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The Swiss Süssmost Industry

By

D. MARTIN*

Süssmost is the trade name applied in Switzerland to unfermented blended apple and pear juice. The Swiss have developed novel and highly efficient techniques and equipment for handling this product. For practical purposes Süssmost may be regarded as pure apple juice, for the addition of pear juice is a matter of expediency rather than choice. Süssmost production began only about 30 years ago as a result of reduced demands for cider and the schnapps distilled from it. In former times, small country factories or even the farmers themselves expressed apple and pear juices, fermented the cider and awaited the visit of a touring distillery on wheels which distilled the schnapps on the spot. The decline of the old industry and the rise of the new is illustrated by the following figures.

	1920 litres	1943 litres
Schnapps production	10,820,000	349,100
Süssmost production	1,950,000	52,551,000

Practically all the Süssmost is consumed within Switzerland, where it is obviously more popular than aerated waters. It is sold in three ways:

(1) in draught from bars and dispensers in cafés at about 4d. per glass of ½ litre,

(2) in returnable litre bottles for home consumption at about 1s. 6d. per bottle,

(3) in 2/5 litre crown sealed bottles for hotel trade at about 9d. per bottle.

While the greater proportion of Süssmost is clarified aerated juice held from the previous season, in larger centres there are sales of cloudy juice sold straight from the presses during the crushing season.

In addition to Süssmost there are still large sales of fermented juice, particularly in cafés, where it is listed as " saft " or " most vergörnen ".

The trees which formerly provided the fruit for cider now provide the raw material for Süssmost. Unfortunately approximately half are pears, which are not as suitable as apples for unfermented juice. Pears are bought at half the price of apples, which in 1947 was about £10 per ton, but, as they reduce the quality of the juice, manufacturers would rather do without them. Cider varieties of apples are preferred, but as there are insufficient quantities of these, large quantities of cull table varieties are used. The final raw material for juice extraction has approximately this composition: 50% table varieties of apples, 20% cider varieties of apples, and 30% pears.

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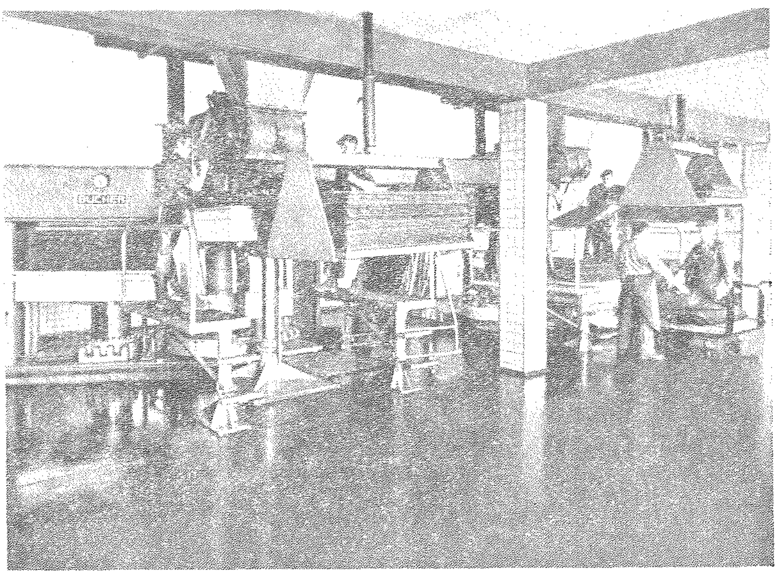
* An officer of C.S.I.R.O. Division of Plant Industry who visited Switzerland in 1947.

The optimum size factory appears to have an intake of approximately 200 tons of fruit per day. With a season of three months this gives a total production of 2,500,000 gallons, which would be divided into 1,000,000 gallons for Süssmost, 500,000 gallons for cider, and 1,000,000 gallons for vinegar and concentrate.

The factories are remarkably uniform in equipment and methods and in a typical factory the flow is as follows: the fruit arrives in bulk in every imaginable type of vehicle from open rail cars and 10-ton lorries to small farm carts. It is dumped into large concrete bins holding about 50 tons. There are usually enough of these to hold about two days' supply. The fruit runs by gravity out of ports in the sloping bottoms of these bins on to conveyors, and after washing is elevated to the mill for crushing. A remarkably efficient and quiet type of mill developed by the Bücher-Guyer organization is generally used. It converts 10 tons of fruit per hour into an even pomace of fine consistency which is discharged directly to hydraulic rack-and-cloth presses or is pumped to receiving bins above the presses.



Bücher-Guyer triple-bed presses. In the foreground a "cheese" is being built and another "cheese" is under high pressure on the extreme left.
(Bücher-Guyer photo.)

