FOOD PRESERVATION QUARTERLY

Vol. 20 No. 4 CSIRO December 1960

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

C.S.I.R.O.

Food Preservation Quarterly

- VOLUME 20
- NUMBER 4
- DECEMBER 1960

Published by the Division of Food Preservation
Commonwealth Scientific and Industrial Research Organization
Sydney, Australia

Some Comparisons of the Meat Industry in Australia and the United Kingdom

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During 1958, Dr. Vickery spent five months in the United Kingdom advising the British Government on the need to establish a Meat Research Centre. In the course of his investigations, he was able to obtain an intimate picture of many aspects of the British meat industry. This article reproduces a talk which Dr. Vickery gave to the New South Wales Country Meat-Works Association at Dubbo in April 1960.

PRODUCTION

Meat production has been rising steadily in both countries during the past 10 years but the United Kingdom still produces the greater quantity—about 1,700,000 tons in 1958, against about 1,470,000 tons in Australia during the same year. The extent to which the U.K. has increased its production is clearly shown by the fact that in 1939, local production in the U.K. was only 50 per cent. of total consumption; today it is 67 per cent.

You may well ask how this high production is maintained and increased in such a small country, only one-thirtieth the size of Australia. For beef and mutton it is based primarily on first-class grassland farming, with supplements of concentrates in the winter months. Let me say, however, that I doubt whether this high production could be maintained without substantial government subsidies. These include subsidies on fertilizers, about £8 per head on beef-type calves, and guaranteed prices on fat-stock at the time of slaughter. At present this guarantee for beef cattle amounts to about 330*s*. (Australian) per 100 lb dressed weight.

Beef production in Australia and the United Kingdom is similar in quantity at about 860,000 tons per annum. In pig meats, however, production in the United Kingdom far exceeds that in Australia, being about 600,000 tons per year, as compared with Australia's 100,000 tons. On the other hand, Australia produces about 475,000 tons of mutton and lamb compared with only 220,000 tons in the United Kingdom.

You may be interested to have an indication of the trends in production in each form of meat in the United Kingdom. Beef production has been increasing, and will probably continue to increase, at an average rate of about 6 per cent. each year, so that, in the absence of increased individual consumption of meat, the market for imported beef from Australia, New Zealand, and the Argentine will steadily diminish.

The production of lamb and mutton is increasing, but only very slowly, and British production is unlikely, for a number of years, to bring about any contraction in the amounts imported from New Zealand and Australia.

The production of pig meats is almost stationary in the United Kingdom, but this is unlikely to affect Australia because we now export very little pork, bacon, and ham.

QUALITY

It is sometimes thought that the general quality of British beef is far superior to Australian. It is true that the top 6 or 7 per cent. of British beef is much superior to the top-quality Australian beef. Nevertheless, a large proportion of British production, like Australian, is disappointingly plain, although British beef has some advantage in that it is generally killed at a rather lower age. This position is not surprising when it is realized that about 75 per cent. of British beef is bred on dairy farms. While most beef from the dairy herds is typical of its origin, there is an increasing output of good beef arising from the crossing of beef bulls with dairy cows other than Jerseys and Guernseys.

Apart from a much higher average quality in British wether mutton I did not observe any appreciable differences in the general run of quality in Australian and British lamb and mutton carcasses.

In Britain, a system of graduated subsidies operates for pig carcasses, and it is heavily weighted in favour of high-quality pigs of the desired weights. Bacon carcasses are graded on the basis of length between shoulder and loin and thickness of back fat. This has made the British farmer very conscious of the financial benefits to be derived from good breeding and feeding practices. The result is to be seen in a relatively high proportion of good-quality carcasses going through the bacon factories. The proportion of over-fat carcasses is certainly much less in the United Kingdom than in Australia.

SLAUGHTERHOUSES

There are no less than 4500 slaughterhouses in England and Wales, but fewer than 100 in Scotland, where much more stringent regulations governing operation and hygiene have been in force for many years. These slaughterhouses range in size from a small, simple shed behind the retail shop to large abattoirs, several of which approach in size the State Abattoir at Homebush. While some of these small slaughterhouses, killing say 20 cattle and 50 "smalls" each week, are excellently designed and operated, the less said about the majority of the small places the better. In contrast, they serve only to emphasize the wisdom of the Australian Commonwealth and State authorities, as well as the Scottish authorities, in insisting on high standards of construction, operation, and hygiene.*

In the slaughterhouses of medium and large size, the methods vary widely. Where the premises are conducted by a single operator, the methods of slaughter, dressing, and handling are somewhat similar to those in Australia, except that the chain system for lamb and mutton is only rarely used, individual slaughtering, as prevailed here many years ago, being the rule.

Local government authorities operate a large number of slaughterhouses in the United Kingdom. A few are leased, by competitive tender, to operators who carry out all slaughtering and dressing for wholesale butchers at fees fixed by the local government. The majority, however, are directly controlled by the local councils themselves. One or more fully equipped slaughter bays are leased to individual wholesale butchers who provide their own labour. The work of the local councils is usually limited to the provision of general facilities and services of an engineering and meat inspection character.

STOCK-HOLDING PENS

Good stock-holding pens or lairages, as they are called in the United Kingdom, are pleasing features of most British slaughterhouses of all sizes. Apart from the usual open-air pens, there is always a liberal provision of covered, semi-dark pens each having a thick bedding of straw. For pigs, particularly, this generous provision of warm, comfortable pens is a feature which materially assists in the maintenance of good meat quality in the carcasses. It has been amply demonstrated in many scientific studies that quietness, comfort, and rest before slaughter are conducive to good-quality pig meat. Admittedly, the provision of good, covered pens is almost essential for protection of stock during the cold British winters. Nevertheless, it is a feature which might well be copied in many meatworks in the colder areas of Australia.

SLAUGHTER

In the United Kingdom, public opinion is insistent on the use of so-called humane methods of slaughter, and these are compulsory. Since it is by no means certain that our present methods of slaughter will always be

*Following the recent proclamation of a British Slaughterhouses Act, major improvements are now being enforced in England and Wales.

tolerated in Australia, you may be interested in some alternative, humane methods.

In the U.K., the captive bolt pistol is always used for the slaughter of cattle. I cannot see any advantage, however, from a humane point of view, in this method over the usual Australian method of knocking with a heavy hammer.

Almost invariably in the U.K., pigs and calves are stunned electrically and are stuck and bled about 20–30 seconds later. This electrical stunning is done by means of tongs with two electrodes which are clamped firmly on either side of the head, and an electric current of 70–90 volts applied. While this method of slaughter appears to be quick and effective, there are frequent complaints that it results in a good deal of "blood-splash" in certain muscles and in the lungs. The Danish Meat Research Institute has done a great deal of careful investigation on slaughtering methods for pigs. Their results confirm these complaints about "blood-splash" arising from electrical stunning. The Danish Institute has investigated various modifications of electrical stunning, but so far it has not devised a method which eliminates "blood-splash".

The use of carbon dioxide anaesthesia for pig slaughter is becoming widespread in Europe and I saw it in operation in Northern Ireland and in Denmark. The pigs are conveyed by an endless metal-belt conveyor into a pit containing 60–65 per cent. carbon dioxide, and each pig takes about 30 seconds to pass through the pit. The carbon dioxide anaesthetizes the pigs in about 12–20 seconds. After emerging from the pit, the carcasses are hoisted and stuck in the usual way. Stunning by carbon dioxide certainly eliminates "blood-splash" and the Danes have clearly proved that, in bacon pigs, it results in carcasses better adapted to curing than either ordinary sticking or electrical stunning and sticking. It must be emphasized, however, that carbon dioxide stunning is probably uneconomic if the killing rate is less than 75 per hour, and that, of course, means a big daily throughput.

While I have not seen or heard of the carbon dioxide stunning method being used for sheep and lambs it is possible that it may be equally effective on these animals.

DRESSING OF CARCASSES

While poor butchering and dressing operations are seen in the United Kingdom as well as in Australia, the general standards are higher in the United Kingdom, perhaps because the butchers' operations are more leisurely. Generally, the output per man-hour is lower than in Australia and this is probably due also to the deficiency of labour-saving equipment in many British slaughterhouses.

