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The Use of MRC Refrigerator Cars for Chilled Beef Transport

By

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Editor's Note

This report is based on investigations with MRC refrigerator cars which are standard New South Wales rail cars approximately 40 ft. long, fitted at each end with a basket bunker having a nominal capacity of one ton. Some of the details apply only to these vehicles but the general principles should apply to cars which are fairly similar in design.

Introduction

There is a fairly large traffic in chilled beef from country meatworks to Sydney, most of which is carried in MRC refrigerator cars. Recent investigations carried out by the New South Wales Railways and the C.S.I.R.O. Division of Food Preservation and Transport have led to a clearer understanding of the performance of these vehicles. The following notes, based on the results of these investigations, are designed to help the users of the vehicles to understand how they work and to operate them in the most efficient and economical manner.

A refrigerator car is essentially a cool store on wheels, but one which is very different in some details of design from the types of cold room used in the meatworks themselves. Like a land store, a refrigerator car consists of an insulated structure with a cooling system.

Insulation

The insulated structure of a refrigerator car is designed on the same general principles as any other insulated structure, but these are subject to some limitations which do not apply to ordinary buildings. For instance, the external dimensions are strictly limited by the railways load gauge. On the other hand the height of the meat rails above the floor must be great enough to accommodate large quarters. Also, the mechanical requirements of a refrigerator car are rather stringent so that the ratio of structural members to insulation must be high, compared with land store standards. Further, the weight of the whole structure must be kept as low as possible. For these and other reasons, most refrigerator cars are much more lightly insulated than most frozen stores and have rather less insulation than many cool stores designed to run at chilling temperatures. The insulation in MRC cars is similar in efficiency to that in standard cars in other parts of the world, and probably a little above the average. More heavily insulated cars have been built for special purposes in various places, but there seems little doubt that the economic optimum insulation for general purpose vehicles is not far from that of the MRC.

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One point of practical importance to shippers of meat arises from the limitations on the dimensions of cars. The newer MRC's have four subsidiary ice bunkers in the roof near the centre of the vehicle. These serve a very useful purpose, but the insulation above them is relatively poor. This is inevitable because the distance between the meat rails and the top of the roof could not be increased so that the installation of the tanks required a decrease in insulation thickness above them. Consequently, when these tanks are full of ice they provide very useful additional cooling, but if they are left empty, as is sometimes done, they become merely a weakness in insulation in the part of the car where this can do most harm.

Cooling System

It is in the cooling system that a refrigerator car differs most from land stores. In land stores it is usual to use pipe coolers which have a fixed area, but the cooler temperature can be varied at will by adjusting the ammonia supply. In MRC cars the cooling system consists of ice in the bunkers. When no salt is added the cooling surface in end bunkers is the surface of the ice in contact with the air flowing through the bunker and its temperature is constant at 32° F. The amount of cooling surface depends on the form and amount of ice in the bunkers. The supplementary roof bunkers in the newer cars work differently ; the main cooling surface consists of the bottom of the tank with its fins. Some water is retained in these tanks and when the car is moving the mixture of ice and water is fairly well stirred, so that the lower surface is kept close to 32° F. until practically all the ice is melted, that is they are more efficient when the car is moving than when it is still, and there is very little decrease in efficiency until practically all the ice is melted.

There is no forced circulation of air in MRC's ; they rely on natural convection for circulation and transfer of heat. Like many land stores relying on natural circulation, they are more suitable for maintaining low temperatures in cargoes loaded cold than for cooling down hot cargoes. If they are used for cooling warm cargoes to carrying temperature, re-icing on the journey will usually be necessary.

Effect of the Form and Amount of Ice on the Performance of End Bunkers

The cooling surface in end bunkers is the surface of the ice lumps in contact with the air stream through the bunker. As already pointed out, ice is used up as the bunker does its work and sooner or later the area of cooling surface must decrease and the efficiency of the bunker as a cooler must fall. Our experiments have shown that the variation in bunker performance with the amount of ice left is generally very similar to that shown in Fig. 1. The bunker performance coefficient (b_1) plotted in this diagram is the rate of heat removal in B.T.U. per car per hour per 1° F. average temperature difference between the cargo space and the ice. The actual figures are for bunkers filled to capacity, the blocks being broken up but not finely crushed. It will be seen from the diagram that the performance of a freshly charged bunker is generally rather poor for a short time. This is, no doubt, due to a high resistance to air flow through the bunker. Channels through the ice soon develop and before 10 per cent. of the ice is melted the bunkers will be working at their maximum efficiency. The performance then remains almost constant until about half the ice is melted, and thereafter it decreases fairly steeply.

