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EXPORTS OF FOODSTUFFS TO GREAT BRITAIN.

In view of the shortage of shipping space for the transport of foodstuffs from Australia to Great Britain, there is an obvious need to stow as much edible material as possible into every cubic foot of freight space. This course of action, if adopted, may lead to the more bulky and wasteful kinds of foodstuffs being eliminated from export. In this connexion, it is of interest to consider briefly the thesis put forward by Orr and Lubbock in their recently-published booklet "Feeding the People in War-time" (London: MacMillan & Co. Ltd.: 1940). Orr and Lubbock strongly advocate the adoption of a policy whereby only those foodstuffs, having high energy (fuel) values per cubic foot of freight space occupied, are imported into Great Britain, leaving to home agriculture the task of supplementing these, and of providing the so-called "protective" foods which will supply the required amounts of minerals and vitamins, e.g. milk, vegetables, and fruits. These authors, therefore, suggest that importations should be limited to edible fats and oils, sugar, wheat, and perhaps, cheese.

If the policy of Orr and Lubbock is adopted (and for Australian exports there are very strong reasons why it should be), then the following table giving, for some common foods, the approximate energy value of the edible material stowed into one cubic foot of freight space will be of considerable interest.

Food	How carried on shipboard *	Energy Value Calories per cubic foot freight space.
Canned Butter Fat	G	160,000
Frozen Butter	R	143,000
Raw Sugar	G	90,000
Wheat	G	69,000
Cheese	R	65,000
Dried Whole Milk	G	60,000
Dried Vine Fruits	G	56,000
Dried Eggs (Powder)	G	56,000
Dried Skim Milk	G	45,000
Pork (Carcases)	R	35,000
Corned Beef	G	31,000
Lamb (Telescoped)	R	31,000
Beef (Quarters)	R	27,000
Eggs-in-Shell	R	13,000
Canned Fruits (various)	G	13,000
Apples	R	5,000

* G = As general cargo.
R = As refrigerated cargo.

Canned butter fat which occupies the highest place on the list is not yet produced in commercial quantities in Australia, but the dairy industry is now obtaining equipment to make large-scale production feasible. Equipment is also being installed to enable the whole of the normal surplus production of eggs to be converted into the dried form.

The low position of eggs-in-shell, canned fruits, and apples should be noted. Since none of the three is essential in a diet containing ample quantities of milk and vegetables, considerable wastage of freight space would occur if they were forwarded to Great Britain.

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HUMIDITY IN COLD STORES: PART 2.

The Measurement of Humidity.

A large number of methods for measuring humidities have been devised and used for various purposes, but many of these are difficult to apply in cold stores. Some of the more important methods are discussed below.

1. CHEMICAL METHOD.

In this method a measured volume of air is drawn slowly over phosphorus pentoxide or some other efficient absorbent of water vapour in a series of U-tubes. By a suitable adjustment of the rate of air flow and the amount of absorbent, it is possible to obtain almost complete absorption of the water vapour, so that the absolute humidity can be calculated from the increase in weight of the tubes containing the absorbent and the volume of air passed through them. This method is very cumbersome, and at low temperatures elaborate precautions are necessary to obtain accurate results, so that it is useless for routine measurements in cold stores. Nevertheless it is of great importance in laboratory work as an ultimate standard of reference for checking the reliability of any other method.

2. DEW POINT METHOD.

Several types of apparatus have been designed for measuring the dew point of air. The essential principle of all of these is that a highly polished surface is cooled very slowly until the appearance of dew is detected. This method is also somewhat cumbersome, and there do not seem to be any dew point instruments on the Australian market which would be at all convenient for routine tests in cold stores. However, the theoretical basis of this method is simple and unquestioned, and for laboratory work the dew point method is generally more

convenient than the chemical method, so that it is often adopted as a working standard of reference.

3. WET AND DRY BULB HYGROMETER.

If a thermometer bulb is covered with a wet bandage, cooling occurs because of the evaporation of water, and the temperature indicated is lower than that shown by an ordinary dry bulb thermometer. The difference between the readings of wet and dry bulb thermometers or "wet bulb depression" depends, in general, on the temperature of the air, the relative humidity, the rate of air flow over the bulbs, the form and materials of the thermometers, the nature and temperatures of neighbouring surfaces, and several other factors. However, if the air speed over the thermometer bulbs exceeds about 10 feet per second, the effects of the temperature and relative humidity of the air on the wet bulb depression are so large relative to the other factors that it is generally safe to neglect all these other factors. Tables of the relation between air temperature and relative humidity and the wet bulb depression may be found in most text books of refrigeration or physics, and these are used for deducing relative humidities from the readings of properly ventilated wet and dry bulb thermometers.

There are many forms of wet and dry bulb hygrometer in common use. In one of the commonest forms, wet and dry bulbs are mounted side by side in a frame for hanging on the wall of a room. These are not generally reliable instruments because the rate of air flow over the bulbs may be much below the minimum of 10 ft./sec. necessary for the application of the usual tables. Some tables for unventilated instruments have been prepared, but these are of little value unless the design of the instrument is accurately standardized and the rate of air flow closely controlled.