In the splitting of beef carcasses into sides, I did not see a circular saw being used. On the other hand, electric, reciprocating saws are widely used, and they do an excellent job even on bulls. They are very slow, however, and, in their present form they would not be acceptable in most Australian meatworks.

TREATMENT OF OFFALS

In most British slaughterhouses, edible offals are dressed and prepared in adjacent spaces, using methods similar to those in Australia.

It is very rare, however, for a slaughterhouse, even a very large one, to have its own treatment plant for inedible offals. The system almost universally adopted in the U.K. is for the inedible offals to be transported to privately-owned central treatment plants. These serve slaughterhouses, ranging from 5 to 100 in number, situated in a radius of 25 miles or so. In view of the large number of small slaughterhouses in the U.K., this system of centralized offal-treatment plants is probably the most economical that can be devised, particularly as they also process the scraps and fat from retail shops. These plants are generally well planned and equipped, and several have much larger outputs of tallows, meat meals, and fertilizers than our largest meatworks.

CHILLING

A minority of British slaughterhouses are equipped with chilling rooms for initial cooling and for holding. Still fewer are equipped with rooms for the freezing of meat. In many municipal abattoirs which have chilling rooms, use of these facilities is not obligatory; in fact, a special charge is often made for their use. As a result, only a portion of the meat slaughtered in these municipal abattoirs is chilled before passing out to the trade. This neglect of chilling is perhaps understandable because in the winter months the atmospheric temperatures generally range from 30–45°F, and hanging of hot meat in a ventilated space generally effects adequate cooling even in sides of beef. But, of course, in hot summer weather losses in beef due to bone taint are sometimes severe where no artificial cooling is available.

While there may still be a few small meatworks in Australia having few or no chilling facilities at, or near, the premises, such places are becoming rare. Nevertheless, it is doubtful whether chilling techniques used in the average Australian meatworks are always as efficient as they might be. At the same time, it is also pertinent to inquire whether slaughterhouses in the United Kingdom really do save money by not prechilling the meat.

We might first set out the main purpose of chilling of meat:

- To cool the carcass or sides from body temperature (100–103°F) to a temperature where microbial growth is very slow—say below 45°F.
- To effect setting of the meat, so that it can be readily cut up without distortion or slip of meat over the bone.

The primary objects of avoiding microbial spoilage and of getting adequate setting should be effected:

- With minimum weight losses, and
- Without depreciating the general quality and appearance of the meat.

Of all the classes of meat, sides of beef present the most difficulties in effective chilling. My remarks will therefore concentrate on beef, and a brief discussion about mutton and lamb carcasses will be given later.

Even under the fastest chilling conditions, the deepest areas of the buttock and shoulder of beef sides remain at temperatures above 80°F for some hours after slaughter. If these areas are infected with bacteria, the organisms will grow vigorously at these comparatively high temperatures and continue to grow steadily until temperatures below 55°F are reached. In order to avoid bacterial spoilage of the deeper parts of beef sides, it is therefore essential to cool rapidly. General experience indicates that for a side of average weight, say 300 lb, the temperature of the deepest part (in the buttock) should be reduced below 60°F in 18 hours.

In order to maintain these fast rates of cooling, it is essential to maintain air temperatures as close as possible to the freezing point of the meat—viz. 30°F. In fact, it is quite safe to keep the air temperature as low as 26°F for an hour or two after the beef is placed in the chillers, but it must be raised to 30–31°F rather quickly thereafter to avoid freezing of the thinner parts such as necks and thin flanks.

Fast rates of air flow over the beef are also essential for fast chilling. For a given rate of changes of air per hour, different systems of forced air distribution give widely different speeds of air flow over the beef. It is therefore impossible to specify a desirable, minimum number of air changes per hour without reference to the system employed. Even with the best system it should, however, not be less than 80 changes per hour.

Minimizing Weight Loss

Perhaps the most important advantage of very fast chilling is the reduced weight losses that it can give. Weight losses lower than 1 per cent. in the first 18 hours are quite possible in well-designed systems, whereas slow cooling may give weight losses up to 2 per cent. in the same period. In general, the faster the rate of cooling, the lower will be the weight losses which occur.

On week days, Tuesday to Fridays, meatworks operators will normally remove the sides of beef after they have been in the chilling rooms for about 18 hours. Friday's kill, however, normally remains in the chilling rooms until early Monday morning, that is, for a period of about 66 hours. If the conditions of chilling which are best for the first 18 hours are maintained over the week-end, then excessive weight losses may occur. To avoid these excessive weight losses, it is necessary on Saturday morning to reduce the forced air flow by reducing the fan speed, perhaps to as low as one-third of the maximum speed. At the same time, the air temperature should still be kept to about 30–31°F. During the first 16–18 hours, the level of relative humidity of the air does not have much effect on the weight losses. Thereafter it becomes increasingly important. For week-end operations, therefore, the refrigeration system employed should be such that the relative humidity of the air around the meat should be higher than 90 per cent. from Saturday to Monday morning.

Under the best conditions, it is possible to keep weight losses below 1·5–1·6 per cent. during the week-end. With unsatisfactory cooling systems, we have found weight losses as high as 2·7 per cent. during this period.

Turning now to the economic aspects of weight losses, it is safe to say that in many meatworks in Australia, the weight losses from chilled beef are at least $\frac{3}{4}$ per cent. higher than they should be. If a meatworks prepares 10,000 tons of beef each year, this represents an avoidable loss of about £16,000 a year at current prices. Quite a lot of improvements in chilling rooms can be effected for this sum of money.

Let us now consider what happens so often in the U.K., without artificial cooling of beef. Under these conditions, the weight losses will be about 1 per cent. higher than would be experienced if fast, artificial chilling were used. With beef at 2*s.* 6*d.* per lb. (the average price of fresh beef sides in England), this represents an avoidable loss of nearly $\frac{1}{3}$*d.* per lb. Running costs and interest and redemption charges on capital used to install good chillers will certainly be less than $\frac{1}{3}$*d.* per lb. of meat chilled. The English butcher therefore does not stand to gain anything financially by continuing to scorn the use of artificial cooling; indeed, he stands to lose heavily if spoilage becomes severe during the warm summer weather.

Turning briefly to the chilling of mutton and lamb, it is found that with fairly fast chilling conditions, cooling of carcasses of about 35–40 lb weight is completed in 8–10 hours. In order to avoid excessive weight losses, it becomes important therefore to reduce the drying power of the air a long time before the carcasses are removed from the chillers. If chilling starts at noon, for instance, cooling may be completed by 9 p.m. In the period of 9 hours between this time and removal at 6 a.m., the rate of air flow must be substantially reduced and conditions adjusted so that the relative humidity of the air is greater than 90 per cent. Careful adjustment of these chilling conditions is important not only by their direct effect on weight losses, but also because excessive rates of weight loss have a most deleterious effect on the bloom of lamb and light mutton carcasses. The wholesale price obtainable for lamb carcasses may be seriously depressed if there is a major loss of bloom.

A further important point to be made in the chilling of mutton and lamb is that their chilling requirements (if excessive weight losses are to be avoided) differ considerably from beef. Separate chilling rooms for these two classes of meat are therefore almost essential.

MARKETING

The same trends towards the retailing of meat in the chilled, prepackaged form are current in the United Kingdom as in Australia. It may be thought, therefore, that there will be an increasing market for meat which has been prepared for retail sale, prepackaged and frozen, and then exported in the frozen state to the United Kingdom. While export trade in these packaged frozen retail cuts may start in the next few years, there is so far little encouragement for it. The British housewife is still prejudiced against frozen meat, and when she buys prepackaged meat she now demands meat which is not, or has not been, frozen.

