FOOD PRESERVATION QUARTERLY

Vol. 24
Nos. 3–4

CSIRO

September–
December 1964

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

Research at Tatura on the Quality of Canning Fruit

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The Horticultural Research Station at Tatura, Victoria, is one of four research stations operated by the Victorian Department of Agriculture and is engaged on horticultural research bearing on the quality of fresh fruit and fruit for processing, juice making, or wine production.

THE Horticultural Research Station at Scoresby, which was the subject of a recent article in this Quarterly,* is principally concerned with storage trials on commercial fruits grown in southern Victoria. The station at Tatura, being situated in the Goulburn Valley (which is the chief centre in Australia for canning fruit production), has a considerable interest in the quality of fruit for canning.

Fruit quality assessment has been an important part of the work at Tatura since the inception of the station. Even before the first orchard plantings were made in 1937, a programme of breeding and selection of cling peach varieties was begun there by research officers of the Victorian Department of Agriculture. An important outcome was the commercial release of four locally bred varieties in 1960.

In 1958 the new laboratory building, which included a canning laboratory, was opened. In 1963 it was decided to add a small fruit quality section to the existing research sections, which comprised Pomology, Soil Physics, Nutrition, Chemistry, Plant Pathology, Entomology, and Vegetables. Experienced staff from the Pomology Section undertook the work on fruit quality, and it has been possible to institute investigations on the assessment of field treatment effects on fruit quality, these having been proposed by the First and Second Australian Fruit Research Conferences in 1958 and 1963.

Most of the earlier work at the station was on cling peaches, but in the 1963–64 season work began on the canning pear variety Williams Bon Chrétien. Tests on tomato fruits for processing are carried out for the Vegetable Branch of the Department's Horticulture Division.

METHODS OF ASSESSMENT

Objective assessments are made of flesh and skin colour, flesh firmness, soluble solids, and acidity; and a panel is used for subjective assessments of colour, flavour, texture, and general appearance.

Flesh and Skin Colour

The Maerz and Paul "Dictionary of Color"* has hitherto been used as a reference

* TINDALE, G. B. (1964).—Experimental cool stores at Scoresby, Victoria. *CSIRO Food Pres. Quart.* **24**: 2–5.

* MAERZ, A., and PAUL, M. R. (1950).—"Dictionary of Color." 2nd Ed. (McGraw-Hill Book Co. Inc.: New York.)

standard in assessing colour in the skin and flesh of peaches, but it is difficult to obtain accurate assessments in this way. Consequently, a new method of maturity assessment based on transmitted light (not reflected light, the usual basis for visual assessment of colour) is to be introduced. This is based on differential light transmittance at two selected wave lengths. Some work has also been done on measurement of tomato colour by the Gardner Colour Difference Meter, kindly lent by a commercial firm. Pear fruit colour has not been measured.

Flesh Firmness

The Ballauf plunger-type penetrometer has been used for measuring the firmness of the flesh in the fresh fruit, but is subject to difficulties in standardizing procedure. A modification of the annular head for the CSIRO Maturometer gives promise of a better-controlled procedure for both fresh and processed samples, as judged by pilot tests on peaches.

Soluble Solids and Acidity

Soluble solids content in fresh and canned fruit is measured on expressed juice by means of a Zeiss Model 0 refractometer (see illustration on page 43), and acidity is measured by titration of the pulped material to pH 8·1 with sodium hydroxide. Tomato samples are not canned for assessment, determinations being made on the fresh material only.

Panel Assessment of Canned Samples

All fruit is canned as halves, using standard syrup of 30°Brix, in No. 2½ cans, and the cooking is done in a steam-heated vertical retort. Samples are presented to an assessing panel for all work in which thorough assessment is needed, and the sampling programme is statistically designed.

The Horticultural Research Station operated by the Victorian Department of Agriculture at Tatura, Vic.

Colour is assessed visually in comparison with a standard fruit sample under standard lights, using intact fruit halves. It is scored on a 1 to 5 scale by each assessor, 5 representing optimum colour, which is taken as that of a fully ripened Golden Queen peach.

Flavour is assessed on pulped samples prepared in a food blender and presented to the panel under a deep orange lamp, which eliminates colour effects. Scores 1 to 5 are again used, and assessors are asked to proffer comments when they allocate a score less than the optimum (5) to a particular sample.

Texture is judged by cutting and biting, and scored 1 to 7 (1 = soft, 4 = ideal, 7 = tough).

General appearance is also scored, but has been found to be closely correlated with colour.

RESEARCH PROJECTS

Cling Peaches

Variety Selections.—The main aim here is to select varieties which have advantages over existing varieties *maturing at the same time.* The cling peach season could not be usefully extended beyond that of the present late-maturing group (mid March). It may be possible to select super-early varieties maturing in the first fortnight of January, but these would be relatively low-yielding because of the short growing season.

Up to now the release of Tatura Dawn and Tatura Sunrise has provided alternatives to existing early varieties, with better yields and less fruit drop. Tatura Sunset, although a little earlier than Pullar's Cling, is of much better colour and less subject to fruit drop, and Tatura Aurora is a highly coloured variety which is easier to size than Wight.

Several other selections are being considered for release. In particular, a replacement for the Warden variety would be useful. This variety sizes well for an early mid-season type, but is highly susceptible to split stones and brown rot. Gaume, a possible alternative, is unsatisfactory in the Goulburn Valley owing to split stones and fruit drop.

Material held for further observation includes Station selections, a range of South African varieties, several Californian varieties, and the Dix series.

As regards flesh colour, there are found to be three general groups of varieties: highly coloured (e.g. Wight, Golden Queen); medium (e.g. Riley, Warden, Cornish, Levis); and pale (e.g. Pullar). Panel tests have shown that even semi-ripe fruit of the highly coloured varieties is acceptable, but only fully ripe fruit of the two other groups is satisfactory. Based on experience in Victoria, a variety will usually need to be at least "medium coloured" to be regarded as suitable for release, but it is not considered essential that it be "highly coloured".

As a general rule, acidity is lower and sugar content higher in later-maturing varieties. However, Yellow Transvaal progeny (e.g. Wight, Tatura Aurora, and most of the South African varieties) are relatively high in acid content, irrespective of maturity date.

Most of the earlier laboratory testing of varieties was done with fruit from Station plantings. However, district plantings of several Station varieties are now beginning to crop, and a programme of assessment of fresh and canned samples from these has been started to keep a check on their performance under a wider range of conditions.

Effects of Fertilizers.—Over three seasons comparisons have been made between Golden Queens receiving 3 lb ammonium sulphate per tree per year and 6 lb per year. It is known that the latter treatment delays maturity by about 5 days and has given significantly better tree growth and yields in the Station's peach fertilizer trial, from which the fruit was taken. If this difference in maturity is allowed for, differences in quality are slight.

Fruit from several trials with differential potassic fertilizer rates has been tested to check whether such fertilizer produced firmer fruits. Results were inconsistent, and a more complete assessment of effects of

Measuring the soluble solids in fruit with a refractometer.

nutrient relationships will be needed if this field is to be better understood.

Effects of Rootstocks.—One of the Station trials is a comparison of several clonal European plum stocks (Brompton, St. Julien A, Damas C, and Ackermann) with Elberta peach seedling as rootstocks for cling peaches. The trial was planted in 1959, and interesting tree growth and yield differences are already starting to develop. Fruit from trees on plum stocks tends to ripen earlier than on peach seedling, and yields are higher up to date.

A pilot test on fruit quality did not show any significant differences due to the rootstocks for any of the four scion varieties.

High-temperature Ripening.—Work in conjunction with the Scoresby Research Station and the Biology Branch of the Department of Agriculture has led to the development of a "heat therapy" technique for ripening semi-mature fruit with minimum fruit rot development. Fruit is exposed for 24 hr to an ambient temperature of 104–106° F, and then ripened as necessary at a lower temperature, ideally 75° F. The work at Tatura has shown that this treatment triggers off very rapid colour development and reduction in acidity, while effect on sugar content varies. A tendency for fruit firmness to increase if the treatment is extended is due probably to dehydration, and a fairly high humidity (75–85% R.H.) is therefore desirable in the treatment chamber.

Panel tests showed that, as compared with tree-ripened fruit, final flavour depended on a complex of variety, maturity, and treatment factors. Extreme effects which caused downgrading of flavour were undue blandness caused by too low an acid content (e.g. over-ripening of Pullar), high acidity (e.g. inadequate ripening of Riley), or off-flavours (caused by over-exposure to the high-temperature treatment).

The heat therapy treatment has been used for several seasons by two major canneries in the Goulburn Valley to deal with a percentage of undercoloured fruit.

Effects of Syrup Strength and Acidity.—By measured additions of citric acid during processing to a naturally sweet peach, it has been shown that the panel of assessors can detect changes in acidity but that they do not downgrade flavour unless the acidity is very high.

The effects of syrup strengths of 15, 25, 30, and 40° Brix on flavour acceptability are currently under test.

Williams Bon Chrétien Pears

Effects of Nitrogen Fertilizers.—A project was undertaken in the 1963–64 season to assess the effects of ammonium sulphate dressings ranging from nil to 20 lb per tree per year. Fresh fruit and canned samples were to be assessed. This project developed from questions concerning the effect of fertilizer practice on the keeping quality of fresh fruit and on storage disorders. Other work on the subject is being carried out by cool storage officers at Scoresby, who have already demonstrated the relation between picking dates, storage life, fruit quality, and storage disorders for a number of pear varieties. However, this is the first time that canning quality effects have been studied. The effects of time of picking and of time in cool storage before ripening are being studied in this project also.

Pear "Pinking".—The development of a pink colour in occasional pieces in the can is known to be due to high leucoanthocyanin content. However, means of identifying potentially affected fruit before processing, and methods of eliminating the problem in the field, have yet to be developed. Observations incidental to the studies on nitrogen fertilizer effects mentioned above have given a useful lead on this problem, and this is being followed up.

