THE USE AND ABUSE OF FOOD PRESERVATIVES.

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SOME COMMON METHODS OF PRESERVING FOOD.

In hot, arid regions the question of the preservation of food is of little interest. An animal may be slain and its carcass hung in the air to dry. Other foods keep correspondingly well. Putrefaction and decay are almost unknown. On the other hand, wherever climatic conditions favor decay this question becomes important, especially for those who live at a distance from markets and who kill and preserve their own meat, and for those who, either on land or sea, are for a number of days remote from a source of supply.

The methods most commonly employed for preserving food, by drying and smoking and with salt, vinegar, alcohol, and sugar, have long been known. Some of them are probably as old as civilization itself, and indeed are not unknown to many tribes of savages. We are told by Herodotus that the ancient Egyptians were conversant with the art of preserving meat with salt, and six centuries before the Christian era Cyrus sustained his troops on long expeditions with salted meat. The aborigines of North and South America were accustomed to cure their meat by smoking or "jerking" (tearing from the bone in long strips and drying in the sun), according to the requirements of the climate. The preservation of meat by salting, drying, and smoking is practiced in Oriental countries by a number of the Mongolian tribes, including the Tartars and the Chinese. It is a matter of common information that these methods are still employed largely in civilized countries and not alone by those in rural districts who preserve their own meat. Our large packing houses smoke immense quantities of meat with hickory wood. One establishment in Chicago has 43 smokehouses, each of which holds 60,000 pounds of ham or shoulder or 120,000 pounds of side meat, besides 11 houses of half that capacity. Meat so preserved is recognized as wholesome. It is not always suitable for the sick room, but its taste is a sure indication of its character and the method of its preparation. This makes it impossible to mistake these products for fresh meat, and thus removes the great temptation to fraudulent practice that attends the use of tasteless preservatives. The preservation of meat by freezing
has always been practiced, and in localities where the temperature favors this method nothing else is to be desired. Until recently, however, this method has necessarily been of limited application.

**INTRODUCTION OF CHEMICAL FOOD PRESERVATIVES AND THEIR EFFECT.**

Within a quarter of a century numerous new methods for the preservation of food have been introduced, and the use of some already known has been developed. Some of these methods have been wonderfully beneficial, others are of questionable nature and value, and still others are open to the most weighty objections. The refrigerator has become a household article, the ice machine has been invented and perfected, and cold storage established in packing house, market, car, and boat; the antiseptic and toxic properties of chemicals have been studied, and the preparation and sale of chemical preservatives have become a distinct industry.

It is now a common thing for wholesale druggists, grocers, dealers in dairy supplies, and especially dealers in butchers' supplies, to advertise as a recent discovery some article of "wonderful preservative properties—but entirely wholesome."

On account of the perishable nature of many foods, it is obvious that a substance having the properties claimed for the various commercial food preservatives would be of incalculable value. At the same time it is of the utmost importance that nothing should be added to foods which is toxic in itself, or which interferes even to the slightest extent with the process of digestion. This last point is especially important in its relation to invalids and children. Food treated with antiseptic drugs may perhaps be eaten with impunity by adults who are in good health, and yet turn the scale against an infant or invalid whose life is in the balance; and, indeed, we can not say that the continued use of small amounts even of those antiseptic chemicals which seem to interfere least with the normal functions of the body will not exert a deleterious influence in time.

Again, we must remember that the absence of preservatives is often an indication of wholesome food, at least as far as cleanly methods and appliances, complete sterilization, and careful, efficient management can make it wholesome. On the other hand, the presence of chemical preservatives may often be taken as an indication that food products have been prepared by shiftless, slovenly, uncleanly, and generally inefficient methods.

Food preservatives are not used for the purpose of killing the germs that cause the decay of food. That would require an antiseptic of such a nature and in such quantity as to be distinctly dangerous to health and life. It would require such drastic measures as are employed by surgeons in disinfecting their instruments. The agents
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recommended by dealers for cleansing dairy utensils, when used in the quantities directed, only paralyze the germs and delay their action for a time. They can in no sense fill the office of plenty of sunshine and steam or boiling water. The use of antiseptics can no more take the place of careful, cleanly work in the preparation of foods and the cleansing of food receptacles than cheap perfumery can replace soap as a toilet article.