On the other hand, the outlook for the export to the U.K. of frozen, boneless, wholesale cuts of beef is particularly bright. There is an increasing demand by caterers for this type of beef, and the demand is certain to grow if the present high standards of preparation and packaging are maintained. There is one aspect which will need to be studied carefully, viz. the size of cartons. It is most desirable to aim at a rate of freezing in the air-blast tunnels which will give a turnover in 24 hours. In order to freeze these cartons in less than 24 hours, there is a definite limitation on the size of the cartons (and therefore on the weight of the contents). Using methods of freezing which are commercially feasible, it is impossible to freeze in 24 hours cartons whose thickness exceed 5 to 6 inches. I know that some British importers demand a proportion of packs containing up to 105 lb of meat and that such packs are often 8½ inches in thickness. Unless the meatworks can profitably operate several tunnels, these excessively large packages greatly retard the general rate of turnover during freezing. Every endeavour should be made, therefore, to limit the size and contents of the cartons so that the thickness does not exceed about 5½ inches.

The Utilization of Apples

By V. L. S. Charley

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Dr. Charley, who has a world-wide reputation for his scientific work on fruit juice production, has summarized here papers read by C. P. Norbury, A. Pollard, G. Borgstrom, and R. P. Walrod at a joint meeting of the Food Group of the Society of Chemical Industry, Commonwealth Fruit Council, and National Farmers' Union, held in London in June 1959. This paper, published originally in the *Journal of the Science of Food and Agriculture*,* gives a good picture of apple processing in Europe and North America and is likely to be of considerable interest in Australia. Reprinted here by kind permission of the author and the Society of Chemical Industry.

INTRODUCTION

It has long been a commonplace to remark that the various apple-growing areas of the world are subject to a series of gluts and shortages, which, although they follow no definite pattern, unfailingly present the grower with acute problems in the overall economic disposal of the fruit which he has grown. The National Farmers' Union has paid distressingly regular attention to this problem, with particular reference to the utilization of low-grade, or cull, fruit during the past 20 years, and the considerable increase in tonnage of apples expected to accrue from new plantations in the next few years has necessitated a new attack on the problem. The food manufacturers of Great Britain could well pay attention to the efforts of other countries to utilize their apple crops economically, in view of the considerable surpluses which may be thrown on the market.

THE RAW MATERIAL

The unfortunate feature, from a processing point of view, of the chemical composition of apple tissue is its water content of about 84 per cent. The storage of apple products without removal of any water is economically unsound, and herein lies the main problem in apple utilization, namely, the removal of water without simultaneous reduction in quality of the final product. The 10–12 per cent. of soluble sugars is composed mainly of fructose, glucose, and sucrose; cellulose and pectic substances in the cell walls contribute to the texture of the flesh, and affect the viscosity of products derived from the fruit. Dried products being rendered hygroscopic by sugars and hydrophilic colloids, the presence of these materials has some disadvantages, but the moisture-retaining properties of some apple products can have advantages in the conditioning of mixed products. (During the last war, for example, concentrated apple juice was used as an ingredient in bread to retard staling.) Other constituents of the apple are organic acids, polyphenols, amino acids, vitamins, enzymes, and volatile components responsible for the aroma of the apples.

A number of specialized uses for apple materials have been devised from time to time. The author, with Dr. Pollard and a colleague, prepared malic acid (or calcium malate) at the Long Ashton Research Station at the beginning of the last war as a source of monohydroxy dibasic acid, which was needed

* Charley, V. L. S. (1960).—*J. Sci. Fd. Agric.* **11**: 177–80.

for the treatment of copper pipes previous to their being dipped in shellac. This process was important at the time, but other sources of malic acid are now available, and it is unlikely that the surplus apple problem will be solved by the application of specialized processes of limited application. It is by the widespread utilization of apples in products which can be purchased by the whole range of the purchasing public that large tonnages of fruit will be taken off the fresh fruit market.

APPLE JUICE

The apple products utilized in Europe are chiefly the juice and concentrate, which are sold in very large quantities both at home and abroad. Concentrate is particularly valuable for conserving the juice from a heavy glut crop over a period of 2 or 3 years until a period of shortage returns. Mention should be made of the fermented products produced from the apple in Europe, such as cider, cider brandy (Calvados), and industrial alcohol. In general, however, these products are produced from the genuine cider apple with bitter-sweet characteristics, and the surplus apple problem does not really extend to this type of fruit.

In addition to these juice products, the Continental countries make a wide variety of apple pulps, jams, jellies, confectionery bases (either apple or blended with other fruits), pectins of various setting values, and, of course, animal feeding stuffs from the fruit residues after the pectin has been extracted.

There would seem to be little doubt that the United Kingdom is behind the rest of Europe in its utilization of apples, but there are signs of an awakening consciousness on the part of some food manufacturers of the value of many of the English varieties of apples as raw materials for a wide variety of attractive foodstuffs.

A new technique for the preparation of spray-dried powders, the Birs process, is being successfully applied on the Continent, and since it includes a method of returning the volatile components to the dried powder, the ultimate product appears to be highly promising.

The apple juice developments on the Continent were much publicized before the war, and since 1948 the production figures have leapt upwards both in Germany and Switzerland. In recent years variations in technique have been introduced on the North American continent, and these will be referred to later.

Probably the most important scientific contribution made to apple juice processing since the Böhl pressure system of storage was introduced, is the latest procedure for the separation and fractionation of the volatiles from the juice. This process, in earlier years, had been attempted at the same vacuum as was used for the main stage of the evaporating process. Unfortunately, the condensation of the volatiles in this case was extremely inefficient. The latest process involves the removal of the volatiles at atmospheric pressure, with a consequent increase in efficiency in the recovery of the fractionated volatiles. These materials can be concentrated up to a figure many thousands of times greater than their concentration in natural juice, and even at a concentration of 150-fold are extremely stable at temperatures below 10°C for several months, and at 0°C for 2 or 3 years.

UTILIZATION IN U.S.A.

In the U.S.A., apparently no less than 35 per cent. of the total apple crop of approximately 2,000,000 tons is utilized in the manufacturing of various categories of foodstuffs. The utilization pattern, expressed as percentage of the total fruit processed in the years 1954–56, was as follows:

Sauce and baby food	33
Juice	26
Slices	16
Dried	10
Frozen	7·5
Vinegar	7·5

Canned Products

The most important American canned apple product is sauce, which is produced with chunks or as a purée. The production of the former type of sauce calls for a most careful choice of fruit in order to get the highest yield of canned product per ton of original fruit. An important item in this search for efficiency is a peeling method involving the least loss of fruit tissue, and flame peeling or the use of electric furnaces is being seriously attempted to this end. Although these methods completely char the outer layers of the epidermis, this material can be removed by a combination of abrasion, brushing, or washing.

Dehydro-canning is a valuable new type of process in which the apple pieces are soaked in a solution of salt with fruit acid, washed clean from these additives, and dried to 35–70 per cent. of water before canning (*see* U.S.Pat. 2,784,059).

Pie fillings are produced on a very large scale from a variety of fruits, but with the apple product predominating. A suitable recipe for such a product would be as follows:

Apples	30 lb	Nutmeg	$\frac{1}{2}$ oz
Water	12 lb	Cinnamon	$\frac{1}{2}$ oz
Sugar	6 lb	Lemon purée	$1\frac{3}{4}$ oz
Starch	1 lb		

Frozen Products

The second world war placed a new emphasis on the freezing of foodstuffs. In the United States apples ranked third to strawberries and cherries among individual fruits preserved by freezing. The apple pie is the most favoured dessert in America, and ready-made frozen pie fillings have been on the market for some years. The frozen fruit pie industry is a major section of the frozen prepared foods market, and apple pies are again the clear leaders in this line of foodstuffs.

Apple Juice

Although apple juice falls far behind citrus, tomato, and pineapple products, its production in America utilizes a very large tonnage of apples. The product is often transported in bulk from the apple-growing areas to States where supplies are not so readily available. The apple has shown itself to be a most accommodating product in that it can be blended in a most satisfactory fashion with other fruits (cherry, cranberry, lime, and apricot) without diminishing to any marked extent the characteristic flavour of the other constituent of the blend.

