Alcoholic Beverages

The alcohol of alcoholic beverages is ethyl alcohol \( \text{C}_2\text{H}_5\text{OH} \). Whatever the beverage the real source of the alcohol is always a sugar, which in its turn may have come from a starch or dextrin, as in beers.

Ethyl alcohol is a colourless liquid, miscible in all proportions in water. Despite its having an OH group, it is quite neutral in reaction, and so does not form salts in the same way as does a hydroxide.

Ethyl alcohol has a boiling point of 78.3°C., which enables it to be easily distilled (with water). Having a specific gravity of 0.7936 its percentages in aqueous solutions are satisfactorily estimated by determinations of the specific gravities of such solutions. Thus, by distilling all the alcohol together with some of the water from a beverage, and determining the specific gravity of the distillate, the percentage of alcohol in the distillate may be obtained from tables, and thereafter the percentage in the original beverage calculated.

Tables, an example of which is given below, are to be found in various standard text books:

<table>
<thead>
<tr>
<th>S.G. at 15.5°C.</th>
<th>% Alcohol by weight</th>
<th>% Alcohol by volume</th>
<th>% Proof spirit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>.9849</td>
<td>9.43</td>
<td>11.70</td>
<td>20.50</td>
</tr>
<tr>
<td>.9669</td>
<td>23.68</td>
<td>26.96</td>
<td>50.57</td>
</tr>
<tr>
<td>.9198</td>
<td>49.24</td>
<td>57.06</td>
<td>99.90</td>
</tr>
<tr>
<td>.8479</td>
<td>88.17</td>
<td>85.63</td>
<td>150.90</td>
</tr>
<tr>
<td>.7938</td>
<td>100.00</td>
<td>100.00</td>
<td>175.25</td>
</tr>
</tbody>
</table>

'Absolute' alcohol is never quite 100%, since it has a powerful affinity for water; by careful distillation it may be obtained greater than 99% but quite short exposure to the atmosphere quickly lowers the percentage to about 95%, which is about the percentage of the 'absolute' alcohol of commerce. "Rectified Spirit" is about 90% alcohol by volume.

Methylated spirit is a mixture of about 9 parts of ethyl alcohol and 1 part of wood-spirit. Wood-spirit consists of methyl alcohol acetone, methyl acetate, etc., which make methylated spirit unsuitable and actually dangerous to imbibe. Methylated spirit, however, has solvent powers very similar to those of ethyl alcohol and is much used in various trades as a solvent.

Other methods of estimating the alcohol content of beverages are Tabarie's Method and by Refractive Index.

Legal

(i) Beers. There are no legal limits as to the amounts of ethyl alcohol in beers.

(ii) Spirits, i.e. whisky, brandy, rum, gin, etc. must contain not less than 65% of proof spirit. (Food and Drugs Adulteration Act, 1928, Section 2)

Proof spirit contains ethyl alcohol:

\[ 49.24\% \text{ by weight, } 57.06\% \text{ by volume, and has a specific gravity of 0.9196.} \]

Analyses for public health work should always be expressed as proof spirit.
65% proof spirit is the same as 35% 'Under Proof' or 35 U.P. Hence a spirit must not be adulterated with water to a degree more than 35 U.P. [Sometimes 35 U.P. is termed 35 degrees U.P.]

Example.

Find the percentage of water added to a whisky which has been found to contain only 60% of proof spirit:-

Since a 'legal' whisky must contain 65% of proof spirit, this sample contains therefore only 60 of what it should contain.

Stated as a percentage = \( \frac{60 \times 100}{65} = 92.3\% \)

Hence water added in excess of amount allowed by law is

\[ 100 - 92.3 \times \frac{65}{92.3} = 7.7\% \]

65% proof spirit = \( \frac{65}{100} \times 57.06\% = 37.09\% \) of ethyl alcohol by volume

Since 57.06% alcohol by volume = 100% proof spirit

\[ X \% = \frac{100 \times X}{57.06} \% \text{proof spirit} \]

i.e. \( X \% = \frac{1.75 \times X}{\%} \)

therefore to convert a known percentage of alcohol (by volume) to its equivalent as proof spirit, multiply by the factor 1.75.

(iii) Wines. No legal limits.

Estimation of Alcohol.

