Food Preservation Quarterly

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DIVISION OF FOOD PRESERVATION
COMMONWEALTH COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

EDITORIAL.

THE production of high quality processed foods which will retain their desirable characteristics during the usual periods of marketing and distribution to the consumer is rightly regarded by those connected with food processing industries as a worthy ideal. It is a well established axiom that consumers will pay for good quality, and it is also true nowadays that quality control is looked upon by many manufacturers as a form of insurance against loss of trade and of goodwill. An inferior product not only reflects on the actual manufacturer but often also on the entire industry.

Before measures can be taken to fix and maintain desirable standards in any product it is necessary to know the actual qualities desired; in addition it is essential to know how to attain them and how to prevent the development of undesirable qualities. Taking a definition of quality as the first requirement, it can be safely stated that with food products which are consumed primarily by reason of their appeal to the appetite the most important qualities are those which render any particular product appetising, *e.g.*, flavour, appearance and texture. Of these, flavour can be regarded as the most important; the consumer may be initially attracted to a product by its appearance but will not be a regular purchaser unless the flavour is satisfactory. The highest possible nutritional value in the product can also be accepted as an essential requirement for quality in any food product.

In former times the attainment of good quality in food products depended almost entirely on rule-of-thumb methods which were of necessity unreliable and haphazard; nowadays scientific methods are rapidly replacing the older methods in many industries.

The first necessary requirement is a thorough understanding of the raw materials which are used, and of the changes the materials may undergo during the manufacturing processes. Selection and inspection of raw materials are very necessary steps in attaining control of quality.

With many raw materials certain chemical and physical tests can be applied in checking quality, *e.g.*, acidity and salt content of pickling fluids, acidity of dairy products and moisture content of sweet corn. Apart from chemical and physical characteristics the properties of flavour, texture and colour in the final products are all important in forming the basis for selection of raw materials.

There are very few chemical or physical tests sufficiently reliable or rapid in application to be of much value in estimating the factors of flavour and appearance, and it is therefore necessary to reply upon organoleptic tests depending on the sense of taste, sight, smell and touch to measure the quality of a particular product. A properly constituted group of tasters should be selected after being trained to recognise flavours or other characters decided upon as desirable as the result of consumer preference tests. It is then essential to organise the manufacturing processes and to train the personnel responsible for production so that the desired quality will normally be produced, and to organise a rigid system of control and inspection so that any variations are detected and adjusted without delay.

Every employee dealing with the preparation of the raw material should be instructed in the variations and defects which occur in all natural products and should be on the lookout for unusual conditions

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so that these can be reported and dealt with promptly. Members of the production personnel should be trained to recognise the variations in raw material which may produce differences in the finished product, and should also appreciate the effect which variations in handling procedure or manufacturing processes will produce.

Since it is the quality of the product when it reaches the consumer and not the quality at the time of manufacture which ultimately determines the appeal of any product, an estimate of the average shelf life of the product should be made. A valuable aid also is a coding system whereby the product, its date of manufacture and if necessary its batch number can be recorded. Accurate records of quality tests are essential and should be retained for comparison from year to year.

The system of quality control which has been briefly outlined can most effectively be brought into operation by the establishment by the food industries of quality control and research laboratories staffed by persons trained in the various branches of food technology. The quality control laboratory should be in close touch with the research laboratory so that production problems may receive prompt attention of the research worker, and conversely, the control laboratory will immediately get the benefit of any worth-while investigations suggested by the research workers.

No system can be completely successful unless it has the support of the entire personnel, and it is most important to develop a spirit of team work and co-operation and to instill into the whole organisation a sense of pride in the quality of the products they help to manufacture.

Quality improvement is a worth-while objective which, when attained, will pay good dividends.

SUBSTITUTE CONTAINERS FOR JAM.

During the war there was a serious shortage of tinplate in Australia, and it was feared that there might not be enough available for the packing of the jam produced in the country. Consequently a study of the possibility of using substitute containers for jam was undertaken as part of a programme of work by the Council's Divisions of Food Preservation and of Industrial Chemistry.

For some years a small proportion of Australia's jam has been packed successfully in paraffin-treated cartons, but these can only be used with jam which is filled into the container at low temperatures. Filling at temperatures of 180°F. or higher is necessary for most of the usual commercial jams, and this would injure the paraffin film and so allow the jam to wet the walls of the container or water to evaporate during storage.

E. W. Hicks and Joan Garden published a short article in "Australian Food Manufacture and Distributor," vol. 15 No. 7, February 1946, "An Experiment with Substitute Containers for Jam with some General Comment on the Problem." This paper describes an experiment to test the use of waxes of higher melting point than paraffin for packing jam filled at temperatures up to 205°F. Copies of this article are available from the Division of Food Preservation, Council for Scientific and Industrial Research, Private Mail Bag, Homebush, N.S.W.