Dehydrated Products

Very large tonnages of apples are dehydrated in the United States each year. Such apple products should have a moisture content not exceeding 3 per cent., whereas dried or evaporated apples may have a water content of about 27 per cent. Apple flour, produced by grinding dehydrated apples, is prepared in limited quantities for therapeutic uses, mainly in the treatment of diarrhoeas. Other forms of powders have been produced experimentally by the puff-drying of concentrates in vacuum. Such powdered products store without deterioration for at least 1 year at 73°F and for 6 months at 100°F when packed in 4-oz cans with a desiccant. These experimental powders were prepared from blended concentrates of 75–80° Brix, dried in a vacuum shelf-dryer, and ground to 10-mesh size. Each can contains 95 g of powder, and an envelope of tough paper containing 9 g of pelleted calcium oxide as a desiccant.

Apple chips and apple crisps have both been produced on a small scale. The first-mentioned are small pieces of apple tissue oven-dried and packed in bags. The crisps are fat-dried and are more fluffy. No major effort has yet been made to introduce them on a wide scale to the American public.

It is possible to remove half the available water in apple slices before freezing, and thus to reduce transport costs without deterioration of the quality of the reconstituted slices. The product is known as dehydro-frozen apple slices, and the institutional market has been purchasing more and more of this product recently.

PROCESSING IN CANADA

In the Okanagan Valley (British Columbia) there are a number of factories responsible for processing the whole of the surplus fruit produced by the apple growers.

The products may be grouped, according to their economic return to the grower, as follows:

- High return products
- Medium return products
- Low return products

High Return Products

This group includes those products which could be expected to give a yield to the grower equal to, or better than, their cost of production. Such products are canned apples, apple sauce, and frozen apples. The solid-pack canned apples are largely used by institutions, and a very large quantity is made each year. Apple sauce continues to gain in popularity due, probably, to a steady improvement in quality occasioned by better processing techniques and more careful selection of raw material. For apple sauce it is essential to make a careful choice of the correct apple in order to achieve the correct sugar/acid balance.

Canned ready-to-use pie fillings have been available to the Canadian housewife for several years, but have often been subject to rapid deterioration in storage, due primarily to unsuitability of the ingredients. The Food Products Laboratory at the Summerland Research Station, under Mr. F. E. Atkinson, recently developed a variety of pie fillings with a fruit content of 70–80 per cent. in which the problems of stability were largely overcome. These methods have been successfully adapted to commercial production. The possibility of exploiting pie fillings made from apples with other fruits is very much in mind, and consumer research work is constantly in progress to assess the value of various experimental products.

The Canadian consumer has shown definite preference for apple pies which carry whole pieces of fruit. One of the problems encountered in the manufacture of apple pie filling is that of retaining whole segments of fruit through the processes of blanching, mixing with other ingredients, cooking, filling, processing, cooling, and ultimately baking by the housewife. The difficulty appeared to originate at the point of blanching, where cell rupture was thought to be caused by expansion of intercellular gases during rapid heating.

While the use of vacuum in the pretreatment of apples for canning is not entirely new, the particular apparatus which was developed in British Columbia to solve the foregoing problem is original in many respects. The unit consists of four stainless steel pressure-vacuum chambers which operate independently, but which are serviced by a common feed and common discharge. The treatment is actually a batch process, but by rotating the operation through four units the result is a continuous flow of material through the production line. The four chambers are filled in sequence with prepared apple sections. When a chamber is full the vessel is closed and the process taken over by a cyclomatic control. This first draws a vacuum of 27·5 in. for a preset period of time, which may be varied for the variety and maturity of the fruit. In 6–9 min intercellular gas pressures reach equilibrium within the chamber. At this point steam is introduced and the vacuum cut. By this method desired temperatures for enzyme inactivation are more quickly reached. The vacuum-blanched apples are then discharged into a surge hopper, from which a constant flow into the production line is maintained by means of a syntron vibrator. The end bells of the chambers, both top and bottom, are activated by pneumatic pistons. In 1958 one of the largest processors in Nova Scotia installed a six-chamber unit of the British Columbia design.

Medium Return Products

Products in this group normally return to the grower only half the cost of production. These products include dehydrated apples, two types of apple juice, apple juice blends, frozen concentrates, and cider. The dehydration process has been developed in Canada by the use of a continuous method of curing dried apples. A large drum 8 ft in diameter and 20 ft long rotates at 3 rev/hr. The dried fruit is conveyed directly into the drum through a port in the centre of one end. Concurrently, a simple pick-up device feeds the cured product directly on to a conveyor feeding the packing line which emerges from a similar port in the discharge end. This labour-saving method of continuous curing has an additional advantage of facilitating the introduction of sulphur dioxide. A blanket of the gas can be readily maintained at high concentrations in the drum from a metered external supply, and is readily absorbed by the constantly moving fruit to concentrations as high as 2000 p.p.m.

The Canadian workers at Summerland were responsible for the initial introduction of the opalescent apple juice by means of the addition of ascorbic acid. This product retains an extremely fresh apple character. A whole range of blends of apple with lime, apricot, and other juices has been prepared, and the apricot product has found wide consumer acceptance in a relatively short time. In exactly the same way, baby food juice blends can be produced.

The Canadian growers have also produced, in association with the Summerland Research Station, a very attractive type of light, sparkling cider from their surplus fruits, and it seems likely that, with suitable publicity, this product will make a substantial contribution to the utilization of their surplus apples.

Low Return Products

Products in this group are the least attractive from an economic point of view. Dried pomace can be produced from the residue left after the juice has been pressed from the milled fruit. Again, apple juice concentrate is made, particularly in Nova Scotia, with special plant designed to evaporate the juice with a minimum of caramelization in a plant in which the heating time is approximately 45 sec.

Apple pectin can be prepared from the pomace, and a range of apple confections made from such pectin helps to provide an outlet for a raw material produced from a by-product of the apple juice factories.

Financial Support for the Division

THE WORK of the Division of Food Preservation during the year ending June 30, 1960, was aided, as in past years, by contributions from Government bodies and private industry. The Commonwealth Treasury provided £272,000 and contributions from Government Departments and statutory bodies amounted to £17,500. The contributors and the purposes for which their funds were used are set out below.

Department of the Army.—Meat dehydration investigations.

Department of Primary Industry.—Sterilization of fruit fly in citrus fruit and investigations on spray residues on fruit.

N.S.W. Department of Agriculture.—Fruit storage investigations.

Metropolitan Meat Industry Board, Sydney.—Muscle biochemistry investigations.

Australian Meat Board.—Meat research and muscle biochemistry investigations.

Queensland Meat Industry Board.—Meat research.

Australian Egg Board.—Egg investigations.

Egg Producers' Council.—Investigation into the deterioration of egg quality during marketing.

Apple and Pear Board.—Apple and pear storage investigations.

With the aid of contributions from the above sources, fresh researches were initiated and other valuable investigations continued. A number of contributors have been supporting the Division for many years and their welcome assistance has helped the Division with its long-term research.

The Division has been delighted to receive over the years numerous contributions from private industry. In the financial year ending June 30, 1960, contributions amounting to over £2000 were received from the following:

Cygnet Co-operative Canning Society, Tasmania.

J. Gadsden Pty. Ltd.

Gordon Edgell & Sons Ltd.

Green's Products Ltd.

W. Gregg & Co. Ltd., New Zealand.

Harry Peck & Co. (Aust.) Pty. Ltd.

Jones Bros., Griffith, N.S.W.

Kia-Ora Industries (Vic.) Pty. Ltd.

Leeton Co-operative Cannery Ltd.

Lewis Berger & Sons (Aust.) Pty. Ltd.

Matthews Thompson Pty. Ltd.

Raleigh Preserving Co. Pty. Ltd.

Taubmans Industrial Coatings Pty. Ltd.

Tom Piper Ltd.

The Division would also like to place on record its thanks to Mr. L. Sampson of Orange, N.S.W., for a generous donation of fruit which was used in investigations on storage and to many others for placing facilities in factories and on farms at the disposal of its research teams.