Modern triple-bed presses, also developed by Bücher-Guyer, have greatly increased the efficiency of rack-and-cloth pressing. First the "cheese" of pomace is built up; the bin of pomace is fitted with an automatic rotary valve which delivers a fixed charge on to the cloth every 20 seconds, and in this time the two operators fold the cloth, put on the next rack and spread a new cloth. The bed on which the "cheese" is built is hydraulically operated, so that it is always at a convenient height. When the "cheese" is complete the press rotates 120°, bringing the cheese over the first ram, which expresses the juice at a moderate pressure. Then by a further rotation of 120° the cheese is brought over a high pressure ram, which presses it a second time. Finally a third rotation returns it to the original position, where it is broken down and a new cheese built up. These presses have a capacity of four to five tons per hour, and the juice yield is 80–87%.

From the press the juice is pumped to tanks, where it is clarified by a combination of enzyme and gelatin treatment at 10° C. (50° F.). This temperature represents a compromise between the slow action of the pectolyzing enzyme at the low temperatures prescribed by the original Schlör process and the dangers of fermentation in warm weather. Concrete tanks lined with organic coatings are generally used for this process.

After clarification is complete (it is strictly controlled by the works chemist, by means of viscosity determinations) the juice is filtered in at least two and usually three filtrations, generally through a bag or "shell" filter, then a plate filter and finally a pulp filter or a Seitz filter. Though most factories have centrifuges, they are not often used or are used merely to take the load off the first filtration. Filter aid is added in one or even two of the filtrations.

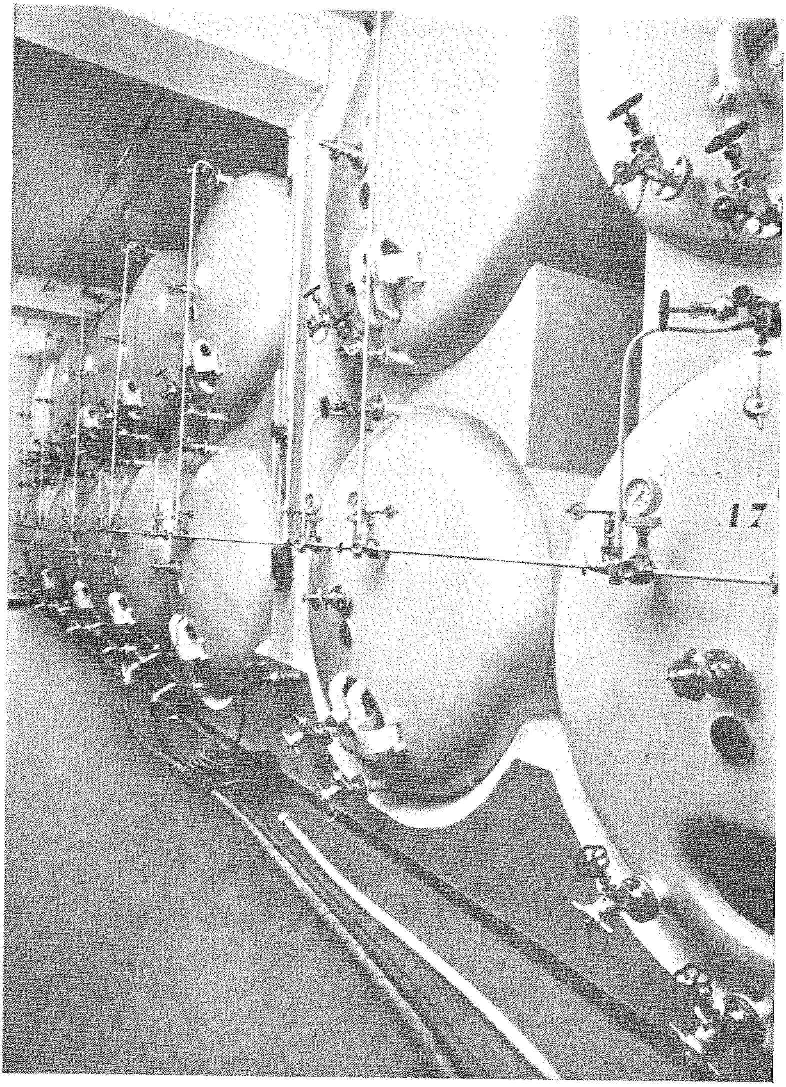
Because a standardized product is desired the clarified juices from the different apple varieties are stored, and then blended and bottled after the season is over. The Boehi method of storage under carbon dioxide (CO_2) pressure is general and there is a definite trend towards a low temperature, low pressure storage and away from the high pressures which were necessary at higher temperatures. The storage tanks are made of aluminium or of steel lined with an organic coating and the juice is held at 2° C. (36° F.), under CO_2 at three atmospheres pressure. Most factories of this size have storage capacity up to 1,000,000 gallons, and it is a most impressive sight to see a spotlessly clean storage chamber with rows of torpedo shaped tanks enamelled pale cream, with gleaming silver-plated fittings. The CO_2 for storage is obtained from the cider fermentation. It is purified by passing over activated charcoal and is stored in empty Boehi tanks. The juice is mixed with the required amount of CO_2 by means of a special impregnator made by Sulzer Brothers.

