

Jam, marmalade, and glucose / by William Murrell, M.D., F.R.C.P., Physician to the Westminster Hospital; lecturer on clinical medicine and joint lecturer on the principles and practice of medicine; examiner in the University of Glasgow.

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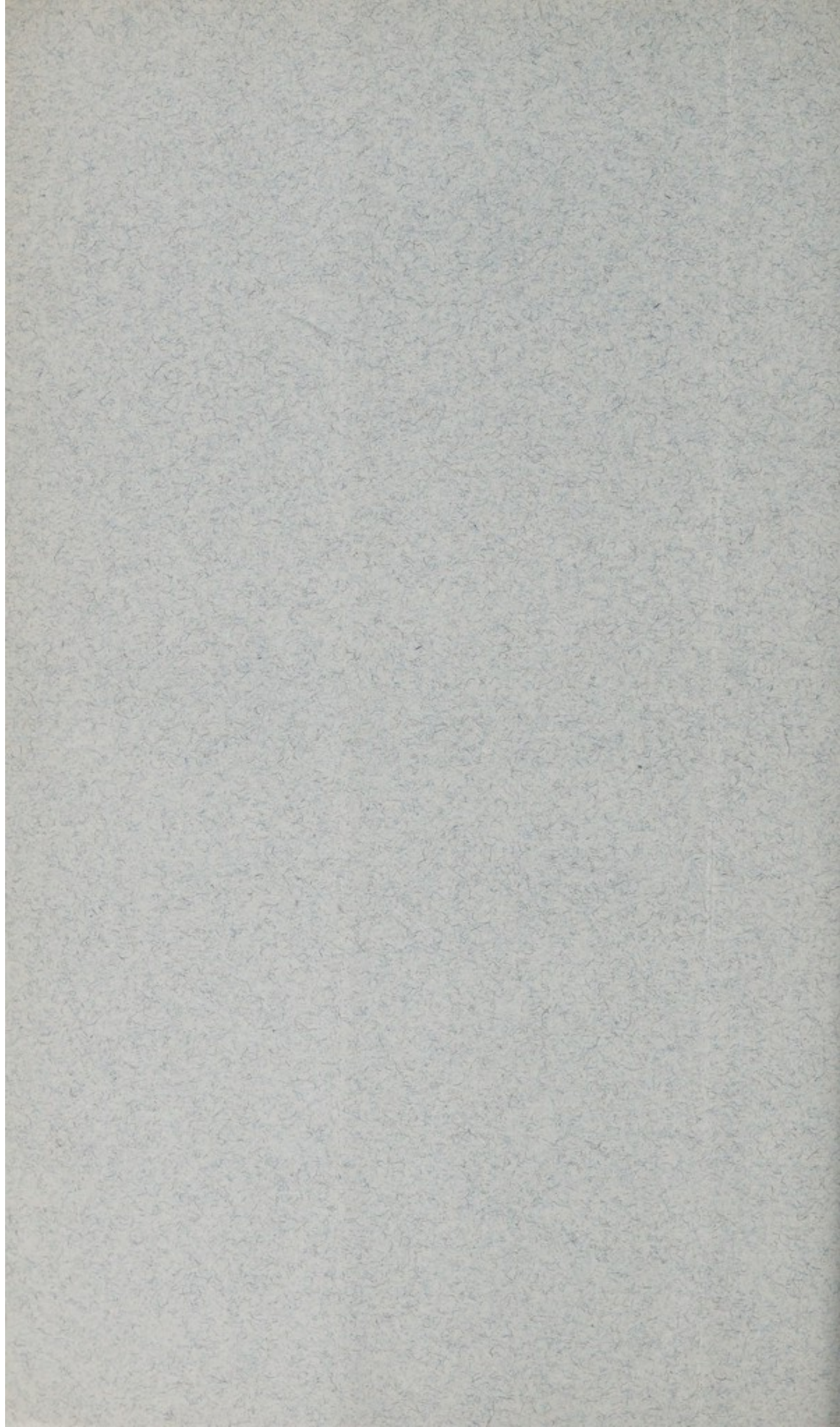
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JAM, MARMALADE, AND GLUCOSE.

THE recent decision in the Worthing marmalade case and its confirmation by the West Sussex Quarter Sessions at Horsham, subject to an appeal to the High Court, is not only of importance to jam manufacturers and fruit growers all over the country, but raises many points of medical interest. It will be remembered that the summons against the appellant was framed under section 6 of the Food and Drugs Act of 1875, and charged him with having unlawfully sold to the prejudice of the purchaser marmalade adulterated with 13 per cent. of glucose. The justices at Worthing found that marmalade was a fruit preserved in cane or beet sugar, and held that the article demanded was not supplied, and fined the defendant. The point really in question was whether the sale was to the prejudice of the purchaser in that he did not get the article asked for, or an article of the nature, substance, and quality demanded by him; in other words, whether glucose was an adulterant and could be used wholly or in part as a substitute for cane or beet sugar in the manufacture of marmalade and jam. Although in the original hearing it was suggested that glucose was injurious to health when employed as a food, this contention was subsequently abandoned, and it was admitted by the prosecution that this view could not be maintained. The Horsham Bench, in giving judgment, stated that they did not consider the added article prejudicial to health. It was urged for the defence that the Food and Drugs Act came in only when what was

done was injurious to the purchaser, and that it did not apply when the article supplied was equal in quality to that which the purchaser had a right to expect, and for which he had paid.