THE DIVISION OF FOOD PRESERVATION AND TRANSPORT.

THE PRESENT PROGRAMME OF INVESTIGATIONS.

By

J. R. Vickery.

In 1942, an account was given in the Food Preservation Quarterly (Vol. 2, No. 4, p. 2) of the re-organization of the Division's work to meet the needs of the war effort. While many of the investigations outlined in the article are still in progress, the ending of the war has enabled some to be dropped and the resumption of several abandoned early in the war. It was pointed out in the previous article that, prior to the war, investigations on the cold storage of foodstuffs comprised the bulk of the Division's work, but that more pressing problems necessitated the suspension of such studies. As laboratory accommodation and the availability of suitable research workers permit, the cold storage investigations are being resumed. The importance of cold storage in Australia's internal economy and export trade is sufficiently great to warrant the Division devoting a considerable proportion of its resources to investigations in this field.

Some of the more important investigations being carried out at the Division's Homebush (N.S.W.) and Brisbane laboratories, and also projected studies, will be described, mainly under the headings of the different foodstuffs.

Meat.

The loss of "bloom" of chilled beef during the long voyage from Australia to the United Kingdom seriously depreciates the value of the meat in the British Markets. Preparations are now being made at the Brisbane laboratory to resume studies on the causes of, and preventive measures for, this loss of "bloom." Other investigations at Brisbane include the ripening of beef.

At Homebush, some general bacteriological and chemical problems are being studied, including the conditions governing the development of spoilage in canned, cured meats subjected to a "light" heat process.

Processing investigations aimed at improving the quality of dehydrated mutton are also in progress.

Fish.

There are a number of outstanding problems on the freezing and storage of fresh fish and the preparation and storage of cured fish, but it has so far been impossible to resume these studies. The Division's research work on fish preservation has, at present, to be limited mainly to canning, in which considerable progress is being made.

Eggs.

Bacterial rotting in shell eggs has occasionally caused serious losses during storage and in British markets has often reduced the confidence in Australian eggs. The causes of this wastage have been defined, and, investigations on a considerable scale have now been resumed in order to find suitable preventive measures.

Fruit and Vegetables.

(*a*) *Fresh Fruit.*—Work in this field has been carried out in close co-operation with the N.S.W. Department of Agriculture. Prior to the war, extensive cold storage trials were in progress on apples, pears, citrus fruit, plums and peaches. It has not been possible to resume all these experiments, and an extensive review of their present status has recently shown that fundamental physiological and biochemical studies on fruit tissues are urgently needed to provide a better understanding of the complete changes taking place during the cold storage of different kinds of fruit. These studies have been commenced recently, and, with the small staff available, it will not be possible to cover at the same time so extensive a range of "applied" projects as in 1939. Attention is, however, being given to the effects of wax and oil coatings on apples with a view to increasing their "life" in common and cold storage; some storage trials on plums, peaches and nectarines have also been resumed.

(*b*) *The Canning of Fruit and Vegetables.*—During the war, the canning research staff was engaged mainly on day-to-day problems encountered by commercial processors which were retarding full production for Service purposes. It has now been possible to concentrate on several long-term projects aimed at effecting considerable improvements in the initial quality of the canned products. These include:

(i) Tests of a number of varieties of freestone peaches many of which are superior in flavour to the clingstone varieties normally used for canning.

(ii) The effects of various conditions of cold-storage of fresh clingstone peaches on the subsequent quality of the canned product.

(iii) The prediction of optimum maturity at picking of sweet-corn intended for canning.

(iv) Variety and picking-maturity trials on tomatoes, green beans, carrots and beetroot grown in several localities.

(*c*) *Dehydrated Fruits and Vegetables.*—The traditional methods of sun-drying several kinds of tree fruits frequently result in products of poor appearance, texture and flavour, as well as in severe loss of vitamins. American investigators have claimed that dried tree fruit of superior initial quality can be produced by blanching or scalding prior to artificial drying by currents of hot air (dehydration). The Division is carrying out work along similar lines on apricots, peaches and pears, giving particular attention to such factors as variety, maturity at the time of treatment, conditions of blanching and drying temperatures. Work is also being done on the storage of dried fruits.

Several vegetable dehydration studies have been abandoned. Current investigations include the suitability for dehydration of a wide range of onion and potato varieties. Detailed studies of the keeping quality of dehydrated potatoes, carrots, cabbage, beetroot and silver beet are being continued.

(*d*) *Quick-frozen Fruit and Vegetables.*—In conjunction with the Division, the N.S.W. Department of Agriculture will shortly commence investigations on the freezing and storage of various fruits and vegetables. This industry is becoming firmly established in the United States of America, and the applicability to local conditions of the techniques developed overseas have to be investigated in detail.

Fruit Products.