It is, perhaps, rather surprising that bunkers remain efficient coolers for so long, but the explanation is simple. Just before the efficiency begins to fall a bunker appears, at first sight, to be still almost full, but there are large air channels through the ice. At a slightly later stage the ice mass will begin to collapse, reducing the surface area and possibly also increasing the resistance to air flow.

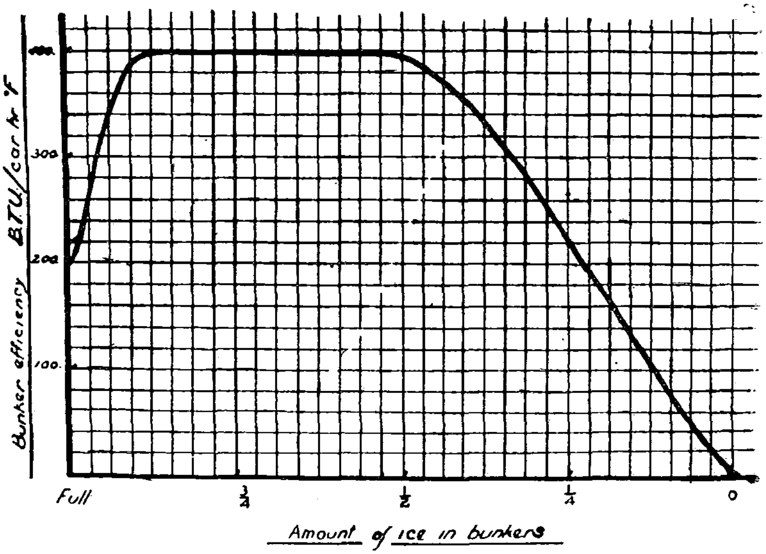

FIGURE 1.
Relation of Bunker Performance to Amount of Ice in Bunkers.

If a bunker is only half filled to begin with, its performance will change in accordance with Fig. 1, but its maximum performance will be only about half that of a full bunker and the efficiency will fall off after quite a short time. Obvious points of practical importance arising from these facts are:

(1) To obtain the best results MRC's should reach their destination with the bunkers nearly half full. This will, in fact, generally happen on journeys of less than three days if the loading conditions are good and the bunkers are completely filled before the train leaves the loading station.

(2) A bunker less than half full of ice is a poor cooling system, and a bunker less than one-quarter full is almost useless as a cooler.

(3) Some ramming of the ice is often necessary before re-icing can be done properly.

The form in which the ice is put into the bunker affects the amount which can be put in and its efficiency as a cooler. If finely crushed ice is used a relatively large amount can be put in but the maximum performance coefficient will be low. This is because crushed ice tends to form a solid block and the cooling surface is then limited to the outside of this block. Consequently, the use of finely crushed ice is generally bad practice but it may be desirable for very long journeys (over 4 days in New South Wales); the effect of temperature on microbial growth is such that a cooler which works rather inefficiently but at a fairly constant rate for the whole journey may give less risk of spoilage than one which works efficiently for the first half of the journey but which becomes very inefficient before the end of the journey.

For average sizes of ice lumps varying between perhaps 2 and 50 lb., the effect of size on the maximum performance seems to be small, so that the amount of ice which can be put into the bunkers is the main consideration. With whole blocks thrown in roughly the bunkers cannot be filled to their full capacity, so the blocks should be broken up. An average size of lump around 5 lb. is satisfactory, but the exact size is not at all critical.

Addition of Salt to Ice

When salt is added to the ice in a bunker the temperature at which the ice melts is reduced, that is the cooler temperature is reduced. If 30 per cent. of salt is added it is theoretically possible to reduce the temperature to $-6°$ F. and actual average bunker temperatures approaching 0° F. can be obtained in practice without much difficulty. These temperatures are, of course, much too low for chilled meat transport, but they are suitable for frozen cargoes. A fairly small percentage of salt has sometimes been used with chilled beef. The exact effect of this is rather complex ; generally a small part of the ice is cooled to a very low temperature and the rest is not affected very much. A lightly salted bunker will give a greater cooling effect than an unsalted one for the first few hours, but the salt will be removed as brine fairly quickly and the bunker then remains as a partly used plain ice one. Further, the amount of heat removed per pound of ice melted is less in the presence of salt than in its absence.