A novel alternative technique for bulk juice storage has recently been developed in Switzerland (Lüthi, 1949). The juice is frozen to snow on a drum-type continuous freezer designed by the engineering firm of Escher-Wyss. The snow is piled in large refrigerated bins and held at freezing temperatures. If this technique proves to be completely successful it will probably make existing Boehi installations obsolete, since it is obviously much cheaper than bulk liquid storage under pressure.

Swiss technicians are quite convinced of the necessity for holding juice at as low a temperature as possible to retain optimum quality, and they try to make the period at high temperature as short as possible. For this reason the juice is bottled only as the market demands.

The juice drawn from the tanks is blended and Seitz filtered, and filled into bottles. By reason of the low temperatures of filling there is a residual carbonation of 0·3%–0·5% CO_2, which gives "life" and sparkle to the liquid at the temperature of consumption without excessive gassiness. About half of the manufacturers still use the cold sterile Seitz filling process, while the others use a low temperature batch pasteurization in the bottle.

In the cold sterile process the filling is done in a sealed room which is washed down daily with SO_2 solution and kept sterile by pumping in sterile filtered air to maintain a positive pressure. As an additional precaution the bottling line within the room is again enclosed in a tunnel. The bottles are sterilized by hot air at 80–85° C. for 4½ hours and pass into the bottling room on an enclosed conveyor. The filling machine is



Boehi storage tanks for refrigerated storage of apple juice under CO_2 pressure.
(Bücher-Guyer photo.)

also enclosed and if crown seals are used these are flamed top and bottom by two gas jets just prior to capping. The returnable stoppered bottles are closed by hand, using a sterilized rubber glove. Each batch remains in the warehouse for an incubation period before being released for distribution.

Swiss technical opinion is firmly against high temperature pasteurization even of the "flash" type. Dr. Lüthi of the Wädenswil Research Station considers that a satisfactory schedule of pasteurization in the bottle is: 10–20 minutes coming up time, 20 minutes at 68–71° C. (155–160° F.) and 10–20 minutes coming down to 40° C. (100° F.). The effectiveness of this schedule is bound up with the extreme clarity of the juice and the CO_2 which remains after the Boehi storage. Some firms consider even 70° C. (158° F.) too high and pasteurize successfully at 68° C. (155° F.). Pasteurization is invariably carried out in a batch system by controlled temperature water sprays.

The only use that high temperature flash pasteurization appears to have is in sterilizing juice before inoculating with standard yeast culture in making cider.

All balanced factories make vinegar, juice concentrate and dried pomace. The vinegar is made by the secondary fermentation of cider in the traditional way but apparently concentration of the dilute vinegar by the Krause freezing method is widespread. Juice concentration is carried out in three-stage evaporators with convection circulation, and sometimes a fourth stage is added. Typical operating temperatures in the three stages are 63°, 53° and 37° C. (145°, 127° and 99° F.). Swiss scientific opinion considers that juice concentration should be carried out at temperatures below 35° C. (95° F.). One very large plant at Märstetten was seen which had a two-stage concentrator with a capacity of 80,000 litres (18,000 gallons) per 24 hours. The reconstituted product which is very satisfactory, and is used in Süssmost up to 20%, relieves the strain on juice storage capacity. Pear juice concentrate was used during the war as a jam substitute to relieve the sugar shortage, but there was evidence of more concentrator capacity than necessary for peacetime requirements. The Märvil factory has a concentrate storage capacity of more than one million gallons. An interesting feature of many concentrators is the application of the heat pump principle, an economical procedure in Switzerland, where coal is dear and electric power is cheap.

Apple pomace is dried in rotary direct oil-fired kilns. The product is bagged in paper bags or shipped in bulk in railway trucks, for the manufacture of pectin. Pear pomace, which has a low pectin value, is dried only for cattle feed or is often sold wet.

The Swiss Süssmost industry therefore is a remarkably efficient and well-balanced one. The production of a fruit juice beverage which is consumed to the extent of more than 10 litres per head of the population per year is a remarkable achievement. The standard of quality in Süssmost is very high and is maintained by rigid adherence to these fundamental principles:

(1) careful clarification,

(2) refrigerated bulk storage,

(3) low temperature pasteurization, or cold sterile filling,

(4) light carbonation.

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Fruit Storage and Plant Physiological Research

By
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The most interesting feature of plant physiological and biochemical research related to fruit and vegetable storage is that so little is being done. The amount of such research is small compared either with the number of problems which face the practical man in the fruit and vegetable industry or with the amount of scientific research normally carried out in even the smaller secondary industries.

Why in this age when science is universally recognized as the spear-head of progress and when so much money is available for research, especially in the physical and medical sciences, should so little fundamental research be in progress in one of the largest sections of the food industry? Some of the various reasons can be mentioned: it is difficult to do good basic research in the biological sciences; agriculture generally depends on traditional experience and seldom calls urgently for new ideas and methods; science, where used, is overwhelmed by the need for solving day-to-day problems; it is generally accepted that crop failures or losses in storage can be expected and are beyond our control. We are resigned to our ignorance. We are resigned to the fact that we cannot manage our problems in agriculture—to which storage traditionally belongs—with the strict control comparable to that of a factory organization. We accept this situation and make little attempt to gain the knowledge necessary for control in agriculture comparable to that in secondary industry. Perhaps some of us, impressed by the overwhelming emphasis on scientific research which results from the military importance of nuclear physics, imagine that the amount of work in progress to examine the scientific bases of agriculture is on a comparable scale. In fact, considering the magnitude of the task because of the depths of our ignorance, attempts to obtain basic knowledge of plants—the theoretical side of agriculture—are minute compared with the colossal efforts that have collected the fundamental knowledge on which the atomic bomb is based.

