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Food Preservation



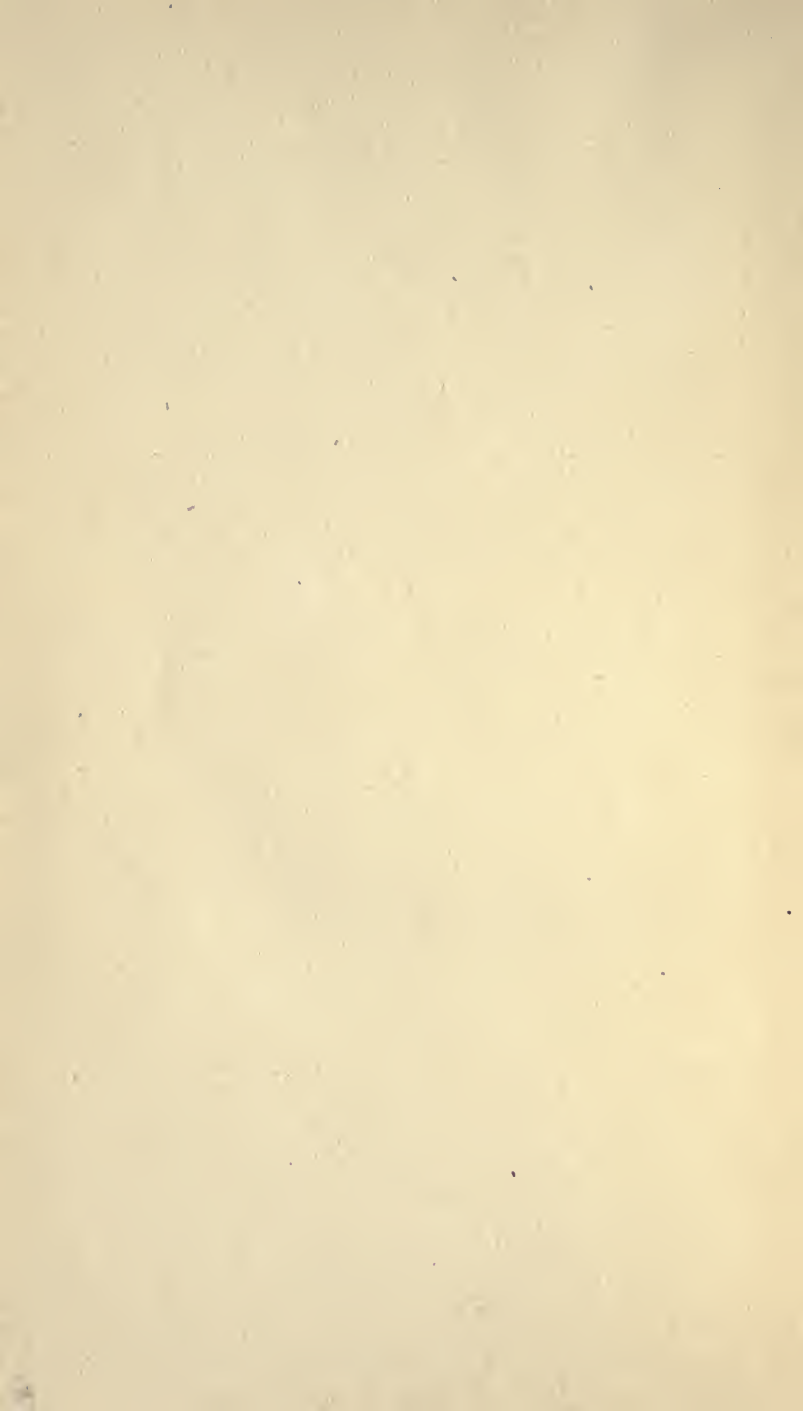
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Food Preservation

No 1909

THIS BOOK is not intended for public sale, but has been prepared for distribution to those who may be interested in the subjects of which it treats.

Issued by
The National Association for the Promotion of Public Health
New York
1909.



THESE NOTES TO THE EDITOR
OF THE PUBLIC OPINION
AND CONDUCT OF THE
MAGISTRATES AND JUDGES
IN THE COURTS OF THE
CITY OF NEW YORK.

Food Preservation

A Statement of Facts in the Case,
Together with References
to The Authorities

Issued by
The National Association for the Promotion of Public Health
New York
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Foreword

Around the subject of proper food preservation there recently has been waged a controversy that is not sufficiently impartial or unbiased by personal consideration to be of real educational value to the public at large. The modern method of preparing food for public consumption is so new that even the latest scientific works on dietetics contain little or no allusion to it, and it is to supply that lack in non-technical language that this volume is issued, based upon the latest scientific experiments and data. In searching the literature of the subject all discussion that is founded upon guesswork or opinion has been eliminated.

New York, August, 1909.

Food Preservation

THE question of proper food preservation is one that is of vital interest to every consumer, but, unfortunately, it is one that has recently been more or less befogged by partial and selfish commercial interests and by the heat of controversy.

From the moment of generation of either fruit, vegetable or flesh there is gradual progress toward maturity and thence to decay. The object of a preservative in foods is to arrest that decay and to hold stationary until needed those materials which are intended for human consumption. In other words, it is the safe banking of food products.