JAM.—Jam is usually described as a conserve of fruit boiled down with sugar, sugar being defined as a sweet substance obtained chiefly from a species of cane. This is a dictionary definition on which too much reliance can not be placed. The popular idea of sugar was originally cane sugar, but after a time beet and other sugars were recognised, and for some years past glucose has been used. It is clear that with the progress of science and the introduction of new products and new methods of manufacture, a more liberal interpretation of the composition of jam must be admitted. There is no known standard of jam, and every maker uses his own judgment as to the manner in which he blends his ingredients. The only test is palatability to the purchaser, provided that the materials are wholesome.

MARMALADE.—Marmalade is a jam, and no definition of it can be framed which would differentiate it from that class of substances. It is an orange jam, and the same substance is sold indifferently under the names of marmalade and orange jam. The name marmalade is derived from the Portuguese word "marmelo," a quince. Marmalade was originally made from quinces, or from a sweet apple grafted on a quince. It is now rarely made from quinces, but is a conserve or preserve prepared from oranges, apples, and other fruits. Lemon peel is often added in order to assist in the conversion of the cane sugar into invert sugar. It is probable that marmalade was originally prepared with honey, which contains 78 per cent. of invert sugar, and only 3 per cent. of cane sugar. At a later period the fruit was preserved with cane sugar, for it was not only the cheapest, but practically the only sugar commercially available. The next step was the introduction of beet sugar, which is closely allied to cane sugar. Now that glucose can be economically prepared from starch, it is not surprising that advan-

tage is taken of its many good qualities for the preparation of marmalade and other jams. When glucose was first employed for this purpose is not known, but it has undoubtedly been in common use for the last sixteen years, and there is documentary evidence to show that some jam manufacturers utilised it as far back as 1864.

There is nothing to show that cane sugar alone is to be used as a preservative and to impart the requisite sweetness to jam, or that beet sugar or glucose may not be employed for this purpose, either alone or in part. One of the cheapest marmalades is made with oranges and cane or beet sugar and water. It is in reality an orange jelly, and as it contains over 50 per cent. of water, it can not be said that it is by any means economical to the purchaser. By the addition of glucose, marmalade can be made with less water, it is more viscid and more palatable, and does not become hard. From 10 to 20 per cent. of glucose is the right proportion, and this quantity effectually prevents candying. Glucose is clearly a more nutritious article than water. When marmalade is prepared with cane sugar only it is stiff in consistence, and after being kept for a time undergoes crystallisation, forming hard, indigestible masses, to which the consumer naturally objects. To remedy this defect, some manufacturers add apple and other fruit jellies to render it less consistent and gritty, and to give it the requisite softness. The same object is attained by the addition of small quantities of tartaric or phosphoric acid before boiling down, so as to convert the cane sugar first into invert sugar, that is, into dextrose and levalose, and subsequently into glucose. Another method is to subject the orange pulp to prolonged boiling in order that the natural acid of the orange may make the necessary conversion. Prolonged boiling impairs the flavour of the product, and there are obvious objections to the use of acids. It is better to obtain the requisite viscosity by the addition of a suitable percentage of glucose, to which it is difficult to see that any objection can be raised.

It will be remembered that glucose or grape sugar is the natural sugar of fruits which do not, as a rule, contain cane sugar.

BEER.—Glucose is largely employed in the manufacture of beer. Of late a demand has sprung up for light sparkling ales, and the old-fashioned fully-flavoured heady beverages have to a great extent gone out of fashion. One of the nicest and cleanest tasting pale ales with which I am acquainted contains a considerable quantity of glucose, and is a wholesome and refreshing drink. Just at the present moment there is a prejudice against the use of glucose, for to the man in the street glucose spells arsenic; but this is a delusion, for glucose as supplied by the best makers is absolutely free from any injurious agent. There has been much talk of late about "pure beer," but as a matter of fact the public do not care for and will not drink a beer prepared from malt and hops alone, and want something lighter and more palatable. As long as they are supplied with a beer which is perfectly wholesome they can not be said to be "prejudiced" even in the technical sense of the word, and the consumer has a perfect right to demand and obtain the product which pleases his taste and suits his requirements.