No tasteless food preservative has been suggested which is entirely nontoxic, and which does not have a marked influence on digestion, even when taken in relatively small doses. Some there may be whose antiseptic action is so slight that food treated with the minimum amount necessary for its preservation is not unwholesome for adults in normal health. But in any case food so treated should be plainly labeled with the name and amount of the added preservative.

PRACTICES OF MANUFACTURERS AND DEALERS.

In using preservatives of unknown composition, reliable and well-meaning food manufacturers may unknowingly commit two wrongs: (1) They may add to their products a compound of markedly toxic properties; (2) they may violate the law. Dependence can not be placed on the claims of dealers. Representations of wholesomeness are worthless, because they accompany every food preservative. The statement that a given preservative may be used according to directions without violating the provisions of any pure-food law is always false. All claims of new discoveries and exceptional preserving power are without foundation. In this category should be placed those preservatives which by name, trade-mark, and advertising matter are represented as having the same effect on food as ice, differing only in the temperature produced.

A favorite practice is to list several compounds of widely different nature under the same or very similar names, and, while suggesting them for different classes of foods, to speak of them as identical in physiological action. The various preservatives handled by one leading firm contain, either alone or mixed with salt or salt and saltpeter in the solid state or dissolved in water, one or more of the following: Borax, boric acid, salicylic acid, salicylate of soda, benzoic acid, benzoate of soda, ammonium fluorid, formaldehyde, and sulphites. Yet, this firm advertises in such a way as to give the impression that its preparation is a definite substance with constant properties. A uniform pasteboard box is used as a container for such varieties of the preservative as may be kept in paper. This box bears a label which reads as follows:

Will keep Milk, Cream, Buttermilk, Butter, Cheese, Eggs, Meats of all kinds, Game, Poultry, Fish, Oysters, Clams, Lobster, Crabs, etc., Fruit, Vegetables, Mince

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Meat, Jams, Preserves, Jellies, in prime condition, perfectly sweet and fresh for any length of time without the use of ice. * * * A superior antiseptic that prevents the spoiling of foods and retains them in their natural fresh state until consumed. Its ingredients are all as healthful as Salt. * * * Is in no sense an adulterant, and can not be used as such. It is a thoroughly harmless yet absolutely effective antiseptic for the preservation of all perishable food substances.

Notwithstanding the fact that the different kinds of preservatives consist of chemicals (often mixtures of two or more) of the most diverse toxic properties, and although these chemicals are all well known to the scientific world and many of them are familiar to the general public, yet the firm claims that its preservative is a single compound, a "perfect chemical combination" of unusual properties, and not susceptible of imitation. The following, quoted from the advertising matter, may illustrate the absurdity of the claims:

* * * The invention of an eminent German chemist and the result of many years study and research. It is a perfect chemical combination, and through this it produces its wonderful success. The invention was considered of such great importance by the government that, besides awarding the inventor more than thirty medals and prizes, the Emperor of Germany conferred upon him a special Gold Medal of Distinction. The German Government went further; for it not only adopted * * * for use in its army and navy, but it granted the Imperial Patent to the discoverer of * * *; it endorsed its general use in the following strong language:

"We do not only highly recommend to Dairymen, Farmers, Fish, Pork, and Meat Packers, as also many other technical industries, the adoption of * * *, but to our Army and Navy, as in time of war it will be of incalculable benefit in provisioning our ships and forts with fresh meats and other food substances."

Several dealers find it advantageous to sell one mixture or compound under several names. Six samples of a preservative, designated by numbers 1 to 6, inclusive, were purchased. These samples were put up in cans bearing a uniform label, on which the number was inserted with a pen. The six samples are sold at different prices and recommended for the preservation of different foods, but their composition is identical.

NEED OF RESTRICTIVE LEGISLATION.

