will, in most egg stores, give a relative humidity approximating rather closely to 85%. However, since the evaporation of moisture from the eggs depends on the level of the relative humidity and, since the lower the humidity the greater the evaporation, it is desirable to aim at as high relative humidity as possible without incurring the risk of mould attack, which may become severe at humidities in excess of 88%. Careful handling of the eggs into store is most desirable because even when the humidity conditions are otherwise good mould growth may start and become severe in and around the cracked eggs.

Room Construction. Cold storage rooms for eggs should have the inner surfaces of walls and floors finished with a smooth material which can be readily washed down and which, at the same time, is free from odour. Eggs very readily take up foreign odours and so the construction material used on the inner surfaces of floors and walls should be free of natural off-odour. Before storage and at its completion, the room should be thoroughly cleaned down to remove all dirt and mould which may have accumulated on the floors, walls and fittings. Such material can readily acquire a stale odour which is transmitted to the eggs.

Oiling of Eggs. The oiling of eggs in a special clean odourless paraffin oil prior to storage has marked advantages when the eggs are to be stored for any length of time. The oiling not only reduces the loss of moisture (and hence the enlargement of the air cell) to less than $\frac{1}{6}$th of that in unoiled eggs, but it also results in the slower loss of fresh egg flavour which inevitably occurs in unoiled eggs.

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(2) FREEZING AND DEHYDRO-FREEZING OF APPLES

The preservation of apples by freezing or quick-freezing is an accepted commercial practice in the U.S.A. The apples are peeled, sliced and treated in any one of a number of ways before packaging into metal or paperboard containers. Sugar may be added before packaging, although it is not necessary for preservation of the apples. The containers of apples are then placed in rooms or tunnels at tempteratures within the range of $+5°$ F. to $-30°$ F., where they are frozen. Apples preserved in this way are used almost exclusively by pie bakers.

The possibilities for frozen apples in Australia will depend to a large extent on the requirements of bakers both in Australia and in overseas markets. There may be times on the English market when Australian fresh apples, transported in chilled space, are not available. Cans of frozen apples could fill such a gap, since they will keep for a period of a year or longer when held in refrigerated storage at a temperature of 0° F. or thereabouts. It may sometimes be easier to provide frozen space on ships than ventilaged apple storage space. The question of adding sugar to the pack must not be overlooked and may be an important sales point during sugar rationing in England. In America, during a sugar shortage, bakers found that it was profitable to buy fruit which was already sugared.

Dehydro-freezing is a new method of preservation hardly past the experimental stage, which claims to combine some of the good features of both dehydration and freezing. The product is first partially dehydrated so that its weight (and volume) is reduced by about 50%. It is then frozen in the normal way.

The main advantage is the saving of space and weight. This saving is combined with the convenience and fresh-like quality of frozen apples. The product is easier to reconstitute on cooking than is the ordinary dehydrated apple. The partial dehydration reduces the time of freezing and therefore the refrigerated load.

While, in general, this method does not appear to have very great possibilities, it may be worth considering in a situation where storage and transport space is a major consideration. From the seller's point of view, it may be difficult to convince the buyer that he is getting the equivalent of twice the weight that he buys.

Recent Publications

1. The Copper-catalysed Oxidation of Ascorbic Acid in Fruit and Vegetable Suspensions. By F. E. Huelin and I. Myee Stephens. *Aust. J. Sci. Res.* B 1: 50-57 (1948).

This paper is concerned with fundamental studies on the effect of low concentrations of copper (0·5-10·0 p.p.m.) on the oxidation of ascorbic acid (vitamin C). The copper-catalysed oxidation increases with increasing pH up to 6·0. The oxidation is very rapid in pure phthalate and phosphate buffers but is reduced by a number of substances, particularly organic acids and thiol compounds, which occur in fruit and vegetable tissues.

2. The Enzyme-catalysed Oxidation of Ascorbic Acid in Fruit and Vegetable Suspensions. By F. E. Huelin and I. Myee Stephens. *Aust. J. Sci. Res.* B 1: 58-64 (1948).

This paper is concerned with the effect of enzymes from fruit and vegetable tissues on the oxidation of ascorbic acid. The properties of the enzyme from cabbage are given in some detail. The oxidase activity of the suspension is often far greater than could be due to its copper content, if present in ionized form.

3. Effect of Ozone on Microbial Growth on Beef Muscle and on the Flavour of Beef Fat. By J. F. Kefford. *J. Coun. Sci. Ind. Res.* (*Aust.*) 21: 116-140 (1948).

In small scale experiments involving the storage of beef muscle of controlled moisture content at temperatures of 1° C. and 5° C. the author reached the following conclusions:

(*a*) Significant controlling effects on microbial growth, even at relatively low moisture levels, were not obtained with ozone concentration less than 3 to 5 p.p.m.

(*b*) With regard to the application of ozone in the cold storage of meat, the present results indicate that useful inhibition of microbial growth is most likely to be obtained when ozone is applied in concentrations of the order of 5 p.p.m. immediately after the initial chilling when the contaminating organisms are still in the lag phase and when the surface moisture content is reduced.

(*c*) In chilled beef carriage by sea under conditions of light stowage, it is not likely that surface moisture contents could be maintained at a level low enough to secure a useful extension of storage life.

