FOOD PRESERVATION QUARTERLY.

Vol. 3, No. 2.

June, 1943.

C O N T E N T S.

	Page
Laboratory Examination of Tinplate Containers for Foodstuffs (continued)	21
Pollution by House Flies in Food Establishments	29
Solid Jams	30
Control of Composition of Meat Packs ..	32

Issued by

DIVISION OF FOOD PRESERVATION

COMMONWEALTH COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

....

LABORATORY EXAMINATION OF TINPLATE CONTAINERS FOR FOODSTUFFS (CONTD.)

Alternative Leakage Tests. In addition to the internal pressure test previously described, there are alternative methods which may be used for detecting leaks in tinplate containers, but most of these require more time for demonstration and are therefore of less practical value in can-making and cannery establishments.

Internal Vacuum Tests. In these tests the container is subjected to a measured internal vacuum (e.g. 10 inches) and the diffusion of air, gas, or a liquid from the exterior into the can is determined. The admission of air will be indicated by the complete or partial loss of the original vacuum. The actual points of leakage will not be disclosed by this method. If, however, blotting paper saturated with lead acetate is placed around the interior of the body of the can before placing the evacuated can in a chamber containing hydrogen sulphide, the points at which the blotting paper is darkened by lead sulphide indicate the approximate areas of leakage. In tests of this kind, the cans should be held at temperatures alternating between 40°F. and 100°F. so that the seams will be subjected to pressure differences due to expansion and contraction of the can and its contents.

The admission of liquid into the evacuated can might be determined by chemical methods. If a small amount of distilled water is placed inside the can which is then immersed in a solution of common salt for two to three hours, the penetration of salt can be ascertained by using the silver nitrate test for the presence of chlorides. Other chemical substances or even dyestuffs might be used in a like manner, taking care to avoid those which might damage the can or the sealing compound. By immersing the can successively to various depths the approximate areas of leakage can be ascertained.

Diffusion Tests. Simple diffusion tests may be applied in which the cans, whilst still at atmospheric pressure, are immersed in water containing suitable non-injurious chemical substances or dyestuffs. Since the can is not subjected to vacuum it is permissible to cut the can across and test both ends simultaneously. This method is open to the criticism that there is no difference in pressure between the exterior and the inside of the can as there is in practice with cans showing a vacuum.

After completion of the leakage tests, the cans are subjected to detailed examination both of leaky and non-leaky areas of the end seams and of leaky areas in soldered seams. The double seams at the ends of sanitary type cans are examined by means of cross-sections, by separation of the ends from the bodies, study of contours, and by measurements of dimensions. Soldered seams are pulled apart for inspection.

Preparation of Cross-Sections. Cross-sections of can seams are made either with a jeweller's saw blade, a file, or a power-driven cutting disc. The first cut is made at right angles to the seam and a second one at such an angle that the two cuts intersect approximately half-an-inch in from the seam. The right angle surface of the cross-section is then polished with coarse and finally with fine emery paper to remove fine metallic particles before it is subjected to detailed examination.

Separation of Ends. Separation of the ends from the bodies of closed double-seamed cans facilitates the examination of the whole circumference of the end seams and at the same time exposes the junction of the side and end seams. This operation, commonly termed stripping the ends, is performed by pulling a strip of metal from the end of the can out to the edge and tearing it along the circumference by pulling or rolling with a pair of pliers. The remaining lower section of the end is then gently tapped down and separated from the body of the can.

Another method which is useful for exposing a portion of the circumference is to make a file cut through the seam at each end of the selected section and then carefully file through the top edge of the seam taking care not to damage the body hook. By gentle tapping the filed through section of the cover can be separated from the body.

Contours and Dimensions. The contours and appearance of the exterior of double seams and of stripped seams may be studied by naked-eye examination and by touch, but cross-sections require some magnification to become clearly visible. Dimensions of seams are measured by means of can seam gauges. For approximate measurements, a stainless steel gauge* with a series of notches is useful, but for more accurate readings a micrometer can seam gauge is necessary.

Soldered Seams. Soldered seams may be torn apart by means of pliers or by the use of can busters which are very effective for separating locked side seams of sanitary cans.