Tomatoes

Assessments are made on fruit from variety and fertilizer trials carried out by the Vegetable Branch of the Department.

FUTURE RESEARCH

Future work at the Station will pay considerable attention to the effects of various field treatments on fruit quality. Improved methods for assessing fruit quality will be sought and increased attention given to the assessment of quality in pears.

It is also planned to study the relationship of fruit drop in peaches to the maturity and colour of the fruit and to a number of other factors.

Some Observations on the Egg Industry in the U.S.A.

By F. S. Shenstone
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At the invitation of the United States Department of Agriculture Mr. Shenstone, who has been engaged for several years on research on eggs at the CSIRO Division of Food Preservation, attended a conference of the American Chemical Society in Atlantic City, New Jersey, in September 1962. After attending the conference Mr. Shenstone remained in the U.S.A. for about two months for discussions with others working in the same research field, and was able to make a brief survey of the egg industry.

THE annual production of eggs in the United States exceeds 5000 million dozen, of which about two-thirds is sold through wholesale and retail channels. The highest production is in California, Iowa, and Minnesota and, with Pennsylvania, these States account for over one-quarter of the national production. There are over two million egg farms in the U.S.A., and next to cattle, grain, and dairy products, the sale of poultry and eggs provides in total the largest source of cash income to U.S. farms. In 1959, the eggs sold yielded a gross return exceeding 1000 million dollars.

My own observations late in 1962 of the industry operations involved in shell egg marketing in the U.S.A. were confined largely to California, although I also visited research and other establishments in several States in order to acquaint myself with scientific progress and technological developments in relation to egg quality and processing techniques. However, because the Californian industry is undergoing rapid changes, methods being adopted there were probably indicative of likely future conditions in the United States as a whole and perhaps also in other parts of the world.

California has moved from a position of deficiency to one of surplus in eggs, and the trend towards bigger units of production is reflected in some farms having over 200,000 layers. According to the official census of 1959, about 5% of the farms in California carried flocks exceeding 6400 hens four months old and over, and these accounted for 60% of the eggs sold in that State. Although farms of this size or larger represented only 0·2% of the national total, they accounted for 22% of total U.S.A. egg sales. In contrast, 79% of egg farms in California carried less than 400 birds each, and these farms produced less than 2% of the total eggs sold.

A somewhat different picture is presented by the mid-west and central States, where 92% of the farms carry less than 400 birds each, while accounting for about half of the commercial eggs produced in those areas. Even there, less than 1% of the farms have flocks larger than 6000 but account for over 7% of the total local egg production. The Mid-west has traditionally been an egg surplus area and has been the site of the largest production of egg products, chiefly because in this region egg processors have been able to buy egg supplies at a very heavy

discount relative to the shell egg market. One reason for this has been that in the Midwest egg production has been a sideline to other farming activities and the small producer is unable to meet specifications for shell egg grades that present no special difficulties to the larger and more efficient egg farms.

In general, the numbers of farms and laying hens in the U.S.A. are both decreasing, partly because of a steady fall in the annual consumption of eggs per person and partly because of the increased egg production per laying hen. The trend towards larger production units evident in all States and the control exercised by some of the large distributing firms has, on the whole, had a beneficial effect on quality standards of shell eggs. For "breaking" eggs there is already a movement towards the production of eggs to meet special requirements and these eggs may enter the market in larger consignments than was possible when production was distributed over a large number of smaller farms.

COLLECTION AND DISTRIBUTION OF SHELL EGGS

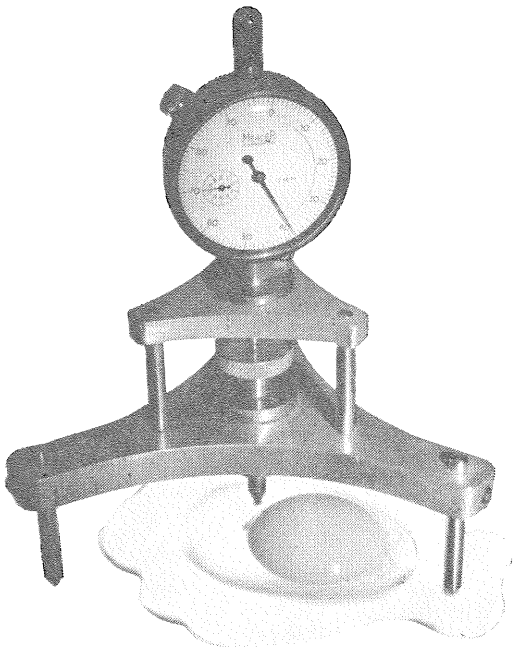
Government Grading

Much emphasis is given in the U.S.A. to the requirement that table eggs should exhibit a good strong thick white gel and a firm rounded yolk with a uniform standard of colour. The former is measured by the height of the thick white and expressed as Haugh unit ratings, while the latter is assessed visually or by the yolk index, which is the ratio of the height of the yolk to its diameter when the intact egg contents or the separated yolk, respectively, lie on a flat smooth surface (see illustration at right). Eggs not meeting these requirements are discounted in price and are diverted to lower retail grades or to egg products.

A standard of market control and inspection of shell eggs is afforded by regulations governing the grading and inspection of shell eggs receiving the official grading stamp, these regulations being administered by the Agricultural Marketing Service of the U.S. Department of Agriculture. Estimates ranging from 5 to 20% have been given for the proportion of eggs officially classified into market grades specified by the regulations. Although this proportion may seem low, officially graded eggs serve as a basis for comparison for eggs marketed under alternative methods of control. The result is that there is a general improvement in the quality of all retail eggs. The granting of grading certificates by the U.S.D.A. is conditional upon weekly sampling of each flock consignment for break-out examination, upon conformity with regulations concerning flock age and farm practices, upon the storage of eggs below 60° F on the farm and during distribution and retailing, and upon the use of an expiry date on the cartons.

Quality Control by Distributors

Marketing methods originally instituted by Olsen Bros. in Los Angeles have also proved very successful in the control of quality, and are being used by other organizations. This group's methods involve specification and



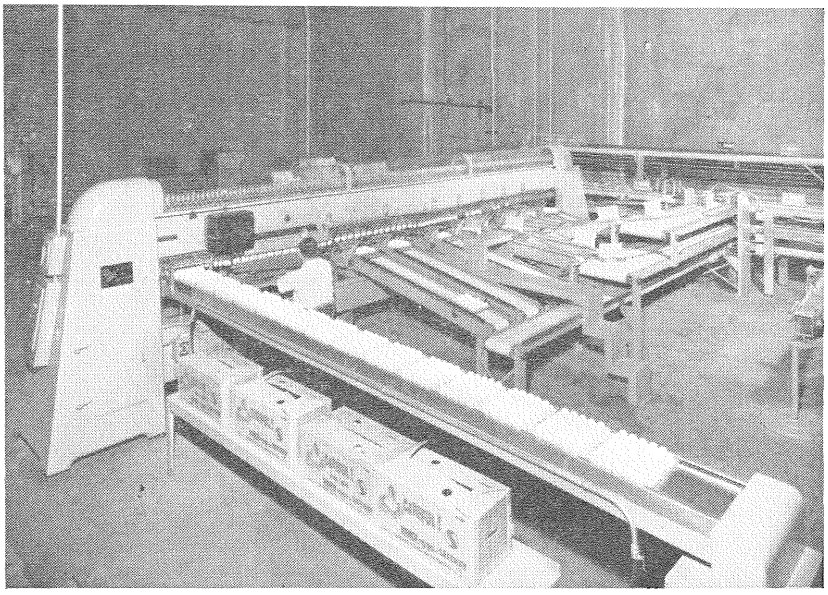
Instrument used to assess internal egg quality in terms of height of the "thick white" (Haugh unit rating) or yolk index.

control of factors during production, in order to ensure that high-quality eggs will be available from the farm. The group takes responsibility for the eggs from the moment they enter the farm cool store and for all subsequent stages in distribution to retail outlets.

The Olsen Bros. group has by now expanded to the point where it supplies a large segment of the Californian retail market, undoubtedly because its efficient marketing methods have been organized to satisfy the demand for eggs of high quality and have resulted in a continually assured uniformity of grades. Egg grading and packing have been carried back to the larger farm units in order to speed up the process of marketing, but smaller consignments may be partially processed at the farm before transfer to local packing centres. Some of the techniques that are being used by this and other distributors are described below.

Washing and Spray Oiling.—The tendency is to wash all eggs in conveyor washers without segregating clean and dirty eggs. The washing machines use hot water spray jets, and some recirculation of wash water is usual, followed by a spray of hot fresh water containing chlorine as a disinfectant. This water is used as make-up water for the main wash tank and contributes the chlorine used in this stage.

The eggs may be transferred to the conveyors for washing or may be spray washed while still in the specially perforated plastic trays used for farm collection. They may be cool stored at 55–60° F at this stage before grading, and if this is done they are usually spray oiled before storage. Such eggs may be graded and packed on the farm premises some time later or may be moved to a central plant for this purpose. At some farms the eggs are cold stored after collection; washing, grading, spray oiling, and packing

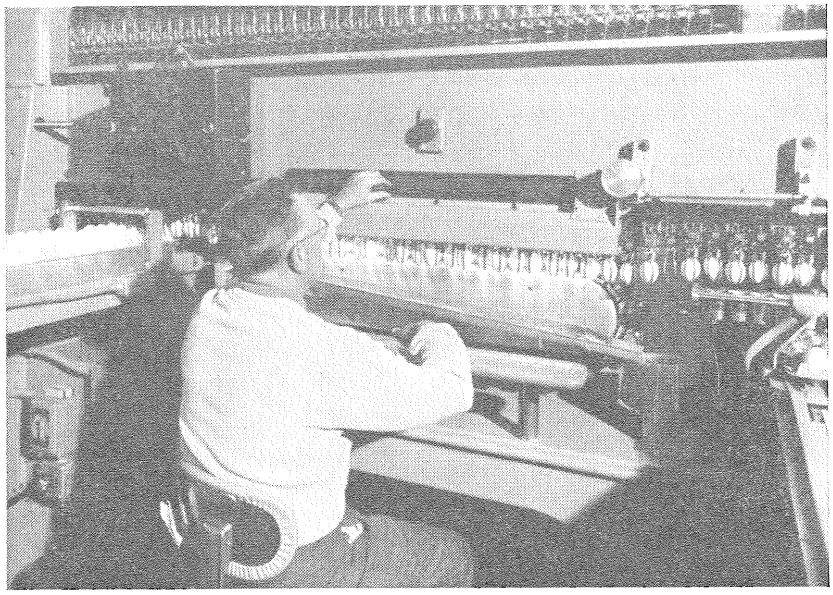


A general view of Safeway's SEE egg grading machine. Eggs moving up the conveyor (at left) in rows of six are picked up by four-fingered claws which take them past the scanning section. (Photo: courtesy Safeway Stores Inc. and Poultry Processing and Marketing.)

are carried out on the following day. At others, the eggs are spray oiled even before they are washed and re-oiled at the packing plant.