Beers. Measure 300 ccs. of beer in a distilling flask. Attach flask to a condenser, and distil over about 200 ccs. Make up the distillate to 300 ccs., and determine the specific gravity by specific gravity bottle.

If weight of dry specific gravity bottle = X

\( \text{bottle full of distilled water} = y \)

\( \text{bottle full of distillate at same temperature as the water} = z \)

then specific gravity of distillate = \( \frac{z - X}{y - X} \)

Then refer to "Alcohol" tables to obtain the percentage of alcohol which corresponds to the specific gravity.

Spirits.

100 ccs. of spirits are diluted to 300 ccs., with water. Exactly 200 ccs. are distilled over, and the specific gravity of the distillate determined as for beers. The alcohol equivalent of this specific gravity is multiplied by two to bring it to the percentage of the original spirit since the volume of the distillate is twice the volume of the spirit taken for estimation.
Wines.

Estimations made as for beers.

Constituents other than Alcohol.

Besides the estimations of alcohol, other estimations are made, for which there are no legal limits - as follows:-

Beers. (1) CO$_2$;

(2) Volatile acids, expressed as acetic acid;

(3) Fixed acids, expressed as lactic acid. The sum of (2) and (3) should not exceed more than the equivalent of 30 ccs. of N/10 NaOH for 100 ccs. of beer - using phenol phthelein;

(4) Malt extract, which can be ascertained from the specific gravity of the beer after distilling away the CO$_2$ and alcohol - by use of tables;

(5) The Hop Resin and Glycerin Contents;

(6) Ash;

(7) Determination of the nature of the 'bitter';

Spirits. (1) Volatile acids;

(2) Fixed acids;

(3) Esters;

(4) Higher Alcohols;

(5) Furfural;

(6) Aldehyde.

Wines. All those made in spirits - [acidity of fixed acids expressed as tartaric acid], with additional examination of the 'extract', i.e. the constituents of the wine other than water and the constituents determined as previously indicated. This includes examination of colouring matter for added sugars, CaSO$_4$, etc.

Alcoholic Beverages may be divided into 4 classes:-

(1) Fermented Fruit Juices, e.g. wines, cider - alcohol 8-25% 

(2) Malt Liquors, e.g. beers, stout - alcohol 3-7% by volume 

(3) Distilled Liquors (spirits), e.g. whisky, brandy, gin, rum - alcohol 30-40% by volume. 

(4) Liqueurs - alcohol 35-55% by volume.

Wine is the fermented juice of the grape, with such additions as are essential to improve the keeping quality. As a wine ages the cane sugar content, alcohol and acidity percentages diminish, the acids combining with the alcohols to form esters. Volatile esters give the odour, and fixed esters the taste to wine. However the total ester content is small.

Acidity [expressed as tartaric acid] should not exceed 1.2%. The colour of red wine turns green at neutrality. Red wines are less acid than white wines.

A sweet wine often has spirit added to prevent fermentation, i.e. it is 'fortified' as in port and sherry.
The only preservative permitted in wine or beer is sulphur dioxide. Preservatives to be looked for are boris acid, formalin, and more commonly salicylic acid.

**Boors, stouts, etc.**

Boor is a fermented saccharine infusion to which has been added a wholesome bitter (e.g. hops, quassia, gentian, etc.). The composition of beers varies somewhat with its method of manufacture and with its age and preservation. In the production of beers, the starch, in grains, such as barley, is first converted into the sugar maltose by the action of the enzyme diastase, produced when the barley is allowed to germinate (production of malt). The maltose is then extracted by water and the solution boiled with hops. After cooling, the maltose is converted first to glucose and then to alcohol and CO\(_2\) by the action of the enzymes, maltase and zymase, in the yeast which is added.

Pale Ale should be made from the finest and highest dried malt and the choicest hops, the bitter being in excess.

Mild Ale is a sweet, rather strong beer.

Porter, as drunk in London, is a rather weak malt-liquor, coloured and flavoured with roasted malt.

Stout is a richer and stronger description of porter.

The German Beers are generally fermented by bottom yeast and are always as the result of after fermentation, well charged with CO\(_2\). The lager, summer, and bock, or export, beers are separated from the winter beers only by the former being brewed from a richer wort, and containing more alcohol, and a greater % of malt extract.