Standards for Can Seams. The adoption of fixed standards for can seams has resulted from the experiences gained over many years of work on fabrication and in the development of devices for the mechanical closing of cans. At the present time the majority of cans used for holding foodstuffs are fabricated and closed by mechanical means. The bodies of such cans have locked and soldered side seams and flanged ends. When the can is closed the curled edge of the can end is interlocked with the body flange to form a double seam. Can-making practices have been so standardized that there is a sufficient length of metal in both the body flange and the curl of the end to allow the formation of a double seam of specified dimensions provided that the machines used for closing the cans conform to specified standards and that they are correctly adjusted and operated. In the closing machines in use at the present time, the can bodies, resting on a baseplate, are pressed against a chuck fitting inside the top of the can end which rests on top of the body. In this position the double seams are formed by the successive operations of two grooved rollers, which are termed first and second operation. The contour and dimensions of the completed double seam will depend on the degree of pressure applied respectively by the baseplate, first operation, and second operation. Since each of these operations may be normal, loose, or tight, depending upon the setting of the closing machine, it is possible to have many different combinations affecting the completed seam. A normal seam is one in which the respective pressures employed in the three different operations have been normal or correct according to accepted practices based on the results of trials with can seams

---

* Gauges of this type are obtainable from Dewey & Almy, Bedford Street, North Melbourne.

belonging to many different groups. The final criterion for judgment is the ability of the closed seam to prevent the admission of air or water into the can during its subsequent life which may include extreme temperature changes and subjection to unavoidable mechanical damage.

For describing the component parts and characteristics of double seams the following terms are commonly used. (see diagram).

Countersink. This refers to the inside wall of the seam when the end of the can is examined directly.

Length. This is the outer wall of the seam taken from the top to the bottom where the end is turned under to interlock with the flange of the body.

Thickness. Thickness is measured at the widest portion of the seam.

Body Hook. The body hook is that portion of the body flange which is turned over to interlock with the cover-hook.

Cover-hook. The cover-hook is that part of the curl of the end which is turned under to interlock with the body hook.

Overlap or Butting. is the extent of overlapping between body and cover hooks.

Lap Junction or Juncture. This refers to the junction of the side and end seams.

Droop or Tooth. The droop or tooth is portion of the outer wall and the cover hook which forms a definite extrusion below the outer lower edge of the seam. It is most frequently found at or near the junctions of side and end seams.

Lips. These are V shaped openings which can be seen inside the cover hook at or near the lap junction.

Cut-over. Cut-over is the term applied to describe an excessively sharp top inner edge of the seam particularly at or near the junctions of side and end seams. In extreme cases the tinplate may show a fracture in this area.

Wrinkle. The wavy appearance of the cover hook is referred to as the wrinkle. This effect is due to the forcing of the curl of the end into a smaller radius as the result of the pressure of the first operation roller. The second operation roller, due to its squeezing action, tends to flatten and iron out these wrinkles. Wrinkle is most readily observed when the ends are completely stripped from the bodies.

Compound. The compound refers to the rubber composition or other material used in the seam to assist the formation of air-tight closure. Paper gaskets are sometimes used for certain products.

Characteristics of Good Double Seams. An accurate judgment of the characteristics of double seams can be made only as the result of complete examinations including a study of cross-sections, contours and seam dimensions.

Contours and Cross-Sections. A cross-section taken away from the junction of side and end seams will show five thicknesses of tinplate, three of which are from the end, and two from the body of the can. Sections at the lap junction will show seven thicknesses of plate due to the fact that the body flange is lapped in this area and, when turned over, will provide two additional thicknesses in the finished seam. Two desirable features in contours are that the five layers of plate should be well pressed together without being buckled or distorted and that the body and cover hooks should be well overlapped with only a small free space at the end of each hook. The shape of the curve in the outer wall of the seam will, however, be influenced by the contour of the second operation roller quite apart from any variations in the adjustment of the closing machine.

