Mr Rooney

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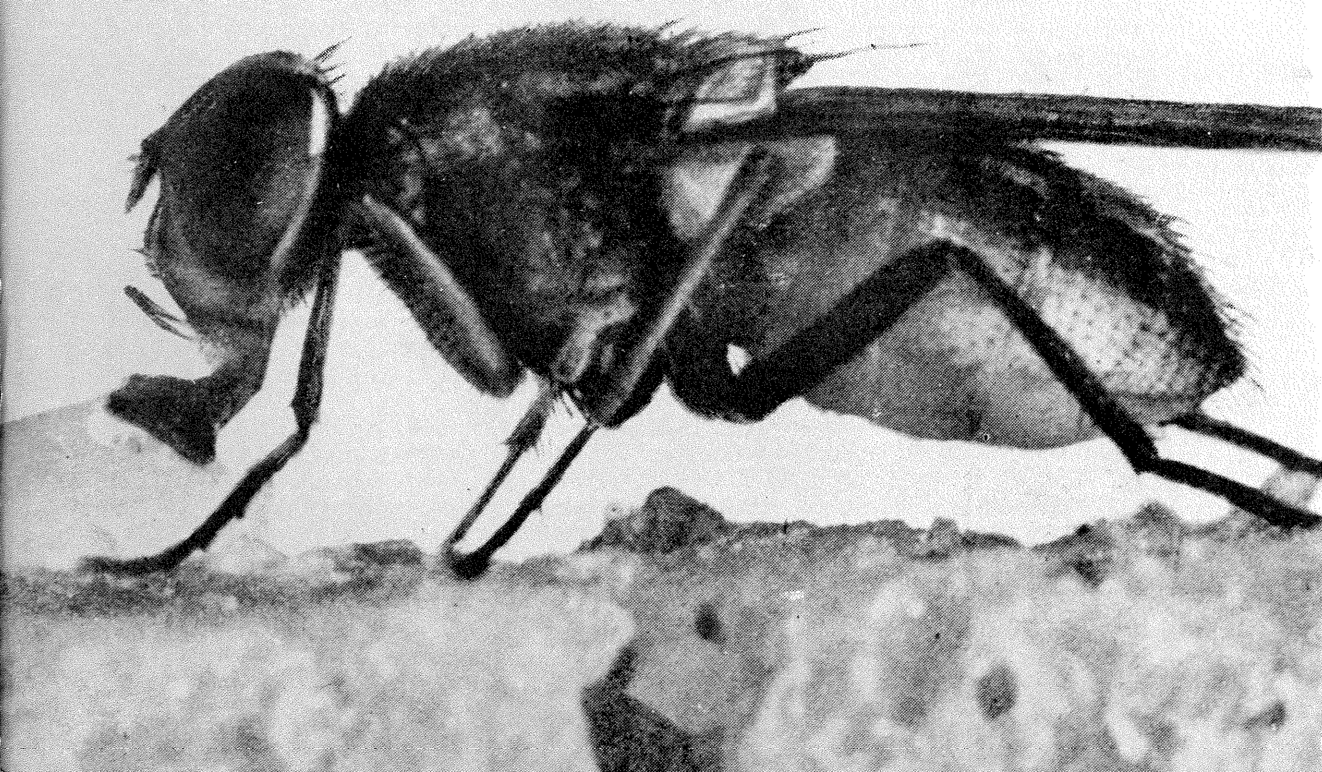


Fly control in food industries

By P. L. Thomas

CSIRO Division of Food Research, Cannon Hill, Qld.

Flies are capable of transmitting a number of diseases to man by contaminating his food. The bacteria on a single house fly may number as many as five million. Thus the presence of flies in a food-processing plant is a potential health hazard. Flies may also be regarded as a good indicator of the efficiency of waste disposal and general sanitary standards in much the same way as the presence of faecal coliforms is used to judge the potability of water supplies. The presence of large numbers may result in the intervention of local public health authorities or of the inspection officers from overseas countries importing produce from the plant, with consequent loss of prestige, loss of export permits or, in extreme cases, prosecution.

Whenever fly control is attempted, the techniques employed should utilize all of the information available about the life cycle, habits and idiosyncrasies of the particular species involved. Such knowledge is more important than a knowledge of insecticides, which should be regarded as having the potential only for providing a temporary respite without lasting benefit, unless the chemicals are used in an integrated control program.

Life cycle

The common house fly, *Musca domestica*, has a life cycle typical of that for most flies that cause concern to the food industry. It starts life as a tiny cream-coloured egg, about the size of a small grass seed, which is deposited by a female fly in moist organic material. Under optimum conditions it hatches within 24 hours as a transparent legless maggot.

On the fourth day under warm conditions it changes to a creamy white colour. The maggot, which is then fully fed, crawls away from its feeding place and burrows into the ground. There it becomes inactive, the skin darkens and hardens to form a chestnut brown pupal jacket, and the transformation into a fly begins.

Three to six days later the end of the puparium is burst by the juvenile fly which then emerges. Tunnelling upwards, it comes out into the light, and as soon as its wings have dried and stiffened it is ready for its 3 weeks or more of active life.

From egg to adult takes between 10 and 21 days depending on climatic conditions, and the young fly is ready for mating after 1–2 days. The female, provided she has found suitable nourishment, will lay the first batch of 100–150 eggs within 1 week of mating. Further batches can be laid on alternate days until a total of about 600 have been produced. Depending on regional variations in climate, 10–15 generations occur each year. The female fly endeavours to lay her eggs where the larvae will have the best chances of survival. The house fly maggot will feed on many types of moist garbage and human or animal excreta as well as on a wide variety of food used by man or animals. Consequently, in the course of her activities filth and food may be visited in quick succession by the adult fly. Hence the threat which the house fly poses as a vector of disease.

Other flies with close similarity to the house fly, and which may be of concern near food-processing plants, are the bush fly (*Musca vetustissima*), stable fly (*Stomoxys calcitrans*), and buffalo fly (*Haematobia exigua*) which are of particular importance near meatworks and animal-holding yards; *Fannia* spp. (*canicularis, australis, scalaris*), the lesser house flies, which are commonly associated with poultry droppings; and *Muscina stabulans*, the false stable fly which breeds in vegetable refuse.

Also of concern are the blow flies. The most common of these during summer, *Calliphora augur*, is able to eliminate the egg stage of the life cycle and produce live maggots. This is the brown blow fly with a blue blaze, the female of which, on impact with a car's windscreen, leaves a mass of

Air curtains

It is sometimes claimed that air curtains will exclude insects and dust as well as prevent the ingress of warm air into controlled temperature rooms. Unless particular care is taken in designing the curtain, it is likely that either it will not be very effective in excluding flies or else the draught will carry away, by entrapment, excessive amounts of the air at the specified temperature. Work at the Meat Industry Research Institute of New Zealand has shown that horizontal draughts are more effective than vertical down-draughts as insect barriers and that a jet velocity increasing linearly from 15 m/s for a 0·6 m opening to 27 m/s for a 3 m opening will positively repel flies. Such curtains would probably be most suitable in frequently used external doorways where they would serve to prevent entry of both insects and dust, and also act as an exhaust fan.

Fans

Positive air pressure maintained by filtered fans or direct draughts may assist in discouraging entry by flies, but this method is only practical in specific limited situations.

Chemical insect repellents

Some chemicals such as di-n-butyl succinate are reasonably effective when sprayed around loading docks, windows and doorways. However, costs would be too high for routine use. Spraying with a residual insecticide is likely to be a more effective measure if the chemical is applied to external surfaces on which insects may land when attempting to gain entry.

Lighting

There has been some suggestion that yellow lights are less attractive to insects than white lights of equal candle power. The evidence for this is not sufficient to lustify a recommendation to install such jighting for the principal purpose of discouraging flies. There is better evidence to suggest that yellow, high-pressure sodium lamps are more satisfactory than white lights for meat inspectors to work under, and if yellow lighting were introduced for this or other similar reasons some additional benefit could be had from a possible reduction in insect numbers particularly if night-flying insects such as moths, mosquitoes and beetles are also a problem.

Destruction of flies

Electrocuters

Insect electrocuters, equipped with attractant lights and placed in darkened rooms, are effective (Fig. 2). They are probably most useful for trapping any insects which do get into working areas, particularly if switched on for a period after the normal working lights have been extinguished.