Various forms of whirling hygrometer or "sling psychrometer" are on the market. In these the two thermometers are mounted side by side in a frame which is rotated on an axle, or swung on a chain to give sufficient air movement over the bulbs. This simple type of instrument is quite accurate enough for many purposes, but at low temperatures it may be unreliable because the observer must swing it for a minute or two, and his presence may alter the temperature and humidity of the air appreciably.

One of the best forms of wet and dry bulb hygrometer available is the Assmann aspiration psychrometer. In this instrument, a small clock-work motor drives a fan which draws air through two metal tubes in which the thermometers are mounted. These instruments are expensive and may not now be obtainable in Australia. An efficient instrument working on the same principle can be made from a hairdresser's fan. An extension tube is fitted to the suction tube of the fan and the thermometers mounted in stoppers in holes in the side of the extension so that the bulbs are in the centre of the tube. The wet bulb thermometer should

always be placed downstream from the dry bulb so that if droplets of water should be blown off the wet bulb they cannot strike the dry bulb. In this instrument the air is warmed appreciably in passing through the fan so that it is necessary to make sure the air is discharged well away from the inlet opening. Vacuum cleaner fans and motors may be used for this type of instrument, but they are a good deal more powerful than is necessary, and if they are used, considerable care is necessary to prevent mixing of heated discharge air with the sample taken in at the inlet. There are, of course, many other ways in which the Assmann principle may be applied. By using resistance thermometers or thermocouples instead of mercury thermometers they may be made distant reading. With resistance thermometers having fairly large bulbs, the minimum air speed for "true" readings may be well above 10 ft. per sec. However, where an electrically driven fan is used it is generally convenient to use an air speed which is undoubtedly sufficient.

The hairdresser's fan type of instrument is sometimes mounted outside the chamber in which the humidity is to be measured and the sample of air drawn through a hole in the wall. New risks of error are introduced with this method and it is not to be recommended except where the instrument cannot conveniently be used inside the room. If the air temperature at the point where the instrument is mounted is considerably above the average of the room being tested, the readings obtained will not apply directly to the mean air conditions of the room and a separate measurement of the dry bulb temperature is necessary. The following example will illustrate the method of calculating the room humidity from the readings :-

Room temperature 5.0°C.

Instrument readings Dry bulb 6.2°C.
Wet bulb 4.7°C.

From the tables we find that the relative humidity of the air sample at 6.2°C. is 80%.

From vapour pressure tables we have - saturation vapour pressure at 6.2°C. = 7.11 mm. Hg.

∴ actual vapour pressure of air = 80% of 7.11 = 5.69 mm.

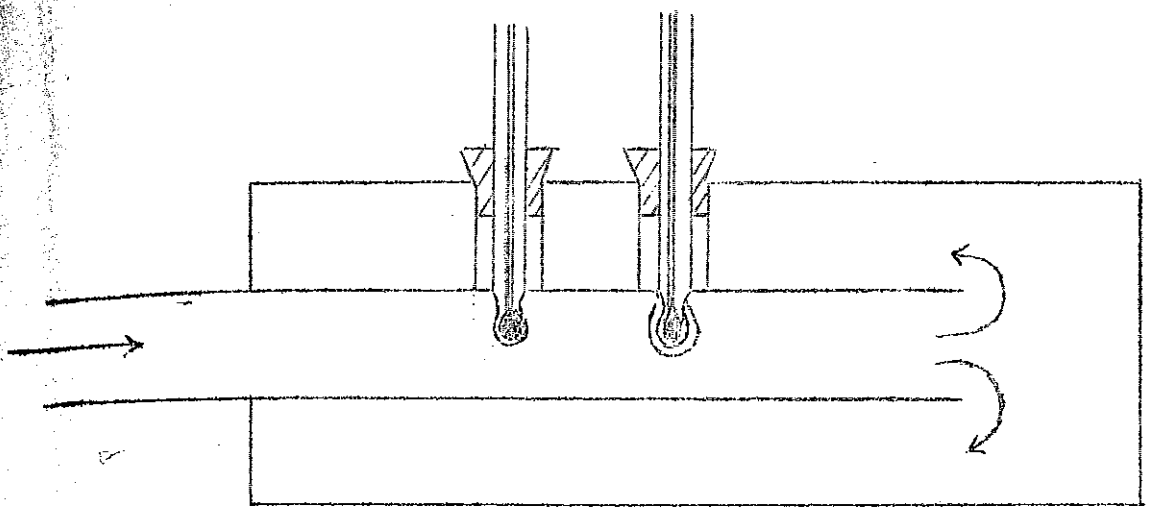
From vapour pressure tables again we have

Saturation vapour pressure at 5.0°C. = 6.54 mm.

∴ relative humidity in room = $\frac{5.69}{6.54} \times 100 = 87\%$.

This type of instrument will, of course, be unreliable if there is any appreciable heating of the air between the wet and

dry bulbs, and an essential preliminary test is to see if a second dry bulb thermometer mounted in the position of the wet bulb, gives the same reading as the ordinary dry bulb. If there is any discrepancy it may be necessary to use a jacketted inlet tube similar to that represented in the diagram.