Dimensions of Double Seams. In a well-formed seam the depth of the countersink should be approximately the same as the length of the outer wall, and the thickness should not be greatly in excess of the combined thicknesses of the five layers of tinplate. The actual dimensions, particularly the thickness, will be influenced by the gauge of tin-plate used in the fabrication of the cans. In Australia, at the present time, the American plate most commonly used appears to correspond with the 100 lb. base weight stock (I.C.L.) with a thickness of 11 to 12 thousandths of an inch. There is evidence however that both lighter and heavier plate are in use, for our laboratory examinations have shown thicknesses ranging between 9 and 13 thousandths of an inch. Taking these points into consideration, the recommended dimensions, in thousandths of an inch for double seams are:-

Tin-plate thickness	11
Length	122-126
Thickness	59-61
Body Hook	74-78
Cover Hook	79-83
Overlap	45-50
Wrinkle Rating	0-2

For plate thicknesses above or below 11 the seam thicknesses will be correspondingly higher or lower, e.g., the range will be 69 to 71 for plate which is 13 thousandths of an inch thick. Seam dimensions apart from thickness should not be greatly influenced by the gauge of plate, provided that the rollers are correctly adjusted for the plate being used.

An arbitary wrinkle rating can be made by noting how far the wrinkles extend across the cover hook. A complete extension is termed 10, a fifty per cent. 5, twenty percent. 2, and so on.

The permissible variations, plus or minus, in seam dimensions of a can made from plate of a specified gauge are 1 for thickness, and 2 for length, body and cover hooks.

Two of the most desirable features are correct thickness and an effective overlap.

Thickness. The space allowed between the layers of plate should be as low as possible consistent with the capacity of the closing machine which is required to handle two extra thicknesses of tinplate plus solder at the lap junction. Where the rollers are equipped with spring adjustments, the additional thickness at the lap is more readily accommodated and there is less tendency to flatten out the seam in this area and cause unhooking with the production of the droops or V's due to deformed cover hooks. Closing machines of this type should be quite capable of producing seams in which the thickness does not exceed the combined plate thicknesses by more than five-thousandths of an inch, and in which there is no tendency to unhooking at the lap junctions. When no adjustment of this kind is provided it will be difficult to produce sufficiently tight seams without causing undue distortion at the junctions.

The maximum seam thickness is also influenced by the contour of the second operation roller and the evenness of its pressure on the seam. A pressure which is uniformly applied over the whole of the seam is desirable, but it is quite possible to have air-tight seams which are squeezed tightly at the bottom and relatively loosely towards the top.

Excessive thickness in the finished seam is a clear indication that the second operation has been too loose. Confirmation of this can usually be obtained from the degree of "wrinkle" in the cover hooks. To illustrate this, a seam which is 68 thousandths thick and showing a wrinkle rating of 5 would be definitely loose if the tinplate thickness were 12 thousandths.

