FOOD PRESERVATION QUARTERLY

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Editor:
W. A. EMPEY

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COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
HOMEBUSH, NEW SOUTH WALES, AUSTRALIA

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Tasting Tests.

By

E. W. Hicks.

In some of the food industries tasting tests have long been regarded as essential. Wine producers and tea firms employ professional tasters who follow strictly standardized procedures in their work. Butter grading, too, is carried out by men who have been carefully trained for the job and who follow a standard procedure in their tasting tests.

In other food industries increasing use is being made of tasting tests, and rightly so, but many of these tests are, at present, very haphazard affairs compared with the careful, systematic work of wine or tea tasters. The techniques used by wine or tea tasters may not be applicable to many other industries but two of their fundamental principles are, namely

(1) the procedures and methods of scoring should be strictly standardized ;

(2) tasting tests should be regarded as serious work by skilled men.

The main problem to be faced in the application of tasting tests in a food industry is, therefore, the development of a suitable standard technique. Preliminary training of tasters and the selection of people with very sensitive palates may often be necessary. There are many gaps in our knowledge of this subject but recent work in the more academic food investigation laboratories in various parts of the world can provide some guidance.

Academic workers have found it necessary to take an interest in tasting tests because the human palate is more sensitive as a detector of some differences than any existing physical or chemical methods. Moreover, there can hardly be any alternative to tasting tests for determining whether or not a particular flavour is attractive. The increasing interest in tasting tests in industry is due to the same reasons.

It is usual, nowadays, to recognize two types of tasting tests. Tests of the first type are generally described as *consumer reaction tests*. Various names have been used for the other type, but *analytical* is probably the most satisfactory.

Consumer Reaction Tests.

Among the questions to which properly conducted consumer reaction tests can provide reliable answers are :

(1) Is a particular product palatable ?

(2) Which of two or three products is the most attractive ?

(3) How far can deterioration proceed before a product becomes unattractive to the consumers ?

Consumer reaction tests are difficult to do well. Firstly it is necessary to work with a group of tasters which is truly representative of the potential consumers and this implies using a large number of tasters. Secondly it is difficult to obtain carefully considered, honest opinions. Thirdly it is not always easy to get the tasters to concentrate their attention on the right point, e.g. in a test once carried out on a method for improving the texture of cheese, the results of a large-scale tasting test were inconclusive because the tasters were more interested in flavour differences than in variations in texture.

Not enough work has been done on consumer reaction tests, to formulate, with complete confidence, rules for their planning and interpretation, but some points are fairly clear, e.g.

(1) The number of tasters should not be less than about 30. One particular army establishment of about 40 men has been shown to give a fairly reliable guide to the average preferences of the people of the U.S.A. In another instance the men in a university students' hostel proved satisfactory as a panel. Panels of 30 or so from the staff of a large laboratory have also been reasonably reliable.

(2) The members of the panel should be people who can have no reason for desiring a particular result.

(3) The number of samples in any one test should be small; comparisons of two only are the most satisfactory.

(4) The samples should be marked with a code number and have no other label or distinguishing marks which might enable tasters to recognize a known product.

(5) The questions asked should be few, simple and definite.

(6) Trained tasters are not required for this type of test but first judgments on an unfamiliar commodity may be unreliable. For instance, in an experiment designed to measure the preferences for two types of cheese using a body of students as a panel, it was found that the results of the first few tests differed from those obtained later, but after offering the two types regularly for a week or so, the ratio of the quantities of the two eaten settled down to a fairly constant value.

(7) The samples should be tasted under conditions which are not too different from those of ordinary consumption of the product. It is not essential that they should be part of a normal meal, though this is often desirable, but they should always be served attractively, at the right temperature and in pleasant, quiet surroundings.

(8) To ensure independent judgments from tasters there must be no discussion during the test.

(9) The results should be examined statistically.

A very efficient technique for determining whether or not there is an appreciable difference between two materials is to present each member of the panel with two samples of one material and one of the other arranged in random order and marked with code numbers. He is asked to say if there are any differences, and if so, which of the three is different from the other two and what is the nature of the difference.

Analytical Tests.

It is the analytical type of test that has been used and studied most in the last few years. As the name implies, a taste panel in this type of test is used as a measuring instrument, to measure differences in palatability which cannot be estimated accurately by physical or chemical methods. In tests of this type it is wise to abandon any hope of obtaining a panel which will be representative of the general public. The members of the panel should be selected for high sensitivity to the differences being studied and consistency in judgment, so that they can assess with some accuracy differences which would be overlooked by ordinary consumers. The ability to recognize particular changes can be enhanced by training, so that a panel should always be given a period of training before final selection of the members and use of the panel for careful measurements. It is generally possible to design a preliminary experiment which will give some useful information and also train the tasters for later, more accurate measurements.