The use of salt is unlikely to be beneficial when there is any risk of more than half the ice being melted on the journey, that is for journeys of about 3 days with no re-icing but thorough initial icing and good loading conditions, or, perhaps, 2 days if the icing, chilling or loading conditions are not as good as they might be.

For short journeys the addition of a little salt may be useful in giving a quicker recovery from temperature rises during loading, but it is unlikely that the cost of salting would often be justifiable under these conditions.

In short, the addition of salt will give faster cooling in the early stages of the journey, but at the cost of increased ice consumption. However, most of the troubles that have occurred in chilled beef transport have been due to depletion of ice early in the journey. Salting would aggravate rather than reduce troubles of this sort.

Temperature of Meat During the Journey

In a properly iced vehicle the temperatures in the meat will be fairly steady, with very small diurnal fluctuations, for the greater part of the journey. There are always variations in temperature with height above the floor in end bunker cars ; in the steady state in summer it is usual for the meat just below the meat rails to be 4–5° F. warmer than near the floor. There is usually little variation along the length of the car. For most purposes it is sufficient to consider the average meat temperature. Some estimates of average meat temperatures, in the steady state, for different average outside air temperatures are given in Table 1. The average air temperatures are taken over 24-hour periods (day and night) and are not necessarily closely related to daytime maxima. To help in interpreting these figures average air temperatures for January at a few places in New South Wales are given in Table 2.

TABLE 1

Estimated Average Temperatures in MRC Cars, Properly Iced and in Steady State

Average Outside Temperature °F.	Average Meat Temperature °F.
60	40
70	42·5
80	45
90	48

TABLE 2

Average Temperatures in January

Town	Average Temperature °F.	Town	Average Temperature °F.
Bathurst	71	Harden	75
Bourke	85	Maitland	75
Casino	77	Orange	67
Condobolin	80	Sydney	72
Dubbo	78	Taree	72
Forbes	78	Tenterfield	69
Griffith	75	Wallangarra ..	68

Comparing Tables 1 and 2 it appears that it should rarely be necessary for meat temperatures above 45° F. over a whole journey to Sydney to occur. The figures in Table 1 are based on data for the older type MRC without roof tanks. The newer cars should give slightly lower temperatures.

Beef is commonly chilled to 32–35° F. before loading, and this is good practice. Some rise in temperature during loading is inevitable, but with good loading facilities and fast loading the average meat temperature should not exceed 40° F. when the doors are closed. The meat temperatures will then rise to the equilibrium temperature quite rapidly (generally within 12 hours). If meat is loaded above its equilibrium temperature, it will cool down rather slowly and the rate of melting of ice will be high during this cooling. To cool a cargo of meat 5° F. it is necessary to melt about one-third ton of ice in addition to that melted in absorbing the heat leakage through the structure, that is the extra ice consumption is about one-seventh of a full charge.

If more than about half the ice is melted before the end of the journey, the meat temperatures will begin to rise, rather slowly at first, but at a steadily increasing rate as the ice level falls lower. An estimate of 3 days for the time the bunkers will remain at maximum efficiency was given earlier. This was based on 75° F. average outside temperature. With 80° F. average outside temperature, some loss of efficiency is to be expected towards the end of the third day. If the average temperature were 90° F., which would occur very rarely, the bunker performance would begin to deteriorate early in the third day.

Some estimates of average meat temperature histories with good chilling and loading conditions and 75° F. outside air temperatures are shown in Fig. 2. The curve for bunkers half full initially is less exact than the others because the efficiency of a half-filled bunker is likely to vary a good deal with the way in which the ice is put in. The increasing rate of rise towards the end of this curve is due to depletion of ice.