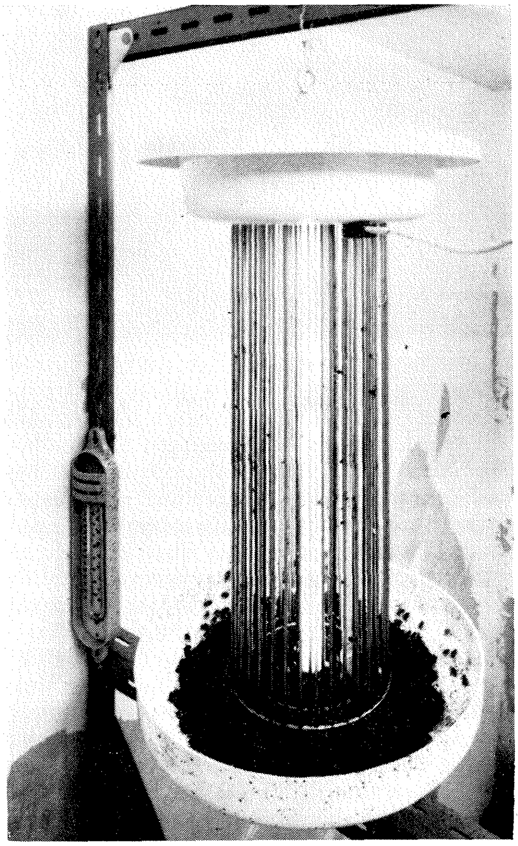


Fig. 2. Insect electrocuter with attractant light.

Non-residual insecticides

In areas where edible products are exposed, and in packaging-material stores, only sprays of non-residual 'knockdown' insecticides, which introduce no risk of tainting the product, are permitted. The activity of some insecticides, and particularly, though not exclusively, those based on pyrethrum can be greatly enhanced by the addition of a small amount of a second chemical called a synergist. Piperonyl butoxide is the most widely used synergist. Its presence in a formulation increases the speed of the insecticidal effect and reduces the amount of the principal ingredient required. Insecticide formulations based on synergized pyrethrin or a synthetic pyrethroid are usually the only materials permitted for use in rooms where food is processed. Synergized pyrethrin sprays should contain less than 1% of synergist unless the product is dispensed as an aerosol spray from an adequate fogging device. Edible product should be removed while spraying is done and equipment must be covered.

With a suitable insecticidal mist or by means of fog generators the space being treated can be filled quickly. The actual spraying time rarely exceeds 10 minutes, but depends on the cubic capacity of the space concerned. A further 10 minutes should be sufficient for all insects to be knocked down. Following the use of such sprays, all surfaces likely to come into contact with any edible product must be thoroughly flushed with hot water, equipment should be inspected to ensure that no flies have found their way under the covers, and all dead and dying flies must be collected and removed or washed away.

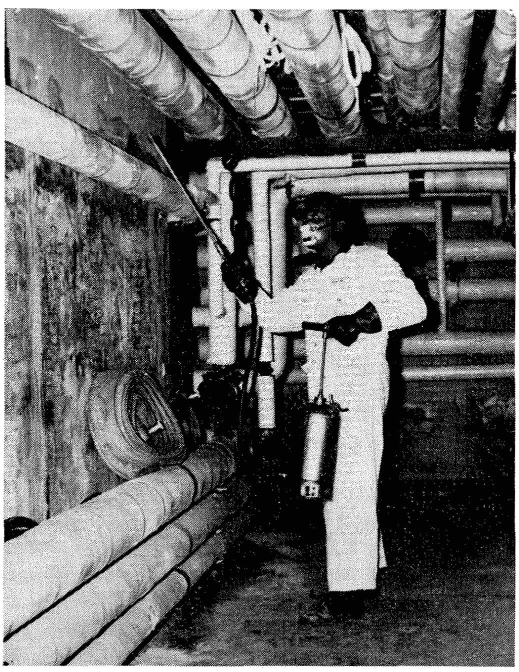


Fig. 3. Pneumatic spray for applying residual insecticide to surfaces.

Fig. 4. Hand-operated dust applicator. This and the long lance in Fig. 5 are particularly useful for depositing insecticide in corners, crevices and other inaccessible places.

Residual insecticides

In areas where neither edible materials nor packaging materials are exposed, residual insecticides may be used (Fig. 3). These are applied by spraying all surfaces—walls, ceilings and fixtures—to the point of run-off. During the summer, weekly spraying may be necessary, but if a regular program is started earlier, monthly treatments may suffice in areas where the surfaces are not washed down or wiped. As part of this program, care should be taken to spray into all otherwise inaccessible areas where cockroaches may congregate (Fig. 4). Offices, canteens and changing-rooms should be included in any fly control program. Poor control in these areas can give visitors an adverse impression as they may assume that all other areas will have a greater number of flies. Neglect of an area will also negate any effort to promote awareness of hygiene among employees. In canteens the same sprays should be used as those recommended for food-processing areas. When required, it is best to spray canteens after meal breaks.

Equipment for applying residual materials should be purchased thoughtfully. A motorized pump and a telescopic lance (Fig. 5) will enable a thorough job to be done with minimum labour, time and effort.

The chlorinated hydrocarbon insecticides such as DDT, methoxychlor, lindane, chlordane, aldrin and dieldrin are no longer generally recommended for use in any part of a food-processing plant even where residual materials are permitted. Resistance has in any case diminished their effectiveness, although in a few instances, e.g. chlordane for controlling ants, their use may still be justified.

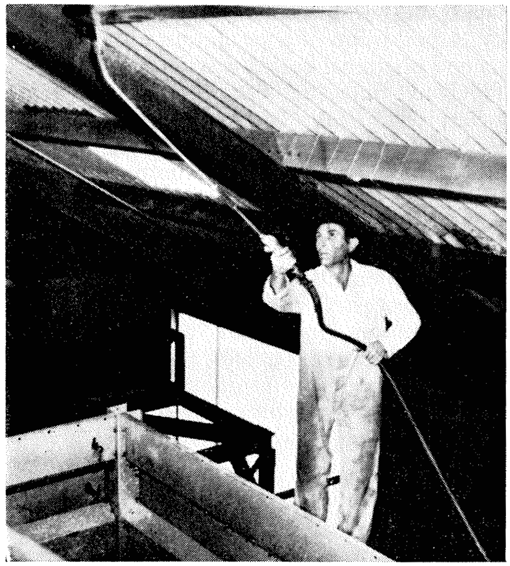


Fig. 5. Telescopic lance.

Residual insecticides

Common name	Some trade names	Name used in in U.S. approved list	Type
carbaryl	Sevin	carbaryl	carbamate
chlorpyrifos	Dursban	Dowco 179	organophosphate
diazinon	Neocid, Neocidol, Nucidol	diazinon	organophosphate
dichlorvos	Vapona, Nuvan, Nuvanol, Mafu, Flyoleen, Cheksall	dichlorvos	organophosphate
dimethoate	Rogor, Perfekthion	dimethoate	organophosphate
fenchlorphos	Ronnel, Korlan, Nankor, Lanokil	Ronnel	organophosphate
fenthion	Baytex, Lebaycid	Entex	organophosphate
maldison	Malathion	Malathion	organophosphate
propoxur	Baygon	Baygon	organophosphate
trichlorphon	Dipterex, Klorfon	Dipterex	organophosphate
chlordane	Chlordane, Chekpest	chlordane	chlorinated hydro-carbon
lindane	Lindane, Gammexane, Gamaphex	lindane	chlorinated hydro-carbon

The residual compounds shown in the Table are authorized in slaughtering and processing plants operating under U.S. inspection programs for poultry, meat, rabbit, egg and fish products (U.S.D.A. 1974).

Baits

Sugar-based baits effectively control house flies in some plants, but frequently the entire site is so attractive that baits have no special allure. Formulations which have been approved by the U.S. Department of Health (1973) for use around food-processing plants (but not in rooms where food is processed) contain diazinon, dichlorvos, Malathion, naled, Ronnel and trichlorphon. Made up as liquids, these pesticides should be sprayed or applied with a watering can onto solid surfaces. Some commercial baits are available labelled for use in dairies and food-processing plants including canneries, food stores and warehouses. All powdered or granular baits must be coloured.

Commercial names and recommendations

Many insecticides and insecticide formulations are best known by their trade names. All labels are required to show also the approved common name of the active ingredients. Examination of a label will show whether any of the materials mentioned here are included. A statement of the percentage content of active ingredients is also required. Do not use any product if the label does not give this information. The instructions printed on labels and included in pamphlets issued by insecticide distributors are approved by State Departments of Health in collaboration with such bodies as the Australian Department of Agriculture and the National Health and Medical Research Council. They should be strictly followed. If there is no recommendation for the use of a particular product in a particular way, it should not be used in that way.

New materials and new directions for use are being approved continually. More may be available next summer. Reputable pest-control operators will provide information on new products as they are introduced.