In analytical tests the tasters are generally asked to score different aspects of the palatability separately, e.g. with frozen peas they may be asked to score characteristic pea flavour, sweetness and off flavours separately, or with canned orange juice they may be asked to score separately characteristic orange flavour, bitterness and cooked flavour. There are two main reasons for doing this, namely (1) scoring can be more precise when only one characteristic is being considered at a time; (2) it is generally differences in particular characteristics on which information is needed in a research job, and these would be concealed in an overall rating. In order to get as much information as possible on defects, it is wise to ask tasters to describe any off flavours as well as giving a score for the intensity of off flavours.

In analytical tests it is usually necessary to adopt a numerical scoring scale. The formulation of a scale suitable for a particular purpose is not easy and it is often desirable to revise the scale after some experience has been gained in the use of a first, tentative scale. The number of intervals to be provided in the scale requires consideration. Numbers of intervals ranging from 3 to 100 have been used by various workers. Many workers try to arrange the scale so that the error of measurement by good tasters will be of the order of one unit. If this basis is adopted, experience suggests that a range of between 5 and 10 points in the scale is all that can generally be justified. A common practice is to use a 5-point scale and permit the use of half points. Some at least of the numbers in a scoring scale must be defined by a description in words. Opinions differ as to whether all the points should be so defined or only a few of them. The following scale definition schemes illustrate the two types:

A. Frozen Peas. Degree of Off Flavour.	B. Dried Meat.
5. No off flavour.	7. Full fresh meat flavour.
4. }	6. Good meat flavour but lacking full fresh flavour. No foreign flavour or rancidity.
3. } Increasing off flavour.	5. Slight foreign flavour (specify) but palatable. No rancidity.
2. }	4. Definite foreign flavour and/or slight rancidity.
1. Pronounced off flavour.	3. Fairly strong foreign flavour or rancidity. Edible but not pleasant.
	2. Strong foreign flavour or rancidity.
	1. Very strong foreign flavour or rancidity. Scarcely edible.
	0. Inedible.

In scheme A only two points are defined. Counting the half points, which are permitted in using this scale, there are seven intermediate points covered by the general description "increasing off flavour". For efficient use of such a scale it is essential that the two "anchor points" are really clearly defined in the minds of the tasters, i.e. in scale A "pronounced off flavour" must mean the same thing to all members of the panel and to any one member at different times. Training in the use of the scale is necessary, as a rule, to develop such consistency. Training is generally needed, too, to obtain consistency in the use of the intermediate scores. Advantages of schemes like A are:

(1) They avoid much of the difficulty of devising adequate descriptions of flavours.

(2) It is commonly believed that tasters will set up for themselves scales in which the interpolation between the anchor points is linear, and this is necessary for valid statistical analysis of the results. It is difficult to achieve linearity when every point is defined.

Schemes such as B have two main advantages:

(1) They do not rely on adequate definition of only two anchor points.

(2) In them, tasters can be directed how to assess the relative importance of different defects, e.g. lack of flavour or presence of off flavours.

There is now general agreement on a number of principles to be observed in carrying out analytical tasting tests. Among these are:

(1) The panel need not be large, but its members should be experienced in the tests being done, and any who prove inconsistent in their judgments should be rejected. The panels in use in different laboratories vary greatly in size, but a large proportion have between four and 15 members. A panel of six skilled tasters should generally be sufficient.

(2) Tasting tests should be regarded as an important part of the work of a food laboratory, and panel members should do tasting tests as carefully as any other important analysis. It is not always easy to develop this attitude to the work.

(3) There must be no discussion during a test, but discussion after a test is often useful, particularly during training in the use of a new scale.

(4) Tests must be strictly blind, i.e. the tasters must not know what results are expected for any particular sample.

(5) Fatigue effects can be serious. The maximum number of samples which can be assessed efficiently in one test varies with the product, but is commonly about four to eight.

The number of tests which can be done efficiently in one day is also limited and again varies with the product. Tests on a particular product must usually be limited to two or at most three in one day.

The hour of the day is also important. Mid to late morning is generally the most satisfactory time, but mid-afternoon may also be suitable.

(6) The judgment on particular samples can vary appreciably with the order in which they are presented and with the number of samples. To avoid bias due to these effects, the number of samples in each test of a series should be constant, and the samples in each test should be presented in random order.

(7) The tests should be carried out under comfortable conditions where it is easy for tasters to avoid being influenced by their neighbours. In some laboratories special rooms with a separate cubicle for each taster are used.

(8) The material to be tasted should be presented in a standard form, in clean, attractive containers and at a suitable temperature for consumption.