Detailed studies on the preparation and storage of canned citrus juices have been resumed with the object of improving the initial and keeping quality. Critical investigations of pasteurisation and deaeration techniques are being conducted, and the problem of the development of bitterness is receiving particular attention.

The techniques of producing concentrated juices are being studied, as well as the reactions of the concentrates to storage.

Refrigerated Storage and Transport.

These investigations are being resumed as opportunity offers. So far they are limited mainly to some basic mathematical and physical studies to obtain information on the rates of cooling and loss of moisture of meat in chilling chambers.

It is planned later to commence a survey of physical conditions obtaining in various types of cold stores, with the objects of determining whether the refrigeration systems employed are maintaining the physical conditions desirable for the type of produce being stored and whether they are economical in design and operation.

A small team of investigators will also be available to attack problems of refrigerated rail and shipboard transport, as they arise.

Financial Assistance.

A considerable part of the cost of the Division's investigations has been met by regular contributions from "outside" organizations. These include the Department of Commerce and Agriculture, the New South Wales Department of Agriculture, the Egg Producers' Council, the Australian Meat Board, the Queensland Meat Industry Board and the Metropolitan Meat Industry Commissioner (Sydney).

Generous help in donations and services has also been given by a number of commercial firms. Without the assistance of these organisations in making available full-scale processing and storage facilities, it would often have been difficult to test on a commercial scale the results of laboratory experiments.

General.

The above programme of major investigations has been drawn up in order to meet what are considered to be the chief technical needs of various branches of the food industry in Australia. This Division would cordially welcome any suggestions as to investigations of general interest which might usefully be undertaken. It should be pointed out that the Division does not carry out any research work on milk and milk products or on cereals and cereal products.

STALING OF BREAD.

United States Patent number 2,285,065 (1942) was granted to Walter A. Taylor and assigned to the Atlas Powder Co. for the addition of 0.54 per cent. sorbitol to the ingredients when making dough for bread. It is claimed that this is sufficient to inhibit the tendency of the bread to become stale after baking but not enough to alter the taste of the bread.

THE ESTIMATION OF ASCORBIC ACID (VITAMIN C).

By

F. E. Huelin.

Vitamin C is an essential food constituent which is present in fresh fruits and vegetables. Serious deficiency results in scurvy, a disease which was known for centuries to be associated with a lack of fresh fruits and vegetables.

Until 1932 Vitamin C could only be determined biologically. One group of experimental animals (the controls) were kept on a diet which contained, as far as possible, all essential constituents except vitamin C. Other groups were fed graded amounts of the material under investigation, and the growth responses compared with those given by standard sources of the vitamin. The vitamin C content of any foodstuff was originally expressed in arbitrary International Units according to the biological response. (One International Unit was taken as equivalent to 0.1 ml. of fresh lemon juice.)

Following on the work of Zilva (1927) and Szent-Györgyi (1928), who showed a close relation between the reducing power and the vitamin C content of food extracts, Tillmans, Hirsch and Hirsch (1932) titrated the reducing material with a solution of 2.6 dichlorophenol-indophenol to obtain an approximate estimation of vitamin C. By the end of 1933 this vitamin was isolated, purified, studied chemically, and prepared synthetically. It is now known as ascorbic acid. One International Unit is defined as equivalent to 0.05mg. of ascorbic acid.

Since Tillmans' original paper, numerous minor modifications have been made in the chemical method of estimation, but the method remains fundamentally the same. Various extracting solutions were tried, and metaphosphoric acid, which was first introduced by Fujita and Iwatake (1935), is now generally preferred. A fairly acid medium (pH 1-2) is most suitable for titration.

The chemical determination of ascorbic acid is now used extensively both by research and control laboratories in Australia. Much of this work originated during the war when the need for ensuring a maximum ascorbic acid content in all foodstuffs was particularly essential. To meet the need for a recognised standard method a pamphlet was prepared by Marston (1943) under the auspices of the Australian Chemical Institute. For further details, readers are referred to this pamphlet. Briefly the procedure involves dispersing the material to a standard volume in 3 per cent. metaphosphoric acid. A Waring Blendor is very convenient for this purpose; otherwise the more tedious procedure of grinding with sand has to be adopted. An aliquot of the extract is then taken for titration with approximately 0.001 M. 2.6 dichlorophenol-indophenol.

This simple chemical procedure requires only a fraction of the time necessary for a biological determination, and is invaluable for many purposes. Chemical methods are the only practical procedures for control laboratories, as the cost and time of biological assays would be prohibitive. Nevertheless, it cannot invariably be assumed that "reducing material" is equivalent to ascorbic acid, and a biological determination is always the final authority for any type of material. Biological methods are less precise but may be more specific than chemical determinations. They give a direct measure of the ability to prevent nutritional deficiency, which is what is ultimately required.