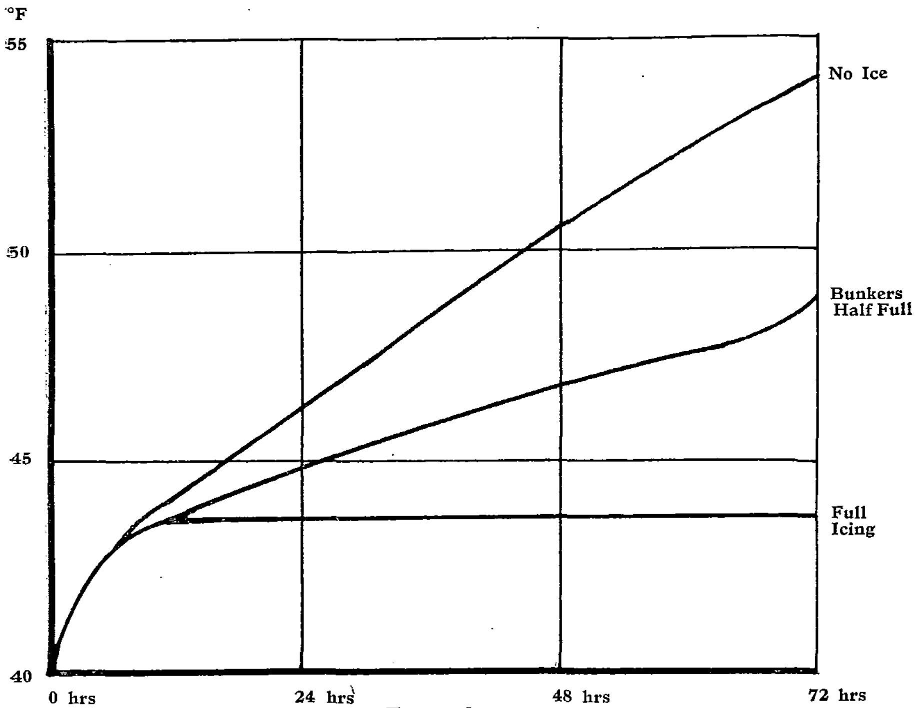

FIGURE 2.
Calculated Temperature Histories—outside temperature 75° F.

Even with full icing the temperatures are high enough for microbial growth to go on fairly rapidly, but experience indicates that they are low enough to deliver cargoes in good condition on normal journeys to Sydney from country works. However, the margin of safety is not very great and spoilage may occur if the temperatures are only a few degrees higher than those obtained with efficient icing.

Precooling of Vehicles

It is desirable to precool the vehicles before loading chilled beef, but it is generally possible to get satisfactory results without precooling. If the car is not precooled additional heat must be transferred to the meat or the ice. This amount is roughly equal to that required to warm the cargo 2° F. or to melt 6 per cent. of a full charge of ice.

Precooling of the vehicles is far more important for frozen cargoes than for chilled. With frozen cargoes the average temperature rise caused by lack of precooling is much greater than for chilled because the temperature differences are greater and the thermal capacity of the cargo is less. Also, the heat is much less evenly distributed in the usual frozen cargoes. Much of it is absorbed by the top layer in the stack and cargo in the top layer near the bunkers can, under unfavourable conditions, be thawed before loading is complete. Moreover, if part of a chilled cargo is seriously warmed during loading it will cool down during the journey, but this is unlikely to occur with frozen cargoes.

At most meatworks the trucks are brought close alongside the store or chiller from which the meat is loaded, so that the exposure of the meat to outside air is kept as small as possible. This is clearly good practice. In some places the loading bays are covered, and some are effectively shielded against winds. Shielding against wind is probably of more value than the provision of a roof.

Some temperature rise during loading is inevitable, but efforts should always be made to keep it as small as possible. The extent of the rise and its practical importance are usually much greater with frozen meat than with chilled. It is most important to load cars as rapidly as possible to make the time the meat is exposed to warm air as short as possible. Apart from its direct effect, slow loading may greatly reduce the benefits of precooling, particularly on the top of the load. Where a choice of time of day for loading is possible it is obviously wise to choose a cool time. It should be remembered, too, that exposure to humid air may be even more harmful than exposure to hot dry air. Further, the temperature rise will be greater in windy weather than when it is calm. It may sometimes be profitable to enclose completely the passageway between the store opening and the door of the car, for example with canvas screens.

Summary and Recommendations

1. MRC refrigerator cars are suitable vehicles for chilled beef transport in New South Wales, but they have not always been used efficiently by shippers.

2. It is an inherent property of the type of end bunker in use that its efficiency as a cooler is high until about half the ice is used, but its performance decreases seriously thereafter. *Consequently it is necessary* for cars to be fully iced when they leave the loading station to be sure of good results in summer. (A full charge is 40–42 nominal half hundredweight blocks in each end bunker.)

3. The blocks of ice should be broken up but not finely crushed (except under some special circumstances).

4. Complete filling of the roof tanks in the newer MRC cars is even more important than filling the end bunkers.

5. Under most conditions with chilled beef cargoes, a fully charged bunker will remain an efficient cooler for about 3 days. On longer journeys re-icing after 48 or 72 hours is desirable. On journeys of 4 days or more in summer it may be best to use finely crushed ice if re-icing *en route* is not possible.

6. The meat should be chilled to 35° F. or lower before loading. If meat is loaded warm the average temperature during the journey will be unduly high and, moreover, the life of the bunkers as efficient coolers will be reduced.