(9) It is often difficult even for experienced tasters to avoid being influenced by factors irrelevant to the particular thing being studied, e.g. judgment of flavour may be affected by the appearance of the product. The method of presentation should be carefully planned to reduce these difficulties, e.g. to obtain judgments on the flavour of peas which are not biassed by differences in appearance, they may be presented in the form of purée. In one laboratory colour differences between samples are often masked by controlled lighting, in order to avoid bias.

(10) Consultation with an experienced statistician interested in tasting test problems is generally essential in working out and applying efficient techniques.

Tasting tests are often carried out in industrial laboratories for routine checking of the quality of the output of the plant. In this work it is not usual to analyse the quality into so many components as in analytical tests in a research laboratory. It is common practice to give a single overall palatability rating. Such tests are much more closely related to the analytical type of test than to consumer preference tests, but they should perhaps be regarded as a third type of test, or at least as a distinct variety of analytical test.

Much remains to be learned about the reliability of overall quality ratings in tasting tests. They are used in many research laboratories in addition to separate ratings on a number of components. Other workers derive overall scores by calculating weighted means of the scores for individual components. The weighting factors are estimated to attempt to make proper allowance for the relative importance of the various components of the quality, but there are few, if any, instances where they can be more than intelligent guesses.

Workers in industry, as in research, should often examine their tasting techniques critically, but there seems no sound reason for believing that overall palatability ratings cannot generally give trustworthy results. The precautions necessary to make such tests efficient are almost identical with those required for strictly analytical tests.

Quick Freezing of Fruits and Vegetables in the U.S.A. and Canada

By

S. M. SYKES.*

The relatively new process of quick freezing is a subject of popular interest today. From time to time we read articles in newspapers and trade journals which tell us what this method of preservation can do. The use of refrigeration and freezing as a means of storing food has been familiar to most people for many years, so that it is natural to ask why quick freezing is novel, and in what way does it differ from the older concept of freezing.

As the name suggests, quick freezing involves a rapid removal of heat from the product, whereas, in other methods, the period of freezing is considerably longer. Special equipment is required for this purpose and, in practice, the freezing unit becomes the final stage in a processing line which closely resembles that of a cannery. One of the most significant features of the new applications of freezing has been that many foods can now be successfully frozen where, previously, only very poor products had resulted.

The quick freezing of fruits in small packages has arisen out of the freezing of fruits in barrels, which began about forty years ago. This bulk freezing is actually slow, and the product is referred to as "cold packed" or "frozen packed" to distinguish it from the true quick frozen article. Cold packing is still carried on and represents a large proportion of the total frozen fruit output. The commercial quick freezing of vegetables did not begin until the early 1930's and did not expand rapidly until about ten years ago. The recent progress achieved in the production of high quality frozen foods has been due, to a large extent, to the fund of technical information and experience that has been built up over a period of years. Many people in the fields of both research and industry have contributed to this advancement. One of the most outstanding figures has been Clarence Birdseye, who has been responsible for much of the progress in the commercial production of quick frozen foods. He is the inventor of the Birdseye Multiplate Froster, a freezing unit which is widely used in America.

Quick freezing preservation, then, means more than just the rapid removal of heat from the product. It implies that the product has been grown, selected, harvested, handled, prepared, frozen, stored and marketed in accordance with the best techniques which have resulted from research over the past thirty years.

The production of frozen fruits and vegetables in commercial plants represents the greater part of the industry today. However, there are two other phases which are steadily becoming more important. These are (*a*) the use of locker plants for the freezing and storage of locally

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produced foods, and (*b*) the home freezing and storage of foods in " zero " cabinets. While locker plants and home freezers are used mainly for meat freezing, the quantities of fruits and vegetables frozen by this means is quite considerable. In some country areas, where fruit and vegetables grow well, freezing preservation makes a significant contribution to the family food supply.

Importance of Quick Freezing to the Farmer.

To the man on the land, quick freezing is of special interest. Firstly, it is an additional outlet for agricultural produce. Any method of processing of raw material, whereby it can be used more efficiently and marketed over a longer period of the year, is to the farmer's advantage. Secondly, it benefits him as a consumer of food. Too often, the diet of the rural family is lacking in variety and nutritive value. The development of locker plants and home freezers in America is doing much to improve conditions in this regard. Packaged frozen foods are also available in country towns, and the housewife may buy a supply of these foods and store them in the home freezing cabinet until they are required.

Since the success of quick freezing is dependent on the maintenance of high quality standards, the farmer has an important part to play in growing the raw material which will yield a product of good quality after processing. The use of the correct varieties, proper cultural operations, and harvesting at prime maturity are essential to the final quality of the frozen article.

The Position of Quick Freezing in America Today.

