Mr Board

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Some Quality Factors in the Freezing of Peas

By

S. M. Sykes*

I. Introduction

No matter how smoothly organized a plant nor how well controlled the quality during processing and freezing, it is impossible to produce high quality frozen peas unless first class raw material is provided. In practice special attention must be given to the selection of varieties, the stage of maturity for harvesting, and the methods of handling the raw peas from field to factory.

A considerable amount of research into these problems has taken place in other countries, particularly in the U.S.A., and similar work is being carried out at the Homebush laboratory of C.S.I.R.O. It is the purpose of this article to present a summary of the latter investigations and wherever possible to discuss results in relation to existing practices.

II. Varieties

The selection of suitable varieties depends to a large extent on local growing conditions. A variety which has many of the desirable characteristics necessary for freezing may not grow well in a particular locality. By means of variety trials which take into account both the agronomic features of the variety (germination, growth habit, yield, resistance to disease and dry conditions, length of growing period, etc.), and the quality of the frozen product, it is possible to say what varieties are most promising for a particular district. These varieties must, of course, be tested over several seasons and finally on a commercial scale before their merits can be assessed.

Peas for freezing should have a uniform bright green colour. They should have a characteristic pea flavour and should retain a reasonable degree of sweetness when the pods have fully grown. When peas were first frozen in the U.S.A., the varieties used were mainly market garden types possessing these desirable qualities: They had, however, been developed specifically for hand-picking with the result that the pods matured over a period of several weeks. Consequently, when the varieties were machine harvested a single cutting gave a lower yield of peas of very mixed maturities. Canning varieties in use at the time had an unattractive grey colour and a poor flavour when frozen, but they had the desirable growth feature of producing most of their pods at the one stage of maturity and were therefore suited to mechanical harvesting. It was necessary for the freezing industry to combine this " concentrated " or " determinate " growth habit of the canning type with the desirable

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features of the market garden type. There are to-day many such varieties in commercial use, and new ones are still being developed to serve the needs of particular districts.

The shape of the pod of a variety is generally regarded as having an influence on the ease of mechanical vining. Blunt "puffy" pods break open more readily in the viner than pointed tightly-filled ones. Many of the freezing varieties possess the blunt-podded character.

In Australia the variety Greenfeast is in widespread use for market gardening, canning and freezing. Several other varieties such as Canners' Perfection and Profusion (Prince of Wales) are used by the canning industry. All of these varieties have been frozen on different occasions at Homebush. Greenfeast has proved satisfactory on the basis of quality but does not have the concentrated maturity of many of the accepted freezing and canning varieties. Canners' Perfection and Profusion have not given satisfactory frozen products because of poor colour, and possibly a slightly inferior flavour.

In a small row-trial of overseas varieties conducted in 1948 at Hawkesbury Agricultural College, Thomas Laxton, Oracle 178, Shasta, Wyola, Gradus and Wando gave high quality frozen packs. All of these varieties showed the typical intense green colour and garden-pea flavour of a good processing variety. The varieties Oracle 178, Wyola and Wando exhibited the concentrated growth habit to a marked degree, and others to a lesser extent. Hot, dry conditions occurred during the maturing of the pods and the varieties differed in the ability to grow and produce satisfactory yields. Wando, Wyola and Oracle 178 were more promising as regards yield than the other varieties. Extensive yield trials would be necessary, however, before any definite conclusions could be reached. The variety Massey Gem, which was already in use at Hawkesbury College, was included in this trial. While it failed to give a good product when frozen, the yield was somewhat better than that of the introduced varieties mentioned above.

The varieties Onward, Wyola, Multifold and Director, grown in Hobart, Tasmania, under very satisfactory soil and weather conditions, were tested in 1951. All varieties yielded very good packs of frozen peas even though two lots were harvested beyond the optimum stage of maturity. All samples had an excellent colour, and very good flavour, and retained their sweetness very well. Peas of the variety Multifold were very large, a fact which would have to be considered in relation to both size grading in the factory and a possible consumer resistance against unusually large peas.

Severe drought conditions caused the failure of a pea variety trial at Blayney, N.S.W., in 1952. It is of interest to note that the early variety Thomas Laxton gave a small yield while other varieties maturing later were almost complete failures.

Several other varieties, the frozen products of which have not been tested at Homebush, should prove satisfactory for freezing. Canner No. 75 and Canner No. 74 are promising varieties from New Zealand; Glacier, an improved Thomas Laxton type, has shown promise in field trials in New South Wales and is recommended for freezing in the U.S.A.

It will be clear that there are many pea varieties which possess the necessary quality characteristics for freezing. The ultimate commercial use will depend largely on their ability to grow and yield well in the soil and climate of each particular locality.