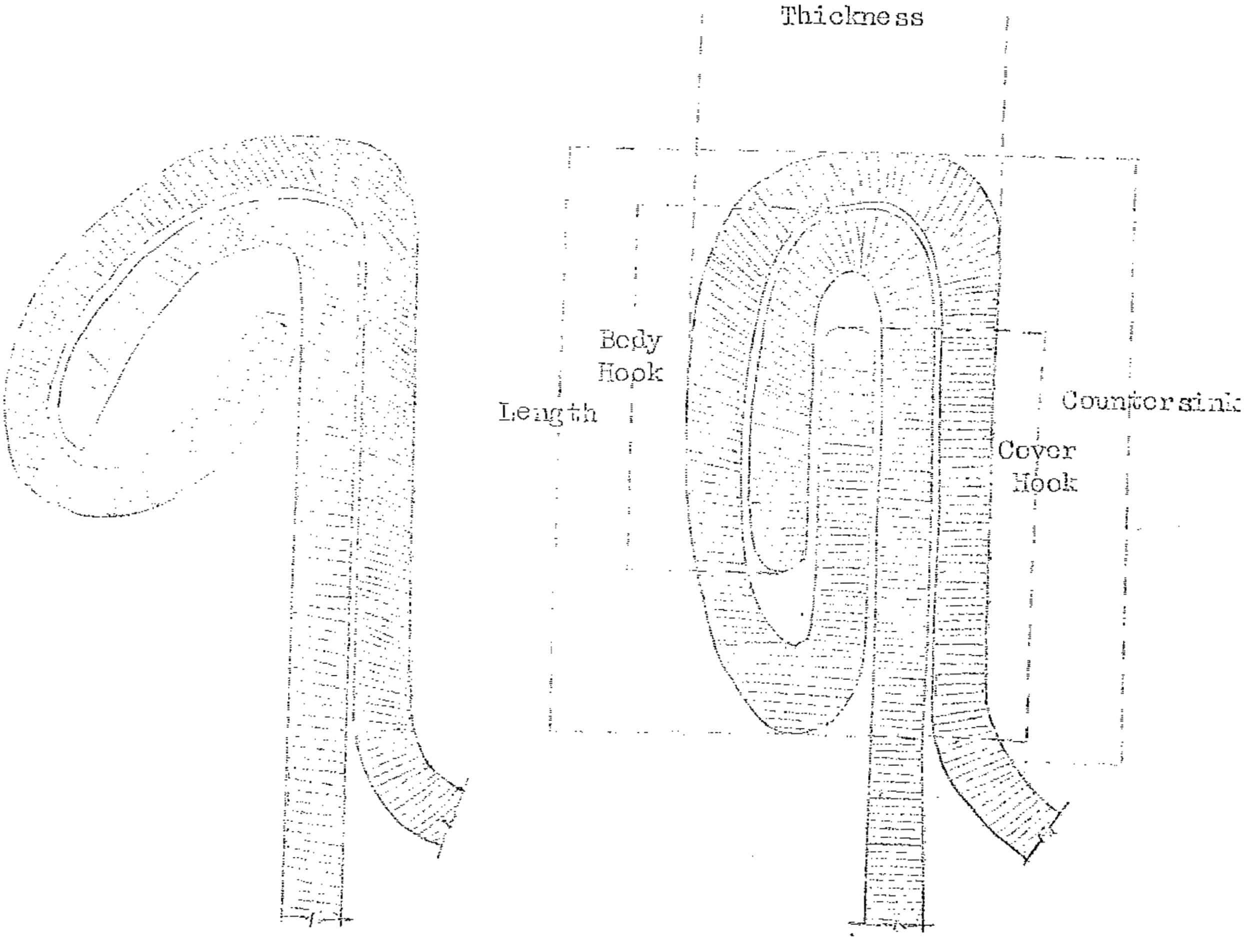
Overlap. An effective overlapping or butting of body and cover hooks increases the air-tightness of the seam and improves its strength and ability to resist the strains imposed during retorting and subsequent handling of the cans.

From magnified cross-sections it is possible to make an estimate of the extent of the overlap by comparing its length with that of the body or cover hook. For example, an overlap equivalent to about two-thirds of the length of a body hook of 75 thousandths would be 50 thousandths. A more accurate calculation can be made by subtracting the overall length of the seam from the combined lengths of the body and cover hooks plus one thickness of tinplate in the cover.

Diagnosis of Faults in Closing. Taking into account the type and characteristics of the closing machine used, and assuming that the can bodies and ends conform to accepted standards, it is possible to diagnose faults in closing from an analysis of the data obtained from examination of contours of cross-sections and from seam dimensions. The exact definition of the combination used in the application of base-plate pressure and the pressures of first and second operation rollers is not always easy, and considerable experience is necessary to make a correct diagnosis. Dealing with the most serious faults in adjustment, namely, those of looseness, a loose base-plate pressure will result in a short body hook, a loose first operation will produce a short cover hook, and a loose second operation will cause an excessively thick and loose seam. A combination involving excessive looseness in each of the three operations will produce a grossly faulty seam in which the body and cover hooks may not overlap. Excessive tightness in the three operations although producing a tight non-leaky seam away from the lap is very likely to cause trouble at the lap junction and in some cases to even cause fractures in these areas.

In practice the effect of the first operation can be judged from cross-sections of seams immediately after the completion of this operation.

The diagrams included below illustrate normal acceptable seams after the completion of first and second operations respectively. A complete range of abnormal seams is illustrated in the publication "Closing Machine Adjustments" by E.G. Blake of the Dewey and Almy Chemical Co. and reprinted from "The Canner" June 4 (1938).



FIRST OPERATION SECOND OPERATION

Magnification 25.