These practices show that before eggs move to the retail outlet, where they must also be held in cool storage to qualify for the top grades, they may be one to five days old.

The precise control of egg stocks and close specification of production methods are tending to reduce the emphasis on candling, but one large retail marketing organization, Safeway Stores, had chosen to strengthen this emphasis. This group had developed an egg grading and packing machine, known as SEE (illustrated on page 47), which by a new technique submits the eggs individually



The scanning section, showing each egg held vertically in the claws. Each egg revolves slowly as it passes through the scanning area accompanied by a beam of light which shows up blood spots, checks, malformation, stain, and displaced yolk. The scanner inspects four to six eggs simultaneously and can reject any one from the line by turning a small dial that travels with each egg. (Photo: courtesy Safeway Stores Inc. and Poultry Processing and Marketing.)

Supplies are sometimes allowed to accumulate in the farm cooler for several days in order to provide for the high rate of buying at the end of the week.

Candling.—Inspection of the eggs by candling is at some places speeded up by the use of "flash" candling on wide conveyors illuminating about 50 eggs at one time. The use of automatic blood spot detectors and the development of crack-detecting devices have further reduced the amount of inspection required.

to a candling operation comparable to hand candling (illustrated above). Attention to constructional details of the conveyors and to the devices used for automatic weighing and packing has reduced supervisory requirements to a minimum and thereby led to a considerable increase in efficiency.* By this means, and by controlling production and distribution practices as described pre-

* A full description of the SEE unit was published in *Poultry Processing and Marketing*, 1963 (August), pp. 26–7 and 45–9.

viously, this retail grocery chain markets eggs of very high and guaranteed grades in its own stores.

After many years of experience with methods of production and marketing, the regular break-out sampling for Haugh unit testing, as specified in the U.S.D.A. regulations for control of internal quality, is being omitted by some marketing groups. This is feasible only when strict consideration is given to production practices on the farm. An example of the care exercised over egg supplies is given by the importance attached to the age of layers. In some instances eggs laid by hens over 18 months old are as a matter of routine removed from the shell egg inspection line, because they may have a low internal quality. Eggs from such hens pass directly to egg products, often without any candling, thereby reducing costs.

Price Structure

At the time of my visit, prices of shell eggs for table use ranged from 3*s* 4*d* to 6*s* 6*d* per dozen in terms of Australian currency. The large range in price was related to the season and the quality grade of the eggs, but 4*s* per dozen would be a fair average price.

With regard to "breaking" eggs, which are used for the manufacture of egg products, processors have been able to operate on a favourable price structure that has aided the sale of their products. For example, prices of dried egg albumen, whole egg, or yolk ranged from 9*s* to 11*s* per pound of dry product. In terms of shell eggs with an equivalent dry solids content, the price per dozen worked out at 1*s* for egg albumen and 2*s* for yolk, or 3*s* per dozen if both the fresh white and yolk were used efficiently by the consumer. However, the wholesale price for grade C eggs could be as low as 1*s* 3*d* per dozen and through direct purchase from the farm even lower prices for "breaking" eggs could be obtained by the processor. The yearly average price of all grades of farm production in some areas was as low as 2*s* 3*d* per dozen.

The pricing of whole egg solids offered to the consumer corresponded to about 2*s* 6*d* per dozen shell egg equivalent and this compared very favourably with shell egg prices on the retail market, where lower-grade eggs are not available.

Since to the American processor larger eggs give a greater return of product rated on throughput per hour, and since also a larger yolk (or a lower ratio of white per egg) yields more of the higher-priced yolk products, he has much to gain from the trend of some of the larger farms to meet his special requirements. Although these may also involve specification of yolk colour and particular functional properties of the egg white, intensive competition has so far prevented any corresponding increase in price, even though few, if any, of the smaller farms are able to meet these special requirements.

EGG PRODUCTS

Egg solids production each year in the United States involves the use of nearly the equivalent of Australia's entire annual shell egg production. Furthermore, if the output of dried egg solids as a proportion of total egg production were comparable for the two countries, Australia should be using about six million dozen eggs per annum for dried eggs for local consumption, instead of less than a million dozen as at present.

There are many ways in which utilization of egg solids in the U.S.A. supports that country's higher relative production. The use of egg solids in school lunch programmes and government buying for mass feeding schemes offer steady support to the industry. Dry prepared cake mixes for retail sale are used extensively for all types of cakes and provide another important outlet. For example, angel-food cake mixture supplies the equivalent of 8 to 10 egg whites per carton at less than the retail cost of the fresh eggs. Dry mixes containing egg solids are being used extensively in the baking trade because of their convenience when holding stocks and because of easier proportioning. Special items such as doughnuts and egg noodles are important outlets for yolk solids.

Frozen or Refrigerated Liquid Egg.—The breaking and separating of eggs for use in liquid, frozen, or dried egg products are

carried out by hand or machine. (The machines are mostly those manufactured by Seymour Foods Inc., but there are indications that other automatic egg-separating systems are being developed to challenge the unique position held by the Seymour machine.) A number of companies specialize in the breaking and separating of eggs and the frozen or liquid products are resold to manufacturers of the processed material. Even when an egg-drying organization breaks its own eggs, the refrigerated liquid egg may be transported in road tankers over long distances to other plants owned by the same firm.

Dried Egg Solids.—The control of a large proportion of the market in dried egg solids resides with just a few corporations. The major corporations consider their operations so specialized that they engage in no other kind of egg handling, excepting perhaps the preparation of some frozen products. The production of normal dried whole egg is largely left to smaller firms because the requirements for successful operation are relatively simpler. Some of the larger companies manufacture more than 20 separate egg products in one factory, and are able to satisfy a multiplicity of specifications on white, yolk, whole egg, and mixtures of these. The dry solids are sold in bulk for remanufacture into other products and for packaging into institutional packs. There is no retailing of these items in packages of a size suitable for home use.

Preparative Methods

The methods employed in the factories producing the best products show the high degree of care needed to maintain their leadership. There is a constant effort to improve existing products and to create new ones. So-called "secret" processes merely reflect the research that has been applied to manufacturing operations.

The basic principles of the preparation of the raw material and the drying are reasonably standard. Fermentation stabilization of liquid egg is carried out with glucose oxidase enzyme or selected bacterial cultures and, when applicable, corn syrup solids are added as a carbohydrate stabilizer. Spray drying is usually performed in Gray–Jensen type cone dryers or Rogers dryers with side-entering nozzles, this latter type being specially favoured for large-volume continuous drying of albumen for angel-food cake dry mixes. Pan drying of albumen is effected in cabinets or in continuous tunnel dehydrators and the dry product is used as large flakes or as a powder. The dry material is cooled, sieved, and packed in fibreboard drums containing 150–175 lb. The use of chemical additives, such as sodium lauryl sulphate, in spray-dried albumen in order to increase the foaming power is now general practice.

The development of off-flavours in the range of spray-dried products made from whole egg, yolk, and mixtures of these—whether glucose-free or stabilized with carbohydrate—is of critical importance in determining the shelf life of finished products. It is usual for the drying processor to hold stocks of these products in cold storage pending delivery to the customer, but the stability of any dry-mix items prepared from the egg solids appears to be satisfactory for the period spent on the retailers' shelves. There are no flavour instability problems with glucose-free dried albumen.

Pasteurization Techniques

The technological problem of salmonella infection of egg products is still a difficult one. Pasteurization is carried out by some processors, but often only when the purchasing authority specifically requests it. In one process for liquid egg the product is heated to 140–143° F in plate units and held at this temperature for 3–3½ min. Albumen is not usually treated in this way but the dried material can be pasteurized to kill salmonella organisms by storing at high temperature for some time, and this procedure is quite usual. For example, the drums of albumen may be stored for about 14 days at temperatures of 140 to 160° F.

New Outlets

An awareness of the need to promote new uses for egg solids is indicated by the efforts of Seymour Foods. This organization is currently marketing two new dry-mix products for institutional use. These are a self-aerating omelette mixture that is ready for cooking immediately after the addition of water, and a custard powder mix contain-

ing eggs. The omelette or scrambled egg mixture is gas packed in cans and it is claimed that it is not necessary to hold it in cold storage in order to prevent changes in flavour or in functional properties. I found a custard prepared from the dry mix to have a very bland flavour, and it was free from the off-flavours that are often associated with the dried yolk component.

The willingness of the industry to meet and even anticipate new demands is also shown by the efforts being made to produce free-flowing dry powders to aid in automatic weighing and filling operations. Finely dispersed silica powder added to the dry material gives the egg solids better flow properties. The addition of other materials and changes in production methods are being investigated to produce pourable powders and also to obtain powders truly instant in use after the addition of water. These aspects become strong selling points.

RESEARCH ACTIVITIES

Research on nutritional, microbiological, or technological problems related to shell egg production and to the processing of egg products is being actively prosecuted in many centres throughout the United States.