It must be emphasized that the use of insecticides in any situation where flies are able to escape after contact will select for insecticide resistance. It should be expected that, whichever insecticide is chosen for present purposes, the degree of control will decline as the proportion of resistant flies in the population increases, and that the resistant flies will have some degree of cross-resistance to the alternative insecticides. Reliance on insecticides alone must be avoided. All other methods of combating flies should also be emphasized.

Personnel

The application of insecticides in and around food-processing plants is a specialized task. It should not be left just to anyone who has a little spare time. Every plant should have a trained operator responsible for all insecticidal applications or a commercial operator should be employed to assist, at least in planning a program. Some of the principal insecticide manufacturers and pest control companies have excellent advisory facilities and State Departments of Agriculture or Primary Industries and Health will also assist.

This article has been concerned almost exclusively with flies. Problems with moths and moth larvae, beetles and beetle larvae, weevils, mites, cockroaches and spiders may also need solving by someone with a knowledge of insecticides and how to use them, in addition to some basic knowledge of the pest. There are considerable advantages in having someone on the spot who is able to deal with all of these pests before they become a major problem in any particular food-processing plant. It is necessary to get away from the idea that all insects are flies and can be dealt with in the same way. Losses from the predatory effects of other pests on raw materials and finished goods in some sectors of the food industry may have much greater economic significance than losses from flies. All require control by a combination of overall cleanliness and good housekeeping, knowledge of the pests, and the judicious use of chemicals.

Acknowledgment

The photographs were supplied by Rentokil Pty Ltd.

References

United States Department of Agriculture (1974). List of Chemical Compounds Authorized for Use under USDA Meat, Poultry, Rabbit and Egg Products Inspection Programs. Animal and Plant Health Inspection Service, USDA. MPI-8.

United States Department of Health, Education and Welfare, Center for Disease Control (1973). Public health pesticides. *Pest Control* **41** (4), 18.

Maximum permitted concentrations of sulphur dioxide (p.p.m.) in some foods

Food	NH & MRC (Aust.)	Qld	N.S.W.	Vic.	Tas.	S.A.	W.A.	Britain
Brewed soft drink	115	115	115	114	115	71	60	70
Cabbage (dehydrated)	1500	1500	1500	1500	1500	1000	1500	2500
Carrots (dehydrated)	1000	1000	1000	1000	1000	500	1000	2000
Cheese mixture	300	300	300	300	300	N*	300	—
Cheese paste	300	300	300	300	300	286	300	—
Cider	100	71	200	71	120	240	100	200
Club cheese	300	300	300	300	300	N	300	—
Concentrated fruit juice	600	600	600	600	571	571	600	350
Cooked manufactured meat	260	257	260	257	260	257	257	—
Cordials	230	230	230	229	229	229	229	—
Cordial bases (when diluted as instructions)	230	230	230	229	229	229	229	—
Essences	230	N	230	N	N	N	228	—
French beans (dehydrated)	750	750	750	N	N	N	750	2000
Fruit drink	115	115	115	115	115	228	115	—
Fruit flavoured drink	115	115	115	115	115	228	115	—
Fruit juice drink	115	115	115	115	115	228	115	—
Fruit juice	115	115	115	115	115	228	115	—
Gelatine	1000	1000	1000	1000	1000	1000	1000	—
Glucose syrup	300	285	285	285	285	N	285	—
Green peas (dehydrated)	1000	1000	1000	1000	1000	500	1000	2000
Low calorie jam	285	N	N	286	N	285	286	—
Luncheon cheese	300	300	300	300	300	N	300	—
Perry	100	71	200	71	43	80	100	200
Pickles	750	714	714	714	750	700	700	—
Potatoes (dehydrated)	500	500	500	500	500	N	500	550
Potatoes, raw (whole peeled or sliced)	50	50	N	N	50	N	50	50
Potted cheese	300	300	300	300	300	N	300	—
Sausages and sausage meat	525	500	525	500	525	500	500	450
Silverbeet (dehydrated)	1500	1500	1500	1500	1500	1500	1500	2000
Soft drinks	115	115	115	115	115	114	115	70
Solid glucose	300	286	286	286	286	N	286	—
Syrups and toppings	230	230	230	229	229	229	229	—
Uncooked sausage meat in a casing	525	500	525	500	525	500	500	—
Uncooked sausage meat not in a casing with not more than 85% meat	525	—	525	500	525	—	—	—
Uncooked sausage meat not in casing	—	500	—	—	—	500	500	—
Vinegar (except wine vinegar)	25	N	N	N	N	N	25	—
Wine	350	450	350	450	350	350	350	450
Wine vinegar	100	N	N	N	N	N	25	70
Also the following foods for which there are no NH & MRC standards:								
Ale, malt ale, beer, malt beer, stout								
(*a*) free sulphur dioxide	—	29	29	29	29	29	29	—
(*b*) total sulphur dioxide	—	71	71	71	71	71	71	70
Crystallized pineapple	—	286	N	N	N	N	N	—
Dried fruit	—	3000	3000	3000	3000	3000	3000	2000
Maraschino or cocktail cherries	—	286	N	N	N	N	N	—

*N, not permitted.

Polyunsaturated ruminant products

By Kerry A. Aicken*

CSIRO Division of Food Research, North Ryde, N.S.W.

An article based on a talk given at the AIFST Convention in Sydney in mid 1974.

Many readers will be aware that CSIRO recently developed a practical method for increasing the level of polyunsaturated fatty acids in ruminant animals by feeding them a protected polyunsaturated supplement (*CSIRO Fd Res. Q.* **33**, 69–70 and **34**, 61–5). As a consequence of this discovery, Dalgety Agri-Lines Pty Ltd have undertaken commercial development of polyunsaturated ruminant products under licence from CSIRO. This article reviews the history of the project and the nutritional and technological properties of the new animal products.

History

For many years workers in several fields looked for a practical way of increasing the polyunsaturation of body fat and milk in ruminant animals to levels comparable to or better than those of monogastric animals such as rabbits, horses, pigs and indeed humans. Two main lines of research were developed. The CSIRO Division of Dairy Research developed a method of encapsulating droplets of butter oil in casein for spray drying to produce a free-flowing powdered butter. The Division of Animal Physiology found that by treating proteins with formaldehyde, the sulphur-rich amino acids could be protected from microbial attack in the first stomach or rumen of cattle and sheep. Their subsequent digestion in the fourth stomach or abomasum was found to be similar to monogastric digestion of unprotected amino acids. By combining the oil encapsulation process and the formaldehyde treatment, scientists discovered that droplets of polyunsaturated oils could be coated with proteins such as casein which in turn could be protected by treatment with formaldehyde. Later it was found that oilseed–casein mixtures after emulsification and formaldehyde treatment yielded products containing protected droplets of oil.

The protected feed supplements may be eaten in the usual way by the animal and they pass through the rumen without the oil being hydrogenated by the rumen microflora (Fig. 1). The protected protein encapsulating the lipid is then broken down at the lower pH of the abomasum and the polyunsaturated oil is digested and absorbed as in a monogastric animal. By feeding cattle, sheep or goats a mixture of

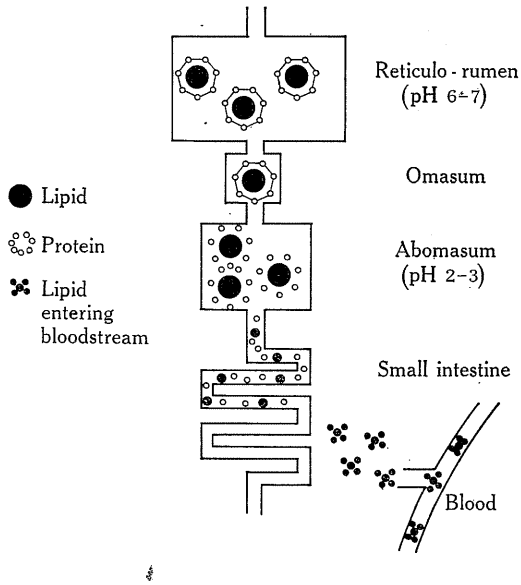


Fig. 1. Diagram of the processes involved in the digestion of protected lipid feed supplements by ruminant animals.

* Present address: Mauri Bros & Thompson Research Laboratories, North Ryde, N.S.W., 2113.

conventional feed and protected polyunsaturated supplements for some weeks, the level of polyunsaturated fatty acids, particularly linoleic acid, in the meat and milk of the animals may be markedly increased. In order to be effective this procedure must be used in conjunction with lot feeding or bail feeding.