GLUCOSE.—It is unfortunate that the term "glucose" is employed in a dual sense. It is used by physiologists as a synonym for dextrose or grape sugar, and by chemists and manufacturers to designate what, for the sake of convenience, may be called "commercial glucose." To add to the confusion, some writers on chemistry apply the word dextrose to the commercial article. It need hardly be pointed out to what complications and misunderstandings this may give rise in courts of law, when witnesses are cross-examined on isolated sentences, taken from papers or books with the context of which they may not be acquainted. The words glucose, grape sugar, starch sugar, dextrose, and dextro-glucose, are used by chemists for the same product. Commercially the term grape sugar is applied to the solid and glucose to the liquid article.

Glucose is one of the sweet principles of fruits, and is the chief constituent of honey. It is prepared on a large scale by the action of an acid on starch, but the acid is subsequently removed by the addition of an alkaline base, and none remains in the finished product. Much of our glucose is of American origin, the raw material employed being corn-flour, a substance of every-day use as a food. Only a very dilute acid is employed, and the conversion is completed by the action of steam under pressure.

Commercial glucose is not a simple substance, but consists of:—

Dextrin, 25 per cent.		Dextrose, 40 per cent.
Maltose, 20 „		Water, 15 „

These figures are approximate only, and there may be slight differences in percentage composition in different specimens, but the statement is practically correct. The Chancellor of the Exchequer, in his Budget speech, pointed out that glucose contained 45 per cent. of pure sugar, which is a low estimate. It is worth noting that whilst he imposes a duty of 4s. 2d. a cwt. on refined sugar, the duty on glucose is only 1s. 8d. a cwt., a 40 per cent. basis. Glucose is largely employed, not only in the manufacture of jam, but in making confectionery, sweets, beer, aerated waters, and numerous other articles of every-day consumption.

It is sometimes said that cane sugar is a natural product whilst glucose is artificial. The answer to this is that corn flour is just as much a natural product as is the sugar cane. Moreover, cane sugar, as we know it in everyday life, has been submitted to a number of complicated and mechanical processes, and this is equally true whether it is obtained from the sugar cane, from beet, or from sorghum. The juice both of the cane and of the sugar beet is not a simple substance, but contains various nitrogenous organic substances and acids together with salts and colouring matters. The crude juice is boiled with lime to get rid of the acids, and other chemicals are employed, their selection varying with the different processes. The sugar is finally obtained in a com-

mercially pure condition by evaporating the clarified solution and allowing it to crystallise. The mother liquors from the various crystallisations are sold as treacle or molasses, and contain the sugars which do not crystallise, together with the saccharine constituents of the juice. Grape sugar is often tinted with ultramarine to neutralise the yellow of the imperfectly-purified article, so that cane sugar is just as much a manufactured article as is glucose.

Commercial glucose contains nothing injurious. I have searched through most of the works on toxicology, and can find no case of poisoning by glucose. I do not believe that such cases exist. An expert witness recently stated that he could not take even the smallest particle of glucose without suffering from headache. Glucose enters so largely into the composition of so many articles of food, that his dietary must have been unpleasantly curtailed. But accepting his statement as being literally correct, it is obviously an example of idiosyncrasy. Such cases in various forms are by no means uncommon, and we all know that there are people who are seriously disturbed by taking lobsters, mussels, strawberries, and even champagne, although such articles are not usually regarded as being of a toxic nature. Another expert witness affirmed that glucose always made him ill, and that he had been forbidden by his doctors to take it, but it leaked out on cross-examination that he was a diabetic, and that bread, potatoes, and starch in all forms were equally inimical to him.

The statement that glucose in jam is the cause of the prevalence of caries of the teeth in children hardly needs refuting. The fear that sugar in any form may injure the teeth is illusionary, and it is well known that negroes who are fed largely on sugar cane have, as a rule, excellent teeth. A jam made with glucose being viscid in consistence is more easily washed away by the saliva, and is less likely to be retained in the interstices of the teeth than a hard crystalline jam made with cane sugar. But this is really beside the question, for decayed

teeth are usually the result of an acid reaction of the secretions of the mouth associated with the presence of micro-organisms.