From the discussion above it will be evident that it is not always easy to get an accurate measurement of humidity of the air in a room using wet and dry bulb thermometers. Where a forced air circulation with delivery and return ducts is installed it is generally much easier to measure the humidity in the ducts than in the room itself. So long as the air speed in a duct is greater than 10 ft. per sec. all that is necessary to measure the humidity in it is to mount wet and dry bulb thermometers through holes in the side of the duct so that the bulbs are near the centre.

At cold storage temperatures the magnitude of the wet bulb depression is small. Thus at 0°C. a wet bulb depression of 0.5°C. is obtained at 91% relative humidity; 1.0°C. at 82%; 1.5°C. at 73%, etc. It is obvious, therefore, that the temperatures must be read very accurately. It is almost essential, therefore, to use thermometers graduated in tenths of a degree (or at least fifths). It is difficult to obtain Fahrenheit thermometers of this sensitivity, but suitable Centigrade thermometers can be obtained from dealers in scientific instruments. All thermometers should be carefully tested before use. Ideally they should be compared with standard thermometers in well-stirred water or some other liquid, at a series of temperatures, but since accuracy in the measurement of the difference between wet bulb and dry bulb is the greatest need, it

will generally be sufficient to check the agreement between each pair of thermometers to be used as wet and dry bulbs.

The bandages on the wet bulb thermometers should always be clean, and must be replaced if they become dirty. Muslin is commonly used for the bandages but other materials may be employed. Tubular corset lace which fits neatly over the thermometer bulbs is very convenient for the purpose. However, if the bandage is too tight it may cause errors of $\frac{1}{4}^{o}$C. or so by pressure on the bulb. It is easy to test for errors of this sort by comparing a bandaged thermometer with an unbandaged one in a vessel of water.

When the wet bulb temperature is below the freezing point of water, the water on the wet bulb may remain supercooled or it may freeze. A frozen wet bulb will show a different temperature from one wet with supercooled water, and different tables are used for the two cases. Frozen wet bulbs take a long time to come to equilibrium, so that in making measurements where the wet bulb temperature is not lower than about -5°C. it is generally advisable to thaw off the ice in water and start afresh, if a wet bulb freezes.

The measurement of humidity in freezers and frozen stores is difficult and will be referred to again in a subsequent article in this series.

4. HAIR HYGROMETER AND SIMILAR INSTRUMENTS.

These instruments make use of the fact that human hair and many other substances, when held under slight tension, will change in length as the relative humidity changes. In most commercial forms of this instrument the changes in length produce movements of a pointer over a scale graduated directly in percentage relative humidity. These instruments are very convenient to use, because a rapid air circulation over them is not necessary and they may simply be hung on a wall of the room and read periodically. Unfortunately, however, their calibration is apt to change considerably with time, particularly if they are subjected to extremes of temperature or humidity. They cannot, therefore, be regarded as trustworthy unless they are checked at frequent intervals at temperatures and humidities similar to those at which they are used.

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THE UTILIZATION OF SURPLUS APPLES: PART 2.

Apple Juice Preservation.

The quality of a processed apple juice is primarily dependent upon the fruit from which it is crushed, and for this reason the factors of variety and maturity are major considerations. In only a few cases can a single apple variety offer the complete juice; a product of good body, well balanced in acid and sugar, and possessing clean, fresh apple aroma. For this reason a juice of desirable type is obtained commercially by blending juices from varieties of known physical and chemical characteristics. Varietal work at Homebush is at a very early stage, some fourteen varieties only receiving consideration during current investigations. Of these, a number have been selected because of their over-production, with a view to using them as a base of more or less neutral character. The incorporation in the base of a small proportion of aromatic fruit such as Delicious or Jonathan will, it is hoped, result in a product of acceptable quality.

The question of maturity at picking is relatively important, and generally it may be said that fruit should be harvested slightly on the immature side of full ripeness. Such a statement, however, if unqualified would unnecessarily restrict pressing operations to comparatively brief periods in the year and therefore prove uneconomic.

The wisest plan is to cope with a maximum quantity of fruit at the stage suggested, and hold the remainder at an appropriate temperature in cool store until such time as it can be used. Juice from stored fruit does not possess the tree-ripe aroma of that which is fresh pressed, but is nevertheless greatly superior to juice from overripe apples.

(a) Washing.

The first step in the conversion of apples to juice is the removal of dust, arsenical residues, and surface biological contamination. Several types of washers have been developed and consist essentially of a mechanical agitation or brushing section followed by a rinse in cold water. The washer in use at Homebush consists merely of wooden slats upon which the acid-treated fruit is placed, hosed by hand and allowed to drain.

(b) Milling and Pressing.

The washed fruit is fed through a mill in which it is finely divided to facilitate juice extraction. The old method of crushing the fruit between stone rollers was adopted many years ago in the cider industries of Great Britain and France, but the stimulus provided by the increasing popularity of unfermented fruit juices has led to the development of high velocity steel mills of two types. The hammer mill disintegrates the fruit by

the impact of heavy hammers supported in a revolving shaft. The type in use at Homebush is the grater mill, in which the effect is dependent upon a series of serrated knives which project about one eighth of an inch from a rotating cylinder. In either case it is now common practice to use corrosion-resistant metal at all points of juice contact, and in fact, the adoption of stainless steel equipment throughout the factory, while expensive, eliminates metallic contamination and development of off-flavours in the product.