III. Maturity

Information from the U.S.A. suggests that peas giving a Tenderometer reading of about 95 are of optimal maturity for freezing. The laboratory determination of "alcohol-insoluble solids" (A.I.S.), which is widely used as an index of maturity in canned peas, gives a corresponding value of about 11 per cent. It has been suggested that peas should be harvested approximately one day before the optimum canning stage to give a fancy-quality frozen product (Tressler and Evers 1947). Another paper mentions the harvesting of peas at an A.I.S. value of 9·9–11·0 per cent. for experimental freezing (Lindquist, Dietrich and Boggs 1950). However, these authors found considerable variation in a number of commercial samples, the lowest A.I.S. value being 10·9 and the

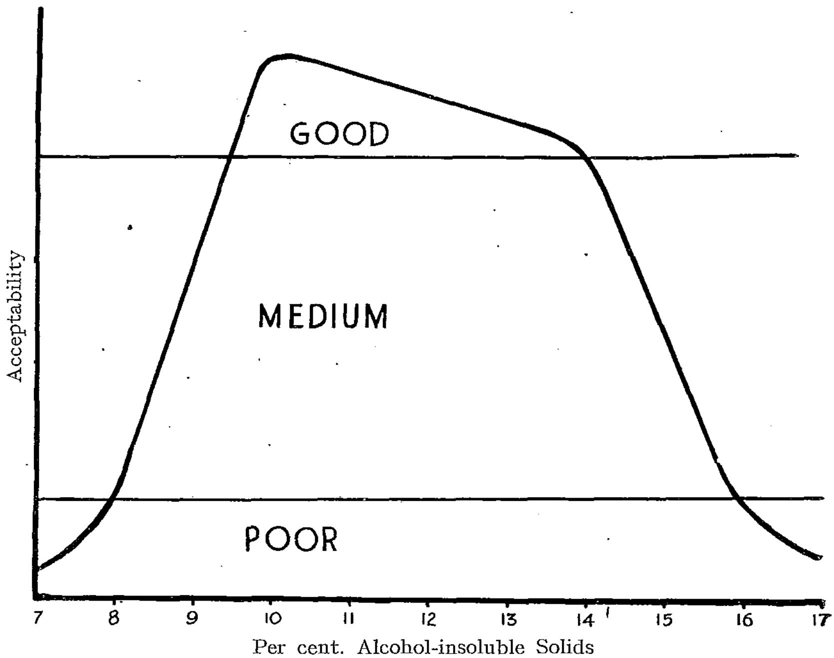

Fig. 1.—Diagram showing the relation between maturity of peas (as indicated by the percentage of alcohol-insoluble solids) and their acceptability to consumers.

highest 16·3 per cent. Results of experiments in England by Adam and Brown (1948) indicated that peas with 13–14 per cent. A.I.S. gave a good quality product, 15 per cent. gave moderate quality, and values of over 15 per cent. were associated with inferior quality. The stage of maturity at which peas should be harvested for freezing depends to a large extent on the preference of the consumer. However, consumer reaction tests are difficult to conduct and, unless the data obtained are carefully analysed, misleading results may be obtained.

At the Homebush laboratory in 1951 a small test on cooked samples of frozen peas of various maturities was carried out with a panel of 35 persons selected at random from the laboratory staff. Tests of the tenderness of the peas had been made at the time of processing with the

C.S.I.R.O. Maturometer (Lynch and Mitchell 1950), and A.I.S. determinations had been carried out on canned material from each lot of raw peas.

Indications from earlier work at Homebush were that peas harvested at a slightly more advanced maturity than the 11 per cent. A.I.S. level suggested in literature from U.S.A. gave a very satisfactory frozen product. In the 1951 test it was found that peas in the range of 10–14 per cent. A.I.S. were regarded by tasters as highly acceptable. Peas with a value of 10 per cent. were preferred slightly to peas at the 14 per cent. level, but the difference was not significant. The acceptability dropped sharply when values rose above 15 per cent. Samples below 10 per cent. were not included in the tasting tests but their acceptability would probably have fallen off sharply below about the 9 per cent. level because of the poor appearance, texture and flavour associated with immature peas. Figure I shows schematically the relation between consumer acceptance and maturity of peas, as derived from the 1950–51 experiments described above and from other sources.

It would appear therefore that peas with A.I.S. values between 10 and 14 per cent. should yield a frozen product of good quality. The aim should be to approach the higher maturity level because of yield considerations but, in view of the marked decrease in acceptability when values rise above 15 per cent., a margin of safety is necessary in practice. It is, therefore, suggested that a value of 12 to 13 per cent. should be the objective in commercial freezing operations. For a sample having 12–13 per cent. A.I.S. the equivalent Tenderometer and C.S.I.R.O. Maturometer readings are 103–110 (approx.) and 243–276 (approx.) respectively.

A crop of peas may be harvested at a stage when the A.I.S. value of the mixed sample is higher than 12–13 per cent., following which a proportion of over-mature peas can be removed (by size grading or in brine) to bring the bulk of the peas within the correct maturity range. The objective of 12–13 per cent. A.I.S. refers to graded peas which are about to be processed.

The A.I.S. range of 10–14 per cent. for frozen peas agrees closely with the 11–14 per cent. range suggested for canning peas by Lynch and Mitchell (1950).

This work on frozen peas is of an exploratory nature : a considerable amount of investigation has yet to be undertaken.

IV. Handling

The deterioration of raw peas during vining, transport and handling has received considerable attention in recent years. Boggs, Campbell and Schwartze (1942 and 1943) found that vining toughened the skins and cotyledons of frozen peas, that delay between vining and freezing further toughened the skins, and that most of this deterioration occurred during the first four to six hours of delay. Washing of the peas lessened, but did not prevent toughening of the skins. For the same period holding at 55° F. gave less toughening of the skins than holding at 75 °F. The development of off-flavour has been shown by several workers to be caused by the combined effects of mechanical bruising and delay before processing (Makower and Ward 1950, Talburt and Legault 1950, and Makower, Boggs and Burr 1952).