A major emphasis in much U.S.A. egg research is given to genetic factors and production variables, with a view to producing eggs of suitable initial quality and maintaining this quality. In connexion with the former, some embryological work on egg formation being carried out in the Department of Poultry Husbandry, University of California, Davis, may show up useful relationships. In general, however, and despite the fact that 90% of U.S.A. egg production is used as shell eggs, there did not appear to be a great deal of research in progress similar to that being undertaken in this Division on the relation of egg disorders and storage factors to the structure and function of the various components of eggs. Nevertheless, the work of the CSIRO Division of Food Preservation in Australia in establishing that cyclopropenoid fatty acids present in certain plant oils (e.g. cottonseed oil) were causative agents of the "pink white" disorder had aroused much interest and at least six laboratories or organizations were actively engaged in research work on various aspects of this problem.

Research at the University of Missouri was relating the components of eggs and egg products to the function demanded of them in cookery. A very long-range view of this is that eggs may be used for the isolation of components for special uses. For example, particular proteins may have desired properties or may be modified in a suitable fashion. For the present, however, such work will help towards using methods for the processing of liquid and egg solids products with a minimum loss of functional properties.

In 1962 at least two universities were commencing projects aimed at investigating infection of egg products with salmonellae. The results of this work were expected to be of use for control of infection in the plant, but meanwhile more precise counting techniques for salmonellae were being developed for better monitoring. The U.S.D.A. Bureau of Animal Industry, Beltsville, uses a mobile laboratory to investigate problems of bacterial infection during processing and considers that the organism *Escherichia coli* may be a satisfactory indicator of faecal contamination.

The effects of many variables affecting infection of shell eggs with rot-producing bacteria have received renewed attention at the U.S.D.A. Western Regional Laboratories and at the University of California. Attempts are being made to consider these effects in the design of more efficient egg washers, which may eventually depend on hot water to obtain pasteurization of the egg instead of the currently favoured use of chlorine.

The manufacturing processes for egg solids were receiving a significant amount of attention, especially at the Western Regional Laboratories. They were investigating the use of direct injection of steam into liquid egg to obtain pasteurizing temperatures above 160° F for short times; flash evaporation in a vacuum chamber was being used to cool the egg and remove the added water. The spray drying stage was being examined by changes in dryer design, and the structure of the dry particles was being varied to obtain free-flowing powders and instant solubility. Some

of these effects are obtained by gas injection into the pressurized liquid egg before spraying and by agglomeration of the dry material into larger particles by post-drying treatment.

Signs of future developments were evident in some of the research. Efforts were being directed at increased usage of eggs by the development of new "convenience" products, as it was considered that the falling egg consumption in the U.S.A. was partly due to competition from ready-to-serve breakfast foods that eliminate cooking. Cooked and frozen egg meals such as scrambled eggs, fried eggs, and French toast were being investigated. A trend in retailing towards the packaging of foods in glass containers to gain customer confidence was being matched on a minor scale with eggs. Very fresh eggs, broken out with careful control of bacteriological contamination, were being visually inspected for defects and packed with up to a dozen entire yolks and whites in a sealed glass container. This product keeps for several weeks under refrigeration.

CONCLUSION

Although there is no true substitute for eggs in many of their applications to cookery, so-called "convenience" foods and prepared breakfast foods that do not contain eggs are nowadays powerful competitors for the housewife's purse in most countries with a highly developed economy. To increase egg consumption above the basic level, it therefore appears to be necessary to offer eggs and egg products that have some special appeal to the consumer.

It is very apparent that through research and a high standard of quality control, and through the development of new egg products, the egg industry in the U.S.A. is making vigorous efforts to meet competition from other foods. In this way it aims to maintain or even improve its position in a market noted for its sensitivity to consumer demand.

In Australia the total egg consumption on a population basis has been unchanged for several years and is 210 per head per annum, while the egg equivalent of egg products contained in this total has reduced from 15 to 12 eggs per person per annum. These figures are below those of many European countries and well below the corresponding U.S.A. figures: in particular, the relatively lower proportion of total production utilized in egg products suggests that the market for egg solids has been largely unexploited in Australia.

It may not always be feasible to transfer the technology and commercial practices of one country directly to another, owing to differences in social and economic structure and in local taste. Nevertheless, there is little doubt that many of the U.S. practices which have proved so obviously successful in maintaining or increasing egg sales in the face of intensive competition could be applied here too. Quality control of production from the farm to the point of retailing could well be based on American practices, suitably adapted to local conditions. This would assure a higher standard of internal quality than is provided by the relatively ineffective candling system of control practised in Australia.

ACKNOWLEDGMENTS

The author gratefully acknowledges the generous financial assistance towards the costs of his visit given by the Australian Egg Board; the National Cottonseed Products Association, Tennessee; Swift and Company, Illinois; Hunt Foods and Industries, California; and the U.S.D.A. Southern Utilization Research and Development Division, New Orleans, Louisiana.

THE LABORATORY EXAMINATION OF CANNED FOODS — XXI

New Methods for Determining Tin and Iron

By P. W. Board and R. G. P. Elbourne
Division of Food Preservation, CSIRO, North Ryde, N.S.W.

In recent years new analytical methods and modifications to methods already in use have resulted in substantial reductions in the time required for the determination of dissolved tin and iron in canned foods. This short article gives particulars of improved methods now being used for routine and other analyses by the CSIRO Division of Food Preservation in its laboratories at North Ryde.

IN an earlier article in this series, Kefford (1958) discussed the problem of dissolved tin and iron in canned foods and described methods then in use in these laboratories for their quantitative determination in food samples. In general, as pointed out in that article, ashing of the food sample is not advisable, because some metals may be lost by volatilization or may become fixed in compounds that resist subsequent solution. Accordingly, wet digestion of the food sample is now almost universally practised, most methods involving destruction of the organic matter by digestion of the sample with hot oxidizing acids. Once a clear solution has thus been obtained, interfering substances are removed if necessary and the analysis for metals may proceed.

For convenience and rapidity in the estimation of tin and iron, colorimetric methods have much to commend them, although there may be some loss of accuracy as compared with conventional but usually more tedious volumetric methods. For both analytical methods, digestion of the sample should be complete, but optical clarity of the solution is essential for the colorimetric methods. Clearly, if full advantage is to be taken of the greater rapidity of colorimetric methods, especially for routine work, it is desirable that preparation of the sample should not be a long or tedious process.

The preparative procedures and analytical methods currently in use in these laboratories and now described have proved reliable and convenient over a large number of determinations.

WET DIGESTION

The method described by Kefford (1958) for preparing the food sample for analysis involved preliminary charring of a 50-g sample of the food in a Kjeldahl flask with a mixture of sulphuric acid and nitric acid. Digestion was completed by adding small quantities of nitric acid, with intermediate heating, until a clear yellow liquid was obtained. The oxidation was finally completed with hydrogen peroxide, which also removed residual nitric acid and its reduction products.

Although with many liquid food products digestion by the above procedure can be effected within an hour or two, experience has shown that many food products require considerably longer before satisfactory optical clarity is attained. A considerable improvement has been obtained, however, by adapting to the present purpose a method recently described by Birnø and Hansen (1962) for the wet digestion of fish meal.

In the new method, which has been successfully used in these laboratories for the digestion of samples of canned fruits, a mixture of sulphuric acid and nitric acid is used, as before, to effect preliminary charring. But the digestion is continued at once with concentrated hydrogen peroxide in place of

nitric acid, thereby eliminating much of the tedium of the earlier method. Moreover, the rate of digestion is much accelerated: preheating and charring take about 1 hr, and the whole digestion process is completed in $1\frac{1}{2}$ hr.

Procedure.—A 50-g sample is transferred to a 500-ml Kjeldahl flask, and 10 ml of sulphuric acid (sp. gr. 1·84) and 40 ml of nitric acid (sp. gr. 1·42) added. The mixture is brought to the boil and heated gently over a Bunsen burner until it is well charred. While the charred mass is still hot, 30% w/v hydrogen peroxide (i.e. 100 vol.) is added slowly and carefully until the solution clears. The solution is then boiled until white fumes appear, but if it darkens again, further peroxide is added and the boiling repeated to the fuming stage. This procedure is repeated if necessary, i.e. if the solution does not remain clear. Usually less than 40 ml of peroxide is needed to clear the digest.

Sometimes a white precipitate of metastannic acid forms in the digest after it has been cleared with peroxide. This precipitate may be dissolved by adding a few millilitres of concentrated hydrochloric acid and boiling.

The clear solution is transferred to a 50-ml volumetric flask and made up to volume with distilled water. It is then ready for the analysis for dissolved metals.

ESTIMATION OF TIN

Volumetric Method

The volumetric procedure described in detail by Kefford (1958) for the determination of tin in an aliquot of the digest was that of McKenzie (1945). The method involves reduction of the dissolved tin to the stannous form by means of nascent hydrogen, generated by aluminium metal and hydrochloric acid in an atmosphere of carbon dioxide to exclude oxygen. The reduced tin salt is then titrated with potassium iodate in the presence of potassium iodide.

The method is somewhat tedious for routine analyses and, in addition, gives low results if traces of oxygen are present in the iodate. To counteract this source of error a recommendation of Townsend *et al.* (1954) has been adopted in our laboratories. This involves the addition of antimony trichloride, which suppresses the catalytic action of iodide on the oxidation of stannous ions by free oxygen in the presence of hydrogen ions (Okell and Lumsden 1935).

In carrying out the analysis the reagents and procedures described by Kefford (1958) are used.* Before the reduction with aluminium, however, one drop of a solution of 1·5 g of antimony trichloride in 100 ml of 5N hydrochloric acid is added to the digest solution.

In a typical analysis of a solution containing 100 p.p.m. tin, antimony chloride increased the recovery of tin from 78 p.p.m. to 98 p.p.m.