Bavarian Beers derive their peculiar properties somewhat from fermentation at a low temperature. They seldom contain > 2% alcohol, are only slightly bittered, have a fine aroma and a peculiar flavour, said to be due to the solution of a minute fraction of the resinous matters used to caulk the casks.

Lambick and Faro Beers are made with unmalted wheat and barley malt. In fermentation the wort is self-imregnated, the process sometimes taking months and being mostly of a bottom character. The beer contains a large quantity of lactic acid and is very harsh in consequence.

Arsenic may occasionally be found in beer. (Introduced by the H\(_2\)SO\(_4\) used in production of sugar from starch, and by way of malt when latter exposed to products of combustion, etc.)

### Spirits

Brandy (German Brantwein = almost any distillate derived from a liquid which has been fermented, e.g. potato, rice, etc.).

Brandy = a spirit derived from the distillation of wine made from the grape.

Cognac = a brandy from a special variety of grape from Charente.

Artificial brandies obtained by addition of various essences to proof or grain spirit.

Chemical analysis inferior as test of quality to that of expert taster. A good many artificial brandies can be detected. A genuine brandy should have 38 parts of ester per 100,000 of alcohol, and should approximate to the analysis. Percentage alcohol 35.3, acetic acid 2.7, aldehyde 7.9, furfural trace, esters 38, higher alcohols 164.8, V. variable.
Rum. Best rum is distilled from fermented molasses, inferior kinds from the debris of cane sugar. Sometimes from molasses of beetroot factories. Imported rum is 44-55% absolute alcohol and so is diluted to nearer legal strength. Esters vary from 106-359 parts per 100,000.

Whisky is one of the corn spirits and is usually manufactured from malted grain. The Scotch distillers generally make it entirely from malt mash, the Irish use malt and raw grain - but variable.

Gin is a spirit flavoured with various substances, e.g. Angelica root, liquorice powder, etc. A good gin should contain at least 70% of proof spirit and a variable amount of sugar and flavouring matters, seldom much over 5%.

Arrack- Best qualities by distillation from fermented juice of coconut tree, palm tree and other palms. Coarser variety from fermented rice liquor. Consumed in large quantities by Hindoos and Malays.

Liqueurs or Cordials.

These terms applied to a number of liqueurs which consist essentially of very strong spirit, flavoured with essences and often very brightly coloured by vegetable colouring agents, such as turmeric, cochineal, etc., e.g. Benedictine, Absinthe.

Absinthe is a yellowish-green liqueur which contains wormwood oil, a poisonous oil having a deleterious action on the nervous system. (0.33% Alcohol 50%). When taken habitually and for a length of time absinthe produces a peculiar train of nervous symptoms, which are distinguishable, by some, from those of chronic alcoholism.

Alcohol as a Food.

Alcoholic beverages are taken with a two-fold object, the desire for a certain flavour and the desire for stimulation. The question of its value as a food is little considered in spite of the fact that this is considerable. It cannot be utilised for synthetic processes such as the repair of the tissues, e.g. proteins, nor can it be stored in the body and called upon when required to supply energy, c.f. CHО & and fats, but it is a fuel that offers an immediate supply of energy, whereby other foods such as CHО can be saved. Its absorption is rapid and it passes into the blood unchanged. (2 parts in 1000 in blood of a drunken man). The blood concentration reaches a maximum in 1-2 hours and it may remain high for 5 hours. Those accustomed to alcohol usually oxidise it completely in 7½ hours, but abstainers generally require twice this time. Absorption is delayed either by dilution or by admixture with food. Milk delays its absorption to a greater extent than meat. A small amount, about 1/50, is usually excreted in the breath and urine but experiments show that 98% is burnt within the body. The following figures give some idea of the value of alcohol as a supplier of energy to the system, the basis of comparison being the caloric value per litre of inspired oxygen.

Sucrose 5.08, EtOH 4.85, Animal fat 4.72, Butter fat 4.62, Protein 4.6.

It has been shown that 1/5 of the total energy requirements of the body can be supplied by alcohol (? Benedict).

Alcohol can replace CHО* fat, or protein, in part, as far as these substances are used for energy production.

* carbohydrate
** ethyl alcohol
Therapeutic Uses.