As in past years, donations from the food industry have been devoted for the most part to the purchase of laboratory and other equipment needed by the research staff. In the 1959/60 financial year, orders amounting to nearly £3500 were placed for apparatus required for research in bacteriology, plant physiology, and food processing.

An Introduction To Meat Dehydration

By A. R. Prater
Division of Food Preservation, C.S.I.R.O., Homebush, N.S.W.

THE preservation of meat by drying has been practised for hundreds of years by nomadic, pastoral, and pioneering peoples, and sun-dried meat has become an important article of commerce in certain regions with warm dry seasons, notably Central and South America. However, since traditional methods of preparing dried meat are dependent for success on suitable climatic conditions, alternative methods of meat dehydration have been or are being developed by the meat packaging industry. The present article aims to provide a general account of various aspects of meat dehydration technology and to indicate some of the principles involved.

ADVANTAGES OF DEHYDRATION

The main advantages of drying as a method of preservation are the savings in weight and space and consequently packing materials which it effects. These savings are increased if the dried food is compressed after drying. For example, 157 cu.ft. of space is required for the carriage of 1 ton of meat solids as canned corned beef, and only 75 cu.ft. for compressed dried meat. The resulting saving in tinplate is approximately two thirds. A 40-lb carcass yields approximately 24 lb of boned meat, from which 12 lb of minced cooked meat is obtained. This in turn, after dehydration, yields 6 lb of dried mince which can be compressed to half its volume for packing in a 6-lb can. The reduction of the mass and volume of meat by dehydration is illustrated in Figure 1, which shows a 40-lb mutton carcass before boning, the boned meat and bones, the equivalent volume of water and dried meat, and finally the dried meat compressed into a 6-lb can. Long storage life without costly refrigeration, and transportation on non-refrigerated ships are additional important advantages of dried meat.

SELECTING A DRYING PROCESS

In selecting a method for drying meat the following factors should be taken into account:

Type of meat to be dried (e.g. beef, mutton, whale meat).

Special characteristics of the raw material (e.g. storage stability of fat).

Quality desired in the finished product. (Is it for human or animal consumption? Have special regulations to be complied with?)

Ease of preparation for eating. (Is the meat raw or precooked?)

Form of the meat (powder, mince, slices, chunks, chops).

Desired shelf life.

Type of pack.

Economics of the process (e.g. capital available for plant).

Availability of steam, water, electricity. refrigeration, and other services at the site,

Whether a batch or continuous process is required.

SUN-DRYING

Since sun-dried meats reconstitute slowly and their flavour and texture do not closely resemble those of freshly cooked meat, they are an acquired taste. The traditional methods still used to make charqui (xerque, or jerked meat), biltong, and pemmican have been described by Sharp (1953).*

Charqui

This form of sun-dried meat is an important article of commerce in Central and South America. Fresh sides of beef are boned by highly skilled butchers to form three long sheets of meat which are cut into strips of

* SHARP, J. G. (1953).—Dehydrated meat. Spec. Rep. Fd. Invest. Bd., Lond. No. 57.

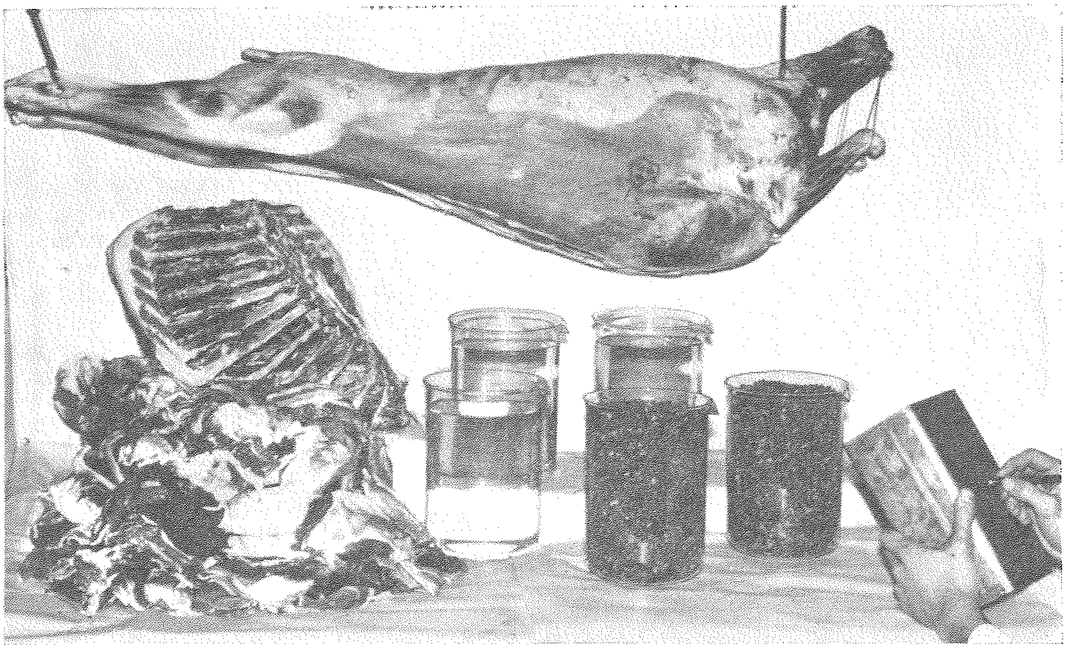


Fig. 1.—Reduction of weight and space of a 40-lb mutton carcass on dehydration showing carcass, meat and bones, extracted water and dried meat, and the final pack in a 6-lb beef can.

uniform thickness. They are hung up for an hour to cool and then submerged for about an hour in saturated brine. After removal from the pickle the strips are drained, covered with coarse salt, and piled to a height of 4–5 ft. The pile is remade on the second day with extra salt, and again on the third and fourth day, without extra salt. The strips are then dried on wooden racks, disposed north and south to get maximum sun. The meat is exposed on the racks for periods of only an hour or two at first, to prevent melting of the fat, and is then piled under a tarpaulin. Alternate hanging (for longer periods) and piling may be carried out five to seven times, according to weather conditions, until the meat has lost about 40 per cent. of its original weight, and is ready for baling as compact blocks in burlap sacks.

Biltong

Lean meat from the legs or loins of beef and game carcasses is cut into long strips, which are lightly cured. The curing mixture (38 parts salt, 1 part saltpetre, 9 parts unrefined sugar) is sprinkled over the meat, which is left to cure for 24 hours and then hung up in the shade in open sheds, until sufficiently dry for storage.

Whereas charqui is a very fatty product (25–35 per cent. fatty tissue), biltong is lean; a typical sample would have 7·5 per cent. fat and 21 per cent. water.

Pemmican

This product was originally prepared by the North American Indians and consists of sun-dried strips of lean meat pounded to a fine meal and mixed with rendered fat.

DEHYDRATION

Drying processes other than sun-drying are termed dehydration. Meat may be dehydrated by several methods:

- By a current of heated air
- Under reduced pressure, with radiant or conducted heat
- By contact with heated surfaces.

Drying by Heated Air

Precooked mince, but not raw mince or pieces of meat more than half an inch in diameter, can be dried satisfactorily by this method.

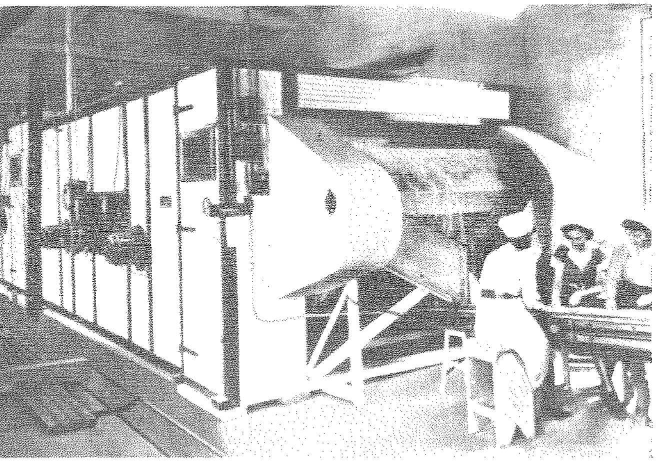


Fig. 2.—The Proctor continuous conveyor dehydrator. (Courtesy Proctor and Schwartz Inc., Philadelphia.)