Composition and potential uses

It is expected that the main consumers of these new products will be people who have heart disease or are considered to be at risk. The roles of saturated fatty acids, triglycerides and cholesterol in heart disease are still being hotly debated in medical circles; here it will be enough to say that there is sufficient evidence to support the view that a proportion of the saturated acids in the average Australian diet should be replaced by polyunsaturated fats.

At this point a comparison of the composition of Alta* foods with that of some other relevant foods is of interest. The much discussed P/S ratio of margarines is defined as the ratio of the percentage of polyunsaturated fatty acids (mainly linoleic acid) to the percentage of total saturated fatty acids. The monounsaturated fats are termed 'neutral' by nutritional experts and are thought to be neither beneficial nor deleterious and are therefore not considered in the ratio. The accompanying table shows the content of saturated fatty acids and of linoleic acid, the main polyunsaturated acid, in three groups of foods of particular interest. It should be pointed out that the cholesterol level is similar in both Alta and conventional foods.

Medical workers at the Australian National University, Canberra, have conducted several clinical trials in which volunteers ate conventional diets, Alta-substituted diets and modified-fat diets. Their serum cholesterol, triglycerides and other parameters were monitored over periods ranging from several days to many weeks. The conclusions drawn from these trials were:

- Substitution of Alta products for conventional ruminant products is a useful means of lowering the plasma cholesterol concentrations in the general population.
- For hypercholesterolaemic patients the substitution of Alta foods would probably increase adherence to prescribed diets and decrease the feeling among the patients that they were unduly restricted in the consumption of ruminant products.
- Far stricter dietary changes and other treatments are required for more severely hyperlipidaemic patients.

Production of supplement

The supplement currently being produced in Australia is a casein–sunflower seed supplement which contains approximately 10% casein and 2% meat meal. Whole sunflower seeds, sodium caseinate and meat meal are augered into a mixing tank together with metered amounts of water and 3·5M caustic soda solution (Fig. 2). The slurry is then passed through a plate mill and a Fryma carborundum mill. The resulting emulsion is pumped to an enclosed cylindrical mixer and formalin is added.

Fatty acid status of some foods

Food type	Saturated fatty acids (%)	Linoleic acid (%)	P/S ratio
Conventional ruminant products	60	3	0·05
Alta ruminant products	40	20	0·5
Polyunsaturated margarines	20	42	>2 by legal definition

*Trade name of Dalgety Agri-Lines Pty Ltd for the new product.

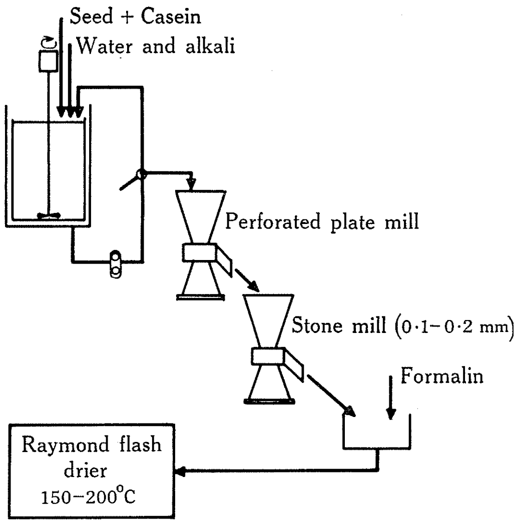


Fig. 2. Flow diagram for the production of protected lipid feed supplement.

After a short mixing time the material is passed to a holding tank and then augered to the flash drier. The resultant supplement has a crumbly texture and is reasonably free flowing. Its micro-structure is shown in Fig. 3. Work has so far been concentrated on casein–sunflower seed but further work is being done on other protein–oilseed combinations to determine whether better and/or cheaper supplements can be produced.

The stability of the supplement in storage varies with equilibrium relative humidity and, probably, with other factors. Provided good processing and handling practices are maintained there should be no problem with mould growth. Rancidity appears to be checked for at least three months, possibly by the large amounts of tocopherol in the oilseeds. The usefulness of the supplement in increasing the polyunsaturation of the animal meat and milk is largely dependent upon how well the oil is protected by the formaldehyde-treated protein as it passes through the rumen. The level of protection is measured empirically by observing the action of sheep-ruminal fluid on the supplement; other methods such as extractability of fats are being investigated.

Animal husbandry

It is envisaged that lean animals will be finished on the supplement because of the more rapid elevation of linoleic acid in their meat and depot fats. Friesian steers are being considered in preference to the popular Hereford with its substantial fat cover, and lambs in a condition considerably below prime will be used. Consequently the meat, as well as attaining higher levels of polyunsaturation more quickly, will have only a light fat cover and this has the advantage of reducing the total fat intake.

A minimum of 20% linoleate has been suggested for Alta foods on the basis of

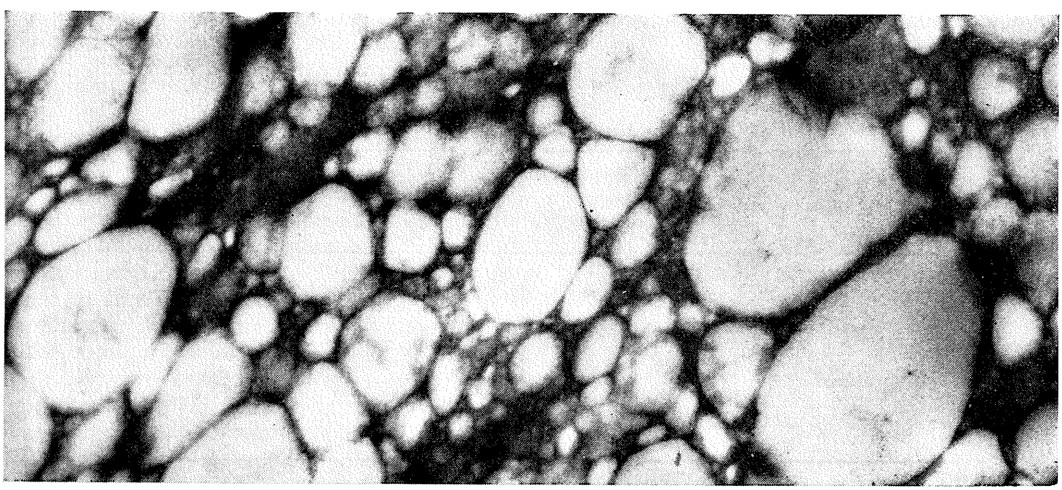


Fig. 3. Microstructure of feed supplement showing droplets of oil encapsulated in a protein matrix.

technological feasibility, and because this level gives useful reductions in serum cholesterol. Steers require approximately 10 weeks and lambs approximately 5 weeks to attain these levels. The progress of the animals is currently being monitored by biopsy of tail-head fat samples which are then evaluated by gas–liquid chromatography for fatty acid composition. It is hoped that by the time the meat is being grown commercially enough will be known about feeding regimes and changes in physiology to permit this practice to be dropped. A quick quality control method is being investigated for use in the abattoir to determine whether or not the carcass has attained the desired level of linoleate. Fig. 4 shows the types of change produced in fatty acid composition of three tissues in steers.

The production of polyunsaturated dairy

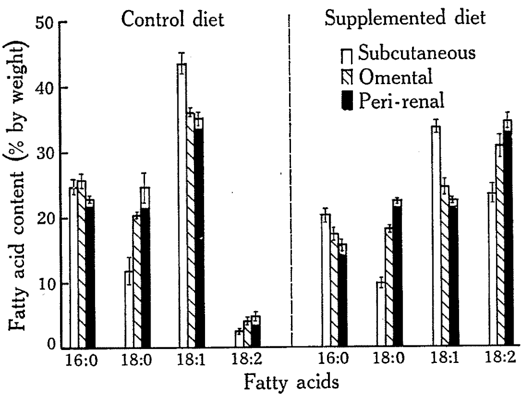


Fig. 4. Fatty acid composition of three tissues from steers fed a conventional diet and a diet containing protected lipid supplement.

products involved long-term feeding of lactating cows. Work is continuing on the physiology of these animals but results obtained so far show that yields of milk and protein are comparable with yields from cows on a conventional diet and there is an increase in the level of butter fat.

Quality of Alta foods

The fat in Alta beef and lamb meat is softer and more oily than that in conventional meats. The flavour of Alta beef is more bland and tends to be somewhat chickeny. Our taste panels have found the meat to be very acceptable but they prefer conventional beef when given a choice. Most tasters agree that they would easily grow accustomed to Alta beef. Until now, however, Alta lamb has been a problem. Although the leaner cuts have been considered acceptable by some outside tasters, our own more critical tasters have rated the lamb well down in flavour. It also gives off a peculiar odour during cooking which is considered very objectionable by many of our staff and their families, although many others cannot detect the odour. The reason for this difference between beef and lamb has not yet been satisfactorily explained, although the volatiles concerned have been identified as a C12 gamma unsaturated lactone and a decadienal. Readers who are experienced with sensory evaluation techniques will appreciate the difficulties which arise from subjective terminology and varying personal sensitivity to odour and flavour stimuli.