7. Precooling of the cars is desirable but generally not essential for chilled beef cargoes. It should be regarded as essential for all frozen cargoes and for chilled beef cargoes when, for some reason, conditions are less favourable than usual.

8. Loading arrangements are fairly satisfactory in most meatworks, but additional precautions may sometimes be desirable. Points which should be kept in mind include:

(*a*) Poor loading conditions have much more serious effects on frozen meat than on chilled.

(*b*) Trucks should be loaded as fast as possible; speed of loading is generally the most important controllable factor.

(*c*) Exposure to humid air may do as much or more harm than exposure to hot, dry air.

(*d*) Temperature rises in windy weather will be greater than in calm weather.

It may sometimes be profitable to provide extra protection against winds, for example by enclosing the passageway between the store opening and the car with canvas screens.

9. The addition of a small proportion of salt to the ice in the bunkers will give better cooling in the first few hours of the journey but at the expense of greater total ice consumption. There do not seem to be many circumstances under which the addition of salt would be desirable for chilled beef transport in New South Wales.

Food Technology in India

With the words " A Mysore palace has been converted into a temple of science ", *Nature* (167, 268, Feb. 17, 1951) begins an account of the inauguration of a Central Food Technological Research Institute, one of the national laboratories of the Council of Scientific and Industrial Research of India. The Institute is magnificently housed in the palatial Chevulamba mansion, formerly occupied by members of the family of the Maharaja of Mysore, which is surrounded by 150 acres of well-kept grounds. It is situated in the centre of a region growing a large variety of fruit and vegetables and in close proximity to areas using rice, millet and tubers as major articles of diet.

The Institute is to do pioneer work in food engineering in India, embracing problems in storage, refrigeration, dehydration, canning and fruit and vegetable preservation, in improving the palatability and digestibility of coarse foods, in the exploration of unfamiliar sources of nutriments, in food sanitation, and in the preparation of concentrated foods.

Problems already under investigation include the preparation of " synthetic rice " from tapioca and peanut cake, the utilization of lucerne in human dietaries, the processing of jack fruit, citrus fruits and cashew fruit, and the standardization of predigested and concentrated protein foods.

The Institute is expected to contribute greatly towards the attainment of the target of food self-sufficiency in India.

Potato Varieties for Dehydration

By

J. Shipton

Introduction

A satisfactory dehydrated potato sample may be defined as one which, when appropriately cooked, can be mashed to give a product comparable to that obtained by cooking and mashing good quality fresh potatoes. The essential features are a white or pale cream colour, which shows no tendency to darken, a typical potato flavour, retention of form during cooking, and free mashing.

The culinary quality of dehydrated potato is wholly dependent on that of the raw material. Hence, a variety suitable for dehydration must have a high culinary quality. The economics of production and processing must also be considered.

Data obtained by the Division of Food Preservation during the 1939–45 war clearly indicated that potato varieties differed greatly in their cooking quality. Therefore, it was appropriate in a programme aimed at the improvement of dehydrated potato quality, to study the characteristics of all available varieties and to elucidate the influence of environment in modifying such characteristics. The accumulated data should be of value to plant breeders seeking better quality potatoes.

It is not possible in this paper to present the results in any detail: it is intended only to briefly describe the experimental work and to indicate the chief conclusions drawn from the results.

It should be emphasized that these investigations ceased in 1947, since when other varieties have appeared which have not been critically assessed. However, samples of newer varieties examined were not superior to the varieties regarded as most suitable at the time this work was completed.

Experimental

(A) *Methods of Assessment.*

The features which were considered in assessing the varieties are discussed below.

(*a*) *Agronomic Characteristics.* High yield, resistance to disease and adaptability to a wide range of climatic and soil conditions are the major factors in the economic production of any crop.

(*b*) *Shape and Size of Tubers.* To minimize wastage in both the field and the processing plant, a high proportion of marketable tubers is necessary. The dehydrator's requirements are rather more specific than those of the fresh market, since he wishes to utilize machinery to the greatest possible extent and minimize hand labour. Therefore, the ideal potato would be smooth-surfaced and of spherical shape and in the size range of 6–12 oz.

(*c*) *Eye Formation.* The eyes should be shallow and unpigmented, so that hand-trimming after mechanical peeling can be largely avoided.

(*d*) *Flesh Colour.* An attractive dehydrated product can only be produced from white or near-white fleshed varieties. Any pigment present in the flesh discolours badly during processing and detracts from the appearance of the product.