(1) Narcotic - allays excitement and distress.

(2) Food value, especially when other food cannot be taken.

(3) It promotes returning blood to the body surface and so, in conjunction with blankets and hot water bottles, it is of use in chills.

It is valueless as a stomachic if the gastric juice is normal but it is probably beneficial in instances of super-secretion, hypochlorhydria and loss of appetite.

It is not a direct cause of obesity but the presence of other substances, such as dextrins in German beers, may bring about fattening.

Life Insurance.

The expectation of life in confirmed alcohol drinkers is about $3\frac{1}{2}$ years less than in abstainers. No evidence is possible for moderate consumers.

Taken in moderation alcoholic beverages contribute greatly to human happiness and constitute one of the solaces of a large part of mankind.
wt of 89 B = 26.68 gm
wt of H₂O = 76.56 gm

wt of H₂O (50cc) = \frac{76.56}{26.68} = 49.88 gm

wt of 89 B + alcohol = 75.2574 gm
wt of alcohol = \frac{26.68}{48.574} gm

sp gravity of alcohol = \frac{48.574}{49.880} = 0.949

Look up tables: he and % alcohol
1.949 = 32.57 41.37 72.50

Signed
FOOD PRESERVATION

The object of food preservation is to retain as far as possible the natural appearance and characteristics of the foodstuffs, and in particular to guard against the consumption of food which is unsound, unwholesome or unfit for man.

Foodstuffs are usually derived from living material and therefore generally exhibit much of the complexity of structure of such material. Life is dynamic and the chemical structure of living material is always changing although these changes are so skillfully controlled that the resulting equilibrium seems to suggest a fixed composition. At death the enzymes responsible for the changes of life do not necessarily lose their activity but the co-ordination and regulation of these enzyme reactions is lost and signs of departure from the normal begin to appear. Thus proteolytic enzymes bring about the breakdown of proteins and lead to the autolysis of cells, other enzymes break down carbohydrates whilst others may facilitate the oxidation of fats.

Most fresh foodstuffs contain proteins, fats, carbohydrates, various organic acids usually in low concentration, inorganic salts, vitamins and water. Those recently derived from living material such as meat, fruit, milk etc. will also contain active enzymes. Many plant foodstuffs remain alive for some time after gathering; fruits are alive when gathered and continue to develop physiologically, e.g. to ripen during storage.

Spoilage of food may result from chemical changes such as oxidation, from endogenous enzymic change, from attack by micro-organisms such as yeasts, moulds and bacteria, of from physical changes induced by bad conditions of storage. The latter is the least important, is usually harmless but affects the appearance of the food so that its value is lowered, and can be readily overcome by greater attention to the handling of the food and the control of the storage conditions.

Various methods of preservation have been evolved in order to reduce the amount of change induced in foodstuffs. These changes may be referred chiefly to the breakdown of fats, carbohydrates and proteins.

(1) Fats are split up by enzymes, sometimes inherent in the food product, sometimes introduced by micro-organisms liberating fatty acids. The limiting factor in the storage time of meat kept at low temperature is frequently the development of rancidity. This is due to the production of acidity together with oxidation of unsaturated glycerides and fatty acids; the oxidation is facilitated by the presence of catalysts, such as traces of metals, and by exposure to sunlight.

Bacteria and moulds may also attack fats liberating disabreable products.

(2) Carbohydrates are attacked by enzymes forming simpler carbohydrates and various organic acids. Oxidation often takes place liberating CO₂.

  e.g.  (i) Starch → glucose - as fruit ripens.
  (ii) Glycogen → lactic acid - during the post-mortem changes of meat.
  (iii) Glucose → CO₂ + H₂O - as fruits respire.
(3) Proteins. Tissue proteins may be broken down by autolysis or by micro-organisms with production of soluble substances, such as peptones, peptides and even amino acids. Autolytic changes are sometimes an advantage in a food but they render the latter more liable to attack by micro-organisms, which may readily produce an undesirable slime over the surface of the food.

Viscera autolyse more rapidly and to a greater extent than muscles (meat). Autolysis changes the flavour and consistency of animal tissues. In game, the products of autolysis are considered to improve the taste, and therefore game is usually kept for a considerable time with the viscera still in the body. With ordinary butcher meat the strong flavours resulting from autolysis are not regarded as being desirable, and so the viscera are removed before the meat is hung. This hanging, which is accompanied by a moderate degree of autolysis of the muscles, leads to the meat becoming tender.