Various types of interference have been reported in connection with the chemical method and these will be discussed briefly. Interference may be due to "apparent ascorbic acid," dehyroascorbic acid, sulphur dioxide, dissolved metals, and coloured extracts.

(*a*) *"Apparent ascorbic acid."*

In fresh fruits and vegetables, chemical and biological determinations of ascorbic acid appear to yield results in quite good agreement. Harris and Olliver (1942) tested a variety of products, and found excellent agreement between the two methods. This result is, however, dependent on precautions being taken to prevent oxidation of ascorbic acid during extraction. If the material is disintegrated in contact with the metaphosphoric acid solution, oxidation should be negligible.

Various workers have suggested that processed foods contain substances other than ascorbic acid, which will reduce the dye use in the estimation. Wokes *et al* (1943a) claimed that high temperatures during processing or subsequent prolonged storage gave an appreciable concentration of "apparent ascorbic acid." Similar interference was claimed in germinated grains, walnuts, parsley, and sorrel.

Lugg (1942) proposed the use of formaldehyde for eliminating this interference. His method was modified and used extensively by Wokes *et al* (1943b). Levy (1943a) found that ascorbic acid did not titrate in a solution containing 20 per cent. hydrochloric acid and claimed that "apparent ascorbic acid" could be distinguished by this procedure.

Information about this type of interference is still far from satisfactory. Claims for the presence of "apparent ascorbic acid" in processed foods have not generally been confirmed by biological determinations. Most of the procedures for overcoming this interference are too elaborate for general use. They are valuable mainly for checking the routine procedure.

(*b*) *Dehydroascorbic acid.*

Ascorbic acid can be oxidised to dehydroascorbic acid which does not titrate with the dye but which has full vitamin C activity. Dehydroascorbic acid is generally absent from fresh fruits and vegetables, but may be present in processed foods. When present in extracts, it can be reduced to ascorbic acid by adjusting the pH to 4.0, passing hydrogen sulphide, and then removing the hydrogen sulphide in a current of nitrogen. After re-acidifying to pH 1-2, both ascorbic and dehydroascorbic acid can be titrated with the dye.

Unfortunately, treatment with hydrogen sulphide may result in the formation of "apparent ascorbic acid" from other substances in the tissues. An elaborate procedure is required to overcome this interference, and hence the determination of dehydroascorbic acid is not usually attempted. Dehydroascorbic acid is definitely of less practical importance than ascorbic acid, as it is unstable and changes fairly rapidly into substances devoid of vitamin C activity.

(*c*) *Sulphur dioxide.*

Many fruit and vegetable products contain sulphur dioxide. This may react with the dye and cause interference. The following methods have been proposed for overcoming this interference:—

(i) In the method of Lugg (1942), sulphur dioxide is condensed with formaldehyde at pH 1.5. Ascorbic acid only condenses slowly at this pH.

(ii) In the method of Mapson (1942), acetone is added to a final concentration of 20 per cent. before titration. The acetone combines with the sulphur dioxide and prevents interference, but somewhat reduces the sharpness of the end point.

(iii) In the method of Marston (1943) and Levy (1943b), hydrogen peroxide (to a concentration of 1.5 per cent.) is added immediately before titration. In solutions containing ascorbic acid and sulphur dioxide, but little other interfering material, the hydrogen peroxide oxidises the sulphur dioxide almost instantaneously, but has practically no effect on the ascorbic acid within the period of the titration. This method is useless in solutions containing ferrous iron, which can promote the oxidation of ascorbic acid by hydrogen peroxide. However, appreciable levels both of sulphur dioxide and ferrous iron are not usually found in the same product.

(*d*) *Dissolved metals.*

Canned foods often contain appreciable levels of dissolved tin, probably in the stannous condition. The author, however, has not found any interference from stannous tin up to 200 parts per million.

More rarely, appreciable levels of dissolved iron are found in canned foods. In the presence of metaphosphoric acid ferrous iron reacts with the dye. The formaldehyde method of Lugg (1942) can be used to overcome this interference as well as that due to "apparent ascorbic acid." Hydrogen peroxide cannot be used for an accurate determination, as it may oxidise some of the ascorbic acid along with the ferrous iron. But it can be used in routine procedures for detecting iron interference in extracts of canned foods. In the absence of such interference, results obtained with and without hydrogen peroxide should not differ by more than 1 mg. for 100 g. Should they differ appreciably the formaldehyde or some other procedure would have to be adopted.

Feaster and Alexander (1944) claimed that, by extracting with 8 per cent. acetic acid instead of metaphosphoric acid, interference from ferrous iron up to 100 parts per million was eliminated. In the author's experience, this procedure may still give interference and it certainly cannot be used without checking by alternative methods.

(*e*). *Coloured extracts.*

Fruit and vegetable extracts are often too coloured to permit of titration. If the colour is due to water soluble anthocyanin pigments, one of several procedures may be adopted.