(*e*) *Physiological Defects.* The most common fault in this category is " hollow heart ", which is not detected until the potatoes have been mechanically cut into strips, at which stage the possibility of hand sorting is limited.

(*f*) *Storage Life.* For economic processing it is necessary that potatoes should be available to the dehydration plant for several months. Thus a variety which stores well is preferred.

(*g*) *Culinary Quality.* Since the final approval of a foodstuff depends on its palatability, this is the most important consideration. The method which has been used in evaluating culinary quality is indicated in Table I. This is a modification of the system proposed by Bewell (1937).

TABLE I

Scoring System for Cooked Potatoes

Character	Maximum Score	Detailed Scoring
Uniformity of cooking	5	The score awarded is based on the proportion of cooked and partially cooked pieces.
Form when cooked	5	Breaks to pieces .. .. 1 Much sloughing .. .. .. 2 Little sloughing .. .. 4 No sloughing 5
Texture	20	Very soggy .. .. .. 0 Soggy .. .. 5 Slightly mealy .. .. .. 10 Mealy .. .. 15 Very mealy 20
Grain when mashed	10	Very coarse .. .. .. 2 Coarse .. .. 4 Medium .. .. 7 Fine 10
Colour when mashed	15	Very dark .. .. .. 0 Dark .. .. 3 Grey .. .. 6 Yellow .. .. 10 White 15
Colour after standing overnight	15	As for " colour when mashed ".
Mashability	10	The score is based on the ease with which the sample gives a lump-free, mealy mash.
Flavour	20	Strong .. .. 4 Slightly strong .. .. .. 8 Flat .. .. 12 Mild .. .. 16 Distinctive potato flavour .. 20

(*h*) *Chemical Composition.* The yield of dehydrated material is directly dependent on the solids content of the fresh potato. Therefore, high solids values are an important feature of a good variety. Since potato forms a staple item in the diet, it can make a significant contribution to the daily requirements of ascorbic acid (Vitamin C). The ascorbic acid content of potatoes is largely dependent on the stage of development of the tuber, and it gradually declines after full development is reached. However, there is sufficient varietal differentiation to justify consideration of the ascorbic acid content in assessing a variety.

(*i*) *Specific Gravity*. The relationship of specific gravity to the texture of cooked potatoes has been given much attention in America [Clark *et al.* (1940), Smith and Nash (1940), Caldwell, Culpepper and Stevenson (1944), Whittenberger and Nutting (1950)]. It has been claimed that high specific gravities are essential for good cooking quality, and a suggestion has been made that potatoes could be graded for cooking by brine separation into density classes.

(B) *Field Experiments*.

Three types of trials were conducted. In the first the widest possible range of varieties was assembled for comparison. These were grown at the Dickson Experiment Farm of the C.S.I.R.O. Division of Plant Industry in Canberra. The second series involved the growing of a smaller group of varieties, selected on the basis of the mass trial results, in the major potato growing districts of New South Wales, Victoria, Tasmania and South Australia. The third type of experiment was designed to assess the effect of environment. In New South Wales the influence of farming practice and district on varieties was studied with two varieties, Factor and Katahdin, grown by three farmers in each of seven districts. The effect of soil type was investigated with varieties grown on two distinct soils in the Sheffield district of Tasmania.

A list of the varieties which have been examined in the course of these trials is given in the Appendix.

Results

The results of the Canberra trials indicated that not more than twelve of the existing varieties could be considered as likely to meet the specific requirements of dehydration. Included in this selected group were Brownell, Houma, Katahdin, Late Carman, Pontiac, Sebago, Sequoia and Up-to-Date. These varieties were used as a nucleus for subsequent variety trials, in which a standard variety for a particular district, not in the selected group, was also included for comparison. Thus Bismarck and Snowflake were included in trials in Victoria and Factor in New South Wales.

The results of these trials and the farm variability experiment clearly indicated that within a group of varieties selected for quality, environment played a more important role in determining yields and culinary quality than did variety. Thus, in one district with adverse conditions all varieties would be more soggy in texture and worse in colour and flavour than in another district with favourable growing conditions. Seasonal variations within one district also produced differences.

The results of the soil-type experiment conducted in Tasmania emphasized the importance of growing conditions. A number of varieties were grown in the Sheffield district on two widely different soil types. One was a red basaltic and the other a black peat soil. The effect on culinary quality is shown in Table 2.