The industry is also well aware of the hazards of transporting and holding peas before freezing, and in practice special precautions are taken to minimize the delay between vining and processing, and if necessary to provide for the pre-cooling and cool storage of the raw material.

Investigations on the problems of holding peas before freezing have been proceeding at Homebush for the past three years. A brief description of the experiments and a summary of the results are given below.

(*a*) 1949–50 *Experiment*

Pods of the variety Greenfeast were harvested by hand at three stages of maturity. Each maturity lot was divided into several batches which received different handling treatments before and during processing as shown in Table 1. Tasting tests on the cooked frozen samples were conducted after storage for six months at 0° F. and the results were analysed statistically. The mean scores for the qualities " skin texture ", " absence of off-flavour " and " true pea flavour " are given in Table 1.

(i) *Skin Texture.*—With all three pickings mechanical hulling resulted in a skin texture which was slightly inferior to that of hand-shelled peas. With hulled peas a delay of two hours before blanching gave a significantly poorer skin texture. A similar delay after blanching had no effect. (With one lot there was an apparent improvement in skin texture but this difference was probably due to some variation in the material.) Holding hulled peas for 20 hours or longer under crushed ice gave a definitely poorer skin texture in all lots. Storage of peas in the pods at 32° F. for 24 hours had a slight effect on skin texture. Any differences between equivalent samples of unstored and stored samples were always in favour of the unstored material. The effect of maturity differences on the different handling methods was not examined statistically in this experiment. There did appear to be a gradual toughening of the skin with increased maturity and this fact might have caused delays in handling to have less pronounced effects with the latest picking.

(ii) *Absence of Off-flavour.*—Scores for " absence of off-flavour " showed effects common to material from all three pickings. Mechanical hulling of itself produced no off-flavour, but, when peas were delayed before blanching for two hours at 70° F. after hulling, a definite off-flavour resulted, the scores being significantly lower for all three maturity lots. A corresponding delay after blanching had no significant effect in the second and third pickings but produced a significant lowering of the score in the first picking. This latter effect may have been due to some chance variation in processing or tasting techniques. Holding the peas at 32° F. for 20 hours or more produced a definite off-flavour. Holding peas in their pods for 24 hours at 32° F. did not appear to have any effect on the development of off-flavour although the two hour delay before blanching had a much more pronounced effect after storage of the pods.

(iii) *True Pea Flavour.*—In general the various effects of hulling and delays on off-flavour development were reflected in the scores for " true pea flavour ". This may have been due, to some extent, to the difficulty of allotting entirely independent scores for these two factors. Hulling may have had some direct effect on pea flavour. There was a significant lowering of score for the third picking, an almost significant lowering of score for the first, and no effect in the second.

(*b*) 1950–51 *Experiment*

In this experiment, closer attention was given to the effect of pre-cooling and holding under refrigeration. The procedure was similar

TABLE 1

Effect of Handling Procedure on Quality of Frozen Peas

Code	Date of Picking	Delay Before Hulling	Method of Hulling	Delay		Mean Taster Scores*		
				Before Blanch	After Blanch	Skin Texture	Absence of Off-flavour	True Pea Flavour
PL1	21.10.49	Nil	Hand	Nil	Nil	4·00	3·78	3·59
PL2	,,	,,	Machine	,,	,,	3·56	3·75	3·09
PL3	,,	,,	,,	2 hr. at 70° F.	,,	2·63	2·56	2·22
PL4	,,	,,	,,	Nil	2 hr. at 70° F.	3·22	2·75	2·41
PL5	,,	,,	,,	96 hr. at 32° F.	Nil	1·88	1·53	1·72
PM1	24.10.49	Nil	Hand	Nil	Nil	3·55	3·83	3·11
PM2	,,	,,	Machine	,,	,,	3·19	3·67	3·11
PM3	,,	,,	,,	2 hr. at 70° F.	,,	2·86	2·89	2·45
PM4	,,	,,	,,	Nil	2 hr. at 70 °F.	3·62	3·79	3·23
PM5	,,	,,	,,	20 hr. at 32° F.	Nil	2·03	1·82	2·33
PM6	24.10.49	24 hr. at 32 °F.	Hand	Nil	Nil	3·50	3·75	3·13
PM7	,,	,,	Machine	,,	,,	2·95	3·75	2·85
PM8	,,	,,	,,	2 hr. at 70° F.	,,	2·56	1·88	1·84
PM9	,,	,,	,,	Nil	2 hr. at 70° F.	2·94	3·66	2·94
PM10	,,	,,	,,	20 hr. at 70° F.	Nil	2·49	2·06	2·12
PN1	27.10.49	Nil	Hand	Nil	Nil	3·31	3·81	3·44
PN2	,,	,,	Machine	,,	,,	2·84	3·75	2·81
PN3	,,	,,	,,	2 hr. at 70° F.	,,	2·12	1·75	1·59
PN4	,,	,,	,,	Nil	2 hr. at 70° F.	2·81	3·97	3·22
PN5	,,	,,	,,	20 hr. at 70° F.	Nil	1·62	1·06	1·06

* After 6 months at 0° F.

Scoring scale: 5 points—Excellent.
3 ,, —Satisfactory.
1 ,, —Very poor.