(i) In the chloroform method of McHenry and Graham (1935), the titration is carried out in a test tube containing a layer of chloroform below the extract. The mixture is agitated by a current of carbon dioxide, and the titration is completed when the colour of excess dye appears in the chloroform layer. (The dye 2.6 dichlorophenol-indophenol is soluble in chloroform, but the anthocyanin pigments are not.)

(ii) Kirkpatrick (1943) added excess dye to a standard volume of chloroform, and determined the residual dye with a photo-electric colorimeter.

(iii) The method of Highet and West (1942) uses xylene instead of chloroform. The xylene forms a layer above the extract, but the method is otherwise similar to that of Kirkpatrick.

The colour of extracts may also be due to chlorophyll or carotenoid pigments. These are insoluble in water but may be in fine suspension. They can usually be removed by centrifuging, but, if this fails, none of the above methods are satisfactory as the pigments are soluble in chloroform and xylene.

The most satisfactory procedure for coloured extracts is a potentiometric titration. A pH meter can readily be adapted for this purpose. The method of Harris, Mapson, and Wang (1942), has been found satisfactory in this laboratory. It involves the use of a specially prepared mercury-coated platinum wire. The platinum wire, which should protrude about 1 cm. from the glass, is cleaned with warm 6 N. nitric acid, then with alcoholic potassium hydroxide, and rinsed with distilled water. It is plated by immersion in one per cent. mercuric chloride, while a current of 1.5 volts is passed for 30-60 seconds. The wire to be plated is made the cathode, while another platinum wire 1-2 cm. distant serves as the anode. The platinum wire should be replated daily.

For titration, the mercury-coated platinum wire is immersed in the extract together with a reference saturated calomel electrode. Carbon dioxide is then bubbled through. The potential remains practically constant throughout the titration and suddenly rises at the end point.

An alternative electronic method has recently been proposed by Liebmann and Ayres (1945).

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CHEMICAL PRESERVATIVES IN FOODSTUFFS.

PART 1.

BY

M. R. J. Salton, D. I. Annear and D. F. Ohye.

1. General.

Historical.—Long ago man learned to preserve food by the use of various chemicals. The rubbing in of salt as a means of preserving meat was practised in ancient times. Owing to its preservative qualities, salt became a commodity of economic importance and it is of interest to record that one of the oldest roads in Italy was built primarily to carry salt into the interior of the country.

In more recent times many other chemicals have been introduced as preservatives for a variety of foods. Many of the compounds used forty to fifty years ago are now prohibited. For example, Blyth (1909) notes that borax and boracic acid were substances most frequently added to milk in order to preserve it for a short time. Mixtures of the two substances were usually sold to the farmers and dairymen under trade names. Blyth states that next in importance to boron compounds was a formalin solution, while other preservatives used in milk from time to time included salicylic acid, sodium salicylate, sodium chloride, sodium carbonate, potassium nitrate, sodium fluoride, sodium fluosilicate, fluoboric acid, naphthol, glycerin, sodium benzoates, etc.

About fifty years ago the use of chemical preservatives in food became a widespread practice. Leach (1920) points out that in the United States of America a large number of commercial preparations were sold for purposes of preserving specific articles of food. With the passage of the Food and Drug Act of 1906, the use of many of the preservative agents was prohibited in the United States. Further advances in other methods of preservation have also tended to decrease their use in most countries.

In Great Britain in 1923, the Departmental Committee on the use of preservatives and colouring matters in food carefully considered the evidence on the physiological action of preservative substances. After consideration of all the evidence the Committee believed it possible to classify the preservatives into the following groups, according to their relative degrees of undesirability, Group I being the most undesirable:—

Group I.—Formaldehyde and its derivatives; hydrofluoric acid, its salts and derivatives.

Group II.—Boron preservatives; salicylic acid and its salts.

Group III.—Benzoic acid, sulphurous acid and their salts.

The Committee came to the conclusion that if preservatives are to be used at all in food it is desirable that they should be confined if possible to those coming under Group III. The question whether preservatives are necessary in the case of butter which is sent to Great Britain from Australia, New Zealand and the Argentine was also considered in detail. From the evidence the Committee believed that it would be possible to dispense with preservatives in all consignments of butter from Australia and New Zealand. It was later shown that the exclusion of boric acid from Australia and New Zealand butter did not impair keeping quality.

Definition of Preservatives.—The New South Wales Pure Food Act defines a "preservative" as any substance which is capable of inhibiting, retarding, or arresting the process of fermentation, acidification or other decomposition of food or of masking any of the evidences of putrefaction, and includes benzoic acid and benzoates, sulphur dioxide and sulphites, boric acid, salicylic acid, hypochlorites; but does not inlude salt (sodium chloride), saltpetre (sodium or potassium nitrate), sugars, acetic acid or vinegar, alcohol, or potable spirits, herbs, hop extract, spices and essential oils used for flavouring purposes or any substance added to food by the process of curing known as "smoking."