TABLE 2

Effect of Soil Type on Culinary Quality
(Figures are means for 12 varieties)

Character	Black Soil	Red Soil
Form when cooked ..	1·43	2·36
Uniformity of cooking ..	1·79	2·88
Texture	11·54	13·44
Grain when mashed ..	4·77	5·10
Colour when mashed ..	11·22	12·60
Colour overnight	9·15	10·14
Mashability	5·43	6·92
Flavour	11·67	12·68
Total	57·00	66·12

The most important effect of these two soil types was that varieties grown on the black soil were much more mealy and coarser grained than those on the red soil. Consequently, when grown on the black soil, those varieties which are normally mealy, such as Up-to-Date and Sebago, sloughed very badly during cooking, whilst types such as Brownell and Bismarck, which are normally soggy, scored well for texture. Under these abnormal conditions varieties usually rated as inferior in culinary quality may surpass the more favoured ones.

Data obtained on the correlation of density with texture only partially confirmed American workers' claims. Mean densities for varieties were not always a reliable indication of texture. However, when one variety was separated by brine flotation into a range of density classes, and each class cooked separately, a very high correlation between density and texture was apparent (see Table 3). The data in Table 3 indicate that it is not correct to claim that all samples of potatoes with a density above a specified figure would be mealy, since at any one density significant differences exist between the texture scores awarded to different varieties. The most that can be said on the basis of these results is that high densities are likely to indicate mealiness.

Conclusions

It is clear from these studies that the selection of varieties for dehydration must be based on (1) culinary and processing quality, and (2) agronomic characteristics such as yield, disease resistance and economy of production. The demands of the dehydrator and producer are not always compatible. For example the processor wants tubers with very few eyes, whereas the farmer seeks them with a larger number so that he may reduce seeding costs by cutting a number of sets from each tuber. In such cases a compromise may be necessary. It is very clear, however, that varieties which are suitable for dehydration will also be ideal for fresh market requirements.

The results of these trials indicate that, for dehydration, the best varieties are Sebago, Sequoia, Katahdin and Up-to-Date. However, it should be realized that even these varieties can only yield high quality tubers when grown under favourable conditions.

TABLE 3

Relation of Specific Gravity of Tubers to Texture of Cooked Potato

Variety	1·065	1·070	1·075	1·080	1·085	1·090	1·095	1·100	1·105	1·110
	Texture Scores for above Specific Gravity Levels									
Factor		7·7		9·7		10·3		12·0		12·6
Houma A				11·5	12·5	13·0	14·0			
Houma B			9·3	10·2	10·2	11·3				
Inverness Favourite ..				11·8	12·2	12·8	12·2	13·0		
Early Carman A			11·3	11·3	11·7	12·7	13·7			
Early Carman B				10·3	11·0					
Katahdin A			9·2	11·3	12·0	12·5	13·0			
Katahdin B		8·0	9·5	10·5	11·5					
Sequoia A				10·3	11·0					
Sequoia B			10·0	10·8	12·0	11·0				
Sequoia C	6·0			11·0	10·3	11·8	14·0			
Sebago A		9·0	9·3	12·7	14·0	12·7				
Sebago B					12·0	12·8	14·3	14·7		
Up-to-Date A				12·0	12·5	12·5	13·8	15·0		
Up-to-Date B					12·5	13·0	13·5	13·5		
Late Carman A					11·7	13·5	15·0			
Late Carman B				11·0	12·0	12·5	14·0			
Snowflake A			7·7	12·7	12·3					
Snowflake B						14·0	15·0	14·5	14·5	
Mean	6·0	8·2	9·5	11·1	11·8	12·4	13·6	13·3	14·5	12·6

Acknowledgments

The co-operation of the C.S.I.R.O. Division of Plant Industry, the Departments of Agriculture in New South Wales, Victoria, Tasmania and South Australia and the individual farmers who grew the experimental material, is gratefully acknowledged.

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APPENDIX

List of Potato Varieties Examined

Ardneil Rose, Arran Banner, Arran Chief, Arran Consul, Arran Pilot, Arran Signet, Arran Victory, Aucklander Short Top, Aucklander Tall Top, Aussie, Beauty of Hebron, Bismarck, Breesee's Prolific, British

Queen, Brownell, Brown's River, Catriona, Chippewa, Cliff's Kidney, Dakota, Delaware, Doone's Early, Dunbar Standard, Early Carman, Early Manhattan, Early Rose, Epicure, Exton's Seedling, Factor, Field Marshal, Findlay's Majestic, Golden Wonder, Great Scot, Green Mountain, Houma, Inverness Favourite, Irish Cobbler, Iron Duke, Kasota, Katahdin, King Edward, Langworthy, Late Carman, Mainguy, Majestic, Manhattan, Manistee, Maori Chief, Mesaba, Mohawk, Netted Gem, North Carolina, Pawnee, Pink Eye, Pioneer Rural, Pontiac, President, Red Dakota, Redskins, Red Warba, Robin Adair, Rural New Yorker, Russet Burbank, Scotia, Scott's Spectator, Sebago, Sequoia, Smooth Rural, Snowdrop, Snowflake, Sussex Red, Tasmanian Red, Up-to-Date, Warba, White Monarch.