3 ,, —Satisfactory.
1 ,, —Very poor.

TABLE 2

Effect of Handling and Pre-cooling Procedure on Quality of Frozen Peas

Code	Date of Picking	Method of Hulling	Delay before Blanching		Method of Pre-cooling (P) and Holding (H)	Mean Taster Scores*		
			At 70° F.	At 32° F.		Skin Texture	Absence of Off-flavour	True Pea Flavour
PS1	21.11.50	Hand	Nil	Nil	—	3·94	4·06	3·88
PS2	,,	Machine	2 hr.	,,	—	3·44	3·22	3·22
PS3	,,	,,	1 hr.	1 hr.	P-water at 32° F. H-water at 32° F.	3·34	3·22	3·22
PS4	,,	,,	1 hr.	3 hr.	,, ,,	3·19	3·16	3·22
PS5	,,	,,	1 hr.	5 hr.	,, ,,	3·03	2·78	2·75
PS6	,,	,,	1 hr.	22 hr.	,, ,,	2·59	2·69	2·34
PT1	23.11.50	Hand	Nil	Nil	—	3·68	3·55	3·21
PT2	,,	Machine	2 hr.	,,	—	3·25	3·36	3·07
PT3	,,	,,	Nil	2 hr.	P-water at 32° F. H-dry at 32° F.	3·21	2·82	2·77
PT4	,,	,,	Nil	4 hr.	,, ,,	2·95	2·77	2·64
PT5	,,	,,	,,	6 hr.	,, ,,	2·82	2·36	2·30
PT6	,,	,,	,,	71 hr.	,, ,,	2·25	1·32	1·36
PU1	27.11.50	Hand	Nil	Nil	—	2·89	3·61	3·18
PU2	,,	Machine	2 hr.	,,	—	2·83	3·33	3·14
PU3	,,	,,	Nil	2 hr.	P-water at 32° F. H-iced at 32° F	2·81	3·06	2·67
PU4	,,	,,	,,	4 hr.	,, ,,	2·81	2·86	2·61
PU5	,,	,,	,,	6 hr.	,, ,,	2·75	2·64	2·60
PU6	,,	,,	,,	22 hr.	,, ,,	2·58	2·14	2·12

* After 6 months at 0° F.
Scoring scale: 5 points—Excellent.
3 ,, —Satisfactory.
1 ,, —Very poor.

to that in the previous experiment. Details of preparation and the results of tasting tests on frozen samples are given in Table 2.

(i) *First Picking.*—In the case of the first picking (Code PS1–6), holding for periods of one to six hours gave very little change in skin texture or off-flavour, but significantly lowered the score for " true pea flavour ", probably because of leaching of soluble flavour constituents. A holding period of 22 hours at 32° F. gave a significant lowering of scores for all factors. The machine-hulled peas delayed at 70° F. for two hours were equal to the best of the pre-cooled material.

(ii) *Second Picking.*—With the second picking (Code PT1–6), the same method of pre-cooling, followed by holding for two hours at 32° F., gave a significantly poorer product than the lot held for the same time at 70° F. Longer holding at 32° F. caused a gradual decrease in scores for off-flavour and also for " true pea flavour ". Holding for 70 hours gave a product of very inferior quality.

(iii) *Third Picking.*—The maturity of the third picking (Code PU1–6) was noticeably more advanced than the previous two lots and the changes due to holding at 32° F. were less significant. The same downward trend was observed for increased periods at 32° F. Again, the scores showed that for a period of two hours, the material held at 70° F. was superior in " true pea flavour " and not significantly different in the other two factors from peas held at 32° F.

(c) *Conclusions from Handling Experiments*

These experiments indicate that the deterioration in skin texture and flavour of mechanically hulled or vined peas is dependent on the period and temperature of holding. Delays before blanching are critical and a period of two hours may have a pronounced effect on quality. Delays of two hours after blanching had little, if any, effect on the quality factors observed. However, delays after blanching are to be avoided because of the danger of growth of bacteria.

Pre-cooling, and holding at 32° F. do not completely prevent deterioration. For short periods, holding in water or ice at 32° F. may actually result in poorer quality than holding at room temperature. For longer holding periods, for example 20 hours, it appears that some form of pre-cooling is necessary.

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C.S.I.R.O Publications

LIST OF PUBLICATIONS

C.S.I.R.O. has put out a new edition of the list of publications which have been issued by the Organization and its predecessors from 1916 to 1951.

The works listed include handbooks and monographs, journals, bulletins (numbering 266), pamphlets (a total of 115), and circulars and publications by the Divisions (such as the Food Preservation Quarterly). Copies of the list may be obtained from the Commonwealth Scientific and Industrial Research Organization, 314 Albert Street, East Melbourne, C.2, Victoria, Australia.

ANNUAL REPORT, 1950–51

The third Annual Report of C.S.I.R.O. (for the year ending 30th June, 1951) has been issued by the Government Printer, Canberra (price 9s. 6d.). In an introductory section the report explains that C.S.I.R.O. was established on the nineteenth of May, 1949, when the Science and Industry Research Act 1949 was proclaimed. Under that Act the Organization took the place of the Council for Scientific and Industrial Research, which, in turn, had in 1926 taken the place of the former Institute of Science and Industry.