Colorimetric Method

When great accuracy is not required, the colorimetric method using dithiol (1-methyl-3,4-dimercaptobenzene) as a chromogenic agent has been found to be a more satisfactory method for the routine determination of tin in canned foods than the volumetric titration method described above. In these laboratories the method used is an adaptation of methods described for tin in canned foods by Dickinson (1944) and for tin in titanium pigments by Williams and Whitehead (1952). Dickinson (1944) fused the ash with a mixture of potassium cyanide and sodium carbonate and then dissolved the product in dilute hydrochloric acid. This caused some of the iron originally present in the sample to separate as insoluble Prussian blue, which was filtered off. Although complete separation of iron is not effected, Dickinson (1944) found that "normal" quantities of iron did not interfere with the colorimetric determination of tin in the filtrate.

Wet oxidation of the sample for analysis by the method previously described is less hazardous, probably faster, and less dependent on the skill of the operator than Dickinson's (1944) ashing and fusing procedure. However, samples prepared by wet digestion contain all the original iron, which may be in sufficiently high concentration to interfere with the estimation of tin. This interference causes cloudiness in the tin-dithiol suspension and leads to irregular and high results for tin. The addition of citrate ions to the dithiol reagent prevents cloudiness

* Attention is drawn to an error in Kefford's paper for the conversion factor for tin content in p.p.m. from the titre with M/800 potassium iodate. The correct factor is 22·3.

and reduces the extent of iron interference to a level acceptable for most routine analyses.

The data in the table show the effectiveness of citrate in reducing interference by iron. The table also shows that the interference by iron in the estimation of tin is proportional to the concentration of iron. Consequently, for more accurate work calibration curves for concentration of tin *v.* optical density may be prepared and used to allow for the effect of iron.

Effect of Citrate on the Determination of Tin in Solutions containing Iron, by the Dithiol Method

Tin Added (p.p.m.)	Iron Added (p.p.m.)	Tin Found (p.p.m.)	
		No Citrate	Citrate
50	0	52	50
50	50	130	58
50	100	215	66
100	0	97	100
100	50	124	115
100	100	183	128

Copper is the only other element likely to be found in canned foods which interferes with the dithiol method. When copper is suspected it may be removed by adding sodium diethyl-dithiocarbamate and extracting the brown complex with carbon tetrachloride (Dickinson 1944).

Reagents.—The dithiol reagent is made by dissolving 0·2 g dithiol, 1·0 g thioglycollic acid, 7·0 ml Teepol 610, and 20 g citric acid in 100 ml of 15% sodium hydroxide and making up to 200 ml with distilled water. Teepol 610* contains a secondary alkyl sulphate as its active ingredient and gives excellent dispersion of the tin-dithiol suspension. Other Teepol formulations available in Australia are not suitable for use in this estimation (Board and Elbourne 1964). The dithiol reagent mixture is stable for about two weeks under refrigeration but should be discarded if it becomes cloudy.

Procedure.—Five ml of digest and 5 ml of reagent are added to a 50-ml volumetric flask and made up to volume with 0·5N sulphuric acid. Ten minutes are allowed for full colour development, and the optical density is measured on a spectrophotometer at 485 mμ. Readings are taken against a blank solution containing all reagents, including those from a digestion blank.

The calibration curve is constructed from measurements made on solutions of tin of known concentration. These solutions are conveniently prepared by dissolving a known weight of pure tin metal in hydrochloric acid and diluting with 7·2N sulphuric acid to give approximately the same acidity as in a digest sample.

The plot of optical density *v.* concentration of tin is linear up to at least 250 p.p.m. tin. Smaller initial samples may be taken for digestion in cases where the concentration of tin exceeds 250 p.p.m. Alternatively, smaller aliquots of the digest solution may be used for analysis. Since the acidity of the final coloured solution should be near 1·5 ml sulphuric acid in 50 ml, the concentration of the diluting solution must in this case be greater than 0·5N.

ANALYSIS FOR IRON

The method used in these laboratories is basically that using 1,10-phenanthroline as the chromogenic agent, described by Kefford (1958). The method has been made less tedious by preparing a bulk reagent containing:

11 g sodium citrate in 40 ml water

80 ml phenanthroline solution (0·35 g 1,10-phenanthroline in 80 ml 2% acetic acid solution)

55 ml concentrated ammonium hydroxide solution (27% w/w NH_3)

This mixture is made up to 1 litre with 7% w/v ammonium acetate solution.

Procedure.—Five ml of digest are pipetted into a 50-ml volumetric flask, 1 ml of a glycin solution (0·2 g glycin in 100 ml 2% sulphuric acid solution) is added, and the solution made up to volume with bulk reagent. The bulk reagent and the glycin solution should be made up each day. The pH of the final solution should be approximately 3·8 and some adjustment of the amount of ammonia in the bulk reagent may be necessary to give this pH. The optical density is measured on a spectrophotometer at 474 mμ after standing the solution for 15 min.

*Teepol 610 is manufactured by Shell Chemical (Aust.) Pty. Ltd.

The procedure described above eliminates a number of pipettings of small volumes of the individual reagents included in the bulk reagent, but the colour produced is identical with that produced by the method described by Kefford (1958).

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Second International Congress of Food Science and Technology

THE second International Congress of Food Science and Technology is to be held in Warsaw, Poland, from August 22 to August 27, 1966. A comprehensive programme has been prepared, covering a wide variety of topics of great interest to food scientists, technologists, and engineers.

The plenary sessions will be devoted to lectures by outstanding scientists and to the discussion of plans for the formation of an international union of national scientific and technical societies or bodies which deal with food science and technology.

Other sessions will be devoted to scientific topics under the following headings:

New Protein Sources and their Utilization

Chemical and Biochemical Changes in Food

Modern Technological Aspects of Food Processing, Manufacture, and Preservation

Advances in Food Engineering

Technical Problems of Producing Wholesome Foods

Assessment of Food Quality

Modern Trends in the Academic Training of Food Scientists and Technologists

Economic, Nutritional, and Sociological Aspects of Food Processing, Manufacture, and Consumption

The papers to be delivered at the sessions will be selected from freely contributed research papers and from others specially solicited.

Titles and abstracts of contributed research papers must be in the hands of the Secretariat not later than November 1, 1965.

Only papers, reports, official transactions of the Congress at the plenary sessions, and the invited papers presented at other sessions will be published in the proceedings. Authors of the contributed papers will be free to publish in journals of their own choice any time after the Congress. Contributed papers must deal only with previously unpublished material.

The Honorary Secretary-General is Professor G. F. Stewart, University of California, Davis, Calif. 95616, U.S.A., and the address of the Executive Committee Secretariat is Instytut Przemyslu Miesnego, Warszawa 12, Ul. Rakowiecka 36, Poland.

Preventing Deterioration of Raspberries between Picking and Processing

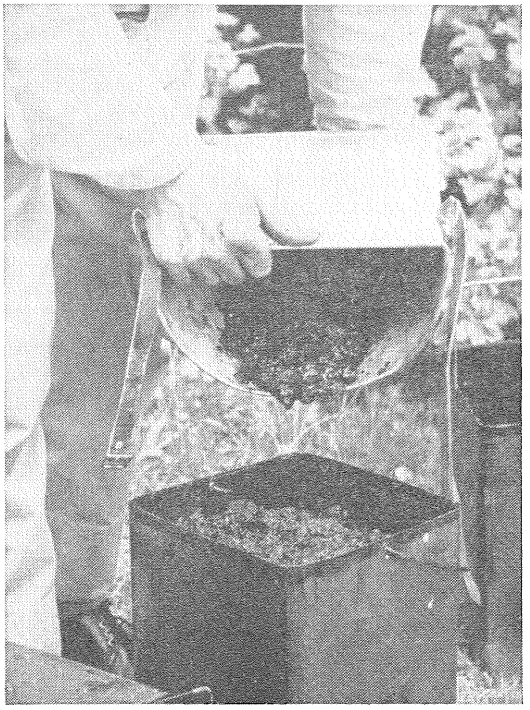
By Betty J. Marshall and S. M. Sykes*
Division of Food Preservation, CSIRO, North Ryde, N.S.W.

MOST of the raspberries harvested in southern Tasmania are transported and held as a semi-liquid raw pulp before processing. The fruit is picked into small metal containers strapped to the pickers' waists and transferred to bulk vessels, usually open, internally lacquered buckets made from 4-gallon cans (see illustration). The fruit is partly crushed during picking and handling and becomes further crushed under its own weight in the bulk container. Hence there is a release of juice and a very effective mixing of the semi-liquid fruit—conditions which help to provide a suitable medium for the subsequent growth of micro-organisms such as yeasts.

The bulk containers of fruit are held, usually under the cover of berry bushes or trees, or in special storage sheds, until they are loaded onto trucks to be transported to the factories. Although some growers transport their own fruit, most are dependent on the organized collection system arranged by the processor. The holding time between picking and collection varies greatly with the location of the plantation in relation to the factory. Some growers have regular collections twice each day, but in more remote areas fruit is collected only every second day.

A further period of holding usually occurs when the fruit reaches the factory but the use of refrigeration is not considered to be justified for the short period involved. Atmospheric temperatures may, however, be fairly high during the berry fruit season. Temperatures of 80° F are common in the field and factory and during hot weather the reading may approach 100° F.

It is thus clear that there are many factors which are favourable to the growth of



Freshly picked raspberries being tipped from a picking container into a lacquered bucket.

*Mr. Sykes is leader of the Division of Food Preservation's Tasmanian group, located at the CSIRO Tasmanian Regional Laboratory in Hobart.

microorganisms. Unfortunately, some processors regard a certain amount of fermentation as inevitable and not of great importance to the quality of the final processed product. While it is true that incipient growth of yeast cells does not seriously affect the quality of raw berry pulp, the fruit should certainly be regarded as spoiled and unsuitable for processing when there are obvious signs of fermentation, e.g. gassing and alcoholic odour.