The States that use large amounts of commercial fertilizers have found it necessary to enact laws requiring that fertilizers be sold only in bags on which the composition of the contents is marked. Such legislation has been found equally advantageous to consumers and to reliable manufacturers, and has changed a business in which honesty once seemed impossible into one in which misrepresentation and deceit are relatively rare: Such laws work no hardship to anyone. They encourage trade and restrict fraud. They receive practically the unanimous support of all reputable citizens who have opportunity to observe their working.

It would seem that similar legislation regarding food preservatives would not be untimely. This would not sanction the miscellaneous
use of preservatives, but would restrict abuses. The air of mystery with which many dealers attempt to surround their wares would thus be dispelled, and preservatives could not be sold, as they sometimes are now, for from twice to thirty times their value.

COMPOSITION OF COMMERCIAL FOOD PRESERVATIVES.

With a view to determining the nature of substances most commonly used for the preservation of food, the writer has recently collected and examined as many as practicable of the more common commercial food preservatives. The collection of samples of this nature is attended with many difficulties, for dealers who advertise their wares as "free from salicylic acid, boric acid, sulphites, formaldehyde, and other poisonous ingredients," and "manufactured in accordance with all pure-food laws," are often anxious to keep their products out of the reach of the chemist. The composition of these samples, and also of various commercial preservatives examined in other laboratories, is given in the Appendix to this Yearbook. Of the 67 samples examined, 33 contained borax or boric acid; 10 sodium, potassium, or calcium sulphite; 8, salicylic acid or its sodium compound; 7, benzoic acid or its sodium compound; 1, boric acid and salicylic acid; 1 boric acid and ammonium fluoride; 3, formaldehyde; 1, ammonium fluoride; 2, pyroligneous acid; and 1, beta-naphthol. These substances may be divided into two classes, those which are undoubtedly injurious, such as formaldehyde, salicylic acid, and sulphites, and those whose toxic action is disputed, like borax and benzoic acid. The addition to foods of substances belonging to the first class should be proscribed. The others should be used only with food which is so marked as to inform the purchaser of their presence.

The efficiency of commercial food preservatives being due to the presence of one or more of a few very familiar chemicals or drugs, these latter will now be briefly considered.

BORAX AND BORIC ACID.

The antiseptic property of boric acid was noted in 1856 by Jacquez, who preserved the carcasses of rabbits by immersing them in a 5 per cent aqueous solution and by injection with a 5 per cent solution. Its use as a food preservative did not become general till about 1880, since which time it has steadily increased. Both boric acid and borax are now extensively employed for the preservation of meat, fish, and dairy products.

According to the directions of dealers in food preservatives, meat that is ready for smoking may be dipped for a few minutes in a solution of 1 pound of boric acid to about 4 gallons of water; chopped meat and sausage are to receive an addition of from 1 to 4 ounces of boric acid to each 100 pounds of meat; brines used in curing meat may
be treated with about 1 pound of boric acid to each 30 gallons of water, while to each 15 gallons of milk and each 30 pounds of butter may be added about an ounce of boric acid. A portion of the boric acid is often replaced with about one and one-half times its weight of borax, and occasionally the latter is used alone.

While boric acid and borax are not as objectionable as some other preservatives, yet they are toxic compounds, and there are still doubts as to whether their use should be permitted. In any case only the minimum quantity should be used, and the sale of foods containing them should not be permitted unless so labeled as to indicate their presence and the amount employed.

The medicinal dose of borax and boric acid is from 30 to 40 grains of the former and from 5 to 15 grains of the latter for an adult. A pound of meat treated according to directions with a boric-acid preservative will contain from 5 to 19 grains, while an infant who is fed each day a quart of milk so treated will receive 8 grains, or a fair-sized dose for an adult.

Borax is used in the ordinary crystallized form with 10 molecules of water, in the rhombohedral form with 5 molecules of water, and as "burned borax." Both the hydrated and the anhydrous boric acids are employed.

SULPHITES.