The pulp discharged from the mill is built up by means of wooden racks and press cloths into the press, and juice is expressed by means of a ram operated by a hydraulic pump. Rack and cloth presses are now popularly used for a number of fruits and are made with outputs varying from 60 to 600 gallons of apple juice per hour.

(c) Clarification.

Juice freshly expressed from apples contains appreciable quantities of dissolved pectin, a complex carbohydrate which possesses the property of forming a gel when mixed with appropriate proportions of sugar and vegetable acids. The removal of the pectin, which is said to form unsightly floccules in the bottle or can, is effected by the addition of an enzyme adsorbed on bran or dried corn sugar. At temperatures of 65° to 70°F. the pectin is in part stabilized in solution as a less complex identity, while the remainder is precipitated as the calcium salt of pectic acid. Pectin stabilization proceeds to completion within 24 hours.

The removal of pectin sludge from apple juice by filtration is tedious, since clogging will occur, thereby providing a bottleneck in the production. For this reason, centrifuges of special design are employed. The machines are high in initial cost but, in addition to facilitating removal of gelatinous sludge, they increase the effectiveness of pasteurization by lowering biological contamination, and they accelerate the rate of flow in the subsequent "polishing" filtration which is necessary for sparkling clarity.

For final clarification, centrifuged juice is passed by gravity through a pulp filter, or pumped through a plate and frame press equipped with compressed filter pads, or with cloths pre-coated with silicious filter aid. The plate and frame press at the C.S.I.R. fruit juice laboratory is of European origin and is equipped with felt pads which are pre-coated prior to filtration. It may alternatively be fitted with compressed mats of fine porosity for brilliant filtration or with similar mats of still smaller pore size, when juice may actually be produced in sterile condition as an alternative to heat pasteurization.

The production of cloudy apple juice is discussed in the Notes at the end of this publication.

(d) Deaeration and Flash Pasteurization.

The process of removing dissolved and occluded oxygen from fruit juices is known as deaeration. It was originally introduced with the object of avoiding development of bitter flavour in orange juice, a defect which is thought to be due largely to the acceleration of oxidations during flash heating. The process has been extended on principle to many other fruit juices with varying degrees of effectiveness. The deaerator consists of an evacuated vessel provided with surfaces upon which the juice may flow in a thin film. Juice is forced into the vessel by atmospheric pressure and allowed to impinge upon the filming surface. For continuous operation the deaerator is elevated some fifteen feet and joined to a pump at floor level. The efficiency of deaeration depends primarily upon the force of impact, thickness of film and temperature of the juice.

A simple but effective type of deaerator is that in which the apple juice is sprayed from an upturned nozzle against a glass dome. The process may be advocated for apple juice because in addition to delaying oxidative changes during storage, it removes off-flavours and taints acquired during processing and bulk storage. It is not recommended for grape juice as it results in a marked decrease in character owing to the loss of volatile flavouring constituents.

From the deaerator the juice is pumped through the flash pasteurizer, in the first section of which it is rapidly heated to the desired temperature, after which it is cooled to the temperature of filling. The flash pasteurizer used at Homebush consists of a series of corrugated stainless steel plates through which flow hot water between one set and juice through the adjacent set, the directions of flow being opposite. Cooling water is circulated in a separate set of plates in order to reduce juice temperature. Recommendations as to the temperature of pasteurization for apple juice vary considerably, higher temperatures of the order of 190° - 195°F. being favoured in U.S.A., while in continental Europe the 175° - 185°F. range is preferred. Experiments at Homebush indicate that apple juice may be safely heated to 200°F. for short periods, providing always that the temperature difference between the product and the heating medium does not exceed 10°F. approximately. It is for this reason that hot water is used in place of steam.

Heat treatment is usually referred to as pasteurization, but in reality it is a dual purpose process, since in addition to killing yeasts and reducing moulds quantitatively, it is required to inactivate enzyme systems which otherwise bring about undesirable chemical and physical changes during storage. In the case of apple juice it is necessary to destroy naturally occurring oxidases and also the pectic enzyme added during clarification, and for this reason it is suggested that a flash temperature of not less than 190°F. be adopted.

(e) Bottling and Canning.

The choice between bottles and cans as a marketing container is one for the individual. From the commercial aspect each possesses its particular virtues and these have been described in the literature on numerous occasions. From the technical aspect the bottle is superior to the plain tin can in that the latter is liable to corrosion and the development of hydrogen swell. On the other hand, cans may be filled hot and cooled rapidly without the risk of loss which is likely with bottles when subjected to shock heat treatment. The disabilities associated with the tin can have been investigated at the C.S.I.R. fruit juice laboratory, and a completely satisfactory method of lining the can with a non-tainting, corrosion-resistant lacquer has been developed. The process, however, is not yet commercialized, and for this reason, together with the uncertainty of supply under wartime conditions, it may be advisable to pack in glass.

The hot filling method consists in cooling the juice in the pasteurizer to an issue temperature of 170°F. and filling directly into the can or bottle. At this temperature sterilization of the walls and bottom of the container is ensured. After sealing, the can is inverted and the bottle laid on its side for two minutes to sterilize the seal. The can is then cooled by direct immersion in cold water, whereas the bottle is placed in a bath of water at some 30° - 40°F. below the filling temperature. Gradual cooling is then carried out by flowing cold water into the bath.