Horticulture, which has regarded the behaviour of fruits and vegetables in storage as part of its province has, in various departments, both here and abroad, done magnificent work in testing and improving methods for prolonging the storage life of various products. The problems which faced store operators in the early days have been largely rectified. It is now unusual, though not by any means impossible (as witness last year's shipments to U.K.), to lose fruits through the development of brown heart due to high carbon dioxide accumulation, and seldom does citrus develop cold injury. While we have defined the limits of what we

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* The author of this article made an extensive tour in South Africa, Great Britain and North America in 1948, to observe developments in plant physiology and storage research.

can do with certain storage conditions, we have often done so with only the vaguest knowledge of why we have done certain things ; further, we are a long way from having the knowledge of our material—these living plant parts, fruits and vegetables—which could lead to revolutionary improvements. For instance, it is a shrewd guess that the oiled wraps which prevent scald in apples, do so by the absorption of some volatile substance produced by the fruit itself ; this has not been conclusively proved and we do not know what substance or substances may be responsible. This lack of knowledge has serious consequences, as we shall see, in relation to developing new methods of scald control.

How can we gain the knowledge that will make the difference between understanding what to do and proceeding by rule of thumb ? As in all scientific work we need enough knowledge to predict and to control what would happen with alteration of conditions. Only such an approach is likely to provide any major improvement in methods and such knowledge can be gained only by complete investigation of the physiology and biochemistry of plant tissues. It might be argued that the problems facing the fruit and vegetable industry in storage and transport do not justify this thoroughness of approach. Against this, while many problems have been solved it must be recognized that those remaining severely limit possible improvements. In addition to scald in apples, for instance, there is the problem of cold injury which forces us to hold citrus and other fruits at comparatively high temperatures at which really long storage is impossible ; the true cause of this cold injury is quite unknown. If some of these varieties could be taken to lower temperatures without increasing susceptibility to cold injury, an increase in life could be expected. As many disorders of storage are being controlled by the effective (if little understood) methods in practice, the end of storage life has been increasingly due to the ultimate development of moulds and rots, from infection present for most of the life of the fruit but developing only after the tissues have reached a certain age. Why ageing fruit is more susceptible to these diseases is still an almost unexplored problem in the physiology of host and parasite.

One could discuss other examples. In most of these problems work is being done but is concerned with solving the practical difficulty and not finding the basic " hows " and " whys ". In other words, most of the work consists of investigations of better conditions, the " hit or miss " method. We find that the whole time of the average plant physiologist or horticulturalist working on storage goes into attempted solutions of practical problems. If he follows some of the physiological or biochemical leads that his work turns up, he has usually to do so largely in his own time together with what little time he can snatch away from the practical side. Some of this work is excellent and great improvements have come from it but we have reached the end of our tether and new developments will come only from increased basic knowledge. This has some interesting consequences. There is almost a tendency to follow fashions in the research programme which is seeking the next and newest application. Thus when someone suggests that charcoal air purification may have beneficial effects on storage of apples, everyone else is dragged in to try it on the particular varieties important in his country or his district.

One of the most investigated problems in fruit storage at present is the production of volatile substances given off by apples. There are two reasons for interest in this work : first, its relation to scald, a world-wide problem ; and second, the effect of volatile substances on ripening. It has been known for a long time that the ethylene given off by fruits themselves or applied artificially results in the acceleration of ripening changes : other volatiles may affect the rate of ripening but this has not been clearly established. The stimulus for much of the recent work on volatiles came from the claims of Smock and Southwick (1948) and later of Van Doren (1948). These workers have claimed that air purification with activated charcoal will make a noticeable difference to the concentration of volatile substances in the store and this will (1) decrease the odours in storage, (2) lengthen the storage life by delaying ripening, and (3) decrease scald. Following these claims, the technique has been used by investigators in Britain (Fidler) and in the United States (Gerhardt) ; the practical trials have defined the usefulness of this technique. It certainly does reduce odours and is therefore useful in mixed storage. It seems to give some slight prolongation of the storage life of apples but this is of doubtful value in relation to the cost of installation. The possibility of effectively reducing scald by this treatment in the absence of oiled wraps seems very doubtful.

The result of these investigations and those that precede them is that they have raised more problems of a physiological nature than they have solved. In spite of much time spent on methods to control scald, very little work is being done on the causes of volatile production and the relation of these various volatiles to scald and ripening. Some work on volatile production and its relation to carbon dioxide in gas storage has been carried out by Griffiths and Potter (1949) and the total production of ethylene and non-ethylene volatiles has been studied by Fidler (1950) and by Gerhardt (1950). The biochemistry of volatile production by the fruit, however, has been almost a closed book. With the characterizing of the individual substances by Thompson (1950) in this Division work can begin in earnest. On the whole, however, the impression gained from surveying the volatile production problem is that there has been much work on its control inadequately supported by investigations of its fundamental nature.