In a preliminary experiment completed in 1962, which was designed to determine the influence of the original fruit on the quality of the jam, samples of raspberry pulp were allowed to ferment to various degrees. There was a marked loss in setting power, a slight deterioration in colour, and a very definite change in flavour with jam prepared from fermented fruit when experimental observations were related to a reference sample of jam prepared from unfermented fruit. In a product such as jam, the amount of cooking and the high sugar content could be expected to mask the original defects. It could reasonably be assumed that in other products the effect of fruit of inferior quality would be carried over to a much greater degree.

MICROBIOLOGICAL CONTENT OF COMMERCIAL RAW FRUIT

In the 1962–63 season, the sources of initial contamination and the growth of fermentative microorganisms in commercial lots of raspberries were examined, using fruit from a typical berry plantation in Tasmania. Counts of viable microorganisms were made on 20-g samples of fruit, using saline as the diluent and plating suitable dilutions in potato dextrose agar. The plates were incubated for 2 days at 77° F (25° C). Soluble solids (as sucrose) were determined using a refractometer. Further details are given below.

Fruit on the Bush

The natural microbiological flora of the raspberry was examined on samples collected at five levels of maturity. Samples of at least 30 berries at each level of maturity were picked from several bushes within two widely separated localities of one plantation. The fruit was crushed and mixed, and viable counts determined. The results (given in the table below) indicated that the number of viable organisms appeared to be independent of maturity except, possibly, where the berries were over-mature or damaged. The types of organisms were also the same and in the same ratio irrespective of the maturity. About 80% were wild yeasts with a pseudomycelial colony formation, 10% were the fermentative type of yeast, and the remaining 10% were various types of moulds. Thus, although the average total number of organisms was 20,000, the number of fermenting organisms was only 2000/g.

Viable Counts and Colony Types of Organisms found on Fresh Raspberries on the Bush

Maturity	Locality 1				Locality 2			
	Viable Count*	Colony Type Present (% of total)			Viable Count*	Colony Type Present (% of total)		
		Yeast 1†	Yeast 2†	Mould		Yeast 1†	Yeast 2†	Mould
A (just coloured)	16	11	77	12	23+	10	86	4
B (slightly immature)	23	5	86	9	15	3	82	15
C (mature)	14	7	86	7	23	3	86	11
D (slightly over-mature)	12	10	87	3	19	4	87	9
E (very over-mature)	110	7	85	8	28	8	86	6

* Viable count/g of pulp (thousands).

† Yeast 1—Smooth yeast colony typical of fermenting type.

Yeast 2—Wild yeast with pseudomycelial type of colony.

Viable Counts of Organisms on Raspberries immediately after Picking

Sample No.	Date of Sampling	Viable Count per Gram (thousands)
1	11.i.63	330
2	,,	710
3	,,	370
4	16.i.63	7100
5	,,	1000
6	,,	200
7	,,	1100
8	,,	1000
9	,,	110

Bulk Fruit Freshly Picked

The table above shows the results when nine commercial samples of fruit in buckets were examined during picking. The numbers of viable organisms were at least 10 times those on the fresh fruit. There was also a change in the type of organism. The number of wild yeasts and moulds remained unchanged, the increase being only in the normal fermenting type of yeast. These fermentative types accounted for more than 90% of the total organisms, and the number was 100 times that found on berries on the bush.

Containers and Buckets

Because of the "inoculation" of the berries during picking, indicated by the above results, the microbiological status of the picking containers and the lacquered buckets was examined. Inspection of containers of both types showed that remnants of old berries were present and, occasionally, small amounts of liquor also. The containers were washed with 200 ml sterile saline and viable counts made from these washings (see table below).

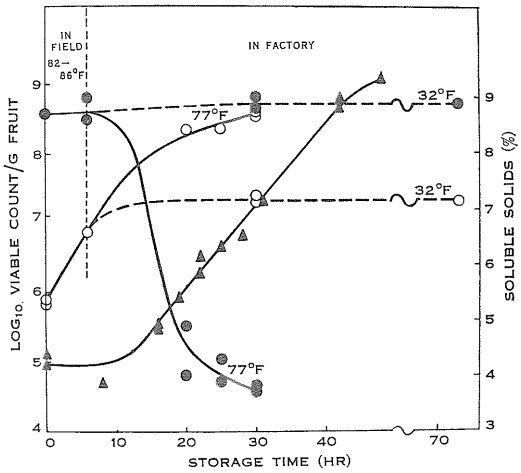
Viable Counts of Yeast in Empty Picking Containers and Buckets

Total Viable Count per Container (millions)	
Picking Containers	Lacquered Buckets
1800	140
750	210
1900	19
2800	200
4400	60
1000	150

All the organisms grown from the containers were yeasts of the fermenting type identical with those found in the berries after picking. They were present in sufficient numbers to account for the increased yeast content of the freshly harvested bulk fruit.

Bulk Fruit in Transport and Storage

Three buckets of fruit were taken after commercial picking and the viable yeast counts and soluble solids determined at



Changes in the yeast count (○) and the soluble solids content (●) of a commercial bulk lot of raspberries when stored at two temperatures. For comparison, the growth of yeast at 77°F is shown when the raspberries were picked into a sterile container (▲).

various intervals of time under different conditions of storage. After some hours in the field and in transport at 82–86°F the fruit was divided into two lots, one being stored at 32°F and the other at 77°F. The results for one bucket of pulp are shown in the diagram above. The results for the other two pulp samples followed the same pattern, with slight differences in absolute values at each particular time interval. There was a steady growth of yeasts in the field, with no apparent growth lag. During storage at 77°F in the factory growth continued until the maximum population was obtained. Growth was arrested when the pulp was stored at 32°F.

The soluble solids content did not change appreciably until the yeast count reached 100–1000 million, after which there was a rapid decline. The end of the rapid yeast growth phase and the associated steep decrease in soluble solids content appeared to coincide with the first obvious external signs of fermentation.

In another experiment, a sample of berries was packed into a clean, sterilized container, transported immediately from the field, mixed, and stored at 77° F. Viable yeast counts were made at various time intervals (see diagram on page 59). The population of the fermentative yeast doubled every 2½ hr, and the apparent lag of 12 hr before growth commenced could be due to the growth of this yeast until the number exceeded that of the wild types present. The time taken to reach 100 million yeast cells was 36 hr, compared with 13, 18, and 24 hr for the three commercial samples of fruit examined in these trials. Good sanitation therefore increased the life of the pulp some 12 to 23 hr, even when temperatures for yeast growth were most favourable.

CONCLUSIONS

The conclusions that may be drawn from the results obtained in the experiments described may be summarized as follows.

- The initial microbiological content of the raspberry fruits at picking consists mainly of yeasts that do not grow in the fruit after picking.
- The few cells present of normally fermentative yeasts multiply after the fruit is picked and cause fermentation and, eventually, loss of natural soluble substances in the juice, such as sugars.
- In the course of picking and holding in the field, the fruit may become further contaminated with large numbers of fermentative yeasts from unclean picking containers and buckets.

Clearly, the storage life of the raw fruit could be appreciably improved by ensuring that the berries are picked and held in containers that have been properly cleaned and dried before use. A further improvement could be effected by prompt cooling early in the post-harvest holding period.

Publication

PASTEURIZED CURED MEATS*

THIS report deals with the safety of lightly cooked cured meats, particularly pasteurized hams, which some microbiologists believe may present a hazard to public health.

The report critically and very thoroughly examines evidence for the presence of food-poisoning organisms in raw pork as it goes into cure, their survival during curing and cooking, and their growth during subsequent storage.

* Pathogenic Organisms in Relation to Pasteurized Cured Meats. British Food Manufacturing Industries Research Association Scientific and Technical Surveys No. 40 (1963). 158 pp. (Price: £2 stg., post free in U.K. Obtainable from BFMIRA, Randalls Road, Leatherhead, Surrey.)

The situation appears to be that food-poisoning organisms are likely to be present in raw pork, and that their elimination cannot be guaranteed by the processes of preparation of the pasteurized hams. The only real safeguard is refrigerated storage, but this is not always applied. Nevertheless, serious trouble with commercial products on this account is rare. The reasons for the discrepancy are not at all well understood, but it is probable that the modern method of rapidly introducing the curing ingredients into the tissues by brine pumping is a major factor contributing to the safety of commercial operations.

Whether this is so or not, there is need for further study of the survival of food-poisoning organisms throughout the whole process of curing and cooking.

Discussions on Food Science and Technology

DURING the second half of 1964 the Division of Food Preservation arranged two functions for the purpose of acquainting the food industry with recent developments in food science and technology.

The first, held at North Ryde on July 8 and repeated on July 9, was attended by 120 food technologists from New South Wales, Victoria, and Queensland. A welcome by the Chief of the Division (Dr. J. R. Vickery) was followed by a series of short talks on modern analytical techniques for food laboratories. The assemblage was then organized into groups which, in the course of the day, were given the opportunity to view six half-hour demonstrations of the following techniques:

- *Analysis of the fatty acid composition of oils and fats by gas liquid chromatography.*—A complete analysis of the fatty acid composition of a normal triglyceride oil or fat was carried out in about one hour.

- *Analysis of the internal atmosphere in sealed food containers by gas chromatography.*—A demonstration was given of methods of sampling and determining the composition of the atmosphere in packages made from modern flexible films. The percentages of oxygen, nitrogen, and carbon dioxide were determined in a matter of 15 minutes.

- *Thin layer chromatography.*—This recently developed technique was used for separating and identifying components of mixtures. It was pointed out that thin layer chromatography was much quicker than paper chromatography, and could be used for compounds not possessing an affinity for water.

- *Microbiological techniques.*—Demonstrations were given on the diagnosis of spoilage in canned foods and on the isolation of food spoilage micro-organisms.

- *Measurement of temperature.*—A demonstration was given of the value of thermocouples for measuring temperatures in food processing, and of the precautions needed to minimize errors.

- *Measurement of humidity.*—The visitors were shown several methods for measuring atmospheric humidity, the equilibrium relative humidity of foods, and surplus moisture on the cut surface of foods.