In the preparation of casks for storing wine it has long been customary to treat them with a small amount of burning sulphur. The sulphurous acid so formed assists in sterilizing the casks and preventing the after fermentation of the wine. Attempts have repeatedly been made to replace sulphurous acid in controlling fermentation with other preservatives, such as salicylic and boric acids, abrastol, and formaldehyde, but all have resulted unsuccessfully. In all wine-producing countries except America the amount of sulphurous acid so employed is limited by law to one or two parts in 10,000 parts of wine (0.1 or 0.2 gram per liter, or from 1.5 to 3 grains per quart). In this connection it must be remembered that the sulphurous acid content of the wine is largely combined as aldehyde sulphurous acid. Free and sulphite sulphurous acid are only permitted in European wines in one-tenth the amount given above. The compound is recognized as distinctly toxic, and a larger proportion than that mentioned is universally recognized as injurious. The sale of beer containing sulphurous acid or sulphite (a sulphurous acid compound of a metal such as sodium or calcium) is specifically prohibited in almost all civilized countries.

By following the directions of dealers in food preservatives, we would add from 1 to 4 ounces of sodium sulphite, or its equivalent, to 100 pounds of meat, or the same amount to from 35 to 50 gallons of cider, beer, or other liquid.

The maximum amount given is certainly unreasonably large, and
considering the fact that sulphites are no more efficacious than less deleterious preservatives, it would seem entirely proper that their addition to foods should be prohibited.

The medicinal dose of crystallized sodium sulphite is from 10 to 60 grains, and that of sodium bisulphite half as much. This is equivalent to from 2½ to 15 grains of combined sulphurous acid. A pound of meat, treated according to the directions mentioned above, will contain from 2½ to 10 grains of sulphurous acid, while a quart of cider, beer, etc., similarly treated will contain from 1 to 7 grains.

The preservatives of this class are not as numerous as those containing boric acid. They are much too common, however, and are often advertised as possessing such unheard-of properties that their promoters are relieved of all suspicion of ingenuousness.

SALICYLIC ACID.

In 1874 H. Kolbe was led, by the readiness with which salicylic acid is converted into carbolic acid, to investigate the antiseptic properties of the former. He found that it prevented the fermentation of amygdalin and sugar and the putrefaction of meat and eggs. He also suggested that South American meat be packed in tight receptacles, covered with salicylic acid, and shipped to Europe.

The perfection of Kolbe's method of manufacturing salicylic acid in 1874 greatly cheapened the product and led to vigorous efforts to extend its use. During the first three or four years immediately following the discovery of its antiseptic properties, and before its physiological action was at all understood, a number of prominent chemists warmly advocated it as a food preservative. It gained in favor at first, and its use increased rapidly until 1880. In that year it was claimed by the industries interested that 110,000 pounds were used in France for the preservation of foods.

Since 1880 the mass of the evidence resulting from physiological studies with salicylic acid tends to condemn the addition of this substance to foods under all circumstances. It is possible that the majority of persons in sound health may suffer no evident injury from small amounts of salicylic acid, but its use by aged and infirm persons is attended with great danger. Many European countries prohibit the addition of salicylic acid to foods. In this country it is rapidly losing favor, and is used much less, relatively to other food preservatives, than it was five years ago. At the present time salicylic acid is chiefly used to preserve fruit and vegetable products. In following the directions of dealers in food preservatives, an ounce of salicylic acid or sodium salicylate is added to from 400 to 600 pounds (50 to 75 gallons) of liquids, and from two to three times that amount to pasty or semisolid substances. Salicylic acid has no advantage over other preservatives which are less deleterious, to say the least, and its addition to
foods would seem to be unwarranted. The medicinal dose of both salicylic acid and sodium salicylate is from 10 to 30 grains for an adult.

Owing to the early exploitation of salicylic acid as a food preservative, and the well-known indifference which characterizes both legislative bodies and the general public regarding the wholesomeness of foods, the use of salicylic acid became so common at one time that many board of health chemists still test for no other preservative. The increased attention that this matter has recently received has resulted in a decreased use of salicylic acid, relatively speaking, and some dealers in food preservatives make a practice of changing the name of a product as soon as its composition becomes generally known.