A similar story is apparent in the work on ripening and its relation to the climacteric—that sharp rise in respiration rate—which accompanies ripening in so many fruits. In the years before the war, following the pioneer work of F. F. Blackman, teams of English investigators under Kidd and West provided much information about the physiological changes in respiration which accompanied ripening and maturity. In spite of this knowledge gained during that period and the uses to which it was put (e.g. in gas storage) the mechanism of this change in respiration rate has never been explained. There is very little work now in progress which is directed to lead to an explanation of this phenomenon which is clearly of paramount importance in the process of normal ripening. Further, biochemical knowledge and technique in general have extended sufficiently to enable their application to this type of problem in plant material, and to give reasonable hope of an explanation of the phenomenon.

The relation of mould to the termination of storage life would suggest that if research institutions interested in storage research were taking a long-range view, the problem of host-parasite relations would be one of the major activities ; this was of course true of some of the D.S.I.R. work in England prior to the war, but practically nothing has been done elsewhere to extend this work. Some work of the sort required—studies of the physiology of the host and the fungus—has now begun under the auspices of this Division, but practically no workers elsewhere are studying the basis of this relationship in fruits or vegetables.

The problems of cold injury and low temperature breakdown have received very scant physiological study. We do not understand the causes of these injuries, which occur at temperatures often well above the freezing points. There are some interesting suggestions arising from the applied work. W. H. Smith (1947) has shown, for instance, that in plums the bad effects of prolonged exposure to low temperature can be overcome by a short exposure to higher temperatures. Again E. M. Harvey (personal communication) has shown that a marked increase in respiration rate follows the exposure of oranges for a short time to low temperatures which would subsequently lead to cold injury. The physiological bases of observations such as these are almost entirely unexplored and little opportunity occurs at present for determining first how this phenomenon affects the cells, and second how this knowledge might open the way for an improvement in practical methods of handling cold susceptible fruits to taking advantage of extending storage life at lower temperatures while eliminating injury.

Undoubtedly the best theoretical solution to storage problems would be to grow fruit of good keeping quality. Some hint that improvements in this way may be possible is available to us. In citrus and apples, for instance, marked differences in keeping quality can be demonstrated. Differences associated with climatic zones are well known, but within any one region marked differences are also apparent. It seems unlikely that these differences are associated with genetical differences because of the method of propagation of fruit trees, but they may be associated with cultural practices including differences in soil, manurial treatment, etc. While a number of experiments have been carried out to determine the differences between fertilizer treatments, we are not yet in a position to describe in physiological terms how good and poor keeping fruits differ from each other. The problem is further illustrated by the work of Carne and Martin* (unpublished) on Tasmanian varieties of apples. It has been shown that smaller fruits are much less susceptible to low temperature breakdown than larger fruits from the same tree, and further that, in fruits of a given size class, those from a light crop tree are very much more susceptible than fruits of the same size from a heavy crop. It is easy to see that the desirable aim would be the production of fruit of larger sizes with the keeping quality of the fruit of the smaller sizes. Before that can be done we need to know what their physiological differences are, and further, how these differences arise during the growth of the fruit on the tree. The only work along these lines was that of Hulme and Smith, carried out before the war: similar work has recently been repeated in this Division. Perhaps nothing more is necessary to emphasize the important point that is of general application in all storage physiology: we must not only understand the physiology of the organ to be stored, but also the physiology of the plant as a whole.

How far can we say that problems of the kind outlined are being investigated? Illustrating this first by Australian experimental work, we can say that there is no plant physiologist or plant biochemist in this country whose work is primarily directed to studying the physiology of any of the major horticultural crops, and the only plant physiological

* At the time of this investigation both workers were Officers of the Division of Plant Industry, C.S.I.R.O.

work carried out in relation to storage amounts to about half the work of the fruit storage section of this Division and a fraction of that carried out by Mr. D. Martin, an officer of the Division of Plant Industry. Something has been said to indicate that the position is not much better overseas. It is usual to meet plant physiologists by training, who, after their appointments to positions in storage research, have found it necessary to spend all their time "trouble shooting", finding quick answers to practical problems in which they can almost forget their physiological training.

This is an age of apparent scientific miracles—miracles because they are entirely revolutionary and seem to come quickly and suddenly. But these are not fast overnight discoveries: the atom bomb depended far less on the work of the Manhattan project than it did on the advances in theoretical and experimental physics of the preceding 50 years. Our miracles in scientific control of agriculture and agricultural products will be delayed until we make a proper attack on the basic sciences of plant physiology and biochemistry.