Quick freezing is now a firmly established part of food processing in the U.S.A. The total annual production of commercially frozen food is about 1,000,000 tons (exclusive of ice cream). In addition, there is about 500,000 tons frozen in locker plants and home freezers. While these figures indicate a large quantity of food, the actual proportion of the total food consumed as frozen food is only about 3%. The amount of fruits and vegetables frozen is still considerably less than the amounts which are canned or consumed fresh. However, production figures have shown a steady increase from year to year, and some people predict that quick freezing will eventually become the most important method of preservation.

The use of locker plants in both city and country areas is still increasing. During the year 1945-46 the total number of plants in the U.S.A. rose from 6,000 to 7,000. There are many reasons suggested for this rapid expansion. The demand for better diets by rural families, the research and extension work by government experiment stations, the economy and satisfaction of this system of preservation are some of the factors influencing the expansion. Home freezing in " zero " cabinets is growing, particularly in rural areas. Manufacturers planned to sell nearly 1,000,000 home freezing cabinets in the ten-year period following the war. Agricultural experiment stations have been fostering the home building of cabinets and the larger models of " walk-in " freezers.

Technical Developments in Quick Freezing.

Raw Material.

The production of high quality fruits and vegetables in the field is now considered to be one of the most important parts of successful quick freezing. Much research has been directed to the improvement of strains and many new varieties have been developed for their special adaptability to freezing. A great deal of agricultural research is devoted to improvements in cultural technique, pest and disease control, and the more accurate determination of the correct maturity for harvesting. With regard to the latter point, freezing plants have a staff of field officers, who are responsible for the supervision of the growing and harvesting operations. The harvesting of a crop such as peas for freezing requires very careful observations by the field officer to determine when the crop should be cut, in order to give the best quality after freezing.

The term "quality control" is applied to that phase of plant organization which is concerned with the maintenance of satisfactory quality standards. Some freezing plants place more importance on quality control in the field than in the plant itself.

Preparation for Freezing.

Practical experience and the results of research have shown that rapid handling after harvesting is essential to high quality. A recent tendency in many plants which process peas—a product which deteriorates rapidly after harvest—is to pre-cool the material immediately after the vining operation. If the peas must be held for some hours before processing, then they are placed in a cold room at 32° F.

Studies on the most desirable methods and times of blanching have provided processors with much information. The use of quality separators in pea processing lines is another development which exemplifies the trend towards higher and more consistent quality.

In the processing of fruits, the prevention of browning and off-flavours has been a major problem. Work is still in progress, but many outstanding successes have been achieved—notably in the use of ascorbic acid with peaches and other fruits, and in the improved use of sugar, both dry and as syrup.

Packaging.

The question of the most suitable container is still very much in the experimental stage. The containers are usually of paper board construction, although there is some packing in cans and glass. Perhaps the best container produced in quantity to date is the "Canco" container (American Can Co.), which has a fibre-board body and metal ends. It has the advantage that it can be handled and closed entirely by machine, in a manner similar to that of a canning line.

New waxes and thermoplastics for the manufacture of moisture-proof containers and wraps have been also developed and are in the course of examination.

Freezing.

A great many different types of equipment are being used in the successful freezing of fruits and vegetables. The Birdseye Multiplate Froster has already been mentioned and is the unit used by General Foods Corporation, the largest producer of frozen foods in the U.S.A. The principle of this method of freezing is that of indirect contact with the refrigerant. The packages are placed between refrigerated metal plates which are brought into close contact with the packages.

Air blast freezing is widely used in a variety of ways. Frequently the packages or loose product are spread on trays which are placed on trucks. The trucks are then placed in a tunnel through which air at about $-30°$ F. is blown. Another type of air blast freezer is commonly used for a free flowing product like peas. Here, the prepared material is fed on to a slowly moving mesh belt. As the material passes through the various stages of the tunnel, cold air is blown through the belt and food. By the time it reaches the discharge end, it has been frozen and the temperature reduced to 0° F.

A small number of plants use the method of freezing by direct contact with the refrigerant. Some form of this method may, in time, prove to be one of the most efficient of freezing techniques, but, so far, there has been no completely satisfactory application of the principle to practical working conditions.

Refrigeration and constructional engineers are carrying out research to develop machines which will enable frozen foods to be produced more efficiently and economically.

Transport and Marketing.

The distribution of frozen foods is a special problem since the products must be held at a temperature of 0° F. from the time they come out of the freezing unit until they are ready to be thawed and consumed. Completely satisfactory rail transport has not yet been achieved, and much of the refrigerated road transport is doubtful. However, these links in the production chain of frozen foods are gradually being strengthened and will help to raise the quality of the food as it reaches the consumer. The retail handling of frozen foods in shops is a phase of the distribution problem which has been in the past and is still a serious limiting factor in the expansion of the frozen food industry. The type of sales cabinet has been improved considerably but the cost is still high. Thus, the capital outlay on retail cabinets represents quite a large proportion of the total costs.