Commercial glucose is not only a food, but a most excellent food. Two of its constituents, maltose and dextrose, are sugars, and are of the greatest possible value in the animal economy. The third constituent, dextrin, is half way between starch and sugar, and as soon as it comes in contact with the saliva and the secretions of the pancreas and intestines is converted into sugar. Much has been made of the fact that there are two varieties of dextrin—erythro-dextrin, which gives a red or violet colouration with iodine, and achroödextrin which does not give the reaction. It has been suggested that a small proportion of the dextrin—presumably the achroödextrin—is not absorbed, and is consequently of no value as a food, but the experiments on which this statement is made are of little value, seeing that they were the result of observations conducted in glass vessels such as test-tubes. The conditions are not identical with those which prevail in the human body, for it is well known that the rapidity of the diastatic action is much increased by dialysis, that is, by the removal of the finished products, maltose and dextrose, which takes place normally in the intestines, but for which no provision is made in the laboratory experiments conducted in glass vessels. Even if an infinitesimal portion escaped conversion by the secretions of the mouth and pancreas, it by no means follows that it would not be assimilated and used as a food, for physiologists are now agreed that any remnants of dextrin not so acted on are absorbed by the cells which line the intestines, and are by them converted into maltose and dextrose, that is, into active food constituents before being turned into the blood stream. From this it follows that not only is glucose a good food, but that it is a valuable nutritious agent comprising all the best qualities of the carbohydrates.

The question whether commercial glucose is indigestible is readily disposed of. There is good reason

for supposing that it is more readily assimilated than cane sugar, for the latter has to undergo a process of inversion—that is, it takes up water and is converted into dextrose and levulose—before it reaches its final stage. This may be said with certainty, that jams made with glucose and cane sugar are more readily assimilated than those made with cane sugar alone. A viscid substance is more readily absorbed than one which is in hard crystalline masses, and a jam which is candied cannot be very readily acted on by the secretions of the stomach or of the intestines.

Apart from physiological considerations, we have clinical proof that glucose is a good food. Dextrin is the active ingredient of some of the most popular children's and invalid's foods, which are constantly prescribed in all kinds of acute illnesses when other forms of nourishment, with the exception perhaps of milk, are contraindicated. Maltose and dextrose are admittedly good foods, and dextrin is the third important ingredient of commercial glucose.

I often prescribe commercial glucose as a food in two-drachm doses three times a day, and have never known it disagree with the patient. As jam contains 13 per cent. of glucose, this is equivalent to six ounces of that substance per diem, which is certainly more than the average consumer eats in the day. I have frequently examined the urine of patients taking glucose, and have never found it reduce Fehling's solution, showing that it is entirely absorbed, and is not eliminated with the urine. The best mode of administration is in a cup of black coffee, which patients tell me is not too sweet. For "wasting" children glucose is an excellent food and they rapidly improve in condition and grow fat on it.

It is difficult to see what objection can be urged against the employment of glucose in the manufacture of jam and marmalade. Glucose is just as nutritious and as easily assimilated as cane sugar. It is every bit as good a food. It is stated that glucose is employed because it is cheaper than cane sugar. This, however, is not the case, for it is practically the same price as cane sugar. Even if it were a little

cheaper weight for weight there would be no saving, for it would not make so much jam. An examination of manufacturers' invoices shows that nothing is gained by using it. Robert Hutchison, in his "Food and Dietetics," says that commercial glucose "is often used to make jam from inferior fruit or from the remains of fruit, the juice of which has been used to make fruit syrups and jellies." I have inquired into this matter, and am assured that this statement is incorrect; good jam cannot be made out of bad fruit even by the addition of glucose. I have since learnt from Dr. Hutchison that his opinion was based on Bannister's Cantor Lectures, published in the "Journal of the Society of Arts" in 1890.

The contention that the purchaser is prejudiced, seeing that he does not get the article which he asks for or an article of the nature and substance and quality demanded by him, admits of a ready answer, for it is obvious that when a man buys a pot of marmalade he does not concern himself, as long as it is palatable and to his taste, with its mode of production, and he certainly knows nothing of the niceties or comparative values of cane sugar, beet sugar, sorghum, or glucose. He may be ignorant, but he is not defrauded.

The arguments in favour of the use of glucose in jam are many. It prevents crystallisation, mildew, and fermentation, and enables a better whole fruit jam to be made, and a jam of more fluid consistency. Above all, it is better adapted to the public taste. A good illustration of this is afforded by the fact that one large firm of jam manufacturers, who have used glucose only during the last seven years, state that prior to that time their business had fallen off, but since then it has notably increased. If jams were required for immediate consumption only, the old-fashioned methods would suffice, but now that they are exported to all parts of the world, and often not consumed for three or four years, during which they are subjected to many changes of temperature, the addition of glucose is imperative. There is reason to think that, with one exception, all

the large jam manufacturers now employ glucose in addition to cane or beet sugar. It is said to be impossible to make whole fruit jam without glucose. One maker who states that he makes a whole fruit jam without glucose probably uses small and very acid strawberries, the acid of which converts the cane sugar into invert sugar.

To sum up it may be safely affirmed that there is no valid objection to the use of glucose as a substitute for cane sugar or beet sugar in jams, marmalade, confectionery, or beer, and that prosecutions for employing it for this purpose are vexatious, and serve no useful purpose, but, on the contrary, are prejudicial both to the consumer and the maker, inasmuch as they tend to restrict the production of the best and most palatable form of articles of every day consumption.

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