Storage trials of the meats have indicated that their satisfactory storage life, as measured by development of rancidity, is similar to that of pork.

Some work has been done on the canning of these meats. There appear to be no problems in preparing and processing the products with conventional equipment; in the trials so far, beef products appeared to be satisfactory but in the processed lamb the low-rated flavour has been a serious shortcoming.

High levels of polyunsaturation increase the risk of autoxidation of milk fat. If precautions are taken to remove copper from the milking equipment the milk from most cows remains stable to oxidative rancidity after pasteurization for about a week without the addition of antioxidants. There is appreciable cow-to-cow variation, so the use of antioxidants is necessary to ensure a reasonable storage life of milk and other dairy products. Although tocopherol and β-carotene had been found useful as antioxidants in milks with low levels of copper, in practice the more powerful and generally used BHA together with the emulsifier Tween-80 would be used. This has raised some interesting legislative problems, the outcome and implications of which will no doubt be closely watched by many industry groups.

Dairy products made from Alta milk

include butter, a variety of cheeses, icecream, yoghurt and cream. The yoghurt and icecream are considered to be highly satisfactory. Some modification in the technology of butter production is necessary, however, since Alta cream churns to butter within 2 minutes in a conventional churning process and this complicates the control of the distribution of salt and moisture. This problem has been overcome by reducing the temperature of churning. A phase-inversion process is being investigated whereby the cream is concentrated by separation to about 80% fat, the salt solution is added and the mixture shock-cooled on a swept-surface heat exchanger to cause phase inversion. Processing variables may be modified for varying fatty acid compositions and good butters have been produced in this way. The flavour of the butter is considered very acceptable. The spreadability is dependent on fatty acid composition and temperature; butters with about 20% linoleic acid are easily cut, without fracturing, at $-3°C$ but tend to become runny at temperatures of about 20° and oil off above 25°. Alta butters are therefore more easily spreadable than conventional butter at low temperatures. There are several ways by which the plasticity range of Alta butter may be expanded but marketing, economic and legislative problems will probably determine its future.

Acceptable cheeses of the Cheddar, Cheedam, Gouda, Brie and Camembert types as well as Cream Cheese have been produced. It is thought that cheeses will probably be the most likely outlet for Alta milk because there are currently no polyunsaturated cheeses marketed in Australia. Processed milks, custards and bakery products based on Alta materials have also been made successfully.

Many readers are no doubt thinking at this point that direct blending of vegetable oils would be a considerably easier and more controllable method of making many polyunsaturated dairy products; it is not possible, however, to make cheese from vegetable oils, and the flavour of such blended products is usually not as attractive. Also, of course, there would be legislative problems. The technology of most of these products is well known and some of them are already being produced commercially, and work is continuing on others.

There is one final point I wish to discuss. Some people have raised doubts about the safety of feeding polyunsaturated diets to humans. CSIRO feels that there is no substantial evidence of a hazard but because we are dealing with what amounts to a range of new foods we are carrying out feeding trials with several kinds of experimental animals. The Alta products are being fed as part of what is essentially a human diet; the foods are homogenized and freeze-dried in cubes which are stored under nitrogen at $-30°C$ until fed to the animals. No problems have been found so far in any of the trials which, of course, are being continued.

Food science and technology abstracts

As from 1 October 1974 the CSIRO Information Service has been providing selective dissemination of information from computer tapes of *Food Science and Technology Abstracts*. The service is available to members of the food science and technology community at large, at a charge of $30 p.a. per user profile. Further information may be obtained from Mr C. Garrow, Manager, CSIRO Information Service, 314 Albert Street, East Melbourne, Vic. 3002.

Rapid uniform warming of cannery pears*

By R. A. Parsons, E. C. Maxie, F. G. Mitchell and Gene Mayer

University of California, Division of Agricultural Sciences,
Berkeley, California, 94720.

Pears in a simulated bin were warmed for ripening from — 1° to 20°C in 15 min and then for 25 min with air at 43° being forced through the bin at flow rates of 2 and 1 l s^{-1} kg^{-1} respectively. Pears held for up to 2 h in the warm rapid air flow were not adversely affected. Pears ripened to processing firmness in 3–4 days when warmed to 20° in 4 h or less. Fruit delayed in warming from 1 to 7½ days was delayed in ripening in almost direct relation to the time required to reach 20°. Slow warming resulted in uneven ripening with soft and hard fruit in the same bin. The concept of a warming tunnel to attain uniform ripening and allow a processor to program a precise schedule for canning is suggested.

Bartlett pears stored and subsequently ripened in bins often show extreme variation in their degree of ripeness at the time of processing, with both hard and mushy fruit within the same bin. Unless care is taken to ensure prompt, uniform warming, the time required to attain the ideal ripening temperature of 15° C may vary by as much as 5–7 days between the most and least accessible fruit within a bin. This study developed a method for rapid and uniform warming of Bartlett pears and compared its effect with that of delayed warming on rate of ripening and fruit quality.

A 610-mm-deep box lined on the sides with foam padding and with approximate inside dimensions of 330 mm square was used to simulate a vertical core of fruit in a pallet bin. The bottom was vented like a bin with two 13-mm-wide slots across the bottom.

The box was filled with about 43 kg of pears and placed on a fan chamber to draw (or force) air through it. Temperatures were recorded at the surface, core, and approximately 10 mm beneath the surface of four 76-mm-diameter pears located at the top and bottom of the test bin. Pears at − 1° C were placed in the bin core and the unit was placed in a 43° C room with the fan operating to draw warm air through the test bin. When the average temperature of the downstream fruit reached 20° C the fan was stopped and the test chamber was moved to a 20° C room, where the fruit temperature was allowed to equalize. This testing procedure simulated the concept of a tunnel bin warmer that would convey bins through a heating chamber, forcing 43° C air vertically through the bin to rapidly warm the fruit (Fig. 1), and deliver the bins to a 20° C ripening room.

When an air flow of 2 l s^{-1} kg^{-1} was used, pears were warmed to an average 20° C in 15 min. The surface temperatures, before removing from the warm room, ranged from 26° to 29° C and core temperatures from 7° to 11° C. Internal fruit temperatures equalized to 20° ± 1·5° C in 30 min. A pressure of 900 Pa was needed to force air at this rate through the bin. At 1 l s^{-1} kg^{-1} and an air pressure of 200 Pa, the average fruit warmed to 20° C in 25 min.

Fruits that were warmed to an average of 20° C in 15 min ripened uniformly to excellent quality in 4 days (Fig. 2). Lots held in the warmer for longer periods, thus

* Reprinted from *California Agriculture* **28**(3) 1974. Units have been converted to the metric system (SI).

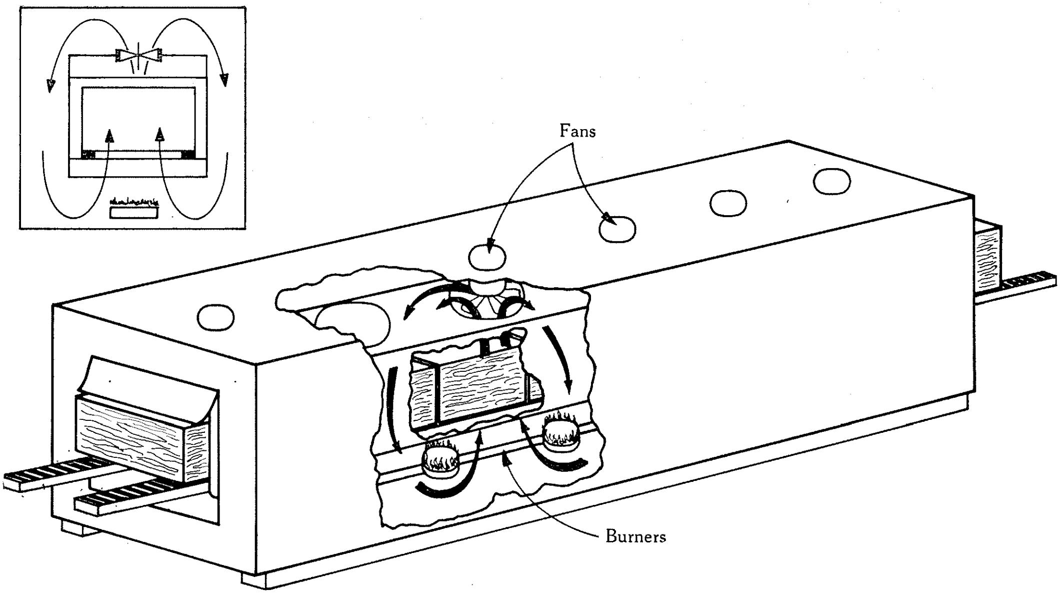


Fig. 1. Cross section and cutaway view of tunnel warmer for pallet bins of pears.