Quick Freezing in N.S.W.

Quick freezing in N.S.W. is, as yet, a very small industry. Only one plant is in operation, and there are very few stores which retail frozen foods to the public. Many difficulties must be expected in the early stages of development. The education of grower, processor, cold store operator, retailer and consumer is, in itself, a major task. The expansion of electric power in country areas, the provision of refrigerated transport and storage, the manufacturing of freezing cabinets, are some of the factors which will influence the growth of the industry. Agricultural and other technical research will be necessary and, in this connection, the N.S.W. Department of Agriculture and the C.S.I.R. Division of Food Preservation are about to commence investigations.

As a new outlet for agricultural produce, quick freezing will be regarded with interest by the primary producer. For the consumer, it is a possible means of raising the quality and variety of the family's food and of ensuring a continuity of supply. The high acceptability and fresh-like flavour of properly prepared frozen foods is sufficient reason for assuming that they will, in time, have a definite place in the Australian diet.

The Use of Surface Active Cations in Detergency and Sterilization

By

M. R. J. SALTON.

Introduction.

Because of the tremendous demands of many industries for new and improved detergents, interface modifiers, wetting and emulsifying agents, a large number of different compounds with "surface active" properties has been synthesized during the past decade. Of these, the surface active cationic compounds have been reported to be particularly effective as germicides, in addition to reducing the surface tension of water and lowering the interfacial tension between water and other surfaces such as solids and liquids. Domagk, in 1935, emphasized the bactericidal properties of synthetic detergents and recommended the use of the cationic, quaternary ammonium detergent, Zephiran, for disinfection of skin surfaces.

Domagk's initial report was followed by many laboratory and clinical studies demonstrating the germicidal action of Zephiran. Considerable interest has been displayed in the cationic detergents and there is now quite an extensive literature on their use as detergents and sterilizing agents in medicine and in industry.

Chemical, Physical and Detergent Properties.

Cationic surface active compounds belong to the following chemical groups: primary and secondary amine acid salts, quaternary ammonium compounds, sulphonium and phosphonium compounds. The most studied and most widely used of these compounds belong to the quaternary ammonium class, of which Cetavlon and Zephiran are typical members. Chemically, Cetavlon is cetyltrimethyl ammonium bromide and has the following structure:

$$\left[\begin{array}{c} CH_3 \\ | \\ CH_3\text{—}N\text{—}CH_3 \\ | \\ C_{16}H_{33} \end{array}\right]^{+} \quad Br^{-}$$

In this class of compound the water-soluble (hydrophilic) portion of the molecule carries a negative charge and the oil-soluble (hydrophobic) portion carries a positive charge.

The cation-active compounds are quite stable and extremely effective detergents in acid solution, in contrast to many of the anion-active types (Price, 1946). These compounds are also stable in alkaline solution. They are incompatible with soap and anion surface active materials, and indeed, if they are mixed in proper proportions a precipitate is formed due to the union of the two oppositely charged hydrophobic groups of the molecules.

Most compounds of the quaternary ammonium class are freely soluble in water and alcohol. However, the rates at which the pure chemicals dissolve are sometimes very slow (Jacobs, 1944). The reduction of the surface tension of water by the cationic detergents has been reported by numerous workers. Huyck (1944) determined the surface tension of aqueous solutions of cetylpyridinium chloride, the results being recorded in the following table :

Concentration of Cetylpyridinium Chloride.	Surface Tension. (Dynes/sq. cm.) at 76° F.
1 : 1,000	40·8
1 : 5,000	45·0
1 : 10,000	51·0
Distilled water	71·2

As detergents, anion-active agents are generally superior to cation-active agents. According to the accepted theory of detergency (Huyck, 1944) the cation-active material forms an emulsion of soiled particles by means of the oil-soluble (hydrophobic) portion of its molecule. Cleansing then takes place as a result of replacement of the emulsified soiled particles from the surface by excess of the agent. The cationic compounds generally do their best cleaning in alkaline solutions. However, Resuggan (1947) points out that for the " detergency " properties of the cation-active compounds to be of any practical importance a much stronger solution than that required for sterilizing purposes must be used, in which case the economic factor may be decisive.

Germicidal Properties.

A great deal of work has been done on the germicidal and inhibitory effects of quaternary ammonium compounds on pathogenic and non-pathogenic bacteria, fungi and viruses. Published laboratory data are too voluminous to present here. However, some reference to the more important findings can be made.