Bacterial Products of Proteins.

Autolyzed tissues form a much better medium for the growth of micro-organisms than fresh tissues. It has been shown that bacteria cannot attack proteins unless peptones be present.

The tryptases of micro-organisms hydrolyse cell protein; but other enzymes present in them may lead to a further decomposition, producing in some cases toxic end products. These substances are produced from amino acids by three chemical processes:-

(1) By Decarboxylation (i.e., loss of CO₂) - yielding organic amines usually of strong and offensive odour, and sometimes marked physiological action, but they are not usually toxic. The popular idea of "ptomaine" poisoning is incorrect.

\[ \text{CH}_3\text{NH}_3 \] - methylamine (from glycine) occurs in quantities in putrid fish.

Putrescine and Cadaverine \( \text{NH}_2\left(\text{CH}_2\right)_4\text{NH}_2 \), are largely responsible for the unpleasant smell of decaying cadavers. Tyramine is formed from tyrosine. Histamine (from histidine) is the active principle of ergot, and has also been isolated from human faeces. Histamine causes a fall in blood pressure. Such substances developing in food by the action of contaminating microorganisms, obviously may be a source of considerable danger.

(2) Deamination (i.e., loss of NH₃) - yielding organic acids. Generally these acids are harmless but often have unpleasant odours. A very common offender is butyric acid.

(3) By Decarboxylation and Deamination - yielding hydrocarbons - again usually harmless, but unpleasant. Tryptophane broken down in this way by certain organisms leads to production of indole and skatole.

Examples of other end-products of the growth of organisms in autolyzing tissues:-

\[ \text{Cl. sporogenes} \] causes much gas which is the cause of many "blown" cases of canned meat.

\[ \text{Cl. botulinum} \] also found in canned food. There is no visible decomposition of the food, but a highly dangerous exotoxin is produced from the organism.

Many anaerobes liberate evil-smelling sulphydryl compounds from proteins containing sulphur.
Methods of Preservation of Foodstuffs.

Since the chief factors leading to spoilage of foods are changes due to enzymes (tissue or microbial), or chemical change, mainly due to oxidation, methods that will inhibit or arrest these changes without unduly altering the character of the food are likely to be satisfactory. These methods fall into two main classes:

(1) Those that effectively slow down the rate of change, e.g.:
   (a) By storing at low temperature.
   (b) By altering the atmospheric conditions of storage, e.g., by adding gases that inhibit microbial growth.
   (c) Inhibition by increasing artificially the free acidity and H+ ion concentration, as in pickling.
   (d) Inhibition by reducing the water content of the tissues, e.g., by drying or by salting.

(2) Those that arrest changes by destroying both tissue and microbial enzymes.
   (a) By heat, as in canning, boiling, blanching, etc.
   (b) By smoking.
   (c) By the addition of chemical preservatives.

General considerations.- It is important that foods be handled hygienically at all stages, both before and during the period of preservation, if the product is to be kept in the best condition. The method of preservation will be far more effective if a foodstuff is as free from micro-organisms as possible, at the outset, and this necessitates clean methods of handling and the use of only those foodstuffs that are initially in sound condition.

Preservation by Cold.

This is the most satisfactory method of food preservation as it usually results in the least interference with the appearance and composition of the foodstuff. The temperature of storage is below normal temperature and is usually as low as possible for the particular food concerned. Actual freezing of the food is usually to be avoided as this tends to cause some damage. In storage at low temperature, besides controlling the temperature, it is essential to control humidity and air circulation in the store. Preservation by cold can be divided into three classes according to temperature, which may be illustrated by the practice with beef.

(1) Storage at 37-78°F. Beef is ripened or conditioned at this temperature. The temperature is not sufficiently low to arrest enzymic change but it is low enough to slow down considerably the rate of growth of micro-organisms. Storage for 12 days at this temperature results in a tender meat, but preservation for a much longer period is impossible.

(2) Chilling.- Chilled beef is stored at about the freezing point, e.g., 28°-29.5°F. Chilled beef will keep for 40 days. The meat is not frozen at this temperature but both enzyme change and growth of micro-organisms are slowed down very considerably.