An alternative method of filling is to sterilize the bottles or cans with an aqueous solution of two per cent sulphur dioxide, drain and fill under reasonably sterile conditions at 140°F. The containers when sealed are permitted to cool in air. The quick cooling method is advocated because holding at an elevated temperature for any length of time seriously affects the natural flavour characteristics of the juice. The higher temperature of filling, also, results in a higher vacuum in the headspace of the container, with consequent exclusion of oxygen. The same objective is obtained at lower filling temperatures when cans are sealed under vacuum. Vacuum can closing machines are now manufactured in Australia.

(f) Bulk Storage.

The above process as described outlines the recognised sequence when juice is canned immediately after expression from the fruit. This is known as the "Quick" or "Enzyme" process. In the "Ageing" process it is assumed that the small amount of naturally occurring pectic enzyme present in apples is capable of stabilizing the juice during storage. The process is used to some extent in U.S.A. and consists in rapidly cooling the juice immediately after extraction and holding at low temperatures until such time as it is required. In Europe the Boehi process

involves centrifuging the expressed juice and impregnating it with carbon dioxide while forcing it into tanks filled with carbon dioxide at a pressure of 120 lb. per square inch. The carbon dioxide content of the juice should be maintained at 1.5 per cent. while temperature should not exceed 54°F. Balloon or carboy storage is a further variant in which the unclarified juice is flash pasteurized to full temperature, cooled to 140°F., and filled into glass carboys previously sterilized with two per cent. sulphur dioxide solution. As a precaution against faulty technique the neck of the carboy is covered with a rubber cap or sealed with a rubber stopper, equipped with a glass tube to which a rubber balloon is attached. Alternatively the carboy may be sealed with a fermentation tube which indicates yeasty fermentation by a succession of bubbles rising through the alcohol-glycerol mixture. Finally the juice may be stored in casks or tanks fitted in a manner similar to the carboy. Cask storage is invariably difficult, since the wood may be contaminated with moulds and contaminated air may be forced between the staves during cooling. Tanks of mild steel coated with a bitumastic lining are growing in favour abroad, while the use of earthenware containers also is being advocated. The ideal bulk container is one fabricated from stainless steel, but at the present time cost is the precluding factor in its use.

Subsequent to bulk storage, juices which have been pasteurized for that purpose must be clarified by pectic enzyme and processed as for fresh juice. For juice stored under refrigeration or in Boehi tanks, further enzymic clarification is unnecessary.

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THE PREVENTION OF BLACK STAIN IN FOOD CANS: PART 2.

Further Notes on the "Oxide Film" Process.

In the last issue of this Quarterly, it was noted that among several methods of preventing black stain in food cans, the chemically produced "oxide film" process, originated by the International Tin Research and Development Council, gave particularly promising results.

This process has now been tested at this laboratory with a further range of products, namely beetroot, French beans, cabbage, spinach, celery, pumpkin, carrots, parsnips, cauliflower, boiled mutton and lamb.

In cans of French beans, cabbage, celery, pumpkin, carrots, parsnips and cauliflower, black staining was completely inhibited.

With the mutton products and spinach some staining occurred, but the treated cans were greatly superior in appearance to plain cans. With beetroot, although the can remained bright, a gradual fading of the red colour occurred, and therefore lacquered cans are recommended for this product.

In addition to these laboratory tests, treated cans were supplied to several canners and have been used with successful results under commercial conditions for the following packs:- Sausages in gravy, sausages and vegetables, sweet corn, meat and vegetable ration, vegetable soup, swede turnips, cabbage, cauliflower, and Brussels sprouts.

As a result of these tests, the "oxide film" process has now been included in the Foodstuffs Specifications of the Department of Supply and Development as an alternative to the lacquering of cans for the following products:- Brussels sprouts, cabbage, cauliflower, green peas, silver beet, spinach, and turnips. It is expected that this list will shortly be extended to cover meat products also.

Several canning organisations are now working co-operatively with this Division in an endeavour to develop suitable plant for the large-scale application of the "oxide film" to made-up cans or to tinplate. Tests are at present being conducted to find out whether satisfactory results can be obtained when the tinplate is treated before making up. It appears probable that this will be possible only when the can-making line has external mandrels, since internal mandrels cause extensive damage to the "oxide film" during fabrication of the can.

This laboratory will supply details of the proposed plant for industrial application of the "oxide film" process to interested organisations on request.

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THE GAS STORAGE OF FRUIT.

For some years, home grown apples have been gas stored in England on a commercial scale, and this method of storage has aroused widespread interest among growers and others engaged in the fruit industry in Australia. This interest is primarily due to the remarkable progress in Great Britain, where the quantity of fruit in gas storage increased from nil in 1928 to nearly a million bushels in 1936. By this means, certain varieties of English apples have been kept in good condition for twice as long as would otherwise be possible, but success has only been obtained after extensive investigations by officers of the Food Investig-

ation Board of Great Britain. Results obtained in the gas storage of fruit in England cannot be applied indiscriminately to other varieties of fruit grown under totally different conditions, and it is necessary to test each variety independently before commercial application is attempted.