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The Preservation of Beef by Freezing: Co-operative Investigations

By

A. Howard and J. R. Vickery

The export from Australia of frozen beef quarters commenced nearly 70 years ago and rapidly grew into a flourishing trade, chiefly with the United Kingdom, which has amounted to an average of about 100,000 tons per annum during the past 20 years. After the year 1934, about 30 per cent. of the quarter beef exports were forwarded in the chilled condition, but, being a highly perishable product, export of chilled beef ceased on the outbreak of war in 1939. The trade in chilled beef has not been resumed since then, resumption being unlikely as long as meat rationing persists in the United Kingdom; equitable distribution under rationing can only be effected by means of the less perishable frozen meat.

It seems likely that, for many years to come, the bulk of Australia's exports of beef will be shipped in the frozen condition, and New Zealand's considerable beef exports will probably be treated similarly.

The Need for Scientific Investigations

In view of the probable continued export of large quantities of frozen beef, considerable thought has been given during the last two years to ways by which the quality of the meat presented to the consumers overseas could be improved. The most important defect in frozen beef is the appearance of the thawed material when it reaches the consumers. Freezing of beef muscle causes a breakdown which results in the appearance at all cut surfaces after thawing of an unsightly viscous red fluid, known as "drip". Another defect, by no means substantiated, is the alleged poorer eating quality of frozen beef as compared with similar fresh meat.

As satisfactory remedies for the defects in frozen beef would benefit both producers and consumers, the British and New Zealand Departments of Scientific and Industrial Research, the British Ministry of Food and the Commonwealth Scientific and Industrial Research Organization co-operated during 1948 and 1949 in discussions designed to define the problems and to devise means whereby they could be studied.

The Research Scheme

The four bodies entered into an agreement to carry out joint research work on an agreed programme in this field.

The main centre for the investigations will be the C.S.I.R.O. Division of Food Preservation laboratory at Brisbane, to which, if possible, trained investigators from England and New Zealand will be seconded to work for periods.

The research workers at the laboratories of the British D.S.I.R. and the Ministry of Food will assist through studies on the fundamental aspects, through the testing of techniques and through the detailed examinations of experimental shipments of beef from Australia and New Zealand.

As facilities become available, investigations will be commenced in New Zealand.

The plan for the co-operative experiments includes fundamental investigations related to the theory of freezing, and the influence on the quality of thawed beef of such factors as initial quality, rate of freezing, duration of frozen storage and thawing techniques.

The applied investigations will be conducted through storage experiments in the laboratory and by experimental shipments of precisely known history. In all such experiments chilled beef will be used as the final reference standard.

A start was made last year to assemble and train the research teams in England and Australia. Some progress has already been made on the development and standardization of techniques; two experimental shipments of frozen beef have been forwarded from Australia to England for detailed examination. A sound basis for future investigations can be built on the outstanding results on the physiology of muscles of small animals obtained at the Low Temperature Research Station, Cambridge. This work has demonstrated the profound effect of the "physiological state" of the muscles at the time of death upon their subsequent reactions to freezing and frozen storage.

It should be emphasized that while the co-operative investigations on frozen beef will occupy a considerable part of the resources of the C.S.I.R.O. Brisbane laboratory, there is no intention of abandoning the studies on chilled beef which were interrupted by the war. Indeed, several long-term chemical and bacteriological investigations having an important bearing on the storage of chilled beef are being actively pursued.

Testing of Glass Container Closure Liners

By
D. J. Menzies

Closures for glass containers commonly contain liners consisting of wads of cork composition, paperboard or felt, faced with metal or plastic foil or coated paper. The facing is intended to prevent penetration of the contents of the containers into the wad with subsequent likelihood of corrosion of metal caps, and leakage of the contents as liquid or as vapour. The mechanism of leakage through closures directly and by vapour transmission is discussed by Wheaton (1948).

Essential properties therefore in closure liners are :

(*a*) restricted permeability to liquids and to water vapour and other volatiles,

(*b*) resistance to the chemical action of the contents of the container,

(*c*) accurate conformity with the glass finish to prevent direct leakage, but not actual adhesion to the glass, and obviously

(*d*) absence of tainting and toxic properties.

The range of materials currently used in closure liners is reviewed by Cowen (1949).

This Division was requested by a closure manufacturer to test three proprietary facing papers (coded A, B and C) for their suitability in closure liners. All three papers were coated with synthetic resin coatings based on vinyl resins.

The results of these experiments are set out in some detail because it is felt that the methods of testing used may be of some value to food technologists who encounter similar problems.

Test Procedures

Cork wads faced with the papers under test were inserted in 35 mm. tinplate screw caps which were applied to $3\frac{1}{2}$ oz. bottles containing a series of test materials representing the classes of products for which closures were required, namely liquid foods, pharmaceuticals, and alcoholic liquors. The five test materials : mustard pickles, cod-liver oil emulsion, whisky, gin and port wine, also provided a range of chemical composition so that the closures were tested in contact with aqueous media containing respectively acids, oils and alcohol.

The bottles were approximately half filled and were placed on their sides, so that portion of the closure liner was in contact with the liquid contents. Some samples were stored at room temperature and the others at 100° F.

Three samples of each paper with each test product were withdrawn for examination after three months, six months and twelve months at 100° F., and after six months and twelve months at room temperature.