Can-Making Faults. Apart from the factor of incorrect adjustment of the can closing machine, defective soldering is the can-making fault most likely to contribute to faulty seams; incorrect flanging of the bodies and curling of the ends together with uneven cutting of body blanks are sometimes encountered.

Soldering. Application of the well-known principles of soldering is necessary to ensure that soldered seams will be air-tight and capable of withstanding the strains to which seams are subjected during retorting. Particular care is required in regard to the notched areas at the ends of the side seams of sanitary cans since a portion of these notches will be included in the completed seam. An excess of solder either between or outside the two layers of tinplate might make the attainment of a lap seam impossible by preventing the formation of a cover hook which will be efficiently interlocked with the two body hooks.

On the other hand a deficiency of, or an irregular flowing in of solder in this area may prevent a complete union between the two layers of tinplate and thus cause leaks at the lap. Frequently, minute pin holes are present and cannot be detected until the internal pressure test is applied. Leaks are rarely encountered in the locked portion of the side seam.

Flanging, Curling, etc. The body flange and the curl of the end may vary appreciably in shape, the chief requirement being that an interlocking is possible in all cases even when the operations of closing are loose. It is essential that the stamping by the dies should provide sufficient metal between the lower edge of the countersink and the edge of the curl to allow the formation of a seam of correct dimensions. The combined lengths of countersink, seam thickness, seam length and cover hook are approximately four-tenths of an inch. Uneven cutting of body blanks may occur when the sheets of tinplate are unevenly trimmed, particularly if the margin allowed for cutting out a given number of bodies from each sheet is very small.

Faults in the Can Closing Machine. Apart from incorrect adjustment of the degree of pressure in baseplate, first and second operations, there may be other faults due to such conditions as worn rollers and chuck, uneven base-plate pressure and incorrect alignment of the seaming rollers. It is essential firstly that baseplate, chuck and seaming rollers should be in parallel planes at the time when pressure is applied on the seam, and also that the rollers are set neither too high nor too low in relation to the chuck.

Uneven baseplate pressure will usually produce a marked variation in the length of the body hook from point to point around the circumference of the seam. This fault is more likely to occur when the baseplate has three separate springs.

When the seaming rollers are set either too high or too low, distorted seams, usually shorter than normal will be formed.

It is of course essential that the whole circumference of the seams should be traversed by both the first and second operation rollers; otherwise the seam will be irregular and incorrectly formed in the areas not subjected to the proper pressure.

The automatic types of closing machines are preferable to the hand-operated type since the latter are subject to the variable human factor in the application of pressure by means of the hand-operated handle.

Sealing Compounds. Without the aid of the commonly used rubber-like sealing compounds, it would be very difficult to produce air-tight seams. Research work by the firms supplying these proprietary substances has indicated the optimum amounts required by seams. The requisite dry weight for ends of No. $2\frac{1}{2}$ cans (diameter 4 1/16 inch) is from 70 to 90 milligrams, depending upon the particular compound used. It is advisable to adhere strictly to the recommendations given by the makers. Best results are obtained in regard to uniformity of distribution when the compounds are applied automatically from special filling machines.

In the routine examination of seams the condition of the sealing compound is noted, particularly for any evidence of deterioration with age. Determination of the actual weight of compound used is not easy except when it is of such a nature that it can be separated out in the form of strips. In other cases it is necessary to use a solvent capable of removing the compound.

Paper gaskets which are sometimes used in seams of hot-filled packs such as jam are not so effective as the rubber compounds in providing air-tight seams.

In the case of cans containing dried foodstuffs, the standards required for air-tightness might be even higher than in the case of wet material since the presence of moisture in the seam renders the passage of air or gas more difficult. With gas-packed dried foodstuffs, additional protection can be obtained by the use of special seam dopes applied after the cans are closed.

Summary and Recommendations. The maintenance of high standards in the production of double-seams requires a knowledge of the characteristics of well-formed seams and of the mechanism and adjustment of the various types of can closing machines. It also involves periodical inspections involving measurement of seam dimensions, examination of contours of cross-sections, and subjection of the cans to leakage pressure tests.

