FOOD PRESERVATION QUARTERLY.

Vol. 1, No. 3. Sept., 1941.

C O N T E N T S.

Issued by

DIVISION OF FOOD PRESERVATION

COMMONWEALTH COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

. . . .

HUMIDITY IN COLD STORES: PART 3.

CONTROL OF HUMIDITY.

It is commonly found that in a store kept at a constant temperature with no large variations in its loading, the relative humidity fluctuates only a few percent. around what may be called its equilibrium value. This equilibrium value is, of course, the result of a balance between the rate of supply of water vapour to the air (mainly from the goods in storage) and the rate of removal of water vapour from the air (almost entirely by condensation on the cooling coils). At any given relative humidity the rate of supply of water vapour to the air of the store by evaporation depends mainly on the following factors :-

(1) the air temperature.
(2) the area of evaporating surface.
(3) the temperature difference between the air and the goods in store.
(4) the rate of air flow.

Outside air coming into the room as the result of leakage or deliberate ventilation is also an important source of supply of water vapour under some conditions.

The practical possibilities of controlling the humidity of a store by varying any of the factors listed above are very limited because most of them are fixed by the requirements of efficient cooling and economical working. It is important to remember, however, that the humidity is generally low in a very <u>lightly loaded store</u>.

As stated above, the removal of water vapour from the air is almost entirely by condensation in the cooling system. Except in the very unusual case of a cooler working at a temperature above the dew point of the air, removal of water vapour is an inevitable accompaniment of the removal of heat and there is a definite relationship between the rate of extraction of heat and the rate of extraction of water vapour. The rate of extraction of heat is fairly accurately proportional to the temperature difference between the air and the <u>cooling surfaces</u>, and the rate of extraction of water vapour is <u>proportional to</u> the vapour pressure difference between the air and the cooling surface. The following consequences of these relationships are important :-

1. The humidity of a store can be reduced by supplying heat to the air. The most efficient position for a heater is between the cooler and the points of delivery of the air over the goods in store. Electric heaters, steam coils or hot water coils are commonly used as heaters for this purpose. In some

installations water for heating coils is heated in a suitable heat exchanger by hot gas from the compressor discharge.

2. The humidity of a store not colder than about 30°F. can conveniently be raised by a fine spray of water or by steam injection into the air. The most suitable position for such a spray or steam jet is in the duct between the cooler and the points of delivery of the air over the goods in store. Compressed air is generally used to operate water sprays for this purpose and automatic control is possible.

3. A lightly insulated store will tend to have a low humidity and a heavily insulated store a high. Where a high humidity is desired it may often be better to install heavier insulation than would otherwise be considered necessary, rather than use artificial humidification. Where a rather low humidity is desired, judicious under-insulating may often be more economical than installing reheaters. It is important to remember that heat leakage between the cooler and the points where the air reaches the stored goods is most useful, and heating of the air on the return to the cooler is relatively ineffective.

4. The rate of removal of heat by the cooler is proportional to the temperature difference between the air and the cooling surface and also to the area of cooling surface. Consequently with a constant heat load, the temperature difference can be reduced by increasing the area of cooling surface. Changes in the area of cooling surface have, therefore, an effect on the humidity of the store. A room which is "underpiped" according to the usual standards will have a low humidity, and an overpiped room will generally have a rather high humidity.

5. The equilibrium humidity of a brine-spray is lower than that of a water or an ice surface at the same temperature, so that a wet battery will give a lower humidity than a dry battery working with the same temperature difference between the air and the cooling surface. This effect is not very important where the heat load is very heavy as in a chiller or pre-cooler, but it can be of considerable importance where the heat load is light.

It will be evident that the methods of humidity control referred to under (1), (2) and (5) above are fairly easily applied where a forced air circulation is used, but difficult where cooling is by roof and wall grids only.

It does not seem possible, in the present state of our knowledge, to calculate exactly, from first principles, the equilibrium humidity of a store under normal working conditions, but it is possible to obtain a useful estimate by calculation and by comparison with test data from existing stores. As a result of growing realization of the importance of humidity in the cool storage of foodstuffs, it is likely that designers of cool stores will in the future be expected to give more careful consideration to the control of humidity than has been usual in the past.

. . . .

THE UTILIZATION OF SURPLUS APPLES: PART 3.

The Manufacture of Pectin.

Pectin can be prepared from whole apples, apple residues or pomace after pressing for extraction of juice, or from skins and cores. This account of the various stages in its manufacture has been taken from directions given by E. K. Nelson and H. H. Mottern, Fruit Products Journal (January, 1931), W. E. Elwell "Pectin, its Manufacture, Properties and Uses" (U.S.A. January, 1939), and W. V. Cruess "Commercial Fruit and Vegetable Products" (U.S.A. 1938).