The air-dryer in its simplest form consists of a fan, a heater with thermostat, a tray to hold the meat, and appropriate ductwork to direct the hot air over the meat (termed "cross-draught" drying) or up through the meat (termed "updraught" or "through-draught" drying).

For small-scale experimental work a dryer of the through-draught type can be made from a 44-gallon drum. The top of the drum is cut out and replaced with a circular wire-bottom meat tray about 6 in. deep. The top of the tray is flanged so that it may be hung inside the drum, and a rubber seal inserted at the contact surfaces to minimize air losses. The hot air, supplied by a thermostatically controlled heater and fan, is led into the drum through a duct near the bottom. The temperature of the air should be about 155°F and the pressure sufficient almost to lift the meat layer.

Commercial dehydrators operating on the same principle were used in Australia during World War II to produce dried meat for the Armed Forces and civilians, and comprised a primary dryer (drying to 20 per cent. moisture) and a secondary dryer. The efficiency of these dryers can be improved by providing for partial recirculation of the air, but the moisture content of the air must be closely watched. The recirculation principle is embodied in the secondary dryers which in Australian practice were used to reduce the moisture content from 20 to 4 per cent.

Cross-draught tunnel dryers, such as are used in vegetable dehydration plants, have been used to air dry mince meat. However, it is generally considered that through-draught drying is faster. Two-stage through-draught belt dryers have been developed for continuous large-scale production (1000 lb of dried meat per hour). These dryers have proved satisfactory and are capable of producing a very uniform product. The dryer consists of a number of sections, each section having its own fan and heater. Figure 2 shows the delivery end of such a dryer. Another type of continuous through-draught dryer is the roto-louvre. The unit consists of a steel drum with an inner cylindrical shell composed of overlapping louvre plates. The wet meat is fed into the inner shell and, as the unit rotates, the meat travels to the discharge end down a slight incline. Hot air is blown into the space between the cylinders and is forced up through the louvre openings and through the meat. More recently the belt-trough dryer has been developed and has been proved capable of drying granular products in a much shorter time than the more conventional type of dryer. Figure 3 shows a battery of these in operation in a Californian plant. The trough is 10 ft long by 4 ft wide.

It should be stressed that, quite irrespective of the type of air dryer selected, careful design and manufacture by experts is most important; large sums of money can be wasted by faulty design and manufacture.

Drying under Reduced Pressure

Generally speaking, the lower the temperature of drying the better the quality of the product. Vacuum methods result in a greater vapour pressure differential (i.e. greater drying power) than with air-drying methods, giving faster drying and lower moisture content. However, they are more expensive than air-drying methods, and more difficult to convert from a batch to a continuous process.

Only precooked mince can be dried satisfactorily by air-drying, but vacuum methods make possible the drying of raw and cooked chunks. Another advantage of vacuum methods is that the fat content of the meat does not affect the drying time to the same extent as in air drying. A decision to use reduced pressure in drying will depend on the form and quality of the product required, and the existence of a market for a higher-priced product.

Freeze-drying.—A product of reasonable quality can be produced by vacuum drying of raw chunks of meat at temperatures up to 160°F. However, an excellent product may be obtained by a process termed "freeze-drying". In this process the meat is frozen and the water is distilled off on to refrigerated surfaces maintained at a very low temperature. The pressure in the vessel must be low (less than 1 mm of mercury), and only enough heat is supplied to drive off the water without thawing the meat. Drying times are long and the cost of production is considerably higher than with more conventional methods.

Drying times and costs of freeze-drying can be reduced, without a big sacrifice in quality, by improving heat transfer to the product by means of heated pressure plates or heated plates with spikes. A method has been developed in the United Kingdom (termed the "vacuum contact-plate process") whereby the meat is dried between heated pressure plates. Figure 4 shows such a plant in operation. In Canada the problem has been attacked in a slightly different way. Spikes are attached to the top and bottom plates and these are pressed into the meat before freezing. Costs of production of material by these two accelerated freeze-drying methods are not yet available, but it is reasonable to assume that they would lie between those of conventional methods and of normal freeze-drying.

New Zealand Vacuum Method.—A vacuum method which does not involve refrigeration during drying, but uses fat as the heat transfer medium, has been developed in New Zealand. Frozen chunks of meat are dropped into molten fat in a vacuum vessel, and the pressure lowered to 2–3 mm of mercury. Heat is supplied to the fat in an external heat exchanger and the vapour from the meat is passed through a water condenser. Drying is completed in 2–3 hours, and the excess fat is then removed in a basket centrifuge. By this method it is possible to dry raw chunks rapidly, but the quality of the product is inferior to that of freeze-dried material.

Contact Drying

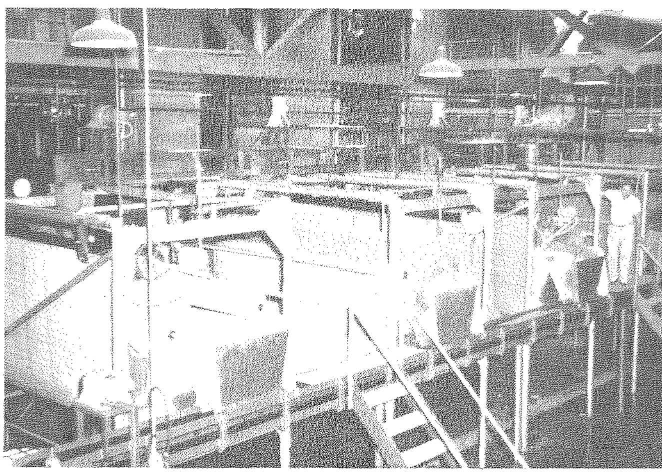
These methods usually result in rapid dehydration, but the danger of scorching is great, and the texture and flavour are generally inferior to that of material dried by other methods. Roller drying depends on exposing a very thin layer of material to contact with the surface of steam-heated rollers at a high temperature for a short time. Meat which has been reduced to a paste by long boiling or pressure cooking can be dried satisfactorily in this way. This type of product is often used in soup powders where the meat only forms a small proportion of the total. Figure 5 shows a roller dryer in operation.

AIR-DRIED MINCE

Air drying of mince is probably the most widely used method of dehydrating meat.

The meat is boned, cut into pieces (approx. 3-in. cubes), and cooked in boiling water (or in live steam at atmospheric pressure) for a period of 45 minutes, then strained off and minced. The fat is separated from the cooking liquor in a gravity separator and the liquor concentrated from about 3 per cent. solids to 24 per cent. solids and spread evenly over the minced cooked meat just before drying. The mince is dried at a temperature of 155°F to a moisture content of

Fig. 3.—Belt-trough dryers in use in a commercial vegetable dehydration plant. This dryer was developed in the U.S. Department of Agriculture's Western Utilization Research and Development Division in Albany, California.



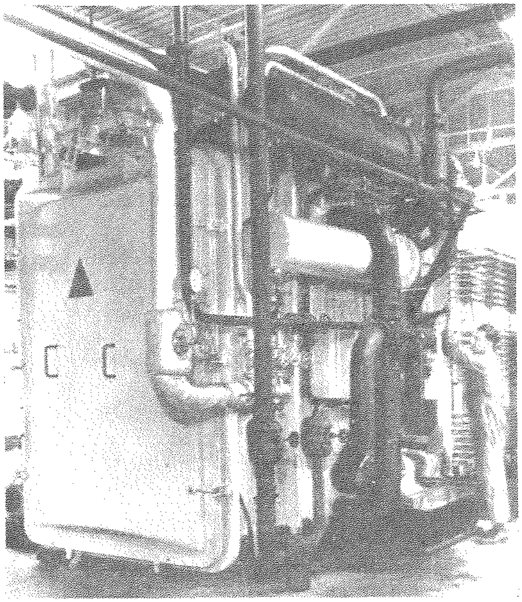


Fig. 4.—Large-scale vacuum contact-plate cabinet. (Courtesy Ministry of Agriculture, Fisheries and Food, U.K.)

approximately 20 per cent. and the final stage of drying (to approximately 4 per cent. moisture) is carried out at an air temperature of 135°F.