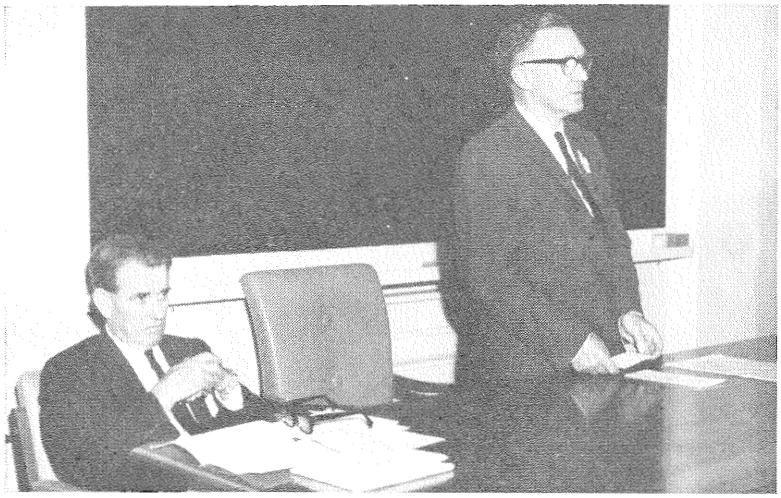
The second function, a conference at the Royal Society's Hall in Melbourne on November 24, was attended by over 60 food industry executives from the southern States of Australia. This gathering was presided over by Dr. I. W. Wark, Member of the CSIRO Executive, who in welcoming the delegates stressed the importance of quality in food products. Dr. Wark reminded his audience that the food manufacturer must seek the help of the food technologist if he wished to make the best use of existing information, but if he sought new principles and fresh methods he must turn to the scientist. A manufacturer should be an innovator, and although courage was needed to be first in the field his rewards were often commensurate with the enterprise he displayed.

Four senior members of the Division's staff gave short lectures on recent developments in food technology and their relevance to the Australian food industry. Dr. J. R. Vickery, Chief of the Division, described a

number of food-dehydration processes of potential value to Australian manufacturers. Conventional methods of drying foods with hot air were relatively slow and adversely affected the flavour of the product, and rehydration of the dried product was also far too slow by modern standards. However, food technologists in America and Europe had devised a number of improvements that had virtually removed these defects from a wide range of foods. The Western Regional Laboratory of the U.S. Department of Agriculture, for instance, had devised a process (foam-mat drying) which looked extremely promising for a range of liquids and slurries derived from fruit and vegetables. Foam-mat drying was being used commercially in U.S.A. to make lemon, orange, and tomato powders and to dry spaghetti mixes.

Dr. Vickery pointed out that it was difficult to adapt hot-air drying to food solids such as vegetable and fruit cubes and strips. There was therefore considerable interest in the patent taken out by the Eastern Regional Laboratory of the U.S. Department of Agriculture for explosively puffing solids (puff drying). Puff-dried foods reconstitute very rapidly and satisfactorily with the addition of water.

A third novel technique mentioned by Dr. Vickery was fluidized-bed drying, in which a high-speed stream of hot air is blown up through a bed of moist food, giving the bed the appearance of a slowly boiling fluid. He also referred to the Birs process, in which the drying agent is very dry air only a few degrees above ambient temperature. However, the process required high capital expenditure and therefore very large markets. High hopes had also been held out for freeze drying, in which the product temperature should not rise above 32° F; but drying rates were slow, and the production costs high. Nevertheless, it is possible that means may yet be found to accelerate drying by this process.



Dr. I. W. Wark (CSIRO Executive) speaking at the Conference on Food Science for Industry at the Royal Society Hall, Melbourne, November 24, 1964. Mr. Lionel Adams (Chairman, Australian Canned Fruits Board), seated.

Mr. J. Shipton, Senior Research Scientist, spoke on the application of the fluidized-bed principle and liquid nitrogen refrigeration to the freezing of food. He said that the use of the fluidized bed, by providing greater heat exchange efficiency, offered significant economies when compared with traditional blast freezing. Although the technique was restricted to food products susceptible to fluidization, i.e. to suspension in a vertical flow of air, it was applicable to a surprisingly wide range of foods. In addition, equipment was available which could function as either

a fluidized-bed or a blast freezer, and hence was applicable to any size or shape of product. Liquid nitrogen had attractive properties for freezing food and there were no obvious technical problems in its application, although additional data for its use with specific products were required. The extent to which it would be used was likely to be restricted only by economic considerations.

this process on fresh fish in the United States. Some processes for the destruction of insects had been shown to be technologically feasible, but were not yet used commercially. An irradiation process to prevent sprouting in potatoes had been approved and used commercially in Canada.

Dr. Scott said that a major problem with the irradiation of food arose from our

The audience at the conference.

Dr. W. J. Scott, Assistant Chief of the Division, reported on progress in the preservation of food by treatment with ionizing radiations. He said that a good deal of research had been carried out on many different kinds of food, and that it had been found that doses sufficient to provide complete sterilization usually caused appreciable changes in odour and flavour and the products were frequently not palatable. A sterilization process for canned bacon had, however, been approved by the U.S. Food and Drug Administration. Experiments with meat and fish had shown that the shelf life of the chilled product could be extended appreciably by radiation, especially when the product was stored in the absence of oxygen. There was current interest in carrying out

limited knowledge of the accompanying chemical changes. The chemical consequences of irradiation were extremely complex, even in a substance as simple as water. In substances with the chemical complexity of food, there was virtually no understanding of the chemical changes induced. Apart from reducing the dose, we had very few ideas on how to avoid undesirable changes in flavour and colour. There was certainly a possibility that harmful substances might be produced, or that desirable nutrients could be destroyed. The public health aspects had, however, received a great deal of scrutiny in several countries, and most authorities now agreed that the health problems were surmountable when controlled processes were used.

Dr. Scott concluded that a conservative appraisal of the present situation would seem to justify an outlook of cautious optimism. It was clear that the technical problems were rather more difficult than was supposed some years ago. On the other hand, some useful advances had been made, and further research could well provide better knowledge and understanding of radiation resistance and sensitivity in different types of cells. Although there was good reason to believe that further progress would be achieved, it would be unwise, on the basis of our present limited understanding, to forecast spectacular advances within the next few years.

Mr. J. F. Kefford, Senior Principal Research Scientist, lectured on food packaging. He stated that in modern food processing the package was an integral part of the preservation process. The traditional materials —tinplate and glass—showed wide versatility as a result of keenly competitive research programmes, but there remained a need for reliable techniques for predicting container performance. Flexible films were now available in great variety and in many combinations, but selection of the most economical package for optimum shelf life was a major problem for food processors. Cartons were now universally used as outer containers for processed foods and were rapidly taking over in the packaging of fresh fruits. Satisfactory out-turn of packaged foods after long ocean journeys was vitally important in the export economy of Australia.

Notes

BRITISH FOOD MANUFACTURING INDUSTRIES RESEARCH ASSOCIATION

It may not be generally known that companies outside the United Kingdom are eligible to join the British Food Manufacturing Industries Research Association.

The activities of the BFMIRA embrace an exceedingly wide range of food products. Scientific publications embodying research results are issued to its members at regular intervals, and abstracts from current world scientific and technical literature are issued monthly. In addition to its monthly journal, the Association from time to time publishes scientific and technical surveys on special problems, such as the one on pasteurized cured meats reviewed in this issue on page 60. An information and advisory service is also available to members.

Subscriptions consist of a basic £25 sterling per manufacturing company, plus a charge per "productive process employee".

The address of the registered office and laboratories of the Association is Randalls Road, Leatherhead, Surrey, England.

PERMANENT INTERNATIONAL COMMITTEE ON CANNED FOODS

The Permanent International Committee on Canned Foods—Comité International Permanent de la Conserve (C.I.P.C.)—was founded in Paris in 1938 to deal with questions of interest to countries producing canned foods. One function of the C.I.P.C. is to arrange investigations by specialist groups and another is to disseminate scientific, technical, and practical knowledge likely to be useful to the canned food industry and to related industries, such as tinplate manufacture and can-making. It also initiates action on an international level that might lead directly or indirectly to an increased consumption of canned foods. Specialist committees may choose to make proposals to a plenary meeting of the C.I.P.C., whose recommendations may be conveyed by member delegates to organizations in their own countries or to their governments.

The membership of the C.I.P.C. comprises private or official professional associations or bodies qualified to represent the canning and allied industries. The associations are mostly from Europe, but the International Tin Research Council is a member, and many organizations from countries outside Europe take a close interest in C.I.P.C. activities.

The C.I.P.C. is a private international organization with no connection in law with the governments of the countries represented. It has, however, established relations with official international bodies such as the Food and Agriculture Organization of the United Nations for the purpose of expediting the implementation of its recommendations. The C.I.P.C. has liaison officers in many countries who collect or disseminate information on its behalf. In Australia, the liaison officer is Mr. L. J. Lynch, CSIRO Division of Food Preservation, Box 43, Post Office, Ryde, New South Wales, Australia.

POLYPHOSPHATES AND CORROSION OF TINPLATE CANS

The Pure Food Acts in Australia were recently amended to permit the addition of phosphates to canned meats in amounts up to the equivalent of 0·3% P_2O_5. Polyphosphates increase the water-holding capacity of meats and so improve yield, and their use also reduces fat separation and improves texture of the meats.

Canners should be cautious in using phosphates in canned meats since severe staining and corrosion of the tinplate may result and the meat may become discoloured where it is in contact with the can. Substantial losses attributable to the use of phosphates in canned ham and meat loaf products have occurred in this country and overseas. A survey of 18 Danish factories undertaken by the Danish Meat Research Institute showed that 15 had had problems with corrosion in pork luncheon meat—nine with corrosion in mixed luncheon meat, and six with canned hams. An investigation, as yet incomplete, by the Danish Meat Research Institute has shown that phosphates accelerate the corrosion of cans and increase the risk of staining the tinplate and the product (J. E. Pedersen. The influence of polyphosphates on the corrosion of tinplate cans. Comité International Permanent de la Conserve. Madrid. May 1964).