(a) Drying.
During drying, the temperature of the pomace should not be allowed to exceed 160°F. Pomace dried at higher temperatures is satisfactory for use as a stock food but is not suitable as a source of pectin.

(b) Leaching.
The dried pomace, placed in vat with a false bottom and an outlet-drain, is leached with a stream of cold water for the removal of residual sugars, flavouring and colouring substances. Leaching should be continued until the specific gravity of the wash-water falls to 1.005. A small amount of water-soluble pectin is lost during this stage, but since this fraction is of low jellying power, its loss is of little importance.

(c) Cooking.
The leached pomace, after being allowed to drain, is acidified with hot water containing 0.1 to 0.2 per cent. of an acid, either organic such as lactic, tartaric, citric, malic, or inorganic such as sulphuric or hydrochloric. Usually three parts by weight of acid solution are added for each part of pomace and the mixture held at a temperature of 185° to 212°F. for $\frac{1}{2}$ to $1\frac{1}{2}$ hours, depending upon the pH which may vary between 2.3 and 4.0. Overheating at a low pH may destroy the jellying power of the pectin, while at a higher pH a poor yield will be obtained if the pomace is insufficiently heated. In the following table an outline is given of the conditions required for obtaining the highest yield of pectin with maximum jellying power.

Temperature °F.	Time of heating (minutes)		
	pH		
	2.3	3.5	4.0
190	60	60-90	90
212	30	30-40	60

(d) Separation and Clarification.

While still hot, the juice is extracted from the pomace in a hydraulic press such as is used in cider manufacture, or it may be run through a special centrifugal separator.

The first stage in clarification is accomplished by natural settling, mechanical precipitation, or by centrifuging at high speed; the last method is said to be the most economical. The pectin liquor at this stage contains proteins, starches and sugars, all of which adversely affect the clarity and jellying power of the pectin.

The second stage consists in the removal of these interfering substances by treatment with diastatic and proteolytic enzymes contained in an enzyme preparation which is dissolved in water, mixed with the pectin liquor, and allowed to act for 30 to 60 minutes at 120°F. In some cases a breakdown of pectin may be brought about by the presence in the enzyme preparation of pectic enzymes but these can be destroyed by subsequently heating the pectin liquor to 170°F.

The third stage is effected by adding decolorizing charcoal and holding at 170° to 180°F. until control filtered samples show complete decoloration. The temperature is then reduced to 140°F. and the liquor clarified by means of a filter press.

(e) Concentration and Preservation.

The dilute clarified pectin solution is concentrated in a vacuum-type evaporator such as used in manufacture of condensed milk. This equipment should be made from stainless steel, block-tin, or alternatively, lined with glass. The use of copper, aluminium or iron should be avoided in all parts which come into contact with the pectin liquor. In order to prevent sticking, a rapid circulation should be provided.

The concentrated pectin solution is cooled, adjusted to proper pectin and acid concentrations as determined by jellying tests, bottled, and pasteurized for 30 minutes at 170°F.

DRIED PECTIN.

The following methods have been developed for the preparation of dried citrus pectin, and some of these may be suitable for the production of apple pectin.

Spray-drying. The concentrated pectin solution obtained by evaporation of the pectin liquor is spray-dried in a dryer similar to that used for dried milk. On account of its tendency to stick and burn, pectin cannot safely be dried by heating in pans or on moving belts.

Alcoholic precipitation. Citrus pectin extracts are evaporated at 140°F. to a thick paste containing 25 to 50 per cent. solids, and while still held at this temperature, sufficient 95 per cent. alcohol is added to form a 60 per cent. alcoholic solution. The pectin forms a granular non-gelatinous mass from which the fluid can be removed by pressure and the alcohol recovered. By using a continuous counter-current washing device, a fairly pure pectin can be precipitated from the paste by using alcohol of minimum strength of 95 per cent.

Aluminium hydroxide precipitation. Citrus peels are quickly heated to destroy enzymes that hydrolyse pectin. The ground peel is then extracted at 176° to 194°F. in water acidified with sulphur dioxide. The extract is filtered and made slightly alkaline with ammonium hydroxide. Sufficient aluminium sulphate is then added to render the solution slightly acid. The pectin precipitate formed is washed, filtered, pressed and dried, and the aluminium hydroxide removed by the use of alcohol acidified with hydrochloric acid.

PATENT SITUATION.

Elwell states that the methods of precipitation by alcohol, concentration by evaporation, and clarification by diastatic enzymes are not covered by patents. The patents on aluminium hydroxide precipitation and clarification by proteolytic enzymes do not expire for several years.

....

THE PRESERVATION OF FISH: PART 1.

The Handling of Freshly-caught fish.