Under the heading " Food ", the report devotes about eight pages to an account of research being undertaken by the Division of Food Preservation and Transport, the central laboratories for which are at Homebush, New South Wales. Mention is also made of investigations on dried vine fruits by the Commonwealth Research Station (Murray Irrigation Areas) at Merbein, Victoria, and on dairy products by the Dairy Research Section, Melbourne, Victoria.

Readers concerned with food production will find much to interest them in the portions of the report devoted to soils, plants, irrigation, animal health and production, sheep, cattle and fisheries.

You Need a Laboratory*

By

DONALD D. MCKAY

Most food manufacturers have imagined or envisaged a perfect factory which contains gleaming machinery operated by white coated attendants, turning out thousands of cans or packages. The factory is bright, airy and attractive in every respect. Somewhere in that factory is a laboratory. That laboratory is the control room for the whole factory and possibly for the whole organization. If this is not the case, it certainly should be.

The laboratory keeps the management out of trouble—trouble with irate customers and trouble with the government on pure food law charges. The laboratory also does constructive work—work on new products, developing new avenues of business, co-ordinating the various functions of the plant, and making them work smoothly together. The laboratory may not be seen from outside the plant, but it is here that the control is carried on.

The laboratory is not an expense, but rather an investment. Let us review some of its activities to test that statement. The general functions of a laboratory fall into two categories : (*a*) control, and (*b*) research. The control work can be considered under three headings : first, examination of incoming raw materials ; second, the determination of various stages of work in progress (for example how much acid is taken up by vegetables in pickle making, or how much water is present in jam) ; third, the examination of the finished product (does it meet the specifications which have been set up for all finished goods, and may it be sent out and sold?).

Control work is very important. It can check to see the manufacturer does not pay too much for his raw materials by buying water or air at high prices ; that he does not buy something already spoiled ; that he really gets what he believes he is buying ; that the material delivered is identical with the buying sample. The control laboratory provides a check that during the process of manufacture the changes in the product are taking place as expected ; that the product, when completed, has the required amount of salt, sugar, water, or other ingredients (which can be determined by analysis), tastes right, and will keep.

There are certain standards set up by the pure food authorities which must be adhered to. You must not allow too much arsenic to go into your product from spray residues, use too much benzoate to keep your pickles, have too much sulphur dioxide left in your fruit juices or marmalades. The control laboratory in this case keeps the management out of jail and reduces the possibility of confiscation and destruction of the offending products. This means much routine analysis which must be done and done accurately. Management is usually happy to have this done, and does not hesitate to pay for it.

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* Reprinted, with permission, from *Canadian Food Industries* (1951), 22 : (2), 25

Many believe that the function of the laboratory ends here. It does not.

There is the realm of development to be considered. This fits into the general classification of research and may embrace many scientific and other facts which have no apparent immediate application to the business. Examples are the preparation of a table of solubilities of a new compound, or of a table of heat transfer in a new material which is to be processed by heat; examination of the apparent constants thought necessary for normal operation of the process; and analytical methods connected with the method of manufacture which will provide a better end-product or result.

There are many projects in the sales and advertising departments that can be carried out by this part of the laboratory. Suppose you want a package for a product so you may sell a certain volume or weight. The chemist can figure this out and find from the container company what stock size can be used. Again, a product is not selling well. Could it be that a change in colour would make it more attractive? The laboratory can advise whether this is possible.

The laboratory man is able to meet the technical people of the suppliers on their own ground and provide benefit for his employer from mutual understanding. It is not suggested that the raw material vendors are not willing and anxious to furnish information, but they can be more useful if they deal with someone who speaks the same scientific language.

Production research covers a wide field. First, the improvement of existing processes; second, the devising of new products or methods: both of these often with the co-operation of the engineering department.

If the improvement or change is of a chemical nature, then of course the laboratory has to take on this work. Very often the specialized knowledge that the technologist has is a great help in making a change that the purely practical man knows nothing about.

The laboratory can be a great help on maintenance problems. Could the oil used be bettered? Is there scale forming in certain pipes? What can be done about it? What is the nature of the scale? How can the condition be corrected? What about the compounds that are used for cleaning? Are they effective? Are they harmful? Are we using a detergent for cleaning cans that does not etch or spangle the tinplate? Are our floors, machinery, windows and conveyor belts clean enough? The laboratory chief often can find out what to do in these cases. He and his staff have no hesitation tackling very simple and homely problems. Scientific knowledge can be applied to improve the operations of the firm in many ways: and each job done means a return on the laboratory investment.

There are new products to be developed. In some laboratories they have new products, or some variations of existing ones, on tap as it were, to bring out whenever the sales department is ready for something new. The laboratory is always watching for something new that can be made and sold. This new product development can be very profitable. Most of the desirable specialties were once novelties. No question can be raised of the value of this activity. It is something that pays, and if the product is successful, it goes on paying.

Inquiring into the economics of a laboratory, it can be seen that the laboratory can have a marked effect on the business, and therefore, should be an essential part of the enterprise just as much as the accounting, sales, advertising or shipping departments.

What it will actually cost you to set up and staff a laboratory will depend entirely on the size of your operations and the amount of work you will allow it to do.

What do you spend on laboratory determinations now ? Have you had to hire a consulting food technologist, and if so what has that cost you ? What new efficiencies would you expect the addition of laboratory staff to provide. Can you estimate the savings ? Have you had products condemned that might have been satisfactory if adequately checked in process ? Would improved quality result from better control during process, and how much more in business and profit would that mean ? These are but a few of the considerations which must be taken into account before determining the importance, size and scope of your laboratory.