(*d*) In any case the fact that ozone in those concentrations, which were effective in controlling microbial spoilage, produced deteriorative changes in fat flavours and muscle colour within a few days suggests that ozone has limited application in the cold storage of meat.

WATERPROOF CAN LABEL

According to an article published in *Modern Packaging*, vol. 21, no. 10, June 1948, the Paramount Canning Co., Haines City, Florida, believes it has solved the problem of paper labels for cans that must withstand long immersion in water. A waterproof lacquer is applied to the under side of the label and a waterproof spirit varnish over the lithographed display side. The under side of the overlap and the top side of the underlap are left untreated, in order that lap paste may be added. Both the waterproof pick-up gum and lap paste used to seal the label on the cans were specially developed by an adhesive manufacturer.

CORRIGENDA

Vol. 8, No. 2

(1) "The Pressures Developed in Containers during Heat Processing."
The second last paragraph on page 24 would perhaps be clearer if worded thus:

"At whatever temperature a can is sealed there will be at 240° F. an *excess* pressure of 10·3 lb. due to the water-vapour present and the pressure due to the air enclosed at sealing will be superimposed upon this. Thus, with a sealing temperature of 130° F., the theoretical *excess* pressure in the can at 240° F. would be 10·3+12·5, i.e. 22·8 lb. per sq. inch (no allowance is made here for expansion of the air with heating)."

(2) "Notes on Some Aspects of the Design of Fruit Cool Stores."
In the first paragraph under the subtitle. "Central Air Cooler Systems", on page 29, read "3000 ft." instead of "3000 sq. ft."

Vol. 8, Nos. 3 and 4 (Commemorative Number)

In the List of Illustrations, the last two page numbers should read 62 and 63.

BIBLIOGRAPHIES AND SUMMARIES OF INFORMATION

The following bibliography may be obtained on application to the Officer-in-Charge, C.S.I.R. Information Service, 314 Albert Street, Melbourne. Applications should state clearly the reason why the bibliography is requested, because the number of copies available is limited.

Number.	Date Prepared.	Title.	No. of Refs.
B349	June, 1948.	Air Transport of Fruit and Vegetables.	16

GAS-PACKAGING OF FOOD

A new package called Flex-Vac, made of thin gauge aluminium foil laminated to cellophane and bleached kraft paper, has recently been used for the gas-packaging of peanuts, whilst the possibilities of its use for bacon, frankfurters, cheese, coffee and frozen fish are being explored. The new package is moisture-, grease-, insect- and dust-proof, while affording protection against chemical change or deterioration.

When used for peanuts, the packages which are prepared for heat sealing and packed with the previously processed nuts, are placed into a vacuum chamber which is drawn to about 28½ inches of vacuum. Nitrogen is then admitted into the chamber, and the bags are then heat sealed.

CHLORINATION OF VEGETABLE PROCESSING PLANT

R. Haynes and J. O. Mundt in an article published in *Food Industries*, vol. 20, no. 7, July 1948, state that "results obtained with inplant chlorination—constant low-pressure sprays of chlorinated water maintained over various operating surfaces—indicate effectiveness of this method for reducing the bacterial count of processed green beans. Coincident with installation of this chlorination the bacterial content of products passing over the sprayed surfaces was materially reduced; slime was eliminated from operating and maintaing surfaces, floors and runways. Odours characteristic of vegetable processing plants were quickly eliminated."

During the first week of operations under inplant chlorination the well water used was given a dosage of 17 parts per million of chlorine, and thereafter the dosage was reduced to 13 p.p.m. for the remainder of the test period. At cleaning time, between shifts, the chlorine dosage was increased to about 50 p.p.m.

FLAVOURING OF COOKED VEGETABLES

In an article entitled "The Role of Monosodium Glutamate in the Seasoning of Certain Vegetables" which appeared in *Food Technology*, vol. 2, no. 4, Oct. 1948, L. B. Sjöström and E. C. Crocker found that the addition of this substance in concentrations usually under 0·5 per cent. markedly improved the flavour of most vegetables, raw or cooked. The principal effects noted by these authors were balancing, blending and reinforcement of the natural flavours and suppression of sourness, rawness and certain other undesirable characteristics. In the concentrations required to produce the desired effects, the presence of glutamate was scarcely noticeable.

PROTECTION OF FROZEN FISH AGAINST RANCIDITY

In recent years a considerable amount of work has been done on the use of antioxidants as protective agents against oxidative rancidity in foodstuffs. An account of tests carried out in U.S.A. by L. S. Stoloff, J. F. Puncochar and H. E. Crowther has been published in *Food Industries*, vol. 20, no. 8, Aug. 1948. Of the antioxidants tried best results were obtained with ascorbic acid 0·2%, gallic acid 1% and nordihydroguaiaretic acid (NDGA). In each case these substances were dissolved in an approximately 1% aqueous solution of refined Irish moss extractive (Krum-Ko-Gel). Such an extractive was shown to be an effective emulsifying agent and protective colloid, thus permitting the use of water-soluble or water-insoluble agents. The colloidal agent prevented the formation of pockets of free oil, and the naturally occurring oils in the flesh of the fish were more readily reached by the antioxidant dispersed in water. It was found also that an appreciable extension of storage life of the fish was obtained by simply coating them with the Irish moss extractive solution. This was attributed to some protection afforded against oxygen of the surrounding air.

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