Amongst flesh foods, fish is well recognized as being particularly susceptible to spoilage which may render it unsuitable for human consumption. After death, fish becomes subject to the action of bacteria and enzymes and to other physical and chemical agencies, all of which may cause deterioration.

BACTERIA.

The flesh of live fish can be regarded as sterile, but bacteria are constantly present in small numbers on the skin, mouth, gills, and in larger numbers in the gut, except where the fish have been penned or welled and starved before death. After death, the defensive mechanisms of the body are broken down as the result of which the tissues become susceptible to bacterial invasion. The penetration from the gut into the adjacent muscle is facilitated by the softening of the gut wall by the digestive action of a naturally-occurring gut enzyme.

These invading bacteria, which live and multiply under the favourable conditions existing in the muscle, break down and soften the tissues and at the same time form certain break-down products which are mainly responsible for the objectionable off-odours and taste of spoiled fish. In the case of most sea-fish one of the break-down products is termed trimethylamine, a substance which has a characteristic "fishy" odour and taste.

ENZYMES.

Certain enzymes which in live fish take part in the life processes continue to function after death. The autolytic or "self-digestion" enzyme causes a partial digestion and softening of the muscle tissues whilst another enzyme accelerates the oxidation of the muscle oils and hastens the development of rancidity.

PHYSICAL AND CHEMICAL AGENCIES.

Because of the high ratio of exposed surface to weight, fish tends to dry out to a marked extent on exposure to air, and on account of its relatively soft texture is subject to damage by bruising when inefficiently packed in ice. The chemical structure of fish oils, either in organs such as the liver or in the muscle, renders them particularly liable to become rancid on exposure to atmospheric oxygen.

METHODS FOR CONTROL OF SPOILAGE.

Methods for the control of spoilage have been discussed in C.S.I.R. Pamphlet No. 93 which can be obtained on application. Briefly, the methods outlined are the adoption of hygienic handling and the practice of rapid cooling of the fish after catching.

ICING.

It is of the utmost importance that fish to be used for any purpose should be efficiently iced immediately after capture and held in ice until the next stage in their treatment is commenced.

The beneficial effects of cooling are due to the reduction in activity of bacteria or enzymes and in the speed of chemical changes. The activity of most tissue enzymes, and the rate of purely chemical changes are approximately halved for each 18°F.

fall in temperature, consequently the extent of changes occurring at 32°F. (temperature of melting ice) will be one-fourth of that in fish at 68°F. For a similar lowering of temperature, the effect on bacteria is even more pronounced being equivalent to a reduction of their rate of growth to about one-tenth, e.g. bacteria which double their numbers in one-and-a-half hours at 68°F. may require 15 hours at 32°F.

Bacteria usually multiply by simple division and the increase in numbers will be in accordance with the following series 1, 2, 4, 8....; thus a single organism will increase to approximately one million at the end of twenty generations.

In the following table the approximate time taken to reach a well-defined spoilage level (approx. 8 million per gram of muscle) is shown in relation to the initial bacterial populations and the temperatures at which the fish are held.

TABLE 1.

Initial population per gram.	Number of generations to reach 8 millions	Approximate time(hours) to reach 8 millions per gram	
		68°F.	32°F.
1	23	34	340
100	16	24	240
1000	13	20	200
10,000	10	15	150
100,000	7	10	100

From the above table it will be seen that while reduction of initial contamination and of the fish temperature are both desirable, the influence of temperature is relatively more important. Even when held at 32°F., the storage life of fish with the moderate bacterial population of 100 per gram will be less than 10 days. Prior holding at 68°F. will reduce the subsequent safe holding period at 32°F. by 15 hours for each generation which has taken place at the higher temperature.

Although the temperatures of the air and of fish taken from the water during winter are lower than in summer, they are not at any time sufficiently low under Australian conditions to dispose of the necessity for prompt icing, particularly if the fish are to be held one or more days. In planning for a regular supply of fresh fish to the market it should be realized that the safe storage-life of fish when promptly iced and held under the best conditions does not exceed 8 days, including the time taken for the fish to reach the consumer.

ANTISEPTIC ICES.