Some activities are apt to be intermittent in time and value, but great value may be obtained from others. I remember one job of development which occupied a month. The new product which resulted paid about 30,000 dollars in net profit, figured over three years. Sometimes the return on these projects will be nil. This is the hazard of conducting work of this kind. In spite of this, however, those concerns maintaining laboratories continue to maintain them and spend money on them. The inference is that they produce a return commensurate with the expenditure on operation.

In conclusion, the laboratory has important work to do, work that is essential to the various departments of a manufacturing organization. The following benefit : production, engineering, sales, advertising, even accounting. It is evident that a department that is in touch with all others, mostly in vital matters, is important ; and conceivably can be a key factor in the organization. This is a department which should be encouraged and cherished by top management. A study of many large corporations shows this to be true. It can also be true for a smaller manufacturer. He should have a laboratory and he should let that laboratory grow with his business. It will give him an intelligent control of his whole operation. In this way the laboratory is not an expense to the business but a vital part of the administration.

Answers to Inquiries

KEEPING PEA VINERS CLEAN

Question: What procedures are recommended for keeping pea viners clean?

Answer: It is recommended that each viner be cleaned after 3 or 4 days' use—more frequently if the vines are wet.

First remove side boards. It is important to keep turn-buttons in operative condition: do not nail side boards in place as is sometimes done. Next remove the screens, then scrape off accumulated material from the side boards, paddles, frame work, apron and screens.

Do not re-assemble until the following day.

Cleaning should be carried out according to a programme. At a four-viner station, for example, one viner should be cleaned each day. This will require the time of two men after vining operations cease for the day, and again for a short time before starting the next day's operations.

It is interesting to note that several American States lay down sanitary standards for the viners as part of their regulations covering the sanitation of canning plants.

The above suggestions on methods of cleaning are from *The Canner*, to which grateful acknowledgement is hereby made.

CANNING OF NECTARINES

Question: Is it possible to can nectarines satisfactorily?

Answer: Quetta and Goldmine nectarines have been successfully canned in the Food Preservation Laboratory at Homebush, using the following technique:

Peeling—the fruit may be canned unpeeled or peeled: in the latter case the skin may be removed by hand after immersion in boiling water for one to three minutes.

Packing—the fruit may be packed whole or in halves.

Container—1 lb. tall plain can.

Fill-in Weight—10 to 11 oz.

Syrup—35° Brix, filled hot.

Exhaust—steam flow closure, or a short exhaust.

Process—20 minutes in boiling water, followed by water cooling.

BORON DEFICIENCY IN BEETROOT

Question: (i) What symptoms are to be observed in beetroot (both fresh and canned) grown in soils deficient in boron? (ii) How may the soil deficiency be overcome?

Answer: (i) The symptoms of boron deficiency in beetroot may be internal, external, or both.

The internal symptoms in the raw beet take the form of spots which are irregular in size, shape, and location, and hard or corky in texture. The spots may be confined to the central regions or to the periphery, or they may be scattered throughout the root. They are most conspicuous between the prominent rings of thick-walled vessels formed by the activity of the secondary cambium zones in the pericycle. The spots are very difficult to see in the cut beet before processing, but they become black in colour and therefore clearly visible in the canned product.

External symptoms are dark spots on the root, usually on the part of greatest circumference. As the root increases in size the spots around the periphery frequently develop into large holes or cankers following desiccation and shrinkage of the dead tissue.

Leaf symptoms are often the best means of detecting the disease in the field. The youngest leaves are the first to show the disease. They become distorted, often one-sided, and commonly longer and narrower than normal leaves. The affected leaves die early and drop off: new ones develop similarly then die, forming a rosette of dead leaves. The affected leaves may also be a much deeper red colour than normal leaves.

(ii) Boron occurs naturally in nearly all soils, but owing to chemical, bacterial, or physical action it may not be available to the plant. For instance, it is readily available in soils which have been highly limed, but not in soils containing little lime. Boron deficiency may also be due to leaching by water.

In U.S.A. it has been found that the application of borax at a rate of 40–60 lb. per acre in boron-deficient areas is effective in reducing the blackening of beets to a minimum. The borax may be mixed with the fertilizer and applied in bands 1½ in. to the side of and at the same depth as the seeds. Broadcasting may also be used. Significant increases in beet yields of up to 25 per cent. have been reported from land treated with 60 lb. of borax per acre. As the deficiency disease is difficult to detect in the raw material many American canneries specify fertilizing with borax in their grower contracts.

Some articles on this disease are:

Borax Consolidated Ltd. (no date).—Boron in Agriculture, pp. 21–29, Leatherhead, Surrey.

Walker, J. C. (1939).—*Phytopathology* 29: 220–228.

Walker, J. C., Jolivette, J. P., and McLean, J. G. (1938).—*Canning Age* 19: (13).

Walker, J. C., Jolivette, J. P., and McLean, J. G. (1943).—*J. Agric. Res.* 66: 97–123.

Canned Dog Food

Question: What are the main constituents of canned dog food, and how may it be prepared?