From observations made in this laboratory the most common faults in can closing appear to have been due to looseness rather than to over-tightness in the adjustment of the closing machines. It cannot be too strongly emphasized that it is necessary to take into account the thickness of tinplate being used. Seaming rollers with spring adjustments should be capable of efficiently handling plate which is one-thousandth more or less in thickness than the plate used for checking the setting of the machine. Since, however, plate thicknesses may range between 9 and 13, it is necessary to know the actual gauge in the cans being used. It should be the responsibility of the can manufacturers to ensure that plate is graded and separated so that can bodies and ends supplied to canners will be of a specified range of thickness. For the average tinplate at present being used in Australia the thickness is about 11.5 in which case a seam thickness of 62 to 63 would be recommended. This relationship may not be obtained, however, with all types of closing machines.

This laboratory will be at all times prepared to assist and advise those seeking information on can closing.

....

POLLUTION BY HOUSE FLIES IN FOOD ESTABLISHMENTS.

The importance of the common house fly as a possible source of contamination of food during its prepartion and storage has been recently studied by M. Ostrolenk and H. Welch of the U.S. Food and Drug Administration, Washington,

The results of the work of these investigators which have been published in Food Research, Vol. 7 (1942) showed that washings from the surface of test flies, bred under captivity from populations which were two generations removed from any contact with faecal matter, yielded total bacterial counts of from 2 to 29 millions per fly. A fairly high proportion of these organisms belonged to the colon-aerogenes group, although it was noted that the number of typical Escherichia coli types diminished as the generations of adult flies became further removed from any contact with faecal matter. Spore-forming bacteria were also found amongst the surface populations. The frequency of the occurrence of various members of the colon-aerogenes bacteria obtained from the internal organs followed the trend of those found on surface washings except that all types were present in much smaller numbers.

To establish actual pollution of food by fly contact, portions of sterilized pecan meats were exposed to flies for varying periods of time, during which bacterial counts were made at regular intervals. Within a very short time large numbers of organisms were deposited on the exposed food by an average population of eight flies feeding at any one time. At the end of a 15 minute interval, 900 bacteria had been deposited per gram of pecans, and after 5 hours there were more than 3 millions per gram.

"Because of the external hairy anatomical structure of house flies and the fact that they indiscriminately breed on and inhabit every conceivable source of filth, these insects are capable of being mechanical carriers of countless numbers and types of bacteria, the external and internal bacterial flora depending largely on the specific places and materials the flies inhabit.

"The results of these studies indicate that flies are potential sources of filth and that the presence of even small numbers of flies in a food establishment constitutes a menace, the seriousness of which may be determined by careful evaluation of surrounding conditions."

The vital importance of protecting foodstuffs, particularly those which are finally consumed in the uncooked condition, from fly-borne contamination is readily apparent.

....

SOLID JAMS.

Solid jams are concentrated products sufficiently solid to be cut into blocks. They are intended to be distributed in bulk and retailed as wrapped blocks or in unit cartons. This laboratory has investigated the preparation of solid jams, as a means of conserving some of the tinplate now used in the retail distribution of jams.

The jelly strength of any jam depends on three factors: the concentration of pectin, the pH (a measure of the hydrogen ion concentration or active acidity), and the concentration of total solids (mostly sugar). In solid jams a level of 70-75 percent solids has been adopted, as compared with 68-72 percent. in ordinary jams. The most suitable pH is practically the same as for ordinary jams, but more exact control is necessary, in view of the necessity of keeping the jelly strength as high as possible. The concentration of pectin in this product is necessarily very much higher. The solid jams prepared in this laboratory have all required added pectin. Pectin is only added to ordinary jams where the fruit is naturally deficient in this substance, e.g., berry fruits.

Sources of Pectin. Suitable pectin extracts have been prepared from Granny Smith and Democrat apples, from dried Batlow pomace (i.e. the residues from apple juice and cider manufacture), and dried skins and cores from Tasmania. The last product is particularly abundant, as it is a by-product of apple dehydration. Another possible source is orange peel from juice plants, but this has not yet been investigated.

In preparing pectin extracts, the material is usually leached first with cold water. This removes most of the sugar and other soluble substances, but leaves practically all the pectin, including that of high jellying power. The pressed residue is then extracted with hot dilute acid solution, and the extract concentrated in vacuo.