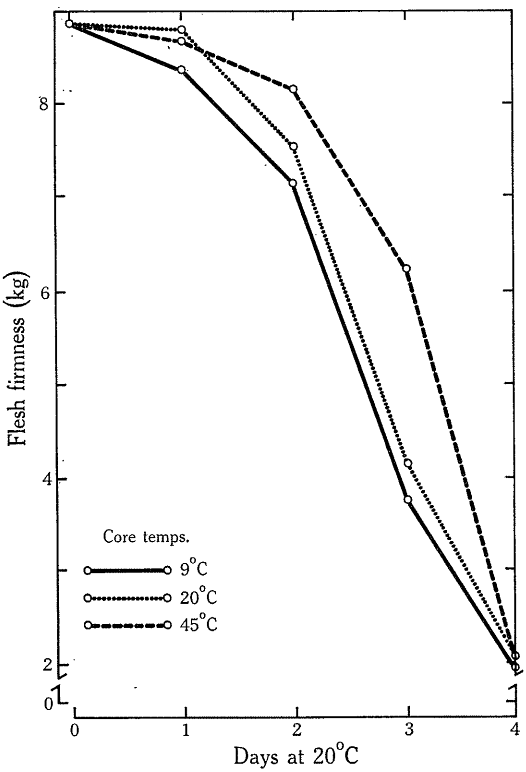


Fig. 2. Rates of softening of Bartlett pears warmed with 43°C air for 15, 30 and 120 min to core temperatures of 9°, 20° and 45°C respectively; then held at 20°C.

attaining much higher average and core temperatures, were not adversely affected. Ripening was slightly delayed where the core temperature reached 43° C (after 2 h in the bin warmer), but the fruit reached full ripeness at the same time as the other lots. It should be emphasized that the higher temperatures were tested as a precaution against mishaps in commercial practice. The uneven ripening that could result from slow and uneven cooling following such high temperatures was not studied.

Warming for 15 min to an average temperature of 20° C was adequate. Typical standard deviation for firmness indicated that variability in lots was narrow on the first and second day following the warming, widened on the third day, then narrowed appreciably on the fourth and final day. At canning ripeness, the range beween fruits in a lot was approximately 1 kg.

To test the effect of delayed warming, samples of pears were warmed to 20° C in 1 h, in 4 h, and progressively moved from 1° to 3°, 5°, 10°, 15° and finally 20° C to give warming times of 1, 2, 3, 5 and 7½ days. After warming, the fruit was held at 20° C for ripening.

Ripening time is acutely sensitive to temperature. Fruit ripened to processing

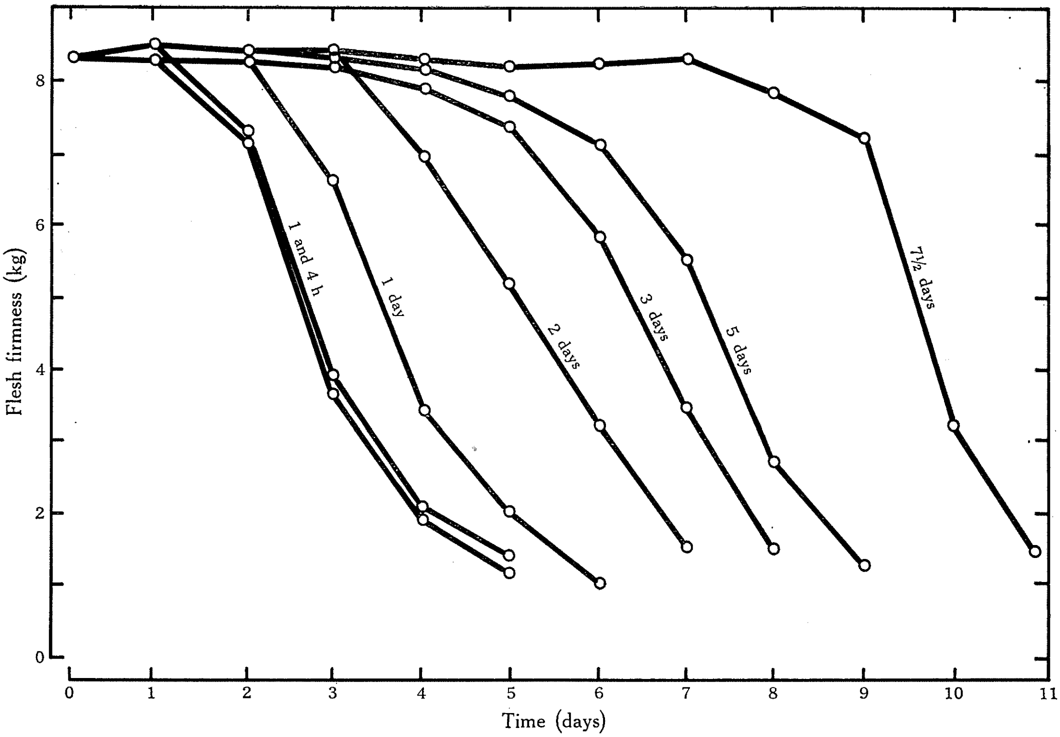


Fig. 3. Rates of softening of late-season Bartlett pears subjected to delays in warming of 1 h to 7½ days following 5 weeks' storage at 1 °C.

firmness between the third and fourth day after 1–4 h warming to 20° C (Fig. 3). Thereafter, ripening was delayed in almost direct relation to the time required to reach 20° C. The ripening pattern was similar for both early- and late-season fruit.

A warming tunnel to warm pears rapidly and uniformly for ripening would readily adapt to existing cannery operations. Eight hundred bins a day could be warmed over a 12-h period by conveying them through a warming tunnel that is two bins wide and eight bins long. Fuel consumption would be minimized and relative humidity kept high by a recirculating air-flow system. If the warmer were placed in the ripening room, fuel required to warm fruit would be only slightly more than that required with the present common practice of stacking bins in the ripening room and using warm outside air as supplemental heat. About 2 m^3 of natural gas or 2·5 l of propane is needed to warm a bin of pears from − 1° to 20° C when the system is 70% efficient.

The warming tunnel concept has the advantage of assuring rapid uniform warming and subsequent uniform ripening, and the conveyor line adapts well to many cannery operations. An alternative approach that would also assure rapid uniform warming would be to use a fan and baffle arrangement to force 20° C air from the ripening room through the bins of fruit. This forced-air concept is used extensively for fruit cooling. While not as rapid as a tunnel, it can cool (or warm) fruit in 8–16 h.

The data presented here show the desirability of rapid and uniform warming of Bartlett pears destined for processing following cold storage. As little as one day's variation in reaching a core temperature of 20° C among fruits in a bin could result in an unacceptable variation in the degree of ripeness for canning. This reflects the phenomenal rate of ripening between the second and fourth day after the fruit temperature reaches 20° C. If the variability in warming was two or more days, fruits with senescent breakdown and unripe hard fruits might be found within a bin. With more than 3 days' variation, senescent and unripe fruit within a bin would be a certainty and many of the former would be mushy. In each case, the range in variation and the number of fruits affected would depend on the relative rate of warming between the most accessible and inaccessible positions in a bin or among bins. Even the most extreme conditions tested occur in some cannery operations in California.

Where Bartlett pears are promptly (within 24 h after harvest) cooled to between 0° and 1° C, held at that temperature for 3–5 weeks, then warmed as described above, a processor should be able to program canning schedules with much greater precision than before and with much improved uniformity of ripening.