Although each Australian State has its own pure food act with definitions of preservatives essentially the same, some variation in the use of preservatives does occur from one State to another. In general, the preservatives permitted in Australia are non-toxic or of limited toxicity. Space does not permit the recording of all differences, but several examples will be given. Benzoic acid is no longer used in tomato sauce and chutney in New South Wales but is used in four other States. Boric acid is permitted in concentrated milk in Victoria, South Australia, Western Australia and Tasmania, but not in New South Wales and Queensland. The Tasmanian and Western Australian regulations permit the use of boric acid in cream. In some instances the quantities of chemical preservatives allowed also vary from one State to another.

A comparison of the Australian regulations covering the use of chemical preservatives with those of Great Britain and the United States is of some interest. In Great Britain the permissible preservatives are sulphur dioxide (including sulphites), benzoic acid (including benzoates) and sodium nitrite, and these may only be used in strictly controlled amounts for specified foods. The regulations do not include substances such as salt, saltpetre, sugar, lactic or acetic acid, glycerine, alcohol, etc., in the definition of "preservative" substances. Boric acid (including borates) may be added under licence to bacon and margarine, but as Baumgartner (3) states, this is presumably only a wartime measure.

In the United States, as far as federal regulation is concerned, no separate standards for food preservatives have been proposed. In unstandardised foods, they are covered by the general provisions of the Food, Drug and Cosmetic Act of 1938, that is, preservatives are prohibited if the preservative is a poison. Many of the States and some of the municipalities have rigid prohibitions about the use of preservatives.

Desirable Properties of Preservatives.—If a chemical preservative is to be incorporated in foodstuffs it must not, under any reasonable conditions, cause injury to the health of the consumer. In addition to this point, Barnard (1911) listed the criteria which are still entirely applicable for a completely adequate chemical preservative. Barnard states that use of a chemical preservative must not allow the utilization of unfit raw material and that its use must not make possible the employment of careless and imperfect methods of manufacture.

These agents must also be non-irritant, efficient in action, must not retard the action of digestive enzymes and they must have no tendency to decompose within the body into substances which have a greater toxicity than that of the preservative itself. One further essential noted by Barnard is that the preservative chemical should lend itself to simple methods of determination and thus simplify the control problem.

The common chemical preservatives in use to-day conform largely to Barnard's criteria. However the perfect chemical preservative has not yet been found.

When chemical preservatives are to be used in foodstuffs, it is essential that they must not be injurious to the health of the consumer. Jacobs (5) makes reference to organic chemicals used for bacteriostatic action in foods and lists some of the common trade names of preservatives and their principal component. This list includes Merfene, which is phenylmercuric borate and a number of quaternary ammonium compounds belonging to the group of cationic detergents. No mention is made of the toxicity of these compounds (the latter class of substances cause slight irritation to the mucous membranes) or the way in which they are used as "food preservatives."

Factors affecting the Action of Preservatives.—The mechanisms whereby chemical agents added to foodstuffs are able to exert preservative actions are not fully understood.

It is known, however, that preservatives may inhibit the growth of micro-organisms without necessarily destroying them. Effective inhibition of microbiological growth thus prevents the spoilage of foods. However the action of preservatives is influenced to a marked degree by a number of factors, these factors being:

1. Concentration of preservative.
2. Temperature.
3. Composition of the food.
4. The type of organism.

Their activity is primarily dependent on concentration. If present in sufficient concentration the effect on micro-organisms is lethal. In lower concentration inhibition of growth, but not death, results, while in very low concentration the toxic effect is lost completely. The degree of dilution required to produce these changes in activity varies with each preservative.

Thus, for example, a particular preservative in a low concentration may be capable of inhibiting organisms, whereas another agent present in an equal concentration may be incapable of suppressing the growth of micro-organisms. However in higher concentrations both preservatives may appear to be equally effective.

Temperature also has an important effect on the activity of preservatives, the toxicity being generally increased by rise in temperature, the increase varying with different substances. The composition of the food is a factor of some importance. The hydrogen-ion concentration of the food influences the efficiency of the preservative and the effect of the organic matter of the food on the agent is another factor regulating activity.

Some organisms are more susceptible to the action of preservatives than others, so this differential response to the inhibitory effect of a chemical agent is another factor influencing activity.

This fact together with the wide range of organisms likely to be encountered in the spoilage of foods, make the selection of preservatives which are effective against all types, a very difficult task.

In subsequent articles, comments on the preservative actions of benzoates, salicylates, and other common preservatives, will be made.

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CAN-CLOSING MACHINES.