A considerable amount of attention has been given to the time of extraction, and the temperature and acidity of the extracting solution. The various extracts were compared by preparing standard jellies in which the pH and sugar content were kept approximately constant. The strength of the jellies was determined with a special instrument which measured the force necessary to push a standard plunger into the jelly. As a result of these tests, boiling with a solution containing 0.1 percent. of citric acid for 30-40 minutes was finally adopted. This extract has a pH of about 3.6.

Preparation and Testing of Pectin Extracts. 100 grams of dried or 400 grams of wet apple residues are soaked in water for 30 minutes, and then leached in running water for another 30 minutes. The residue is pressed to remove most of the water and then boiled for 40 minutes with 800 ml. of 0.1 percent. citric acid solution. The extract is pressed out in a tincture press, and concentrated in vacuo to 100 ml.

In preparing jellies, 10 grams of the concentrated extract is just brought to boiling with 20 grams of invert syrup and 20 grams of cane sugar. The ingredients are mixed in a 50 ml. beaker and left to stand overnight, preferably in the refrigerator, before the jelly strength is determined.

The invert syrup contains about 75 percent. of sugar and is buffered to pH 5.2 with McIlvaine's citrate-phosphate buffer. To prepare, dissolve 300 grams of cane sugar in 100 grams of boiling water, and add 15.8 grams of citric acid. Heat in a boiling water bath for 30 minutes, when about 85 percent. of the sugar is inverted. Then add 17.7 grams of disodium phosphate $Na_2HPO_4 12H_2O$.

The resultant jelly contains 70 percent. of sugar, of which about one-third is inverted. The jelly strength is measured in this laboratory as the weight required to force a plunger of spherical surface (1.6 cm. diameter by 0.5 cm. depth) into the jelly. Jellies have also been prepared with solutions of 100-grade citrus pectin of various concentrations, and a curve derived which gives percent. pectin in terms of jelly strength. This curve is used in evaluating the pectin content of extracts from apple residues.

Preparation of Solid Jam. Concentrated pectin extracts were prepared from Granny Smith apples, Butlow pomace, and Tasmanian skins and cores, and used for making solid plum and raspberry jam. A commercial pectin extract was also used for this purpose.

A series of jelly tests indicated that the strongest jellies were obtained with 70-75 percent. sugar, and at a pH of 3.2-3.4. By comparing these jellies with others made from Californian 100-grade citrus pectin, it was possible to evaluate the jellying power of the extracts in terms of a standard product. On this basis, the extracts were equivalent to about 4 to 7 percent. of citrus pectin.

Plum jam of suitable strength was prepared by boiling 150 parts of plum pulp and 40 parts of five per cent. liquid pectin extract with 100 parts of sugar. The mixture was boiled down rapidly to 70-75 percent. solids (as determined with a refractometer). This jam is sufficiently solid to withstand a good deal of handling, and has less tendency to "weeping", or exudation of syrup than weaker jams. It only spreads with difficulty, but can be broken down to a jam of more normal consistency by boiling with one part of water and two parts of sugar.

Weaker plum jam can be prepared using about half the quantity of pectin. This would be still fairly solid, but less resistant to handling and more liable to "weeping". It would, of course, spread more easily.

To prepare solid raspberry jam of comparable strength, it was necessary to boil 200 parts of raspberry pulp and 50 parts of five percent. liquid pectin extract with 100 parts of sugar. Less success was obtained with apricot jam, even when the pH was adjusted to 3.2 by the addition of acid.

Storage. Blocks of solid plum jam, approximately one pound in weight, were wrapped in waxed paper or moisture-proof cellulose film, and stored for three months at temperatures varying from 68-99°F. and humidities from 50 to 85 percent. The blocks were from three batches of jam, and varied in jelly strength from weak to quite strong.

The best results were obtained from the stronger blocks, as these were much less liable to "weeping" and retained their shape well when supporting other blocks. Except for slight surface crystallisation, these blocks were in good condition after three months' storage under conditions similar to those in Southern Australia.

The material kept well at the lower humidities at all temperatures up to 86°F., but there was serious deterioration in flavour and texture at a constant temperature of 99°F. for three months. At 85 percent. relative humidity there was serious mould attack, increasing in severity with increasing temperature. Hence it is unlikely to withstand moist tropical or extremely hot conditions.