A poorer quality dried mince may be produced by pressure cooking the meat on the bone for 1½–2 hours at a pressure of 15–20 lb/sq.in., and picking out the bones after cooking. Other details would be the same as for air-dried mince. This process may prove useful in the production of pet food, for which there is quite a demand.

HYGIENE

The importance of hygiene in dried meat production cannot be over-emphasized. High standards of slaughtering and meat inspection *must be strictly maintained.* Great care must be taken to prevent the use of raw meat showing the slightest sign of attack by bacteria or moulds. Also, scrupulous care must be taken with the regular cleaning and sterilization of all equipment used. Meat left in a mincer, for example, is often a source of contamination of the next batch. Raw or cooked meat must not be allowed to stand at room temperature for any length of time; if it cannot be processed at once it should be critically examined immediately before use. This also applies to cooking liquors before and after concentration.

Routine bacterial counts should be carried out on the product. A count of 10,000 organisms per gram of dried meat, determined under specified conditions, has been accepted as the maximum permissible. A number greater than this indicates that plant hygiene is below standard, and that production should be stopped and an investigation made of the plant and process. The count referred to is a total count only: it does not give information on the type of organisms present or their possible effects on the consumer. More detailed tests are required for this purpose.

STORAGE

There is a popular misconception that, provided insect attack is eliminated, dried foods are very durable. With few exceptions, this is not the case, and most dried foods, including meat, are perishable. Packaging must be studied carefully, therefore, if a reasonably long storage life is to be obtained.

Types of Deterioration

The types of deteriorative change which may take place in dried meat during storage, can be grouped under three headings:

- **Microbial Attack.**—It should be noted that attack by bacteria, yeasts, and mould is inhibited at certain levels of moisture content, which in dried meat is expressed as a percentage of total weight, as grams water per 100 grams dry fat-free solids, or in terms of relative humidity. A safe working maximum for dried meat of normal composition would be a relative humidity of 63 per cent., corresponding to an equilibrium moisture content of 14·3 grams of water per 100 grams of dry fat-free solids. This is equivalent to 8·75 per cent. moisture with dried meat of 30 per cent. fat, and to 7·5 per cent. moisture with dried meat of 40 per cent. fat content. In any drying process care must be taken to ensure that the meat is dried to a figure lower than the safe moisture content, to allow for uptake of moisture from the air during handling. Uptake of moisture from the air by the product is prevented by packing in a moisture-proof container.

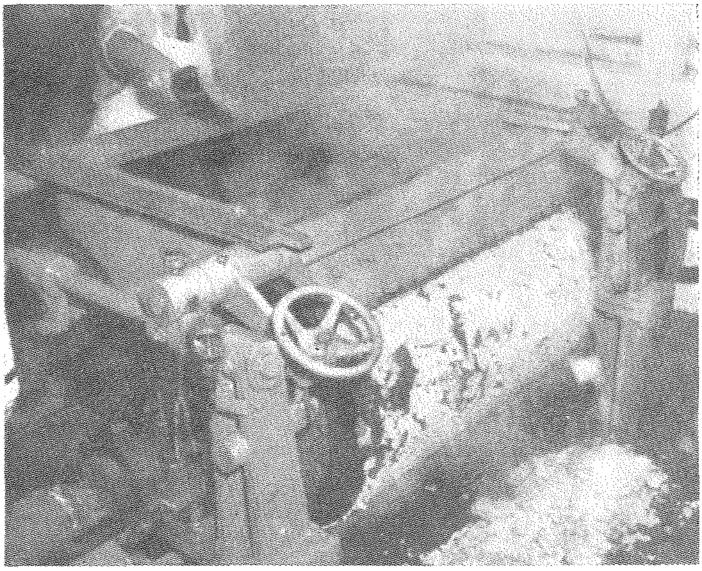


Fig. 5.—A roller dryer in operation.
(Courtesy U.S. Dept. of Agriculture.)

● **Changes in Fat Fractions.**—Two types of chemical change may occur in the fat fraction, namely, hydrolysis leading to liberation of free fatty acids, and oxidation (by oxygen from the air) leading to rancidity. At normal moisture contents hydrolysis is generally not a problem, and rancidity, which is more likely to occur in pork than in beef or mutton fat, is controlled by exclusion of air from the pack (gas packing) and/or by incorporation of antioxidants. If the use of antioxidants is contemplated, the regulations under the local Pure Foods Act should be examined.

● **Changes in the Protein Fraction (lean meat).**—Exclusion of oxygen by gas or vacuum packing retards development of certain off-flavours, but others, termed "browning changes", develop in gas-packed material. Browning changes can be retarded, but are not serious unless a particularly long shelf life is required.

Packing Methods

Rigid containers are not only the best moisture and gas barriers but, by their rigidity, protect the contents against damage during handling. Gas packing or vacuum packing in rigid containers is simpler and more satisfactory than in substitute containers. However, satisfactory gas or vacuum packs may be made with substitute containers, provided the container material has a good gas barrier. Gas packing involves removal of air from the pack and its replacement with an inert gas such as nitrogen. Vacuum packing should be equally effective, provided the oxygen is removed to the extent of at least 98 per cent. and the container is capable of withstanding a pressure of 1 atmosphere.

Air-dried mince can be compressed into rigid blocks of approximately half the volume of the original meat without serious damage to its texture. The meat may be compressed directly into cans, or blocked first and the blocks transferred to cans of suitable size. Alternatively, the blocks may be wrapped or placed in bags and packed in cardboard cartons. Blocking of the meat not only results in considerable saving in space and tinplate, but most of the air is excluded during the operation and the storage life is almost equal to that of gas- or vacuum-packed material.

Effect of Temperature on Shelf Life

The shelf life of dried meat will depend on a number of factors such as the quality of the raw material, the process used for preparation, whether the material is precooked or not, the type of pack, and the temperature of storage. At the end of the shelf life off-flavour develops to a degree that makes the meat unsuitable for table use, but it may be used in some manufactured products in which meat forms only a small proportion of the total constituents.

Increasing the temperature of storage reduces the shelf life. The magnitude of this effect will vary with the type of dried meat under consideration, but air-dried mutton mince may be cited as an example. Air packs of air-dried mutton mince may have a storage life of approximately 10 months at 77°F, and $1\frac{1}{2}$ years at 32°F. The corresponding figures for blocks would be 2 years, and greater than $2\frac{1}{2}$ years, while for nitrogen packs the figures would be $2\frac{1}{2}$ years and greater than 3 years.

QUALITY CONTROL

To ensure consistent high-quality production close supervision of the processing and regular testing of the dried meat will be necessary. These tests should include water uptake on reconstitution, determinations of fat and moisture, bacteriological counts, and palatability tests.

The palatability tests are carried out by reconstituting and cooking a small quantity of the dried meat under standardized conditions, and submitting it to a small panel of trained tasters drawn, if possible, from the staff of the establishment. The panel should look for good meat flavour, little or no off-flavour, and good texture. The latter should include particle size, tenderness, and juiciness.

Contamination of Smoked Foods with Arsenic

THE INCREASING USE of preservatives containing arsenic for the treatment of sawn timber has raised a serious problem in relation to the curing of bacon and fish by smoke preservation. Whilst it may be only occasionally that timber so treated would be used for smoke curing of meat and fish, the risk of arsenic contamination from such a source is always present, and should not be overlooked.

There are at least two well-known brands of water-soluble wood preservatives in use in Australia which contain arsenic. These products also contain copper sulphate and potassium dichromate, the latter component assisting in "fixing" the copper and arsenic salts in the wood. Application is by pressure impregnation at 200–250 lb/sq.in., using cold solutions, and although the water-soluble wood preservatives may contain up to 11 per cent. arsenic pentoxide ($As_2O_5.2H_2O$), fixation of the preservative is generally good, so that direct contamination of crated food products by the leaching out of arsenical salts from the timber is extremely unlikely.