It is often desirable to produce a vacuum in a canned product without passing the cans through an exhaust box where the steam or hot water treatment may result in too much softening of the food. This vacuum may be achieved by a closing machine with attachment to a vacuum pump or by a device to fill the headspace of the can with live steam just as the lid is sealed on. The condensation of the steam after sealing creates a partial vacuum in the can. L. O. van Blaricom, of the South Carolina Agricultural Experiment Station, describes experiments with such a steaming device in the "Food Packer" for October, 1945.

In experiments with numerous lots of peaches packed in No. 2½ (401 x 411) cans, using a Panama closing machine of the Continental Can Company with a universal seaming head, type F paddle packers, and a steaming device without a tunnel, he found that the temperature of the syrup did not significantly affect the vacuum which varied from 0-7½ inches of mercury depending on the headspace in the can.

The steaming device seemed particularly suitable for use with soft varieties of peaches as steam exhausting tended to make those at the top of the can lose their shape and become mashed in closing. Firm peaches had a tendency to rise in the can after the headspace plunger had depressed them, and this caused a loss of vacuum.

In cans with a large headspace (17/32 inch or greater) where one or two half peaches were above the syrup, there was a tendency for them to turn brown when the closing machine with the steaming device was used, but this browning was not serious in most cases.

Experiments with a steam-closing device at the C.S.I.R., Division of Food Preservation laboratories, have shown that higher vacua than those recorded by van Blaricom may be produced in the cans when the lids to be sealed are heated before use. This work is proceeding and will be described in a later issue of the Food Preservation Quarterly.

AN HISTORICAL SURVEY OF THE CANNING OF PEACHES.

BY

P. Thompson.

Nicholas Appert, the inventor of canning, was acquainted with peaches and had packed some in hermetically sealed bottles before 1810, recording in his treatise, that:—

> "The large Mignonne and the Calande are the two best kinds of peaches in which are united the best quality and aroma; in default of these two kinds the best possible are taken for preserving by the same processes as those employed for apricots."

Two main classes of peaches exist, namely freestone and clingstone, the nomenclature arising from the characteristic freedom or adherence of the pulp to the pit.

On the American continent the packing of peaches was began very early, mainly in the Eastern States of Maryland and Delaware, although the first fruit packed was in New York City in 1819 by Thomas Kensett, an Englishman, who followed Appert's precepts, packing in glass and "processing" in hot water. This same pioneer was granted a patent in 1825 for "an improvement in the art of preserving," the use of "vessels of tin."

By 1850 canning had progressed considerably, although the largest canner seldom packed more than 2,000 cases per season. All the fruit was prepared by hand and freestone varieties such as the Crawford were most commonly used. During the Civil War which began in 1863 peaches and tomatoes were the main canned products supplied to the fighting forces. The preference for freestone peaches continued through the 1870's and 1880's until a disease colloquially known as "peach yellows" caused a sudden drop in output of the canned product. Although many thousands of acres of peaches were still grown for the fresh market it was clearly recognised that the west coast had become the centre of the peach canning industry.

Preservation of the fruit in glass had begun in San Francisco about 1854, but canning in "vessels of tin" did not start till 1863. Already a swing had started towards the canning of clingstones and the varieties, Tuscan Cling, Hauss Cling, Orange Cling and Phillips Cling were becoming prominent. The firm flesh and relatively small pit of the clingstone gave halves which did not flatten during cooking and were thus more attractive than the freestone in which the flesh was softer and pit was usually large. The flavour of the freestone varieties was, however, usually superior to that of the clingstone.

With the introduction of lye-peeling in 1876 by William Archdeacon, freestone canning suffered another setback, since it was found that a jelly-like layer often formed in the pit after the peeling operation, and a ragged appearance also developed.

Gradually a standard for suitable canning varieties has been derived and it is now considered that a good canning variety must possess the following characteristics:—

"It should be of large uniform size, of symmertical shape, of yellow colour, of close tender fibre, not coarse or ragged, and of good cooking quality, i.e., should retain their form, size, flavour, colour and aroma during sterilisation in the can. The pit snould be small in order to give thick halves that do not flatten during heating. The fruit should ripen evenly from the surface to the pit and should not be softer at the pit than at the surface."

In general these properties are possessed by the yellow clingstone varieties, e.g., Tuscan, Hauss, Phillips and Golden Queen whereas the freestone varieties are deficient in one or more of the above characteristics. Another factor of importance to commercial packers is the higher yield obtained from clingstones. The Dunkley Canning Machinery Company sets the average yield at 44 to 46.5 cases of cling peaches and 39.8 to 42.75 cases of freestone peaches per ton when a spray lye peeler is used.

A comparison of the peaches packed by the United States and Australia since 1937 is interesting.

U.S. AND AUSTRALIAN PEACH PACKS.

Standard Cases of 24/30 oz. Cans.