Gas storage is usually only successful in conjunction with refrigeration and consists essentially in varying the composition of the atmosphere so that it contains more carbon dioxide and less oxygen than occurs in ordinary air. Ordinary air contains approximately 21 per cent. of oxygen, 79 per cent. of nitrogen, and only 0.04 per cent. of carbon dioxide. But all fruits, even after picking, still consist of living tissue, and in respiration absorb oxygen from the atmosphere and give off carbon dioxide. If the fruit is stored in a gas-tight chamber with an adjustable port for ventilation, the carbon dioxide content of the atmosphere can be allowed to rise to any desired level and then maintained constant by controlling the ventilation. As most respiring fruits absorb oxygen and produce carbon dioxide in approximately equal amounts, the oxygen content of the atmosphere is reduced to the same extent that its carbon dioxide content is increased. Hence if the carbon dioxide is allowed to rise to 5 per cent., the oxygen falls to 21 minus 5, or 16 per cent. And if the carbon dioxide rises to 10 per cent., the oxygen falls to 21 minus 10, or 11 per cent. The latter atmosphere has proved eminently suitable for gas storage of Bramley's Seedling apples in Great Britain.

In making a chamber gas-tight, it has been customary in English gas stores to line the walls and ceiling with sheet iron and cover the floor with bitumen. All joints are then filled with grease. Owing to the scarcity of sheet iron under war conditions, other types of coating are desirable, e.g. bitumen preparations, a number of which are now on the market.

Gas storage in an atmosphere containing five per cent. of carbon dioxide and only three to five per cent. of oxygen has been recommended for some varieties of English apples, particularly Cox's Orange Pippin. This atmosphere cannot be obtained by controlled ventilation alone, since if ventilation was restricted sufficiently to reduce the oxygen to five per cent, the carbon dioxide would accumulate to about sixteen per cent. Hence in this case it is necessary to circulate the atmosphere of the chamber over a chemical absorbent (such as milk of lime) which removes the excess carbon dioxide.

Investigations on the gas storage of Australian fruits have been carried out in Victoria, New South Wales, and Tasmania. In Victoria, the investigations have been carried out by the Division of Food Preservation, C.S.I.R., in conjunction with the Victorian Department of Agriculture; in New South Wales by the Division of Food Preservation, C.S.I.R., in conjunction with the

New South Wales Department of Agriculture; and in Tasmania by the Division of Plant Industry, C.S.I.R., in conjunction with the University of Tasmania.

With regard to apples, the investigations in Tasmania have been confined to atmospheres obtainable by controlled ventilation and have been primarily concerned with gas storage for periods of eight weeks or less, as the control of atmosphere in ships' holds has been mainly under consideration. The varieties Sturmer and French Crab have been found unsuitable for gas storage, as they are readily injured by three to five per cent. of carbon dioxide. The Sturmer is the leading Tasmanian variety and its liability to injury rather limits the application of gas storage in this State.

The Jonathan is by far the leading apple variety in Victoria, and is also of importance in New South Wales and Tasmania. Gas storage of Jonathan apples in five per cent. carbon dioxide, sixteen per cent. oxygen, has practically eliminated Jonathan Spot, but apart from this, the keeping quality has not been appreciably affected. The value of gas storage in this variety is determined almost entirely by the importance of Jonathan Spot, and this disorder varies considerably in different districts and also from year to year.

Experiments on the gas storage of green cooking varieties such as the Granny Smith are giving promising results, since colouring and softening is considerably delayed, and Granny Smith apples in Victoria have been held practically unchanged in colour or firmness until December. This variety, however, in New South Wales is very liable to superficial scald even when stored in oiled wraps.

A point to remember is that the liability to superficial scald is very much increased by gas storage, and it is always advisable to use oiled wraps (which considerably reduce this disorder) unless there is clear evidence that the variety is resistant. When gas stored, Jonathan apples from Red Hill and Blackburn in Victoria have been practically free from superficial scald, but the same variety from Orange and Batlow in New South Wales has been seriously affected.

Pears, which are normally picked green and hard, do not ripen in cool storage but only after removal to higher temperatures. Each variety has been found to have a characteristic storage life, which is the maximum period that the fruit can be kept in cool storage and still ripen normally on removal to higher temperatures. Gas storage has generally resulted in some increase in the storage life of pears, but the effect has varied considerably among different varieties. The most striking results have been obtained in Victoria with Williams' Bon Chretien (W.B.C.), Bosc, and Winter Cole pears, the storage life of which has been approximately

doubled by storage in five per cent. of carbon dioxide and sixteen per cent. of oxygen. Increases as large as these have not, however, been obtained in New South Wales.

The possibilities of gas storage in extending the canning season for W.B.C. pears have been appreciated by a large cannery in Victoria, which has already equipped a refrigerated chamber for this purpose. Air storage at 32°F. limits the canning season to ten weeks, as the storage life under such conditions is only ten to twelve weeks. By using gas storage this period can be approximately doubled.

Gas storage experiments have also been carried out on Victorian dessert peaches. The storage life of hard, immature peaches has been increased, but that of soft semi-ripe peaches has been generally reduced. This result gives no foundation for commercial gas storage, as it is practically impossible to pick peaches to an exact stage of maturity.