At times, attempts have been made to increase the effectiveness of ice by the inclusion of antiseptics, but the results have been variable. The choice of antiseptics is limited by public health regulations, and it is generally necessary to obtain intimate contact between antiseptic ice and the fish before the bacteria have begun to penetrate below the exposed surfaces. In Canadian laboratory experiments the most promising results have been obtained with ice containing 0.1 per cent. sodium nitrite which has the advantage of being able to penetrate the tissues. By the use of ice containing nitrite in this concentration the storage life of fish was approximately doubled, and the amount of nitrite taken up by the flesh was below that allowable under Canadian regulations for cured meats and fish. Ice containing a similar proportion of benzoic acid was found to be less effective than nitrite, and moreover could not legally be used for this purpose. Chlorine-containing compounds have been used in ice with some success, depending upon the condition of the fish at the time of treatment. Since chlorine is rapidly dissipated on contact with organic matter, it is effective only if the concentration at the fish surfaces is maintained at a sufficiently high level and if it is applied before bacterial penetration has occurred. It has been reported that considerable reduction in superficial bacterial contamination of fish fillets has been secured by washing them in running sea-water maintained at a strength of 5 parts per million available chlorine. Chlorine disinfectants, generally employed as hypochlorites, act as deodorizers and have the additional advantage of leaving end-products which are harmless to the consumer. Apart from their possible disinfectant action on the fish, these antiseptic ices have some value in being free from bacteria even when prepared from relatively impure water and will not add to the contamination already present on the fish.

STORAGE OF ICED FISH.

It is sometimes necessary to hold supplies of fish while awaiting transport in which case adequate provision should be made to keep the fish properly cooled. It is difficult to attain and hold a temperature of 32°F. in iced fish stored in unprotected wooden boxes, and replacement of the ice is usually necessary. Because of this, it is advisable to provide a refrigerated and insulated cold room held at 31° to 32°F. and which can also serve as a storehouse for ice. In this room, boxes of iced fish can be placed on metal-lined shelves so designed that the water from the melting ice can be drained away without flowing over the fish in any of the other boxes. The necessity for re-icing before shipment will depend on the amount of unmelted ice remaining after completion of storage. In order to avoid danger of freezing the fish, the air temperature should not be allowed to fall below 31°F. at any point in such a room.

CLEANING AND DISINFECTION.

A room used for the storage of fresh fish will soon become heavily contaminated and develop a very fishy odour unless it is regularly cleaned and disinfected. Cleaning is facilitated in rooms and equipment by the provision of impervious surfaces, and for this reason the use of unprotected wooden fittings should be avoided. Galvanized iron should provide adequate protection for wooden structures used for supporting boxes of fish. The most suitable disinfectants for use in these rooms are formalin and chlorine-containing compounds, but in all cases a preliminary cleaning is essential. The initial cleaning is carried out by thorough scrubbing of all exposed surfaces with hot water and a detergent such as sodium metasilicate of which there are several proprietary brands on the market. The surfaces are then rinsed with water and the disinfectant applied by swabbing or by a pressure spray.

FORMALIN.

Four parts of commercial formalin are added to one hundred parts by volume of water but this disinfectant should not be used while fish are stored in the room.

CHLORINE-CONTAINING SUBSTANCES.

These are usually applied as hypochlorites, and when proprietary brands are used, it is essential to closely follow the instructions given by the makers. The following method can be used for making up a stock solution containing about 0.4 per cent. (1 in 250) of available chlorine which will not deteriorate seriously in 10 days at ordinary temperatures and which will last longer if kept in cold storage :-

2 ounces of freshly-opened bleaching powder (chloride of lime), 4 ounces of washing soda and a little water are made into a thick cream. While being stirred, sufficient water is added to make one gallon. The sediment is allowed to settle and the clear liquid is decanted or filtered off and stored in a non-metal container. Bleaching powder rapidly loses its strength on contact with moisture of the air, and for this reason it is better to make up a quantity of solution containing the entire contents of the tin. When used in a pressure-spray, clear water should be subsequently pumped through to protect the machine from corrosion.

Chlorine is somewhat corrosive to metal from which it should be washed off by spraying after a contact period of 10 minutes. It can safely be used even when the fish are held in the room provided that they are protected by cloth or paper coverings.

TRANSPORT OF FISH IN ICE.

At present, iced fish are forwarded to market in single boxes, but this method is inefficient for long-distance transport which necessitates additional protection to keep the fish properly cooled. For the latter purpose an insulated box to hold a number of the 70-lb. boxes could be used. The size of this special box will depend on the facilities for handling, and on the score of cost, it would require to be returnable for further use. In order to keep the weight of the box at a minimum the walls should be insulated, for example, one-half inch of cork would have greater insulating value than 3 inches of wood. The interior of such a box should be efficiently waterproofed to protect the insulation, and a drainage outlet for the melting ice is necessary. Some degree of protection could be obtained by the use of an outer box made up from half-inch timber and provided with a closely-fitting lid. This would serve the purpose of reducing air movement which is a big factor in causing the melting of ice in ordinary boxes, and in addition would provide protection against sun and wind. It is only by trial that the measures necessary for the adequate protection of the fish can be ascertained. Where the volume of trade is sufficiently high, the use of refrigerated vans, cars or ships' holds is advisable for fish which require to be held longer than 24 hours from the time of their despatch to the market.