(3) Frozen beef is stored at 10-15°F. At this temperature the beef itself is frozen and all change is arrested during storage, which may last for years. On thawing, owing to a certain amount of damage done by the freezing, the meat juices tend to escape.
A lower temperature does not always lengthen the period of successful storage. Fish, poultry, eggs and meat products can be stored satisfactorily immersed in syrup (e.g. soft fruits such as strawberries, raspberries, etc.) Different fruits have different optimum temperatures for storage, e.g. apples 32°-40°F, according to the variety, oranges 38°-42°F., bananas 53°-55°F., pineapples 45°-50°F., plums 34°-38°F., and pears 32°-34 F. Storage below these temperatures causes various forms of low temperature troubles, e.g. bananas turn khaki coloured, brown or black, apples and pears may have internal breakdown or develop superficial troubles such as scald, etc. Fruit continues to ripen, but more slowly, at these low temperatures.

**Gas Storage or Preservation by Air Conditioning.**

In this method the atmosphere surrounding the food is altered so as to slow down changes which would otherwise occur. e.g. the food is stored anaerobically, or the humidity, the carbon dioxide or the oxygen content of the atmosphere is altered to the disadvantage of changes that would otherwise occur.

This method is usually combined with storage at low temperature.

The adjustment of the oxygen and carbon dioxide content of store atmospheres improves the keeping qualities of many fruits, e.g. with apples:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Temp.</th>
<th>Storage life in air</th>
<th>Storage life in gas</th>
<th>Composition of gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CO₂</td>
</tr>
<tr>
<td>Bramley's Seedling</td>
<td>40°F.</td>
<td>23 days</td>
<td>40 days</td>
<td>8</td>
</tr>
<tr>
<td>Cox's Orange Pippin</td>
<td>40°F.</td>
<td>16 &quot;</td>
<td>25 &quot;</td>
<td>5</td>
</tr>
</tbody>
</table>

Too much CO₂ may cause damage, e.g. Brown Heart.

1.(c). **Chemistry of Pickling.**

The optimum reaction for autolytic enzymes is pH 4.5-5.0. The limiting reaction for the growth of nearly all bacteria is pH 5.0-5.5. Therefore by raising the acidity, and increasing the H ion concentration it is possible to inhibit autolysis and growth of organisms. This is the principle of pickling.

The reaction of the pickling liquid may be as high as pH 2.8. Acetic acid is always used (15% concentration) - usually in the form of distilled vinegar. Salt is always added since tissues swell in acid solution.

Pickling can be used to preserve meat, fish and vegetables, though meat and vegetables are not usually pickled nowadays.

1. (d). **Method of Dehydration, i.e. by Reducing Water Content.**

Dehydration by direct evaporation under influence of direct sunlight and warmth is only possible in a hot, dry climate, and is now only adopted in tropical countries of low culture.

Under civilized conditions direct evaporation is used to produce certain dried foodstuffs, such as dried milk, dried eggs, etc. This adds to convenience and cheapness in transport, but the dietetic value of such foods is inferior to that of the original foodstuffs.
The drying of vegetables leads to reduction of vitamin content.

By Salting.

Either dry-salting or brining (i.e. steeping in saturated crude NaCl solution) may be used. In either case, water from the tissues dialyses outwards, and some NaCl diffuses inwards.

These two physical processes lead to a reduction of water content of the cells, and in the resulting condition the cell enzymes are greatly reduced in activity. A 4% concentration of NaCl in the tissues noticeably retards autolysis and bacterial growth. A 20% concentration inhibits both to such an extent that the food can be preserved for long periods at ordinary temperatures.

Solutions for curing contain about 33% NaCl, 2.5% KNO₃ and 5% sugar. Most forms of meat are cured, and periods of exposure vary from two days to two weeks.

Some articles, such as bacon and ham are subjected to a process of smoking, after salting.

2. (a). Heating - as in Canning.

The two most important features in canning are (1) heating the contents of the can to destroy bacteria, (2) subsequent exclusion of air, i.e. oxygen must not be admitted after the process is completed.