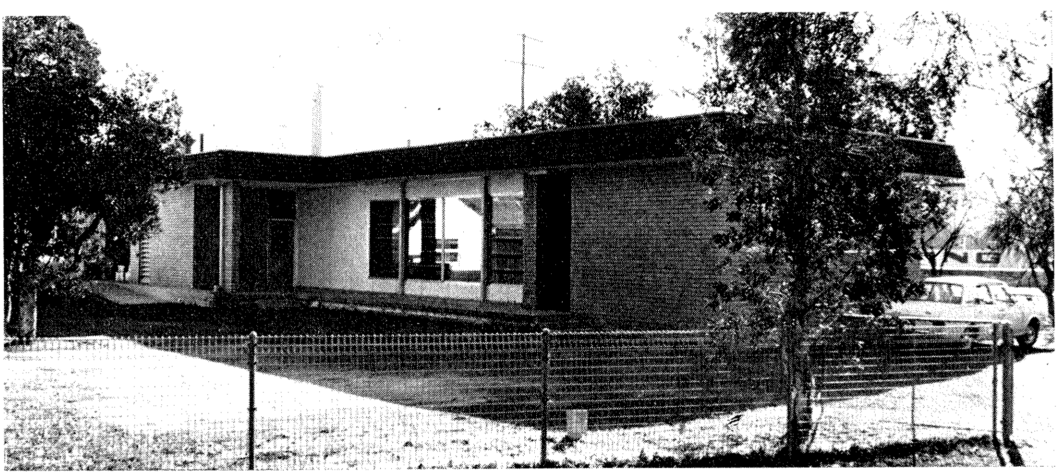
New Gosford Laboratory

On 23 August 1974, the New South Wales Minister for Agriculture, the Hon. G. R. Crawford, D.C.M., M.L.A., officially opened a new Fresh Fruit Disinfestation Laboratory, built at a cost of $100 000, at the Gosford Postharvest Horticultural Laboratory (formerly the Citrus Wastage Research Laboratory). The ceremony was attended by about 70 guests, representing horticultural industries and Australian and State Government departments.

The new building will provide much needed facilities for research. A laboratory, a library, a large fruit-fly breeding room, cool storage and fumigation facilities and offices are all included.

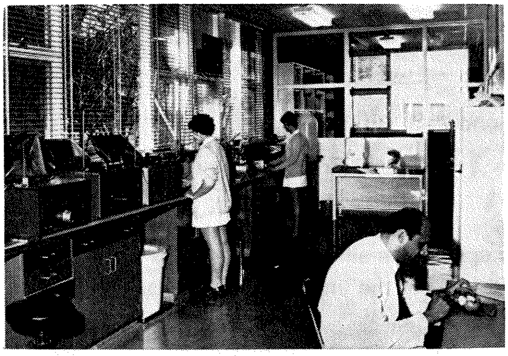
A number of potential export markets have refused to accept Australian fruit because it may be infested with pests such as Queensland fruit fly, light brown apple moth and codlin moth which are not found in the particular importing countries. Within Australia, too, there are some barriers to trade in fresh fruit and vegetables because of the need to prevent further spread of insect pests such as Queensland fruit fly.

The Gosford Laboratory has already developed effective treatments for the disinfestation of some fruits and, as a result, new export markets have become available. Notable amongst these are the ethylene dibromide (EDB) sterilization of oranges against Queensland fruit fly, a procedure accepted by New Zealand authorities, and the sterilization of apples and pears against fruit fly by cold treatment, a procedure accepted by the United States. At present the Laboratory is investigating a satisfactory treatment for apples and pears against light brown apple moth, whose presence in these



The fresh fruit disinfestation laboratory.

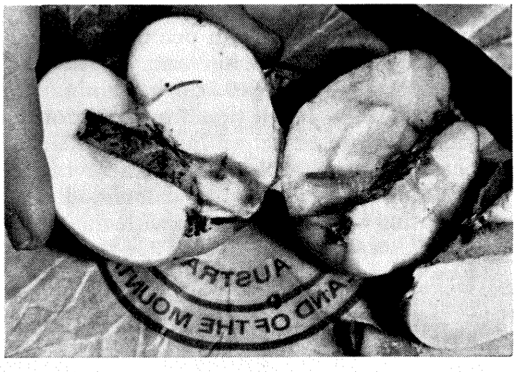
Photos: W. E. Rushton



fruits has disrupted the promising North American export trade. Sterilization of tomatoes against fruit fly is also under investigation.

Because of its national importance, disinfestation research is directed by the Fresh Fruit Disinfestation Committee, comprising representatives of the Australian and State Government Departments of Agriculture, the Queensland Department of Primary Industries and the CSIRO Division of Food Research. Funds for the new laboratory were provided by the member organizations of this Committee.

P. F. Rylands

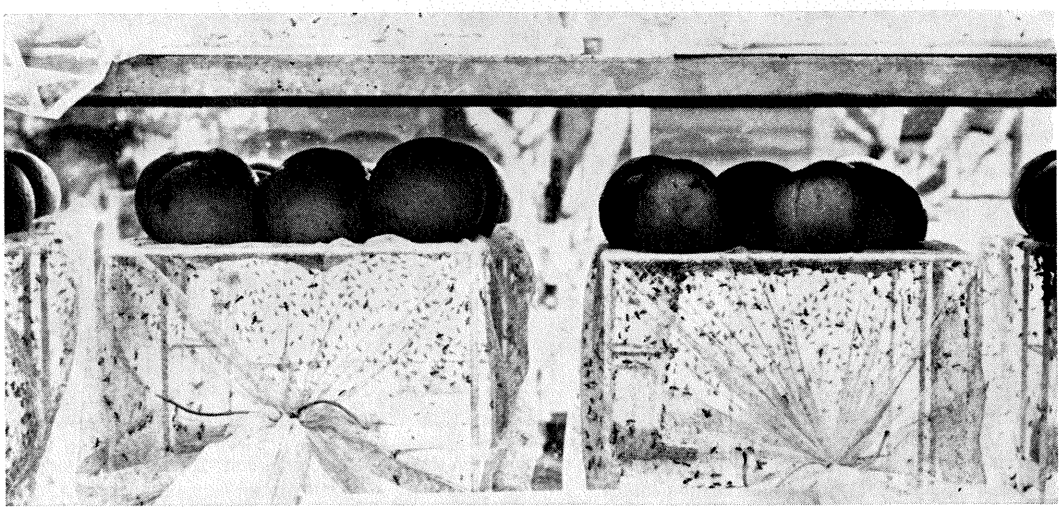


Work on light brown apple moth (*Epiphyas postvittana*): after being fumigated, fruit is cut to determine effectiveness of treatment (above).

The main working area of the new laboratory (top left).

Adult Queensland fruit flies (*Dacus* [*Strumeta*] *tryoni*) feeding on sugar inside a cage (left).

Work on Queensland fruit fly: this infested fruit is stored to allow the insects to develop, and is then fumigated (below).



A counter for small objects

By E. R. Cousins, G. W. Francis, J. N. Huntington and P. J. Rutledge
CSIRO Division of Food Research, North Ryde, N.S.W.

An instrument which will accurately count, at high speeds, small objects of a wide range of sizes has been designed and built at North Ryde. Several of the units have been used in research programs in these laboratories and elsewhere

The impetus to develop a counter for small objects came during investigations of the distribution of maturity in pea crops, and from studies of the damage and weight changes occurring in peas during vining and processing. In all these investigations it was necessary to determine the number of peas in large samples so that the average weight of each pea could be calculated.

Counting was done at first with the aid of a metal plate containing a known number of holes, into which individual peas fitted. Later a machine was built to count peas delivered to the detector system by a vibratory feed. A light-dependent resistor was used as the detector and an electro-mechanical counter as the readout. As this instrument could count only at a slow rate, the unit described here was designed to count small objects at high speed.

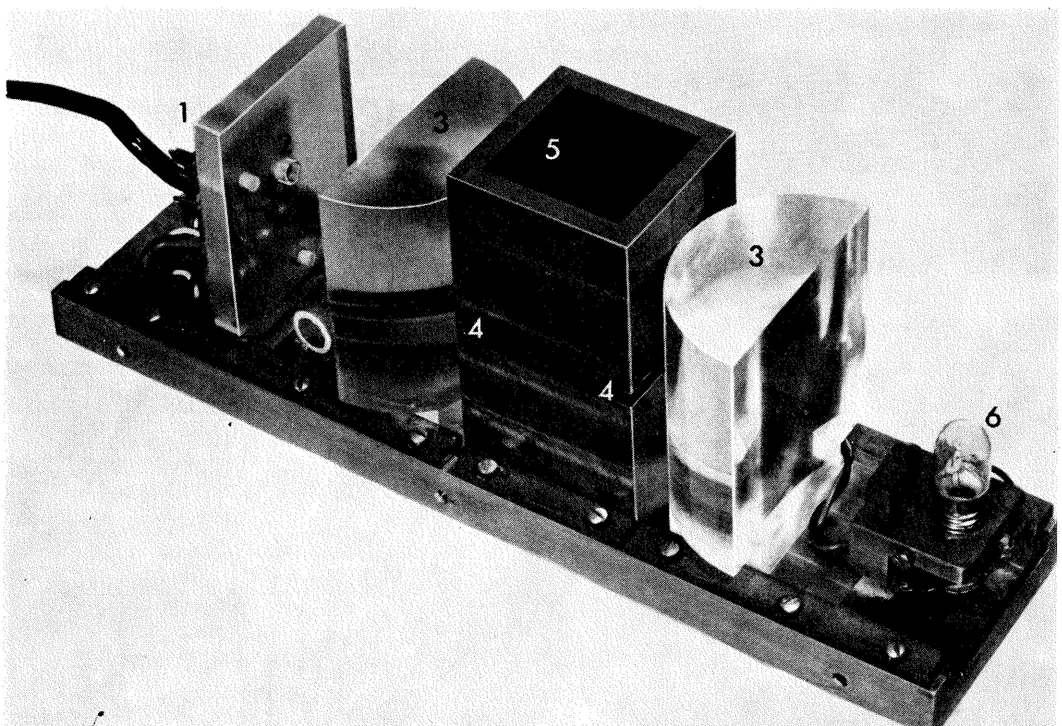


Fig. 1. Detector unit with the cover removed. The unit is 20 cm long. 1, Detector circuit; 2, phototransistor; 3, lenses; 4, slits; 5, sample chute; 6, light source.