Most of the research on the evaluation of the bactericidal potency of these compounds has utilized the United States Department of Agriculture Food and Drug Administration method developed by Ruehle and Brewer (1931). This method involves the determination of the highest dilution of the agent killing a standard inoculum in ten minutes, but not in five minutes. The results are usually reported as the " phenol coefficient ", as in the case of the somewhat similar Rideal-Walker (1903) method.

Blubaugh, Botts and Gerwe (1940) showed that both tinctures and aqueous solutions of cetylpyridinium chloride are highly bactericidal for a variety of organisms, including *Staphylococcus aureus*, *Bacterium coli* and *Bacillus subtilis*. Blubaugh and others (1941) showed that a 1 : 4,000 dilution of cetylpyridinium chloride is bactericidal in less than fifteen seconds when used against vegetative cells of various organisms. Gershenfeld and Perlstein (1941) reported that 1 : 75,000 Zephiran (alkyl-dimethylbenzyl ammonium chloride) is the killing dilution for *Staph. aureus*. Maier (referred to by McCulloch, 1945) found that the germicidal range of Zephiran extends to 1 : 100,000, whilst it is inhibitory up to a dilution of 1 : 800,000. Klein and Stevens (1945) studied the activity of cationic detergents against influenza A virus and found inactivation took place in ten minutes with a 1 : 8,000 dilution of cetylpyridinium chloride and a 1 : 4,000 dilution of Zephiran. Quisno and Foter (1946) found cetylpyridinium chloride germicidal in high dilutions against a variety of micro-organisms, this activity being high under acid or alkaline conditions at room temperature and at 99° F. Although a strict comparison of the germicidal data from various laboratories is not possible (owing to the use of different strains of organisms, different temperatures of testing and unspecified purity of compounds used) some general conclusions can be made. The gram-positive organisms such as *Staphylococcus aureus* and *Streptococcus* spp. are more susceptible to the germicidal action of the quaternary ammonium compounds than the gram-negative organisms, e.g. *Bacterium coli, Pseudomonas fluorescens, Proteus vulgaris,* etc. Bacterial spores are more resistant to these germicides and generally require killing concentrations higher than those required by vegetative cells of the sporing organisms and the gram-positive and negative organisms. Nevertheless, Green and Birkeland (1941) stated that cetylpyridinium chloride is an effective and practical germicide for bacterial spores. Finally, there is general agreement throughout the literature that the presence of protein or serum in test solutions results in a lowering of germicidal activity.

McCulloch (1945), in referring to the effectiveness of these compounds, cautions " that these disinfectants should not be overrated at the present time, but that some may be valuable germicides ". Indeed, there is some evidence—Brewer (1943), Klarmann and Wright (1946) and McCulloch (1947)—to suggest that evaluation of the quaternary ammonium compounds by the Food and Drug Administration method has over-estimated their germicidal activities. Klarmann and Wright (1946) found that various modifications of the F.D.A. method for testing disinfectants indicate that bacteria are capable of surviving greater concentrations of four commercially available quaternary ammonium compounds than would be indicated by the results of tests obtained when using the regular procedure. The primary reason for the inadequacy of the F.D.A. method appears to depend on the creation of a condition which interferes with the transfer of a representative bacterial sample into the subculture.

Sterilization of Food-Handling Equipment.

In the operation of any industry concerned with food and food products close attention to cleanliness and plant hygiene is of the utmost importance. The surface active cations have found some application in the field of plant cleanliness and disinfection, particularly in the dairy industry.

Mallmann and Churchill (1946) refer to the use of quaternary ammonium compounds in surface disinfection of food preparation and storage rooms. They studied the inhibitory effect of these compounds against spores of *Bacillus subtilis* at temperatures of 0°, 35° and 90° F. Effective inhibition of the spores, even after exposure for 14 days, was apparent at all temperatures. These compounds effectively sanitized clean wall surfaces, but they were less effective in reducing the bacterial population of a badly contaminated wall of a frankfurter packing room. However, treatment of the wall with the cationic disinfectant after washing with trisodium phosphate brought about a substantial reduction in the bacterial count. This emphasizes the necessity for good cleaning prior to sterilization, the quaternary compounds showing no difference from other agents in this respect.

Mueller and others (1947) reported that 200 parts per million (p.p.m.) of quaternary ammonium compound effectively sanitized metal parts of dairy equipment when properly washed. A spray treatment for milk cans showed a significant reduction in counts. To obtain maximum efficiency with these compounds, Davis (1947) suggested that all equipment should be clean; small parts to be dipped in the disinfecting solutions before assembly; joints, pipe-connections, etc., should be left loose so that all surfaces may be contacted; and finally, the system to be pumped through with a solution containing 200 p.p.m. of the agent.