Answer: The materials generally used in dog food are meat (horse meat or waste meat from the slaughter house), cereals (such as unpolished rice), charcoal, cod-liver oil, and sometimes other products. Not all of these materials, of course, are used in every dog food. The simplest formula calls for a mixture of ground meat and cereal, frequently mixed with unpolished rice. The meat and rice may be mixed in various proportions, but a typical recipe is:

Ground meat	60–70 lb.
Dry, unpolished rice ..	about 8 lb.
Water	sufficient to make 100 lb. of mixture.

A more complicated formula is:

Ground meat	50 lb.
Water	42 lb.

Charcoal	.. ..	$\frac{1}{2}$–1 lb.
Cod-liver oil	.. ..	1–2 pt.
Cereal	.. .. ..	6–8 lb.

The cereal in this case may consist of rice, barley and wheat bran (or whole wheat).

Sodium nitrite is sometimes added in the proportion of $^1/_{10}$ oz. per 100 lb. of mixture, for the purpose of giving a redder colour to the meat.

The procedure for preparation is as follows: the cereal and water are placed in a steam jacketed kettle or a container provided with a perforated steam pipe. The mixture is boiled for a short time. The meat and other materials are then added, thoroughly mixed, and the heating is continued. The mixture when cooked is filled into cans while still hot.

On a large scale the filling is best done by means of a commercial filling and can-closing machine. The temperature of the contents after filling should be 170°–180° F. 303×509 cans (21 oz.) should be processed for about 70 minutes at 230° F., and then cooled with water.

On account of the starch in the cereals, the product will be considerably thicker after processing than when filled into the can. The amounts of cereal and water should therefore be adjusted to secure the desired consistency.

News from the Division of Food Preservation

Plant Physiology Unit, Sydney University

Among the branch laboratories of the Division of Food Preservation and Transport is the Plant Physiology Unit operated in conjunction with the Botany School, University of Sydney. This was officially opened on the fifth of June, 1952.

The Division of Food Preservation has collaborated closely for some years with the Botany School in research into plant physiology and biochemistry: the provision of special laboratory facilities will give opportunities to extend the co-operative work.

The opening function was attended by the Vice-Chancellor of the University of Sydney, Professor S. H. Roberts, and the Chairman of the Executive of C.S.I.R.O., Dr. I. Clunies Ross, and by other representatives of the University and of C.S.I.R.O. Professor Roberts said that the University welcomed this further expression of the good relations between itself and C.S.I.R.O. Dr. Clunies Ross referred to the value of bringing workers in similar fields together and thanked Professor Burges, the Professor of Botany, for taking the initiative in suggesting the joint arrangement. Dr. J. R. Vickery, Chief of the Division of Food Preservation and Transport, said that one of Australia's greatest needs in agricultural research was a supply of properly trained research workers in biology. It was hoped that the Unit would not only carry out research of value to primary industry but also provide a post-graduate training centre for plant physiologists and biochemists.

The work of the Unit, which will be under the joint supervision of Dr. F. V. Mercer, University of Sydney, and Dr. R. N. Robertson, C.S.I.R.O., is co-ordinated with research already in progress on fruit storage and transport; the latter research is a tribute to successful collaboration by the University of Sydney, the C.S.I.R.O. and the New South Wales Department of Agriculture. The work of the Unit will be concerned largely with plant physiology and biochemistry, basic to the problem of keeping fruit in store. In the two-way traffic of ideas between academic and applied research, the one stimulates the other. This has been exemplified recently by the history of investigation of fruit size in relation to storage behaviour. The storage work of W. M. Carne and D. Martin in Tasmania showed that large apples are more susceptible to low temperature break-down than small apples, and further that apples of a certain size from a light crop are more susceptible than apples of the same size from a heavy crop. These observations stimulated the plant physiologists of Food Preservation Division to investigate the physiology of size in apple fruits, and the results of these academic investigations in turn suggested a new line of work to Mr. Martin, who now has an hypothesis to account for the difference in storage behaviour between large and small fruits and between fruits from light and heavy crops.

All the present work of the Unit is in the field of plant cell physiology and can be summarized under four headings: the nature of the cell surface, the organization of the cytoplasm with special reference to particles within cells, the mechanism of respiration, and the physiology of growth in fruits. Progress in new methods of fruit storage depends on a better knowledge of the growth and behaviour of plant cells. This will be obtained only by research.

In addition to two members of the Botany School, and four research officers, two technical officers and three assistants of C.S.I.R.O., the Unit has started with two graduates on research studentships and two honours students of the Faculty of Agriculture. It is hoped that the work of the Unit will attract others.

Conference on Pea Canning

C.S.I.R.O. arranged a conference on pea canning in Melbourne on June 11–12, 1952, for the purpose of conveying to pea canners the results of recent researches by the Division of Food Preservation and Transport. The conference was attended by canners, representatives of three State Departments of Agriculture, and research workers of C.S.I.R.O.

In opening the conference the Chairman of C.S.I.R.O. (Dr. I. Clunies Ross) emphasized the need for improvement in texture, flavour and colour of canned peas.

Papers were delivered as follows:

Pea Seed Production: R. Pryse-Jones (Gordon Edgell & Sons, Bathurst, N.S.W.).

Pea Seed Varieties: T. D. Raphael (Tasmanian Department of Agriculture).

Analyses of Growing Pea Crops: R. S. Mitchell (C.S.I.R.O., Division of Food Preservation and Transport).