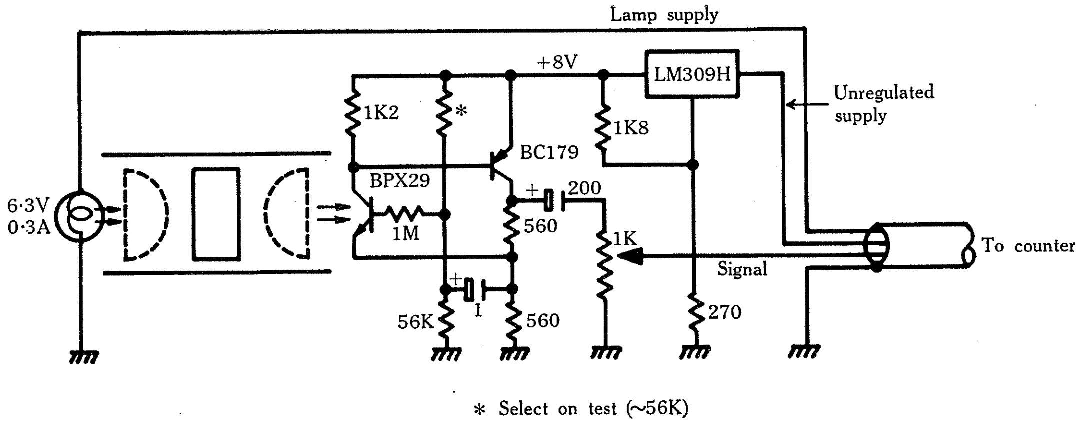


Fig. 2. Circuit diagram for detector.

Construction

The instrument has two main parts—a detector head and a counter section. This arrangement permits the counter to be used with other detectors and allows flexibility in positioning the detector head. An electromagnetic vibrator is used to feed the objects into the detector.

A phototransistor is used as the detector and the counter-circuit feeds a light-emitting diode display. The components of the detector head are mounted on a machined aluminium slide. These comprise a globe and holder, two Perspex lenses, the sample chute with two slits, and the detector with its circuit. Fig. 1 shows the detector head with its cover removed. The light from the globe is made parallel by the first lens and passes through the 3·180-mm slit in one side of the sample chute. It crosses the chute and enters the 0·254-mm slit in the opposite side. The light is then converged by the second lens to focus on the phototransistor. The signal from the phototransistor is amplified in the counter and fed to the display unit.

Fig. 2 shows details of the detector circuit and Fig. 3 shows the counter circuit, the mains filter and power supply.

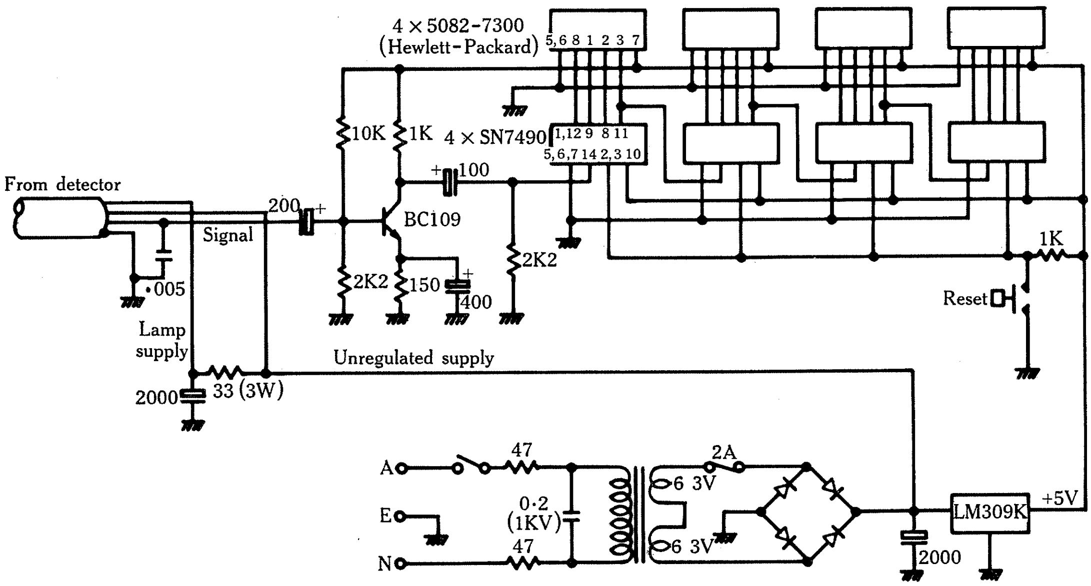


Fig. 3. Circuit diagram for counter.

The detector is adjusted for optimum performance by selecting the resistor marked with an asterisk in Fig. 2 to give 4 volts between the collector of the BC179 and earth. The width of the fine slit and the optics are then adjusted to provide even illumination across the slits and to focus the light onto the phototransistor. The mains filter was found to be essential to eliminate stray counts occurring from spikes in the mains power supply.

The counter has been used to count peas and grapes from early to late maturity. The size of these objects varied from somewhat less than 1 mm to 2·5 cm. The counting rate has been as high as 200 per minute using the vibrator feed and the instrument is capable of counting at a much higher rate. However, in practice the counting speed is limited by the need to feed the objects into the chute so that there is some space (at least 1 mm) between each one. If there is no space, two objects may be counted as one.

News from the Division

More communication

The Division has decided to improve its service to the public by ensuring that the research results and expertise accumulated in many fields reach as wide an audience as possible. With this aim in view the following steps will be taken:

- A new series of pamphlets will be issued on subjects of particular interest to the consumer, sometimes based on enquiries received from the public by telephone or letter. The pamphlets are for general distribution through consumer organizations and will also be made available to newspapers, radio and television.
- The existing series of Divisional Circulars, which until now have been intended mainly for industry, will in future include special issues containing information for consumers, which will also be of interest to food wholesalers and retailers. The Circulars will be widely distributed by CSIRO Head Office and by the Division.
- A regular newsletter will be printed and distributed to the dairy industry with information on current projects and results of completed work of particular relevance to that industry.
- The Meat Research Newsletter will continue to be printed and distributed as before.

Appointments

Dr P. Y. White has been appointed to PPU at Macquarie University; his work will include research on chilling susceptibility in plants.

Mr W. A. Davies joined FRL's Physical Biochemistry Section to work on proteins of egg yolk and their interaction with lipids.

Mr W. E. Rushton is the new Divisional Photographer. Mr Rushton's early training was with the University of Sydney's Illustration Department; he has spent the past 5 years as Assistant Photographer at the CSIRO Division of Animal Physiology at Prospect, N.S.W.

Work overseas

Dr J. I. Pitt of FRL's Microbiology Section will spend 10 months as guest worker at the Commonwealth Mycological Institute at Kew in England.

Dr F. H. Grau of MRL recently spent 6 months at the Roche Institute of Molecular Biology in New Jersey, U.S.A., where he worked on transport mechanisms in bacteria. Dr Grau also attended the Annual Meeting of the American Society for Microbiology in Chicago and visited laboratories engaged in research on freezing and heat damage to microorganisms and on the microbiology of foods, particularly with reference to food-poisoning bacteria.

Award

Dr R. M. Smillie, leader of PPU, has been awarded the degree of Doctor of Science by the University of Sydney for his published work 'Biogenesis and Function of Chloroplasts'.