Generally, plums and grapes have not responded favourably to gas storage. The storage life of plums has in most cases been definitely reduced, and some varieties have been injured by as little as two per cent. of carbon dioxide.

For successful gas storage, the temperature and composition of the atmosphere must be properly controlled, and the fruit should be gas stored within about four days of picking. In the Australian experiments, the most suitable temperature for gas storage has been found to be the same as that adopted for ordinary air storage. Pears are best stored at 31°F. or as low as possible without risk of freezing. Jonathan apples are very liable to soft scald and breakdown at 32°F., and, to avoid these disorders as much as possible it is preferable to store at 36°F. until the middle of May and then at 32°F.

The atmosphere adopted for gas storage must be strictly controlled to avoid excess of carbon dioxide or too low a concentration of oxygen, otherwise various forms of internal injury may occur. "Brown heart" in apples occurs as sharply defined brown areas within the fruit, and it cannot generally be detected without cutting. In pears ripened after gas storage, hard areas have been found surrounded by soft, ripe tissue and the term "hard heart" is appropriate for this disorder. An atmosphere containing five per cent. of carbon dioxide and sixteen per cent. of oxygen is generally the safest to use, and it is advisable to keep strictly to this atmosphere to avoid injury to Jonathan apples. In the case of pears, several varieties have developed "hard heart" when stored in ten per cent. of carbon dioxide and eleven per cent. of oxygen, but there is evidence that they can stand these conditions for an initial period, after which the carbon dioxide must be reduced to five per cent. For W.B.C. pears this initial period would be not more than three months.

It is necessary to emphasize the importance of prompt gas storage, as pears which have been stored for some weeks in air are very liable to injury in subsequent gas storage. These conditions are most liable to arise when pears are shipped in badly ventilated holds after being first held in local cool storage, but care must also be taken to avoid them if gas storage for local marketing is attempted.

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N O T E S.

HANGING ROOMS FOR SMOKED MEATS.

As reported in the National Provisioner, Vol. 104, No.11, March, 1941, p. 38, American meat packers generally adopt the practice of quick chilling of freshly smoked meats in order to reduce fat drip to a minimum. Although ideal conditions cannot be specified to suit all smoked meat hanging rooms, it has been found that air temperatures of 55°F. to 60°F. with relative humidities between 72 and 75 per cent. are generally satisfactory. At temperatures below 55°F. the colour of smoked meats tends to fade. When delivery in unrefrigerated trucks is practised, the storage temperature should not be too low, otherwise condensation on the meats is likely to occur on removal from storage.

WRAPPING OF FROZEN MEATS.

Paper waxed on one side is commonly used for wrapping frozen meats; the waxed side should always be placed against the meat or the wrapper will become soaked and tear easily before freezing. The unwaxed surface makes proper marking of packages possible.

THE TREATMENT OF CASKS FOR STORAGE OF FRUIT JUICES.

The problem of mould contamination of fruit juices stored for relatively long periods in wooden casks is an important one, and because of the extent of the losses thereby incurred, manufacturers have contemplated the use of metal containers for storage of these juices. By reason of the present scarcity of metals suitable for these containers, it is likely that casks will still be widely used as in the past. The means whereby the danger of contamination of juices stored in casks can be reduced to a minimum is outlined in this brief note.

Cleaning: The disinfection of casks is facilitated by an initial cleansing process which at the same time effects the removal of substances which may be responsible for the development of undesirable odours and flavours in the stored juices.

New casks are treated with low pressure steam and the condensate allowed to drain away until colourless and clear. They

are then filled with water and drained after 24 hours. Leaching with water is repeated daily for 3 or 4 days.

Used casks are steamed to soften deposits on walls and leached with water until the rinse is clear, colourless, and devoid of smell and taste.

Mouldy casks must be opened up and mechanically cleaned with brushes and cold water, rinsed, steamed, and again scrubbed and rinsed. They are then treated with a 1 per cent. solution of sulphuric acid for 12 hours, drained, and given a final prolonged rinsing to ensure complete removal of acid solution.

Disinfection: After cleaning, disinfection is carried out by burning dry sulphur at the rate of four and a half ounces per 50 gallons inside the sealed cask which must be somewhat moist to obtain the maximum effect. The sulphur dioxide so formed must be allowed to act for at least four hours if the casks are to be immediately placed in commission. If they are to be stored empty, sulphur fumigation must be repeated monthly.

DRIED ONIONS.

Because of the cessation of importation of onions into England, an acute scarcity of this commodity has developed, and as a result the Imperial Institute of Great Britain has been exploring the possibility of obtaining supplies of dried onions from Empire sources. In a recent Egglish publication directions were given for the manufacture of this dried product and a request was made for the forwarding of samples to the Imperial Institute, London. Prior to the war the prices for good quality dried onions on the English markets were 65s. to 70s. per cwt. whilst the present price is about 150s.

The bulbs, peeled by hand, are cut into thin slices which may then be immersed in a 5 per cent. salt solution for 3 to 5 minutes to prevent discolouration. Drying is carried out on trays in tunnel driers for about 5 to 10 hours, the slices being kept turned to hasten the process. The temperature of the air should not be allowed to rise above 140°F. or flavour of the onions is lost and the slices become dark in colour. The finished material should be dry and crisp with a moisture content of 5-7 per cent. Sun drying is said to give less satisfactory results than artificial drying. One ton of dried material represents about 10 tons of fresh onions. The dried product is usually shipped in tin-lined cases of 1 or 2 cwt. each.