	U.S.A.	*Australia.*
1937	13,879,554	1,393,858
1938	10,400,358	1,790,742
1939	12,116,173	1,852,796
1940	11,463,883	1,312,292
1941	14,778,415	1,659,404
1942	16,726,040	1,348,073
1943	11,450,269	1,139,829
1944	13,779,619	1,307,868

These figures represent the total clingstone and freestone packs for the United States while the Australian figures are essentially for clingstones.

California packs represent approximately ninety-five per cent. of the total American peach pack and a comparison of clingstone and freestone packs indicates that freestones are showing an upward trend, although figures for 1943-1944 are down to 1938 levels. Several explanations have been advanced for this sharp decline. Firstly 1943 was a subnormal year and produced an exceedingly poor crop, and, although 1944 provided a big harvest inexperienced labour was not able to handle the normal tonnage.

CALIFORNIA CANNED PEACHES.

Standard Cases—24/30 oz. Cans.

	Clingstone.	Freestone.
1935	10,850,492	365,769
1936	10,236,033	475,091
1937	12,205,478	1,042,953
1938	9,445,927	376,423
1939	10,579,366	882,463
1940	9,608,126	1,133,737
1941	10,581,448	2,151,691
1942	12,901,714	1,088,671
1943	10,182,027	536,697
1944	12,279,619	339,201

Canning in Australia owes its beginning to the collapse of credit in the 1840's and the consequent severe depression of 1843. At this time enterprising citizens of the infant colony began to seek new avenues of employment which led to the introduction and development of new industries.

One of the most farseeing citizens of this period was one named Sizar Elliott. Elliott started with a meat canning works, and gradually extended his range of products. An exhibition of 1846 contained samples of his mackerel, beef and carrots and mutton preserved in tins.

This pioneer was also the first to can fruit in Australia, and the ubiquitous peach was amongst the initial products canned. Elliott's products continued to gain popularity and history has recorded the following testimonial by several sea captains of the period: "We intend to supply ourselves from Mr. Elliott's stock, and have much pleasure in recommending all persons going to sea to follow our example."

However, response was not up to expectations and Elliott is credited with the following complaint: "Having now established the industry, the great drawback was want of support from the public. The Colonial merchant is too much interested in importing. English ship captains will not look at anything made in the colony. None but captains of American men-of-war, American whalers, and a few others can be induced to take the meats, or in any way patronise the industry. However, my trial has convinced others that this is the proper country for carrying on this industry, and it has been taken up by persons with means sufficient to ship the product to England."

In spite of these early beginnings the development of the canned fruit industry was not rapid, although the rate was sufficient to sponsor the local manufacture of fruit canning machinery, John Heine & Son Pty. Ltd., winning a silver medal for its manufacture at the Royal Agricultural Society's Show in 1892.

The last thirty years, however, has witnessed a very substantial progress in the industry. This improvement began with the establishment of a cannery at Leeton on the Murrumbidgee Irrigation Area by the New South Wales Government in 1914. About the same time South Australian fruitgrowers opened a co-operative cannery in Adelaide, and closer settlement schemes which encouraged heavier plantings of fruit trees culminated in the foundation of the co-operative cannery at Shepparton, Victoria in 1918.

From this period the industry has continued to expand helped materially by the cheap sugar concessions granted by the Commonwealth Government. The Ottawa Imperial Preferences also benefited the industry and figures for 1931 and 1936 indicate the increase in production.

Year ended June	1931	1936.
Fruit preserved:—		
Tons	22,651	52,097
Value	£854,844	£2,070,290

During this remarkable growth of the fruit canning industry the peaches canned have been clingstone varieties to the total exclusion of freestone types. Our exported packs have consisted almost entirely of three varieties, Golden Queen, Phillips and Pullars.

The varieties received most favourably by the overseas market are Golden Queen and Phillips with a slight preference for the former variety. However these varieties are inferior in flavour and aroma to the best canning freestones and their toughness is also undesirable.

At one period some difficulty was experienced in disposing of canned peaches on the Canadian market. This was traced to the Pullar variety which has a red centre. If not entirely removed it develops a purple colour during processing which is regarded by consumers as the commencement of deterioration.

Recently this laboratory has undertaken a canning trial of various freestone varieties in co-operation with the New South Wales Department of Agriculture. In all, thirteen varieties were canned, the packs being prepared with and without removal of the flesh immediately surrounding the pit.

It was established that in the majority of varieties it is essential to remove the flesh immediately surrounding the pit since it has a tendency towards discolouration and a slightly bitter flavour sometimes develops during processing.

Observing the trend in the United States of America, and bearing in mind the dependence of the Australian peach canning industry upon successful export, steps should be taken towards the development of suitable freestone canning varieties as an integral part of Australia's peach pack.

Sydney: Thomas Henry Tennant, Government Printer—1946.