Methods of Use. Solid jams could be produced which are reasonably firm, but still capable of being spread easily on bread.

If it is necessary to have the product as strong as possible, it would not spread easily, but could be broken down with sugar and water to give a more normal jam.

Solid jams have also been used as confection in Southern Europe.

....

CONTROL OF COMPOSITION OF MEAT PACKS.

It is often necessary for meat canners to ensure that the final composition of a particular canned meat product should conform to certain specifications for percentages of moisture, fat or protein. The chief factors which may affect the final proportions of these constituents in the canned product are the initial composition of the meat selected for canning and the treatment to which it is subjected before the cans are sealed.

Initial Composition of Meat. The chief constituents of meat are water, protein, fat and ash. The approximate composition of ox or sheep muscles entirely free from fat is:- water 77 percent., protein 22 percent., and ash 1 percent. With the inclusion of fat, which is almost devoid of water and protein, the percentages of water and protein in the meat will be correspondingly reduced. The effect on the composition of meat of the inclusion of various proportions of fat is shown in the accompanying table.

In practice, the canner is at an advantage if he is able to make a close estimate of the fat content of the meat selected for canning. Factors which are of primary importance are the areas of the carcase from which the meat is taken, and the general condition of the carcases. Generally, the muscles of the shin and shank, neck, and hind leg are lowest in fat content and those of the sternum and loin will be highest. The experienced canner will be able to make a fairly close calculation of fat contents and thus be in the position to mix fat and lean meat in the proportions required to give a final product of a specified fat content.

<u>Effect of Processing.</u> Meat is commonly scalded in boiling water before canning in order to remove some of the water, thereby shrinking the meat and producing a firmer texture. This is of great importance in assisting the production of firm, easily sliced blocks of meat such as those commonly prepared in the tapered type of can in Australia. In addition to moisture content, the consistency of the meat block will be affected by its fat content, but this effect will vary with the temperature at which the meat is held. In a cold environment, whilst the fat is relatively solid, a block with relatively high fat and water contents may be as firm as one with lower proportion of these constituents, but softening of the fat at higher temperatures would have a relatively greater effect on texture of the former than the latter. In practice it is necessary to remove a certain proportion of the water from the meat prior to placing it in the can, otherwise there will be an excessive amount of free water driven out into the cans during retorting, thus producing a "sloppy" pack. For corned beef and mutton packs, shrinkages of the order of 40 percent. are commonly obtained.

When it is desired to keep the fat content at or below a maximum level, e.g. 17 percent., in the canned product it will be noted that the maximum fat allowed in the meat prior to a 40 percent. shrink would be about 10 percent. In order to obtain this result without the necessity of removing excess fat, the canner is restricted in his choice of the grade of meat and the type of cut. Meat from carcases of the higher grades of beef and mutton available in Australia at the present time would require the removal of considerable amounts of fat, but third quality carcases of mutton, particularly from the Merino breed could probably be used without the necessity for removing any fat. For more complete data on the composition of various cuts of beef and mutton, reference may be made to C.S.I.R. Pamphlet No.107, entitled "Food Composition Tables".

<u>APPROXIMATE COMPOSITION OF BONELESS MEAT (BEEF OR MUTTON) BEFORE AND AFTER SCALDING.</u>

BEFORE SCALDING			FOLLOWING LOSS OF WATER DURING SCALDING.								
			20 percent. shrink			30 percent. shrink			40 percent. shrink		
Water	Fat	Protein	Water	Fat	Protein	Water	Fat	Protein	Water	Fat	Protein
74	5	20	67	6	25	63	7	28	57	8	33
70	10	19	62	12	24	57	14	27	50	17	31
66	15	18	57	19	22	51	22	25	43	25	30
63	20	16	54	25	20	47	28	23	38	33	27
58	25	15	48	31	19	40	36	22	30	42	26
55	30	13	44	38	16	36	43	19	25	50	23

The above figures will be affected to some extent by losses of protein and fat during scalding.

Protein losses are likely to be less than 1 percent. but fat losses may reach 1 percent. or higher during a 40 percent. shrinkage.

....