. . . .

THE DEVELOPMENT OF MUSCLE COLOUR IN FRESHLY-SLAUGHTERED BEEF.

In well-bled animals the amount of blood remaining in the muscles is insufficient to contribute appreciably to the colour of the muscles which is due chiefly to the presence of a muscle pigment, myohemoglobin, very similar to the blood pigment, hemoglobin. This pigment, in freshly-killed beef, exists in the reduced form giving to the freshly-cut surfaces a dark reddish-purple coloration which, on exposure to air, changes to varying degrees of redness due to the oxidation and conversion of the pigment to the bright red oxyhemoglobin. The difference in colour is comparable to that existing between venous and arterial blood.

There is a definite effect of age of the animal or muscle colour which is illustrated by the change from pale pink to brilliant red with increasing maturity from veal to beef. This intensification of colour with increasing age is produced merely by increased amounts of muscle pigmentation or muscle myohemoglobin. Old cows and mature bulls tend to cut darker than normal beef while calves and vealers show much lighter colour.

Apart from the differences due to age, some beef carcases fail to develop the normal bright red colour on exposure to air, and these are variously referred to by those in the meat trade as "black", "dark" or "shady" cutters in contra-distinction to the more normal light-cutting beef. This abnormal development of colour in beef has been the subject for investigations during the past ten years, particularly in America, as the result of which, evidence has been obtained of some factors responsible for dark-cutting beef.

In 1935 there appeared in the report of the American Society of Animal Production an account by D.L. Mackintosh and T.L. Hall of experiments carried out at the New York and Illinois Agricultural Experiment Stations.

The dark-cutting beef examined was divided into two classes without any definite line of demarcation

(a) those in which the colour failed to brighten materially or which brightened much slower than normal on exposure of cut surfaces for three hours

(b) those in which the colour did not brighten at all and which remained dull and gummy in appearance and sticky to the touch.

The chief factors studied were those of age, exercise, feeding, inheritance, particular pigmentation, delayed bleeding and the amount of blood in the muscle. That maturity tended to produce darker beef was confirmed by laboratory observations, and all evidence was contrary to the theory that exercise prior to slaughter produces either dark or black-cutters. Steers on pasture indulged in considerably more exercise than cattle fed in dry lots, but there was no significant difference in colour of beef produced with animals of similar age. The only clear-cut evidence obtained was that, with steers of similar breeding, age and feeding, it was shown conclusively that delayed bleeding, for 10 minutes after stunning, resulted in a high proportion of dark-cutting carcases. These observations, however, did not explain why delayed bleeding caused dark beef or why some did not show this condition following this procedure. Observations on a large number of muscles showed that the total amount of muscle plus blood hemoglobin was not significantly higher in the dark-cutting beef, even in the case of delayed bleeding.

Since deoxygenated hemoglobin is nearly black and oxygenated hemoglobin is a bright red, the authors have suggested that in dark-cutters a condition exists which renders the tissue impervious to the oxygen of the air. This permeability factor is thought to rest in the muscle tissue rather than in the fat and to depend on the mineral balance in the muscle tissue which makes the muscle more or less adherent to the layers of fat. <u>In conclusion, the authors state that dark and black-cutters have been produced by delayed bleeding but by no other experimentally controlled conditions.</u>

More recently, the National Livé Stock and Meat Board of U.S.A. has carried out extensive investigations, the results of which were summarized and reported under the title "Some Factors responsible for Dark-cutting Beef" in the National Provisioner, Vol. 104 (1941) p.15. Generally, the observations were made on groups of club calves in which records of breeding, feeding and management were available. These animals, on reaching the age for slaughtering as young beef, were killed and examinations were then made on particular muscles for chemical characteristics and for the measurement of colour by the U.S.A. Department of Agriculture Munsell colour system. In one lot of over 300 animals the following colour grades were found:- black 3 per cent, dark 6 per cent, shady-cutters 9 per cent and light-cutters 82 per cent. In conformity with the findings of Mackintosh and Hall no significant difference was noted in the amount of muscle pigment present in light and dark-cutting beef, but data obtained on similar muscles from different carcases indicated that dark-cutting beef had a characteristically lower total hydrolyzable sugar, lower pyruvic acid, lower inorganic phosphorus, lower fat, higher moisture, higher pH and a more negative redox potential. In further experiments the dark colour was induced in steers in which the muscle sugar had been depleted prior to slaughtering by the administration of insulin, and in these animals the chemical data closely resembled that of the naturally occurring dark-cutting beef. The intravenous administration of adrenalin raised the blood sugar and yielded a lighter-cutting beef than was obtained with untreated controls.