Johns (1947) compared the sanitizing efficiencies of hypochlorites and quaternary ammonium compounds. He used a glass slide technique (test organisms present in a partially dried film of diluted skim-milk on the surface of a microscopic slide) which appears to offer advantages in the evaluation of the germicidal efficiency of products designed for sanitizing metal or glass surfaces in food processing plants. Johns concluded that it was unsafe to generalize concerning the relative values of quaternary compounds and hypochlorites in the sterilization of food equipment. However, he refers to certain fields in which they may excel, for example, sanitizing egg-breaking sets, treatment of milk shipping cans, beverage glasses, dishes and silverware.

A non-foaming cationic compound (di-n-octyl dimethylammonium bromide) was used by Resuggan and Davis (1947) in bottle-washing machine tests. Results showed considerable reductions in the bacterial counts of swabbings, very good bottle appearance and a complete absence of fobbing in the machines.

Portley (1948) reported that, used in dilutions of 200-400 p.p.m. as a spray or rinse for cleaned dairy equipment, certain quaternary compounds are excellent germicides. He recommended various procedures for the sterilization of pails, cans, strainers, milking machines, storage tanks, vats, pasteurizers, milk bottles, filling machines, etc., with a quaternary ammonium compound.

Disinfection of Eating and Drinking Utensils.

Public health authorities throughout the world are more concerned than ever before regarding the spread of infection by direct contact, particularly with eating and drinking utensils in public places. There appears to be no doubt that improperly washed and sterilized utensils are carriers of bacteria and may be directly responsible for transmission of disease (Krog and Marshall, 1940). The cationic detergents have recently come into prominence in laboratory and field studies of their ability to sterilize eating and drinking utensils.

Krog and Marshall established that a 1 : 5,000 solution of alkyl-dimethylbenzyl ammonium chloride sanitized utensils to a remarkable degree in the laboratory under most rigid conditions. As a result of laboratory and field trials these workers concluded that a 1 : 5,000 solution of the quaternary compound was markedly germicidal for bacteria found on eating and drinking utensils; that detergents such as trisodium phosphate, powdered soap in the concentrations used, had little or no effect on the potency of the quaternary compound; temperatures above 70° F. did not adversely affect stability or germicidal efficiency.

MacPherson (1944) reported that hand-washed eating and drinking utensils may be effectively sterilized by washing in hot soapy water followed by rinsing in a 1 : 5,000 solution of alkyl-dimethylbenzyl ammonium chloride. Total plate counts for the most part were below 100 per utensil, there being an absence of organisms of the colon group. Davis and Resuggan (1947) made an investigation of the bacteriological condition of glass-rinsing waters in public houses and found that by the use of a disinfectant-detergent preparation (containing di-n-octyl dimethyl ammonium bromide and hydrated sodium metasilicate) adequate sanitation was ensured without imparting any taste to the beverage subsequently filled into the glass.

Unpublished data on the use of a 1 : 500 solution of Fixanol C (cetylpyridinium bromide) in egg-cleaning machines in N.S.W. showed, on the first day of use, a substantial reduction of bacterial rotting in stored shell eggs. However, continued use of the cationic disinfectant resulted in a progressive deterioration in the control of rotting, and this was most probably due to the survival of some bacterial types which were more resistant to the disinfectant.

In addition to their germicidal action, these compounds have the added advantages of being non-irritant to the skin (in contrast to hypochlorites), odourless, tasteless and non-toxic in the concentrations recommended.

Conclusions.

There can be no question as to the general usefulness of the surface-active cations as germicidal agents. However, it must be emphasized that the available methods for testing disinfectants can lead to erroneous conclusions as to the germicidal value of these compounds.

Thorough cleaning with an inexpensive detergent, such as trisodium phosphate, hexametaphosphate or soap, prior to treatment of food equipment and utensils with quaternary ammonium compounds, will result in maximum germicidal efficiency. A concentration of one part of quaternary ammonium compound in 5,000 parts of water (i.e. 200 p.p.m.) appears to be the most widely used and recommended solution strength. Equipment and utensils treated with the germicidal solution are permitted to drain and dry without further rinsing.

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A CORRECTION

In the article on the " Cold Storage of Butter and Cheese " in the December, 1947, issue of the FOOD PRESERVATION QUARTERLY, it was stated that :

> " the waxing of export cheese is prohibited as it is not favoured on the English market ".

The true position is that the export of waxed cheese is not prohibited, but at the request of the British Ministry of Food, waxed cheese may not be included in cheese sold to Great Britain under the terms of the British Contract.

Answers to Inquiries

RED CURRANTS FOR JELLY.

An enquirer requested information on the following points connected with the handling of red currants for jelly manufacture:

(i) What is the best procedure for extracting red currant juice?

(ii) Is it possible to can this juice and store it for jelly making at a later date?