Visual examinations were made for penetration of the liner and the wad and corrosion of the tinplate cap. In addition weight losses were determined as a measure of vapour or liquid leakage.

Results

Mustard Pickles. All three papers were stained bright yellow by the turmeric pigment in the pickles. After three months at 100° F., rusting of the tinplate caps was evident in closures faced with papers A and B, and the cork wads were blackened, probably by iron " tannates " formed as a result of corrosion ; closures faced with paper C were in good condition. After six months at 100° F. closures A and B had rusted to the point of perforation. Closure C was still satisfactory, but it did show rusting after twelve months at 100° F.

Cod-liver Oil Emulsion. In closures A and B the papers were swollen and discoloured after three months at 100° F., the cork wad had absorbed oil, and the cap was slightly rusty. These conditions became accentuated during subsequent storage. Closure C showed only slight evidence of oil absorption.

Whisky, Gin and Port Wine. These three products were similar in their effects on the closures tested. Papers A and B were soft and discoloured after three months at 100° F., the cork wads were blackened, and the caps rusted. Closures C remained in satisfactory condition after twelve months at 100° F. ; a loss of gloss from the surface was the only defect.

With all the test products the condition of the closures after twelve months at room temperature was similar to that after three months at 100° F.

Weight Losses. Percentage weight losses after three months at 100° F. and after twelve months at room temperature (R.T.) are tabulated below. Again closure C proved superior to closures A and B in sealing properties.

Percentage Loss in Weight in Storage.

Product.	Closure A.		Closure B.		Closure C.	
	100° F.	R.T.	100° F.	R.T.	100° F.	R.T.
Pickles ..	5	5	5	10	2	2
Emulsion	9	14	7	13	3	4
Whisky ..	29	24	25	25	5	4
Gin ..	12	11	15	15	7	10
Wine ..	6	10	8	10	2	2

Conclusions

The test procedures outlined gave a useful assessment of the relative merits of facing papers for use in closure liners. For accelerated testing a period of three months at 100° F. may be regarded as approximately equivalent to twelve months at room temperature, both with respect to the determination of weight losses through leakage and the assessment of the general performance of closures.

Acknowledgements

The assistance of the Union Can Co., Melbourne, in providing materials for these tests is gratefully acknowledged.

References

COWEN, T. (1949).—Mod. Packaging 22 (10) (June) : 149-52.
WHEATON, J. M. (1948).—Mod. Packaging 21 (8) (April) : 184-5.

Notices of Recent Publications by the Staff of the Division of food Preservation

(1) A Review of Fish Preservation Investigations in Australia. By W. A. Empey. Australian Fisheries Handbook edited by I. G. MacInnes (1950).

This article will be found in Chapter 8 (processing), pages 87 to 90, under the heading of Research.

(2) Investigations on the Stability and Determination of Dehydroascorbic Acid. By F. E. Huelin. Aust. J. Sci. Res. B 2 : 346-354 (1949).

The rate of destruction of dehydroascorbic acid (which is the oxidized form of vitamin C) has been studied over a wide range of temperature (0°-100° C.) and pH (0-7). The result for each set of conditions is expressed as the time required for destruction of half the original dehydroascorbic acid. The data can be used to predict the retention of dehydroascorbic acid in stored and processed foods. Borate has been shown to accelerate the destruction.

An improved method for determining dehydroascorbic acid is given. The result obtained by the usual procedure (reduction to ascorbic acid and titration with indophenol) is corrected by subtracting a blank, which is obtained after rapid destruction of dehydroascorbic acid at pH 5·3 in the presence of borate.

Copies of this paper are available from the Librarian, Division of Food Preservation.

Answers to Inquiries

PREVENTION OF MOULD WASTAGE IN FRUIT CAKE

A number of manufacturers have sought advice on the prevention of mould wastage in fruit cake.

The experience of the Division of Food Preservation is summarized below. It began when the Division assisted the Australian Army to develop a cake that could be successfully transported to tropical areas.

The main factor controlling the stability of fruit cakes against mould attack is the equilibrium relative humidity (ERH), which is a property related to the moisture content of the cake. The ERH and the moisture content are determined by the composition of the mix and the baking schedule.

The Australian Army Service Corps drew up a specification for fruit cake along the following lines :

Formula.

Margarine	20 lb. (13·1%)
Sugar	20 lb. (13·1%)
Egg pulp	20 lb. (13·1%)
Flour	25 lb. (16·3%)
Sultanas	60 lb. (39·2%)
Peel	8 lb. (5·7%)
Baking powder (2 : 1)	1 oz.
Lemon essence	1 fl. oz.
Colour	As required
Total	153 lb. to yield approx. 140 lb. of baked cake

Ingredients.

The dried fruit should be cleaned and washed, and allowed to stand 24 hours before use.

No water or milk should be added to the mix.

The use of artificial crystallized cherries should be avoided.

Scaling.

The cake mixture should be scaled at 6 lb. 9 oz. to yield a cake weighing 6 lb. when baked and cooled. It was the experience of Army bakers that it was easier to control the amount and uniformity of the weight loss in 6 lb. cakes than in cakes of larger size.