SOURING OF SAUSAGE BY CASINGS.

In the National Provisioner, Vol. 104, No. 9 (1941), p.20, it is stated that hog bungs which have not been carefully fatted and cured may cause trouble when used on dry sausage. Hog bungs should be prepared at least 30 days in advance of use and as much fat as possible removed. Even when carefully fatted there are always many fat spots left in the casings. This fat will dry

out so that it will not sour easily if the casings are salted for 30 days or longer. Beef middles and rounds are generally well fatted when received by the sausage department and do not require as much time in curing or preparing as hog bungs. The appearance of dry sausage may be spoiled by too much fat in beef middles or rounds, however, as the fat shows through the casing.

RANCIDITY IN FLAKED BREAKFAST FOOD CEREALS.

L.W. Elder in Oil and Soap, Vol. 18 (1941), p.38, states that the factors affecting the tendency towards the development of rancidity in cereal flakes are: the moisture content, the presence or absence of salt, and the physical effects of flaking. The incorporation of anti-oxygens of demonstrated potency was in all cases without significant effect. Test results supported the view that the physical extrusion of oil from the oil cells and the resultant smearing of the fat over a relatively large surface, thus greatly increasing its exposure to atmospheric oxygen, had the greatest effect of all of the processing operations in accelerating rancidity in flaked products.

SUBSTITUTES FOR TIN CANS.

In view of the prevailing shortage of tinplate, this Division has undertaken an investigation of possible substitutes for tinplate containers for foodstuffs and other products.

The work is as yet in the preliminary stages but the Division may be able to assist enquirers to find suitable containers for materials for which tinplate must not be used under the recent National Security Regulations.

The results of a current investigation on substitute containers for jams and other hot-filled materials will be reported in due course.

COLOUR IN POTATO CHIPS.

Recent investigations by F. E. Denny and N. C. Thornton, Contrib. Boyce Thompson Institute, Vol.11 (1940), p.290, have shown that the colour produced in potato chips is influenced by the variety of potato, temperature of storage, and the amount of reducing sugar formed. The most desirable colour was obtained from samples with 5 milligrams of reducing sugar per millilitre of juice (4 mg. per gram of fresh potato). The colour of the chips became progressively paler as the percentage of reducing sugar was lowered. The content of sucrose (cane sugar) was found to be no guide to colour.

TWELVE CAUSES OF SPRINGERS IN CANS.

In the canning industry, in general a "springer" is a can, one end of which is slightly bulged, and when this end is forced in, the other is pushed out. A "flipper" is a can one end of which becomes bulged on percussion but which, when pushed in, remains flat. These latter are often called springers.

Frequently, springers occur as the result of a combination of conditions. A list of the more important factors causing springers in canned meats is set out by G. V. Hallman, of the Continental Can Co., Chicago, in Food Industries, Vol. 13, No.3 (1941), p.67.

1. Overfilling of the can.
2. Low closing temperature of the product when the can is exhausted by heat.
3. Insufficient vacuum when this is obtained by physical means.
4. Delay between closure and processing of cans.
5. Incipient spoilage of product.
6. Leakage of can.
7. Excessive distortion of can ends during processing.
8. Rough handling and denting of can.
9. Changes in altitude and temperature of storage.
10. Type of ends.
11. Chemical reaction between ingredients of the product.
12. Chemical reaction between product and can.

Some of these factors which are fully discussed by the author apply to canned meats in general, while some of them apply only to specific types of canned meat products.

CLOUDY APPLE JUICES.

On the Continent of Europe, and so far in Australia and New Zealand, manufacturers have aimed at the production of brilliantly clear apple juices which, though pleasing to the eye, are somewhat lacking in true apple flavour due to the removal of certain characteristic flavouring constituents during clarification. In America where production of apple juices was commenced much later than on the Continent the tendency is to market a high proportion of unclarified or cloudy juices. The production of such juices is greatly simplified by the omission of the depectinization and filtration procedures and the costs of production are materially reduced.

Commercial samples of clear and cloudy apple juices imported from America, together with similar samples of Australian juices prepared at Homebush, have been tested in this laboratory and in every case the cloudy juices have been judged to be superior to the corresponding clear juices on the score of palatability.

Australian manufacturers are urged to carry out similar tests for themselves and are invited to acquaint this laboratory with the results of such tests. Cloudy juices would not be satisfactory for carbonation where a clear sparkling effect is desired.

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INFORMATION SERVICES.

The attention of readers is drawn to the fact that enquiries of a technical or general nature may be submitted to the Council's Information Section, 314 Albert Street, East Melbourne, C.2, Victoria. Written replies to such queries will be furnished in due course.

SUGGESTIONS.

We would be glad if readers would offer comments and suggestions regarding the form of the Quarterly, and also suggest subjects for inclusion in future issues. Correspondence dealing with these matters should be addressed to: The Chief, Division of Food Preservation, Private Bag, Homebush P.O., N.S.Wales.

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