(iii) What is the procedure for preserving red currants in casks with the addition of sulphur dioxide?

The following information was supplied. It is based largely on the experience of the Fruit and Vegetable Products Laboratory, Summerland, B.C., Canada.

Extraction of Red Currant Juice for Jelly Making.

Red currants for jelly are preferably harvested when fully mature in order to obtain the finest flavour. They should be thoroughly washed while still on the stem and then passed through a stemming machine. Stemming before boiling is the usual practice, but there are some varieties in which the stems do not impart too much tannic acid to the product. Practice is also variable as to whether the currants are milled at this stage in a grater or hammer mill or whether they are left whole.

The fruit is boiled in a steam-jacketed pan with the addition of some water. A fruit to water ratio of 1 : 1 has been recommended as the most economical proportion. When lower proportions of water are used a second extraction of the pomace may be necessary to secure a good recovery of pectin, colour and flavour. After boiling for 5-10 minutes the juice is extracted from the pulp in a rack and cloth hydraulic press. The pulp is inclined to be slimy in consistency and to assist pressing it is advisable to add about 3% of a coarse filter aid to the pulp, to place only a small amount of pulp in each press cloth, and to apply the hydraulic pressure slowly.

The juice is immediately clarified. A succession of operations is found to give the most efficient removal of suspended matter; for instance, the juice is screened then allowed to settle, the clear layer is centrifuged, heated again to boiling and filtered brilliantly clear in a pad filter or a filter press with the addition of a filter aid.

Red currant jelly is best made from freshly expressed juice but it is possible to can the juice for later manufacture into jelly. Better practice would be to can whole berry pulp and press as required for jelly making. Both for berries and juice well lacquered cans are necessary to avoid discoloration of the product by the action of dissolved tin on the anthocyanin pigments and to avoid corrosion spoilage. The process recommended is: fill the product at 190-195° F. into cans preferably made from tinplate having a coating weight of 1·5 lb. per base box and coated with a high quality fruit juice lacquer; close the cans and hold on their sides for five minutes before cooling. If cold storage facilities are available, the best method for storing red currant juice for later jelly manufacture is to freeze it in casks and hold at 0° F.

Preservation of Red Currants in Casks.

If the red currants are to be used for jelly they are put down in casks after the stemming operation and preserved by the use of sulphur dioxide. For each 100 lb. of fruit, $5\frac{1}{2}$ oz. of potassium metabisulphite (P.M.S.) or $6\frac{1}{2}$ lb. of 3% sulphur dioxide solution are required, i.e. sufficient to give a sulphur dioxide concentration of approximately 2,000 parts per million. Portion (about one-third) of the sulphur dioxide solution is added first to the open topped cask. Then the currants are added with thorough stirring until the cask is half full. A further portion of sulphur dioxide solution is added at this point, then filling is continued with stirring. Finally the remaining preservative solution is added. As there is a considerable chance of pockets developing, the practice is often followed with fruits of this consistency of filling the casks one-half to two-thirds full on the day of packing and covering temporarily with vapour-proof paper held tightly on top with a hoop. Next day the contents are combined to give full casks. In order to assist further the uniform distribution of the preservative throughout the contents it is good practice to roll the casks each day for several days after packing.

If, on the other hand, the red currants are to be used for jam, it is preferable to cask a hot pulp. The currants are pulped in a steam-jacketed pan with about 15% added water until all the fruits are broken and the pulp is smooth in texture. The pulp is cooled to 180° F. and filled into casks through two-inch side holes. The preservative solution is added at three stages during filling as suggested above, and in the same proportions. When full the casks are bunged immediately and rolled to ensure uniform mixing of the preservative.

RECENT PUBLICATIONS.

1. The Colorimetric Determination of Iron in Canned Foods with 1, 10-Phenanthroline. By Hugh A. McKenzie. *J. Proc. Roy. Soc. N.S.W.* 81: 147-53 (1947).

This paper describes a rapid, highly specific method for determining iron in canned foods, particularly in trace quantities. The canned food sample is subjected to wet digestion and iron is estimated colorimetrically using the reagent 1, 10-phenanthroline. The precision and reproducibility of the method in the analysis of canned foods and in the presence of various interfering elements are shown to be of the order of 3 per cent.

2. The Determination of Tin Coating Weights on Tinplate. By Hugh A. McKenzie. *J. Soc. Chem. Ind.* 66: 313-9 (1947).

Investigations of corrosion problems in canned food containers frequently require determinations of tin coating weights on tinplate. This paper examines a number of procedures for accuracy and convenience in estimations of coating weights on both hot-dipped and electrolytic tinplates. A stripping method using Clarke's reagent (hydrochloric acid inhibited with antimony trichloride) was found to be the most satisfactory procedure for both types of tinplate.