Prediction of Optimal Harvest Date of Pea Canning Crops: L. J. Lynch (C.S.I.R.O., Division of Food Preservation and Transport).

Mr. Lynch outlined a method of predicting the optimal harvest date of a pea crop. A sample is taken according to a set procedure, and after thorough mixing its Maturometer Index (which indicates its degree of maturity) is determined by the Maturometer devised by C.S.I.R.O. The next step is to use a circular rule (the Maturometer Predictor), from which the number of days to maturity may be found.

The new method has been the subject of a letter to *Food Technology* (Vol. 6 : 24, 28, 30), and will also be described in a C.S.I.R.O. publication.

PERSONAL

Mr. D. Martin, Officer-in-charge of the C.S.I.R.O. Tasmanian Regional Laboratory, and Mr. J. F. Kefford of the Division of Food Preservation have accepted membership of the Scientific and Technical Committee of the Federation Internationale des Producteurs de Jus de Fruits, which is an international body organized to promote the production and consumption of fruit juice beverages and to encourage research in all aspects of fruit juice technology.

RECENT PUBLICATIONS BY THE STAFF

(1) Volatile Products of Apples. I. Identification of Acids and Alcohols. By Adrienne R. Thompson (1951).—*Aust. J. Sci. Res.* B 4: 283–292. II. Production of Volatile Esters by Granny Smith Apples. By Adrienne R. Thompson and F. E. Huelin (1951).—*Aust. J. Sci. Res.* B 4: 544–553.

As there is evidence that volatile substances given off to the atmosphere by apples are responsible for superficial scald, a functional disorder of cold-stored fruit, a systematic study of these volatile substances was undertaken.

Part I describes methods for the identification of the acids and alcohols. The volatile substances given off to the air by Granny Smith apples at 20° C. were condensed at low temperature. By conversion to hydroxamic acids, followed by chromatographic separation on paper, the acids were identified as formic, acetic, propionic, butyric (probably normal), valeric, and caproic. All these acids were shown to be present in the esterified form. Formic and acetic acids were shown to occur in both the free and esterified forms. All these acids do not necessarily occur in every sample of volatiles. For instance, formic acid has been found in some samples but not in others. The alcohols obtained on saponification were found to be predominantly primary and saturated, and the major constituents were found to be methanol, ethanol, and *n*-propanol. Ethanol and *n*-propanol were identified by paper chromatography after conversion to hydroxamic acids and methanol by a specific colour test.

Part II describes how Granny Smith apples were stored at 0° C., and samples removed at intervals for determination of volatile ester production at 20° C. In early removals ester production at 20° C. increased to a maximum and then decreased. In later removals the increase was much less and finally became negligible. Ester production at 0° C. appeared to increase steadily. Early picking reduced ester production and a higher rate of air flow increased it. Reducing the oxygen concentration to six per cent. first increased and then decreased ester production in comparison with air. The metabolic significance of the results is discussed.

(2) Studies in the Natural Coating of Apples. I. Preparation and Properties of Fractions. II. Changes in the Fractions during Storage. By F. E. Huelin and R. A. Gallop (1951).—*Aust. J. Sci. Res.* B 4: 526–532, 533–543.

The natural coating of apples is of importance in the physiological behaviour of the fruit as it forms the major barrier to diffusion of water vapour and other gases. The preparation and properties of the main fractions of the natural coating of Granny Smith apples are described in Part I. These include the oil, wax, ursolic acid and " cutin " fractions. Particular attention was given to the oil fraction, which contains unsaturated esters; and the cutin fraction, which gives complex hydroxy acids on saponification. The use of ammonium oxalate for separating apple skin is described. Methods are given for quantitative determination of the coating fractions, and their distribution in the cuticle and epidermis is discussed.

During storage of Granny Smith apples (described in Part II), every fraction of their natural coating changed, but particularly the oil fraction, which increased to 3–4 times its original concentration. Other fractions increased slightly after prolonged storage. Apples picked later had a higher oil content. The iodine number of the oil increased with increasing concentration. " Gas storage " of the apples reduced the increase in the oil fraction. The fatty esters of the oil fraction were produced most rapidly at the beginning of storage. Later the production of these non-volatile esters declined, while the rate of production of volatile esters increased. There was no definite correlation between the oil content and the resistance of the skin to gaseous diffusion, although both increased during storage.

(3) Some Implications of Recent Theoretical Work on Canning Processes. By E. W. Hicks (1952).—*Food Tech., Champaign* 6 : 175–178.

The heat treatment of canned foods must be sufficient to destroy organisms which could grow in the can and cause spoilage or endanger the health of consumers. The amount of heating required must depend on the resistance to heat of the spores present in the pack, and on the rate of heat penetration into the contents of the can.

New approaches to the evaluation of canning processes have recently been suggested by Stumbo, Gillespy and Hicks. The basic principles adopted by all three workers are identical, and the differences in detail are not great. The development of these ideas involves rather elaborate algebra and a somewhat intricate set of definitions and terminology. In these details the three papers are all different and all are difficult to read. In the note mentioned above Mr. Hicks attempts to outline the basic ideas, giving no more algebraic details than are absolutely necessary, and discusses the practical implications.

Reprints of the papers abstracted above are available on application to The Librarian, C.S.I.R.O., Division of Food Preservation, Private Bag, Homebush P.O., or by telephoning UM 8431.