Having demonstrated the fundamental nature of the differences existing between light and dark-cutting beef, attempts were made to produce dark-cutters by control of the pre-slaughter conditions. The withholding of food for 3 days prior to slaughter was without effect in the summer-time, but in the winter a similar period of starvation resulted in a high percentage of dark-cutters showing the characteristics previously described. With cattle of the same group which were exposed to low temperatures but fed there were no dark-cutters. <u>Dark-cutting beef was thus produced by the combined effects of exposure to low temperatures and inadequate feeding prior to slaughter.</u> Further experiments served to confirm these observations and indicated that dark-cutters were produced in direct relationship to the severity of the exposure to cold of the unfed cattle prior to slaughter. Similar experiments with wether lambs exposed to low temperatures and with feed withheld prior to slaughter showed that, although wide variations existed within each group, there were definite indications that such treatment before slaughter caused darker coloured meat with lower reducing sugars and of higher pH.

DISCUSSION.

The conditions conducive to the development of dark-cutting beef have been shown by different sets of investigations to be firstly, delayed bleeding, and secondly, a combination of exposure to low temperatures and inadequate feeding prior to slaughter. No chemical data have been given for the muscles from the former, but the description of certain dark muscles which remained gummy in appearance and sticky to the touch is suggestive of muscle tissue with high pH levels. Mackintosh and Hall's theory of the relatively lower permeability to atmospheric oxygen in the case of the darker muscles appears to be sound, but the exact nature of the changes has not yet been clearly established. Most of the experimental data have been secured from animals artificially fed and housed under American conditions, and could not therefore be applied without question to Australian beef cattle which are rarely housed and artificially fed. The writer has however observed that the darker muscle from beef in Australia are invariably of high pH and that this relationship is shown quite clearly in the relatively dark flexor and extensor leg (shank and shin) muscles from mature beef carcases.

It would be appreciated by the Division if persons associated with the meat industry in Australia would communicate their observations on dark-cutting beef, particularly in reference to seasonal incidence and the pre-slaughter treatment of the animals.

....

CANNING OF TOMATOES.

W.V. Cruess in "Commercial Fruit and Vegetable Products" (U.S.A. 1938) gives the following procedure for the canning of whole tomatoes.

Tomatoes for canning should be moderately large, smooth, so that peeling can be easily accomplished, evenly ripened to the stems, of a clear red colour and possessing a large proportion of solid meat of good flavour. Tomatoes of irregular shape and wrinkled skins are difficult to peel and there is excessive loss in preparation. Varieties with large seed cavities, and soft watery varieties soften badly in the can and are therefore undesirable. The fruit should be prime ripe, without green areas around the stem end and not over-ripe.

In transporting tomatoes to the cannery care must be taken to avoid crushing, and to this end shallow boxes are essential. As picking boxes become contaminated with moulds, yeast and bacteria, the picking boxes should be thoroughly washed and steamed at the cannery before return to the grower. Tomatoes deteriorate rapidly after delivery and therefore should be canned as promptly as possible.

Washing is not so important in canning as in the manufacture of tomato pulp, nevertheless it is usually desirable to wash the fruit before scalding.

In the majority of plants canning tomatoes, the peelers do most of the sorting. However, sorting can be more efficiently and satisfactorily done by a few sorters than by a number of peelers.

After washing and sorting, the tomatoes are scalded by passing through boiling water or through live steam $\frac{1}{4}$ to 1 minute, depending on their condition. The scalding should be sufficient to loosen the skin, but no so long that the pulp and flesh are thoroughly heated. As the tomatoes emerge from the scalder they are sprayed with, or immersed in, cold water to check further cooking and to crack the skin.

The scalded tomatoes are delivered to the peeling tables where they are peeled by hand as promptly as possible. They are peeled by first pulling the skin back from the blossom end with a short coring and peeling knife. The operation is completed by removing the core with the point of the knife, which is directed towards the centre to avoid opening the seed cavity. Green and other undesirable spots are removed by the peelers. The majority of canners scald and hand peel as lye peeling is not so satisfactory.

The sound cores and peels are sent to the pulping machines for the manufacture of low-grade puree which is used for addition to standard-pack tomatoes or for other tomatoe products. The peeled tomatoes are conveyed to the canning tables.

There are two packs, the solid-pack and the standard-pack. Solid-pack tomatoes are the whole, firm, evenly coloured tomatoes packed carefully by hand into cans without the addition of juice or puree. Some canners add to each can of the highest grade tomatoes a level teaspoonful of an equal mixture of salt and sugar to improve the flavour.

Standard-pack tomatoes consist of the small tomatoes, those of imperfect colour, soft tomatoes and trimmed tomatoes. Often puree from trimmings and cores is added to fill the spaces between the pieces and to cheapen the product. The standard tomatoes are just as nutritious and wholesome as the solid pack and are cheaper.