Fully lacquered cans fitted with aluminium anodes have been developed for phosphate-cured meats, such as hams, which are stored under refrigeration. These cans are widely used in Australia and effectively control staining and corrosion, which caused heavy losses when phosphate cures were first used.

Several lots of meat-loaf-type products showing severe staining and corrosion have recently been examined in the laboratories of the CSIRO Division of Food Preservation. In extreme cases the cans were almost completely detinned and the discoloured surfaces of the product contained heavy concentrations of brown and black compounds of both tin and iron. Frequently the cans were swelled by hydrogen produced by the processes of corrosion. An investigation of the effect of phosphates on the storage life of canned meats has since been commenced in these laboratories.

NEWS FROM THE DIVISION OF FOOD PRESERVATION

PHYSICAL CHEMISTRY UNIT

The Division's Physical Chemistry Unit, which has been housed in the Biochemistry School at the University of Sydney since 1951, transferred to new laboratories at divisional headquarters at North Ryde during September 1964.

Research conducted by the Unit over the last 13 years has covered a very wide field. It has included studies on amino acid metal complexes, on the polarography of trace

elements in food constituents, and on the physical chemistry of proteins, particularly in relation to denaturation phenomena. Over the last four years the unit has concentrated on studies of the physical chemistry of muscle and egg proteins.

The equipment of the laboratories includes a refrigerated ultracentrifuge and a moving boundary electrophoresis unit.

The staff consists of Mr. M. B. Smith and Dr. R. W. Burley (Senior Research Scientists), Miss J. Back and Mr. W. J. H. Jackson (Experimental Officers), one Technical Officer, and two Technical Assistants.

APPOINTMENTS

Dr. R. K. Scopes, a Cambridge graduate who was on the staff of the Low Temperature Research Station, Cambridge, from 1962 to 1964, has joined the group in the Division of Food Preservation engaged on research on muscle biochemistry. The investigations are financed by the Australian Cattle and Beef Research Committee. Dr. Scopes, who is stationed at North Ryde, arrived in Sydney on September 3, 1964.

Miss R. A. Sherwood, who holds the B.Sc. degree from the University of New South Wales, has been appointed an Experimental Officer in the Microbiology Section at North Ryde, where she will participate in research on the heat resistance of bacterial spores. Miss Sherwood joined the Division on December 14, 1964.

OVERSEAS TRAVEL

Dr. J. R. Vickery, Chief of the Division, was overseas from August 25 to October 20, 1964. He delivered a paper entitled "The chemistry and biological effects of cyclopropenoid compounds" at a meeting of the American Chemical Society in Chicago at the beginning of September, and attended the International Conference on Radiation Preservation of Food at Boston at the end of that month. During September he also visited several of the regional research laboratories of the United States Department of Agriculture, and other research establishments. After a short visit to the United Kingdom he took part in the deliberations in Warsaw of the Executive Committee of the Second International Congress on Food Science and Technology.

Dr. W. J. Scott, Assistant Chief of the Division and Leader of Meat Research, paid a short visit to New Zealand in November for the purpose of making observations on meat research and the meat industry in that Dominion. Among the research institutions he visited were the New Zealand Meat Research Institute, the New Zealand Dairy Research Institute, the Massey University of Manawatu, and the Fats Research Laboratory of the New Zealand D.S.I.R.

Mr. D. J. Casimir, of the Division's Canned Foods Section, returned from the United States via Europe on August 11, 1964, after a period of 15 months at the New York State Agricultural Experiment Station at Geneva, N.Y., where he was attached to the Department of Food Science and Technology.

VISITORS

Dr. Louise Anderson, of the Department of Microbiology, Dartmouth Medical School, Hanover, New Hampshire, U.S.A., arrived in Sydney on September 25, 1964, to spend one year at the Division's Plant Physiology Unit, located at Sydney University.

Dr. Anderson is investigating some aspects of the biochemistry of chloroplasts and their development. Her visit was made possible by a grant from the Charles F. Kettering Foundation of Dayton, Ohio, U.S.A., which has financially supported the research on photosynthesis by Dr. R. M. Smillie, leader of the Plant Physiology Unit.

Dr. Martin W. Miller, who is an Associate Professor in the Department of Food Science and Technology, University of California, Davis, U.S.A., arrived in Sydney on December 2, 1964, to spend about seven months in Australia as a Fulbright Scholar. He will be a guest worker at the North Ryde laboratories of the Division of Food Preservation, and he will also study the dried fruits industry in the Murray Valley, the Murrumbidgee Irrigation Area, and the Young district, N.S.W.

Sources of Finance, 1963-64

THE Division of Food Preservation wishes once again to place on record its deep appreciation of the financial support accorded its work by a wide circle of contributors.

In the financial year 1963–64, expenditure from contributory sources in Australia accounted for over £47,000 of the Division's total expenditure (£481,162), the balance coming from the Commonwealth Treasury.

The following organizations made contributions towards specific researches:

Australian Canned Fruits Board
Investigations on external water damage to canned fruits
Australian Cattle and Beef Research Committee
Pure and applied research on beef quality, processing, storage, and transport
Australian Apple and Pear Board
Apple and pear storage investigations
Experimental shipments of apples and pears
Australian Egg Board
Investigations on egg storage
Australian Meat Board
Investigations at Meat Research Laboratory, Cannon Hill, Qld.
Banana Research Advisory Committee
Research on storage, transport, packaging, and ripening of bananas
Department of Primary Industry
Fruit fly sterilization investigations on citrus fruits and pears*
Metropolitan Meat Industry Board, Sydney
Muscle biochemistry investigations
New South Wales Department of Agriculture
Fruit storage investigations
Queensland Meat Industry Board, Brisbane
Investigations at Meat Research Laboratory, Cannon Hill, Qld.

In addition, no less than 68 firms from the food and related industries in Australia donated the highly creditable total of £8211 for general purposes. The Division is delighted at this generous response, and proposes to spend the contributions on equipment for research of value to the food industry.

*Central funds made up of contributions from several States and the citrus and pear industries.

Contributors to General Donations Account, 1963-64
Abattoir Construction & Engineering Co. Pty. Ltd.
Ainsworth Consolidated Industries Pty. Ltd.
Alfred Snashall Pty. Ltd.
Ardmona Fruit Products Co-operative Co. Ltd.
Arthur Yates & Co. Pty. Ltd.
Australian Consolidated Industries Ltd.
Australian Fibreboard Container Manufacturers' Association
Batlow Packing House Co-operative Ltd.
Bender & Co. Ltd.
Berri Fruit Juices Co-operative Ltd.
Blue Moon Fruit Co-operative Ltd.
Campbells Soups Pty. Ltd.
Coca-Cola Export Corporation
Committee of Direction of Fruit Marketing
Containers Limited
Corona Essence Pty. Ltd.
Cottee's Ltd.
Craig Mostyn & Co. Pty. Ltd.
Crosse & Blackwell (Aust.) Pty. Ltd.
Dark's Ice & Cold Storage Ltd.
Dewey & Almy Pty. Ltd.
F.M.C. (Australia) Ltd.
Fremantle Cold Storage Co. Pty. Ltd.
Gordon Brothers Pty. Ltd.
Gordon Edgell Pty. Ltd.
Griffith Producers' Co-operative Ltd.
Harry Peck & Co. (Aust.) Pty. Ltd.
Helix Electrical Products Pty. Ltd.
Henry Lewis & Sons Pty. Ltd.
H. Jones & Co. Ltd.
H. Rowe & Company
Intercontinental Packers Pty. Ltd.
James Barnes Pty. Ltd.
J. Gadsden Pty. Ltd.
John Darling & Sons Pty. Ltd.
John Heine & Son Pty. Ltd.
Jones Bros., Griffith, N.S.W.
Jusfrute Ltd.
J. Wildridge & Sinclair
Kyabram Preserving Co. Ltd.
Laboratory Supply & Chemical Co. Pty. Ltd.
Leeton Co-operative Cannery Ltd.
Lewis Berger & Sons (Aust.) Pty. Ltd.
Marrickville Margarine Pty. Ltd.
Northern Peargrowers Ltd.
Nugan (Griffith) Pty. Ltd.
Orange Fruit Growers' Co-operative Cool Stores Ltd.
Pick-Me-Up Food Products Ltd.
Plaistowe & Co. Ltd.

P. Methven & Sons Pty. Ltd.
Producers Cold Storage Ltd.
Prune Growers' Co-operative Ltd.
Queensland Cold Storage Co-operative Federation
Riverland Fruit Products Co-operative Ltd.
Roche Products Pty. Ltd.
Schweppes (Australia) Ltd.
Sidac (Aust.) Ltd.
Sidney Cooke Pty. Ltd.
Sou'West Frozen Food Packers Ltd.
Swift Australian Co. (Pty.) Ltd.
Taubmans Industrial Coatings Pty. Ltd.
The Nestlé Co. (Aust.) Ltd.
Tom Piper Ltd.
W. A. Ice & Cold Storage Association
W. Angliss & Co. (Aust.) Pty. Ltd.
W. G. Goetz & Sons Ltd.
W. Gregg & Co. Ltd., New Zealand
White Wings Pty. Ltd.
Winn's Food Products Pty. Ltd.

During 1963–64, the Division of Food Preservation was the recipient of grants from the United States Department of Agriculture. A grant of £46,000 over five years was made towards the cost of an investigation into cyclopropenoid compounds, which are found in cottonseed and cottonseed products. The United States Department of Agriculture also granted £8200 over three years for a study of the differences in the chemical structure of ovalbumin and S-ovalbumin.

Finally, grateful acknowledgment is made to companies and organizations which have provided facilities for experiments, made gifts of raw materials or equipment, or given financial support to the work of individuals on the Division's research staff.

Recent Publications of the Division

Copies of most of these papers may be obtained from the Librarian, Division of Food Preservation, Box 43, P.O., Ryde, N.S.W. (Telephone 88 0233.)

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* Division of Mathematical Statistics, CSIRO.