**BENZOIC ACID.**

The antiseptic properties of benzoic acid were investigated by Salkowski in 1875, and this substance was early suggested as a food preservative. Its use for this purpose was sufficiently widespread in 1880 to warrant the publication of methods for its detection. During the last ten years the use of benzoic acid for the preservation of food has been rapidly increasing. This is largely due to the fact that many food manufacturers have replaced the salicylic acid they formerly employed with benzoic acid. It is usually added to wine, beer, cider, and fruit and vegetable preparations, sometimes to canned soup, and more rarely to dairy products.

According to the directions of dealers in commercial preservatives, cider, wine, and similar liquids may receive an addition of an ounce of benzoic acid or sodium benzoate to from 15 to 30 gallons, and some direct that half that quantity be added again if the liquid be racked off in the spring. This quantity, however, seems to be excessive. A firm whose methods necessitate the use of so much of an antiseptic substance should have nothing to do with the preparation of foods. It is customary to add from two to two and one-half times as much to pasty or semi-solid food products as to liquids.

Benzoic acid is not as objectionable as are some compounds used as food preservatives, but there is still doubt as to its wholesomeness, and in any case the sale of food containing it and not so labeled as to inform the purchaser of that fact should be prohibited.

The dose of benzoic acid for adults is from 10 to 40 grains, and that of sodium benzoate from 10 to 60 grains. A quart of cider treated with the maximum amount mentioned above would contain 12 grains of benzoic acid.

**FORMALDEHYDE.**

Formaldehyde has been used as a disinfectant and germicide for a number of years, and has also been suggested for use in surgical operations, but owing to its irritating character it has not filled the
office that was expected in that field. Its use as a food preservative
dates back to about 1895. It is now extensively employed for the
preservation of milk, and has been reported in other articles of food.
The addition of formaldehyde to foods is undoubtedly objectionable,
and should be prohibited. Not only does it interfere with digestion to
a marked extent, but it has been definitely proved that a compound is
formed with the casein of milk which causes the latter, when treated
with dilute acid such as exists in the gastric juice, to separate in hard
lumps that are attacked only with difficulty by digestive ferments.

The addition of formaldehyde to milk has become only too common,
and considering the fact that other and less objectionable preserva-
tives will accomplish the same object, its use should be condemned
in unqualified terms.

**Flourids.**

Within the last ten years the flourids, silico-flourids, and boro-
flourids have come into use to a somewhat limited extent as food pre-
servatives. It was at first believed by many that these compounds
were without deleterious effect on the human organism. It is now well
known, however, that they possess a marked toxic action, and should
under no circumstances be added to foods. The writer has no infor-
mation concerning the use of silico-flourids in this country as food preservatives, but they are said to be used to some extent abroad. The medicinal dose of ammonium flourid for adults is from 0.003 to
0.065 grams (0.04 to 1 grain). But one of the samples purchased con-
sisted of ammonium flourid. A quart of beer treated as directed in
the circular accompanying the package would contain 0.28 grains of
ammonium flourid, or seven times the minimum dose.

**Beta-naphthol.**

Beta-naphthol has been suggested as a food preservative, and it has
been used for that purpose to a very limited extent for at least twelve
years. It is a compound of marked toxic properties. The dose for
an adult is from 0.2 to 0.52 grams (3 to 8 grains), and the statement is
added in Merck’s Index that it must be administered with caution. Its use as a food preservative would therefore seem to be unwarranted.

**Pyroligneous Acid.**

The preserving effect of smoke is recognized to be due to creosote. During the early part of the nineteenth century various newspapers
called attention to the possibility of avoiding the somewhat tedious
process of smoking meat by immersing it for a moment in pyroligneous
acid and allowing it to dry. Several experiments on this subject were
made by William Ramsay, and the results were recorded in an article
published in 1820.
In recent years a great deal of pyroligneous acid has been sold under such names as "Extract of smoke" and "Liquid smoke." The use of this substance has not been studied from a hygienic standpoint, and we can only say that meat preserved with it should not be sold as smoked meat. "Liquid smoke" sells for 75 cents a quart. The same article can be bought as pyroligneous acid for 30 cents a gallon.