Baking.

The characteristics of individual baker's ovens vary so widely that it is not possible to make useful recommendations regarding baking time and temperature. The baking schedule is best controlled in terms of weight loss, which represents water loss. Fruit cakes should be well baked for a time sufficiently long to give the weight loss noted above (approx. 8·5%). It is also important to ensure that the weight loss is uniform throughout the cakes in a batch.

Extensive tests on cakes prepared by the Army, according to the specified conditions, indicated that cakes having an ERH less than 74% and a moisture content less than 23% should remain free from mould spoilage for at least six months. Cakes having these properties are completely palatable, although they may be a little drier than the optimum. According to the results of our examinations of cake samples during recent months, local bakers are able to produce cakes showing ERH's around 73% and moisture contents around 21%, while some have recorded ERH 69% and moisture 20%.

Manufacturers are advised, before exporting fruit cake, to have samples of the cake analysed for equilibrium relative humidity and moisture content by a competent analyst.

Reviews

Vinegar Products. By S. V. Poultney. London : Chapman and Hall, 1949. 126 pp. 15 plates. Local price, 19/6.

Food preservation by pickling, depending upon inhibition of microbial spoilage in the presence of salt, acids, herbs and spices, is one of the most ancient of the culinary arts. Even today pickles and sauces are manufactured with more art and less science than most processed foods. The literature on the subject is scanty and mainly American in origin and outlook.

The series of articles on " Vinegar Products " which Mr. S. V. Poultney contributed to the British journal " Food " during 1948-49, was a welcome addition to published information on pickling technology. These articles have now been brought together in a book which should be favourably received by Australian food manufacturers.

The main feature of the book is a collection of recipes covering a wide range of products—spiced vinegars, pickles, sauces, relishes, chutneys and salad dressings. The attendant information on procedures and the use of equipment is practical and very readable, and the illustrations of British food machinery are well chosen. The author has not attempted to present basic scientific principles, but he has established a common basis for keeping quality in the various products formulated, in terms of the acidity of the aqueous phase.

J.F.K.

World Fisheries Abstracts. A bimonthly review of technical literature on fisheries and related industries.

The first issue of this periodical has lately been received in Sydney. It is published by the Food and Agriculture Organization of the United Nations, and is truly international in character. It includes summaries written by experts of all the important articles from about 140 journals published all over the world in many languages. None of us has time, opportunity nor the knowledge of languages to read all these articles in the original. Here we find, for example, summaries of an article in Flemish from a Belgian journal describing new aluminium boxes and other packaging techniques for fish, a Russian article on unloading fish by means of a suction hose, and an American article on " Rakes Literally Wired for Sound to Locate Underwater Clam Beds ". Articles on fish from the biological point of view are not included, and in the first issue less than a quarter deal with fishing boats and gear and the majority deal with methods for handling and preserving fish.

The format of this journal, copied from " Commercial Fisheries Abstracts " of the United States Fish and Wildlife Service, is revolutionary. On the outside it looks like any ordinary booklet, but when opened each page is seen to consist of three cards (of standard library size) to be cut out and filed to make a permanent index for quick reference. They are printed by photo-lithography, which permits the reproduction of diagrams and pictures on the back of the cards. The type is small but clear and the paper is of good quality and seems stiff enough for use as cards.

The editors have provided three alternative headings on each card for use in filing. Most readers will, no doubt, prefer to make an encyclopædia by filing them under alphabetical headings, such as :

Bait
Biochemistry
By-products—
    Gelatin
    Pharmaceutical products
Canned Fish
Canned Fish—
    Discoloration
    Grading
    Pastes
    Spoilage.

Libraries devoted entirely to fisheries will probably file instead by the code numbers of the United States Fish and Wildlife Service given on each card, and libraries interested in a wider field will prefer the Universal Decimal Classification numbers which are also given on the cards.

With the first issue of the journal, " Handbook for World Fisheries Abstracts " is sent to subscribers. It explains the three filing systems employed and gives an outline of each. The list of Universal Decimal Classification code numbers for fisheries technology provides the first English edition of several parts of the U.D.C. tables, and will be welcomed by librarians who have been struggling with French, German or abridged editions. Until now there has been no good list of subject headings in English for use in libraries on fisheries. The list included in this Handbook will not be favoured by all librarians, as it departs from the principle of specific entry and recommends, for example :

REDUCTION OF FISHERY PRODUCTS.—Methods and Equipment.—*Solvent extraction.*

FISHING.—Miscellaneous Salt Water Fishes.—*Barracudas*

where one might expect to find such information under SOLVENT EXTRACTION and BARRACUDAS. However, many indexers prefer this type of classified arrangement and the use of the list, with its full cross references, would give welcome uniformity in libraries on the subject.

" World Fisheries Abstracts " is published in English, French and Spanish editions at $4.00 a year. This subscription may be paid in Australian currency to the local agent, H. A. Goddard Pty. Ltd., 255*a* George Street, Sydney.

B.J.