Answers to Inquiries

HOW CAN CITRUS WASTES BE CONVERTED TO STOCK FOOD?

The waste, mostly pulp and peel, is subjected to the following treatment:

(i) Comminution by grinding or mincing.

(ii) Treatment with lime.

(iii) Curing for 1–2 hours, during which time the lime reacts with pectin in the mass, giving a material which presses more readily.

(iv) Pressing in continuous screw presses. This gives a pulp fraction and a liquor fraction.

(v) The pulp fraction (approximately 70 per cent moisture) is dried in direct-fired rotary driers.

(vi) The liquor fraction (approximately 10 per cent solids) is neutralized and evaporated to a molasses of about 70 per cent solids. In large plants, having a capacity of about 1,500 tons of fruit per day, evaporation of the liquor is carried out in large-capacity multiple-effect evaporators. For small quantities a simple batch-type vacuum pan of suitable capacity would suffice.

(vii) The "molasses" is generally added to the dried pulp to make the stock feed.

Detailed information on the subject will be found in the following articles:

J. L. Heid, "Drying Citrus Cannery Wastes". Food Industries (1945), 17: 1479.

F. J. Van Antwerpen, "Utilization of Citrus Wastes". Industrial and Engineering Chemistry (1941), 33: 1422.

W. H. Shearon and E. M. Burdick, "Citrus Fruit Processing". Industrial and Engineering Chemistry (1948), 40: 370.

Use of Term "Cellophane"

The term " Cellophane " was used in a number of places in an article on " Studies of Packaging Materials and Packages for Frozen Foods ", by G. Kaess, which appeared in Volume 9, No. 2, of the FOOD PRESERVATION QUARTERLY.

British Cellophane Limited have drawn attention to the fact that the Company is the registered owner in the Commonwealth of Australia of the trade mark " Cellophane " and that such trade mark indicates that goods, in relation to which it is used, are the manufacture of the proprietor of the mark.

The company has requested that references to " Cellophane " in the article should be amended as follows:

Page 21, line 19. Change " Cellophane " to " regenerated cellulose film ".

Page 22, line 6. Change " Cellophane AST " to " regenerated cellulose film, moistureproof anchored type ".

Page 22, lines 11-12. Change " Cellophane AST " to " moisture proof anchored type of regenerated cellulose film ".

Page 22, lines 16, 17. Change " Cellophane " to " regenerated cellulose ".

Page 22, line 40. Change " Cellophane " to " regenerated cellulose film ".

Page 23, line 13. Change " Cellophane AST " to " moistureproof anchored type of regenerated cellulose film ".

In the interests of technical accuracy, it should be pointed out that Dr. Kaess used the products of Kalle and Company, Wiesbaden, for his experiments, which were carried out in Munich, Germany. The trade marks of these materials are referred to in the original papers of Dr. G. Kaess (1943): Papier Fabrikante 41: 203; 42: 21.

Ascorbic Acid in Chinese Gooseberries

Miss Pamela Matheson, Analyst, of the Customs Laboratory, Stowell Avenue, Hobart, Tasmania, has recently determined the ascorbic acid content of Chinese gooseberries.

The fruits which belong to the genus Actinidia, family Dilleniaceae, came from Auckland, New Zealand, where they are grown commercially. They are roughly cylindrical in shape, with a circumference of about 5 inches and length about 2½ inches. The stem is tough and fibrous, fairly thin, and light brown in colour. The pulp is bright green.

Determinations were made on the pulp of three separate fruits immediately after exposure to the air and at intervals (Table 1).

TABLE 1

Assay for Ascorbic Acid in Pulp of Chinese Gooseberries

Fruit	Time of Assay	Milligrams of Ascorbic Acid per Hundred Grams of Pulp
A	Immediate	141
	After 20 minutes	137
B	Immediate	128
	After 1 hour	114
	Left overnight	91
C	Immediate	58
	After 3 hours	43
	After 5 hours	39