The addition of water to tomatoes is never necessary or desirable and constitutes an adulteration.

The tomatoes should be thoroughly exhausted at a moderate temperature because solid-pack tomatoes heat very slowly. The length of the exhaust should be adjusted so that the centre of the can reaches at least 130°F. if possible 150°F. C.H. Campbell ("Canning, Preserving and Pickling", U.S.A. 1937) recommends a long low temperature exhaust using water of about 100°F. For American standard cans Nos. 2½ and 3 (capacities given below) 4 minutes is stated to be sufficient.

For processing, the agitating continuous cooker operating at 212°F. has largely superseded the retort and the open cooker formerly used. The length of time varies according to the consistency of the pack. Solid-pack tomatoes heat more slowly than the standard-pack and so require longer processing.

Type of Cooker	American Standard Can No.	Diameter Inches	Height, Inches, Sealed Can	Capacity Oz. Avoirdupois of water at 68°F. Sealed Can	Temperature, Degrees F.	Time, Minutes
Open, non-agitating	2½ 3	4 1/16 4¼	4 11/16 4 7/8	29.79 35.08	212 212	30-55 30-55
Agitating, continuous	2½				212	25

Considerable spoilage may occur unless the centres of the contents of the cans attain 190°F. or higher. Temperatures are taken regularly by plunging an armoured, sharp-pointed thermometer to the centres of several cans taken directly from the outlet of the cooker.

Tomatoes should be cooled completely and quickly after sterilising so as to avoid browning and loss of flavour.

Cleanliness of equipment is of the greatest importance in the canning of tomatoes.

....

CANNING OF CARROTS.

The following procedure is given by Campbell for the canning of carrots.

There are usually three sizes used in canning, small whole ones about 1 to 1¼ inches in diameter; split ones that are about 1¼ to 1¾ inches in diameter; others cut into discs or diced.

When received at the packing plant, carrots should be thoroughly washed.

Lye-peeling is recommended in preference to the mechanical abrading type of potato peeler. Due to their shape, carrots are not so economically peeled by this last method.

Blanch for 10 minutes at 212°F., fill into cans, and cover with hot 2 per cent. salt brine.

Exhaust a No. 3 can (American Standard) 3 minutes and process 25 minutes at 240°F.

....

NOTES ON THE CANNING OF RABBITS.

The process described below is believed to give a satisfactory product, but it has not been tested in the Council's laboratory. It is suggested, therefore, that those interested should carry out several small-scale canning tests before starting large-scale production.

Presuming that the rabbits are obtained in a skinned, cleaned and frozen condition, the first step in the processing is to thaw them in warm water after which subsequent processing treatment is effected with the utmost rapidity in order to minimise a persistent, though slight odour, of sulphuretted hydrogen which is noticeable in the finished product. The rabbits are next submerged in brine of 45° salometer ($17\frac{1}{2}$ ounces per gallon) for three hours after which they are removed and boiled for 30 minutes and transferred to cold lactose (milk-sugar) solution for 10 minutes for the purpose of whitening the flesh. The lactose solution is made by dissolving 6 ounces of lactose in $\frac{1}{2}$ gallon of hot water and poured into 19 gallons of cold water. After removal from the lactose solution the rabbits are wiped with cheesecloth, blackened ends and other unsightly portions, as well as surplus body fat are trimmed off, the backbone broken and the rabbit folded into the can. Agar solution consisting of 4 ounces of agar and $2\frac{1}{2}$ ounces of salt to 1 gallon of water is added and the cans exhausted, sealed and processed for 75-90 minutes at 240°F. (for a 2 lb. can).

To maintain clarity in the gel, 1 ounce of the following solution may be added to 1 gallon of agar solution; $\frac{1}{2}$ lb. alum, 1 gallon of water. Alternatively, the agar solution might be clarified by hot filtration.

The rabbit pack may be made still more attractive by the incorporation of a certain amount of vegetable material and for the purpose the addition of small quantities of peas and sliced carrot is suggested.

Contact of the flesh with metals such as copper, iron and tin may bring about undesirable color changes in the product. In order to avoid discolouration due to such metals in the processing equipment it is advisable to use either stainless steel or galvanized iron on all surfaces which come into contact with the product prior to filling. To minimize black-staining due to exposed tin-plate, the cans should be internally coated with lacquers of the sulphur-resisting type.

....

NOTES.

REDUCTION OF DUST-BORNE BACTERIA BY TREATING FLOORS.

In food factories where foodstuffs either in the prepared state or during the course of preparation are exposed to contamination from the air it is desirable to adopt means to reduce the extent of this infection to a minimum.