Meat is pickled with a mixture of common salt, KNO₃ and sugar; cut up and trimmed and then partially cooked. It is then mechanically filled into the cans and pressed. Cans of the 'Hole and Cap' pattern are usually used for corned beef and canned salmon. The caps are soldered into position and the central hole of the cap is left open. The caps are then put into an exhausting machine by which, firstly a vacuum of 20-25 inches is attained within the can, and then follows mechanical closing of the hole in the cap by solder, the inside of the can remaining at the pressure stated. The cans are removed, and the tops and bottoms of the cans should present a concave appearance. The cans are then heated in retorts at 100°C. or higher. The temperatures and times of heating vary with the foodstuff. In some cases more than one heating is required. Heating causes the cans to bulge, but subsequent cooling under cold water restores the original degree of vacuum and the sides collapse. On inspection any cans which have not collapsed sides are rejected, a leakage of air inwards having obviously occurred.

Most marine products other than salmon, and also fruits are contained in cases of the 'Sanitary' type. Here the top is open, and the can filled and the lid mechanically placed on the can. The filled can is put into the exhaust, and there, by means of a mechanical device, the lid is pressed on and 'crimped'. After that the can goes to the retort. The heating process causes a special solution in the seam to flow to all parts of the join, and by cooling the vessel becomes hermetically sealed.

Lacquering of cans improves the appearance and diminishes the action of acid foods in the container.

The methods of examination adopted are those of external examination, pulpation, percussion and shaking; palpation reveals loss of vacuum, percussion in some foods, but not all, is a useful means of testing for soundness; shaking, which ordinarily produces no sound from a tin of canned meat, will give a splashing sound when the meat is in an advanced state of decomposition. Shaking is relied upon mostly in the case of canned marine products.
Inspection is not easy. On arrival in the United Kingdom 10% of a bulk of cans are examined by incubating at 37-40°C. for 14 days; and any 'blowers' noted. Further samples are incubated at 37°C. for another 8 days when spores will have germinated.

No class of canned food is always sterile but the percentage of non-sterile but sound food is usually high. Sporulating organisms - particularly Cl. botulinum, are the source of a real, if small, risk of poisoning.

Canning process is usually but not always destruction of vitamin C. Vitamins A and B are less affected.

Glass containers are becoming more popular but sometimes glass particles are found with foodstuffs. They also are bulky and heavy.

The tin lined iron can is liable to corrosion, and much research is being carried out to eliminate this cause of economic loss and danger to health. Fortunately the signs of corrosion are similar to those of unsound contents.

2. (b) Blanching.

Green peas are preserved by bringing them rapidly to boiling point and keeping them there for a few minutes. The "blanching" destroys enzymes and allows them to be stored subsequently at low temperature.

2. (c) Smoking.

When fish or meat are 'cured' by smoking, partial dehydration occurs, but in addition the surface of the tissue becomes impregnated with phenolic substances present in the smoke. These inhibit growth of microorganisms.

Smoked foods have only a limited resistance to contaminating bacteria or moulds. With bacon, Scotch kippers and Finnan haddocks smoking is a part of the method of 'curing'. Vegetables are never smoked.

Preservation of Foodstuffs by the addition of Preservatives.

The following propositions may be said to govern this practice.

(1) That it is undesirable to add to articles of food any material not of the nature, substance and quality of the food.

(2) That if for commercial or other reasons the addition is necessary it should be limited to the minimum required to effect its purpose.

(3) That if it can be shown that some of these materials are less undesirable than others, preference should be given to the use of the less undesirable materials.

Many preservatives used to be employed in foods in this country before 1925, but since then, and following upon the recommendations of "The Report of the Departmental Committee on the Use of Preservatives and Colouring Matters in Food" (1924) it has been enacted that no preservative can be added to food except in certain specific instances, e.g. sausages, beers, wines, mineral waters, cordials, coffee extracts, and dried fruit, when either benzoic acid or SO₂ is allowed in certain specified amounts. The details can be obtained from the Acts in question or in Jameson and Parkinson, 4th edition, p. 335.
The term "preservative" in these Acts does not include salt, saltpetre, sugar, vinegar, acetic acid, alcohol, spices, or the minute quantities of preservative agents introduced by the process of curing known as "smoking".

References to Literature.


Meat Preservation - Wooldridge, Veterinary Record, Nov. 4th, 1933, pages 1112-1126.


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