Contamination of smoke-cured fish and bacon with arsenical compounds volatilized from impregnated timber and present in the smoke derived from the wood has been shown by studies undertaken in New Zealand to be a distinct toxicity hazard. Thus Watson (1958*a*) has demonstrated in controlled pilot-scale burning trials on sawdust derived from wood treated with a 1 per cent. (approx.) solution of a commercial wood preservative that 8·6 per cent. of the arsenic present in the treated timber (0·233 per cent. arsenic content) was volatilized in the smoke box. Similar studies (Watson 1958*b*) using wood shavings containing 0·388 per cent. arsenic showed that over 22 per cent. of the arsenic was evolved under the particular conditions employed. Both bacon and fish absorbed significant quantities of arsenic from the smoke during the curing process. The maximum quantities of arsenic found in the cured bacon were within the range 1·3–2·3 p.p.m., but for blue cod—with a natural arsenic content of 0·5–1·5 p.p.m.—it was concluded that the figure might reach 25 p.p.m. after curing.

These data indicate that there is a real toxicity hazard associated with the use of arsenic-treated timber for smoke curing, and such material should not be used either alone or in admixture with other shavings.

ACKNOWLEDGMENTS

We are indebted to the Division of Wood Technology, Forestry Commission of New South Wales, for information relating to the use of wood-preserving arsenicals in Australia.

REFERENCES

WATSON, C. C. (1958*a*).—The contamination of bacon from smoke derived from preservatised wood. *N.Z.J.Sci.* **1**: 361–8.

WATSON, C. C. (1958*b*).—The contamination of fish by arsenic from smoke derived from preservatised wood. *N.Z.J.Sci.* **1**: 369–72.

NEWS FROM THE DIVISION OF FOOD PRESERVATION

TITLE OF THE DIVISION

Readers of the *Food Preservation Quarterly* will have noticed that the title of the Division has been shortened by the omission of the word "Transport". The word was intended to convey that the Division's field of work included the transport *of food*, but neither lay nor scientific personnel invariably interpreted it this way. With the introduction of the shorter title it is expected that the Divisional telephonist will no longer be asked for information on omnibus time-tables !

PLANT PHYSIOLOGY UNIT

For the first time since the inception of the Division's Plant Physiology Unit at the Botany School, University of Sydney, there has been a change in its leadership. Dr. F. V. Mercer, Associate Professor of Botany at the University of Sydney, has been one of the two joint leaders since June 1952, but Dr. R. N. Robertson, now a member of the C.S.I.R.O. Executive, has been succeeded by Dr. D. D. Davies. Dr. Davies was formerly Reader in Biochemistry at the University of London, where he graduated B.Sc. in 1950 and Ph.D. in 1954, and distinguished himself by his researches in plant biochemistry. Dr. Davies joined the Division in England in September 1960 and arrived in Sydney early in October.

Dr. J. F. Turner, a senior member of the Unit's staff, is spending a period of 10 months with Professor Martin Gibbs in the Department of Biochemistry at Cornell University, Ithaca, New York, where he has been accorded the rank and status of Visiting Professor. Dr. Turner is accompanied by his wife, Dr. Donella Turner, who is also a member of the staff of the Plant Physiology Unit. At the conclusion of Dr Turner's term at Cornell, he and his wife are returning to Australia via the United Kingdom and Europe. In August 1961 they are visiting Moscow to attend the International Congress of Biochemistry, where Dr. J. F. Turner is presenting a paper.

Two members of the research staff of the Plant Physiology Unit resigned in the latter half of 1960: Dr. H. S. McKee transferred to the C.S.I.R.O. Division of Plant Industry at Canberra, and Dr. M. D. Hatch joined the staff of the David North Plant Research Centre, established by the Colonial Sugar Refining Co. Ltd. at Indooroopilly, Qld.

FOOD SCIENCE CONFERENCE

New food research laboratories for the Commonwealth Scientific and Industrial Research Organization, Australia, are being opened at North Ryde, near Sydney, on September 18, 1961, and to mark the occasion a food science conference is being held there from September 19 to 22.

The conference will take the form of three symposia, each introduced by a distinguished food scientist, and two general discussions led by panels of scientists.

The tentative programme is as follows:

September 18

3.15 p.m. Official opening of new headquarters and laboratories for the C.S.I.R.O. Division of Food Preservation.

September 19

9.30 a.m. Opening of food science conference.

9.50 a.m. Symposium—Chemical aspects of food processing.

2.30 p.m. Inspection of North Ryde research laboratories.

6.00 p.m. Reception.

September 20

9.30 a.m. Symposium—Factors affecting meat quality.

9.30 a.m. Symposium (Parallel session)—Contributed papers on chemical aspects of food processing.

2.00 p.m. Panel discussion—Public health aspects of handling and processing of foods.

September 21

9.30 a.m. Symposium—Food preservation and the organization of plant and animal tissues.

9.30 a.m. Symposium (Parallel session)—Contributed papers on chemical aspects of food processing.

3.45 p.m. Unveiling of memorial to the late Mr. E. W. Hicks, former leader of the Physics Section in the Division.

September 22

9.30 a.m. Panel discussion—Trends in food research.

12.30 p.m. Closing of Conference.

The Conference is open to scientists, technologists, and managerial staff from the food industry and food research laboratories, and the organizers are most anxious to encourage participation by research workers from as many countries as possible. A number of twenty-minute papers are to be delivered in each symposium. Research papers on the chemical aspects of food would be welcome: titles should reach the Division by April 1. Persons proposing to attend the conference are invited to write for registration forms and further information to:

The Chief,
Division of Food Preservation,
C.S.I.R.O.,
Private Bag, Post Office, Homebush,
New South Wales, Australia.

PUBLICATIONS BY STAFF

Conduction Errors in Thermocouples Used for Heat Penetration Measurements in Foods which Heat by Conduction. N. D. Cowell, H. L. Evans, E. W. Hicks, and J. D. Mellor. *Food Tech.* **13**: 425–9 (1959).

Errors are introduced into heat penetration measurements in cans of conduction-heating foodstuffs by the conduction of heat down the thermocouple wires used for temperature measurement. These errors are largest in the early stages of heating and cooling and may cause important errors in the evaluation of the lethal value of the cooling phase of the sterilizing process. Experimental work on model systems has shown that the theoretical equation developed by Jaeger may be used to calculate the errors involved. To minimize the errors, only fine thermocouple wires should be used and copper wires should be replaced as a thermocouple material by a metal of lower thermal conductivity, e.g. nichrome.

Chemical Changes during Growth and Storage of the Avocado Fruit. J. B. Davenport and S. C. Ellis. *Aust. J. Biol. Sci.* **12**: 445–54 (1959).

Studies of the avocado fruit were undertaken primarily to follow the pattern of fatty acid synthesis during 6 months' development on the tree, and during storage at 20°C of the fully grown fruit, and to relate this fat production to other chemical changes in the flesh of the fruit.

Reduction of Bisulphite to Elemental Sulphur by Reducing Sugars. D. L. Ingles. *Chem. & Ind.* **1959**: 1045–6.

This paper discusses the interaction of sugars and sulphur dioxide which may occur in sulphured dried fruits.

Respiration of Washington Navel and Valencia Oranges. S. A. Trout,* F. E. Huelin, and G. B. Tindale.† *C.S.I.R.O. Aust. Div. Food Pres. Tech. Pap. No.* 14 (1960).

The respiratory drift of Washington Navel and Valencia oranges from three coastal and four inland irrigated districts was measured after harvesting. In most cases a climacteric rise occurred as the oranges approached commercial maturity. Oranges affected by cold injury tended to give irregular curves. The significance of these results is discussed.

* Now Director of Horticulture and of Food Preservation Research Laboratory, Department of Agriculture and Stock, Queensland.

† Department of Agriculture, Victoria.

Copies of the papers mentioned above may be obtained from the Librarian, Division of Food Preservation, Private Bag, P.O., Homebush, New South Wales. Telephone: 76-8431, 76-0274.