In a recent issue of the Lancet, M.V. Ende, D. Lush and D.G. Edward have reported that floors treated with crude liquid paraffin (spindle oil) could be swept with a very much reduced re-dispersal of the micro-organisms present in the accumulated dust. The amount of oil necessary was very small and the initial slipperiness of the floor surface disappeared after 24 hours when the oil soaked into the linoleum coverings. The dull non-oily surface remained effective for at least 10 days even with one or two washes. Such treatment would not be applicable to surfaces that are continually moist but may be useful for relatively dry floors found in some food processing plants.

USE OF DRY SUGAR IN SWEETENING FOODS CANNED IN SYRUP.

In Food Industries, Vol. 13 (1941) Nos. 2 and 3, it has been reported by O.G. Braun, G.L. Hays and H.A. Benjamin of the American Can Co. that an outbreak of "flat-sour" spoilage in canned sweet potatoes occurred when dry sugar was substituted for sugar syrup in the packing of the product before processing. A 32 per cent. decrease in lethal value of the sterilizing process of 70 minutes at 240°F. was found to be effected by the use of dry sugar. Examinations after retorting showed that from 8 to 40 per cent. of the added sugar was undissolved and caked in the bottom of the containers and it was found that the survival of the micro-organisms responsible for subsequent spoilage was due to the protective action against heat, of the concentrated sugar solutions in these areas. Regardless of the way in which sugar was added, the rate of heat penetration was found to be slower at the bottom of all the cans examined than at the can centres, indicating the existence of convection currents. When the cans with added dry sugar were inverted, shaken, or rolled for 15 seconds after closure there was no undissolved sugar detected after the completion of processing and the usual retorting procedure was sufficient to sterilize the contents.

When contemplating any radical change in a well-established procedure for canning of food it is important that all the possible effects of the changed methods be closely considered and that strictly controlled trials be carried out to test these possibilities.

NOTE ON THE USE OF YEAST TO DESTROY GLUTATHIONE IN WHEAT-GERM FOR BREAD MAKING.

One of the reasons for the removal of the germ is that its presence would cause the loaf of bread made from the flour to have a very coarse crumb texture rendering it unpalatable to most people. Investigators have indicated that this defect is due to the presence in the germ of reduced glutathione.

In the New Zealand Journal of Science and Technology, Vol. 22, No. 1 B pp. 44B - 47B (1940) E.W. Hullet has described a method whereby the reduced glutathione is destroyed thus making possible the inclusion of the germ in flour used for bread making. A mixture of germ, yeast and water is allowed to ferment for a number of hours until the reduced glutathione disappears as indicated by the failure to give the nitroprusside reaction. The ferment is then mixed with flour, salt, sugar and more water and made into a dough from which bread is made in the ordinary manner. Using up to 4 per cent. of treated germ (on a flour basis) the bread made is very similar to ordinary white bread. With 10 per cent. of germ the crumb texture and volume are only slightly affected, but the crumb is coloured a light brown.

An important fact is that a yeast quantity which ripens an ordinary dough in eight hours will, after treatment in the ferment, ripen the dough in only two hours. Low-grade flours (with high glutathione contents) can be fermented alone by this method and then ordinary flour may be added when the dough is made.

AN IMPROVED METHOD OF DEFROSTING FROZEN EGG PULP.

Users of frozen egg pulp are aware that, in order to avoid the danger of spoilage during handling, it is necessary to thaw the material rapidly and to use it without undue delay. The reasons for this are that the micro-organisms which have survived the processes of freezing and subsequent storage in the frozen state begin to multiply when the temperature of the thawed pulp becomes sufficiently high. Under very slow conditions of thawing it is quite possible for the defrosted outer layers to become spoiled while the middle layers are still in the frozen state.

In America the usual practice adopted is to defrost the cans of egg pulp in cold running water. A method designed to produce a more rapid transmission of heat into the frozen egg material has recently been described by D.S. Brownlee and L.H. James in the Seventh World's Poultry Congress Exposition July-August 1939, page 488. Using water at about 53°F. the times taken for defrosting 30 lb. cans of egg pulp were 25 hours in running water and 9 hours with the aid of the device which has been described.

In one lot of fairly heavily contaminated egg pulp the bacterial increase during 22 hours thawing in running water at 53°F. was sufficient to bring about spoilage during that time. Under similar conditions of defrosting all of the less heavily contaminated lots showed marked increases in numbers of bacteria. After the completion of defrosting in 9 hours by the new method the bacterial populations were in all cases only slightly higher than at the commencement of defrosting.

In the preparation and handling of such a perishable product it is therefore important to reduce contamination to a minimum and to defrost and use the product as rapidly as possible. When it is necessary to hold some of the egg pulp for some time after thawing it should be held at a temperature as low as possible without freezing.

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.

....