The original method of preservation, particularly of flesh products, after the primitive salting and drying, was that known to the Egyptians when they used the essential oils of spices for the preservation of their mummies. With very slight

changes, this is the method that has come down to the present day in what is ordinarily known as the "home" method of preservation, except that to the essential oils of spices has been added vinegar, the whole, with the process of cooking, forming a condimental method of preservation. Cooking is chemistry, and the preservative employed, leaving aside all question of technicalities, is acetic acid and the essential oils of spices. A distinction should be kept in mind between what may be called "canned" goods, which by the Appert process—heat, sterilization and hermetic sealing—require no other preservative, and condimental substances, such as catsup, jams, preserves and jellies. The preparation of the latter, unless a preservative is used, requires heavy boiling in open kettles, thus increasing oxidization and reducing the whole to a pulpy mass which has lost its original form, color and taste. The restoration of color and taste is the mission of condiments, to which also is added the preservative qualities of the condiments used.

Perhaps the greatest step forward in the preservation of material was made when Lord John Lister, the eminent Scotch surgeon, discovered the septic action of matter, and it is this fact that has been taken advantage of and worked out by all chemists. The working of the law is that if you would prevent decay you must forestall the tendency thereto, and this tendency is found in the normal presence of bacteria. The thing that will overcome this tendency to deterioration must necessarily be the employment of some agent having either a prophylactic or antiseptic quality. In plain language, the preservative, to be a preservative, must hold within itself the power of destroying the bacteria without injury to the ingredients or component parts of the fruit, vegetable or flesh to be preserved, which, if left to themselves, would go through the necessary processes to final dissolution. We are, therefore, forced to the conclusion that if a spice preserves an apple the spice must have a sufficient power to destroy or retard the development



of the bacteria in the apple that would produce decay, or that might find entry there by contact or from the air. If decay has already begun in even the slightest degree, then the spice must have the antiseptic power of offsetting and destroying the further work of the bacteria that had begun operations.

Heat and the exclusion of air, as well as any condiment used in sufficient quantity, will act as a preservative and do the necessary work in preventing the natural process of decay. The treatment with spices in heavy quantities for the purpose of preserving, opens up another question at once, for there is a wide difference between the use of a limited quantity of a spice for flavoring, and the employment of a sufficient amount to break down or annihilate the whole of the natural process of deterioration. Authorities are at variance upon that point to a marked degree.

The chemical action of heat on food materials to which had been added condiments had been the sole method of preservation for years, until modern science

cast about for a more efficient and more certain substitute. Many have been tried and practically abandoned, for it has been found that most chemicals which will preserve food will also modify digestive functions. At the present writing benzoate of soda—which is common soda treated with benzoic acid—is the sole preserving agent that has been determined by the highest scientific authorities to be at once efficient and also so little harmful in the quantities necessary to employ that measurable deleterious effect cannot be found.* The controversy, then, narrows itself down to the conflict between the old method of spices and vinegar and heavy cooking as against the innovation represented by benzoate of soda. Such controversies are linked with and are a part of scientific progress, and, in their final outcome, beneficial. | Gallileo was persecuted because he dared the traditional belief of ages; | the serum theory and anti-toxin were bitterly

*Testimony of Dr. Harvey W. Wiley before Interstate and Foreign Commerce Committee of House of Representatives, page 311.

assailed until the death rate from diphtheria had been so reduced as to prove the clinching argument; the X-ray was scoffed at.

THE NATURAL SAFEGUARD

QUITE early in the history of modern chemistry it was found that certain minor fruits possessed the quality of keeping indefinitely, or, to say the least, of postponing the inevitable process of decay for an extended period of time. The inquiring mind naturally set itself to asking why the cranberry, the huckleberry, the birch, etc., should possess this apparent immunity, and in the course of time it was discovered that under the skin of the berries and the bark of the tree there was contained a natural preservative. To this was given the name benzoic acid.

There is some doubt as to whom falls the honor of the discovery, inasmuch as such investigations have usually been carried on independently by several experimenters, each unaware of the other's labors, but it is certain that the medicinal properties of benzoin—the active principle of benzoic

acid—has been known since shortly after the Elizabethan era. The use of this substance as a preservative for foods, however, was not attempted, nor perhaps known, until a decade ago. Manufacturers of food products who had been using the acetic acid and spice method cast about for an equivalent that would perform the desired service with fewer of the drawbacks of the earlier or home method, and it was suggested that benzoic acid could be “cut” or neutralized with soda. Exhaustive experiments were carried on along these lines, and after two years several firms decided to make use of it. This took place in 1899, or nearly seven years before the adoption of the present Food and Drug Law.

Benzoic acid, then, we have learned, is actually the vital natural substance, contained in certain minor fruits and vegetables, that acts as a preservative against decay. When combined with soda and applied to any vegetable or animal substance, its action is precisely the same as in its natural state and place—it arrests the processes of decay. The quantity necessary

adequately to prevent the process of fermentation—which is in actuality decay—is very small, and it effectually prevents the development of bacteria, destroying these should they find entry. In the form of benzoate of soda this preservative is a white crystalline substance, and it is colorless, odorless and practically tasteless. That which is used in foods is obtained from toluene, a coal-tar product. The impression which has been fostered to the effect that it is obtained from hippuric acid is erroneous. Such benzoic acid is too expensive for commercial use and is of German production. Importers state that not an ounce is sold in this country for use in foods. Dr. H. W. Wiley has stated: “In so far as I know, none of this particular kind of benzoic acid is used in foods.”*

HEAT NOT ALWAYS EFFECTIVE

IT has already been made clear that comparatively few food products require a preservative other than heat. In the majority of processes it is unnecessary, such,

*Testimony before Interstate and Foreign Commerce Committee of the House of Representatives.

for instance, as the strictly canning industries, in which fruits, vegetables, soups or meats are put up as "air-tights" and are intended to be used entirely and immediately as soon as the package is opened. These require no preservative of any sort. It is only in products that are intended for gradual consumption that any preservative is necessary, and by gradual consumption is meant this: that a jar of fruit preserves may be purchased, opened and left upon the table or in an icebox for a week possibly, until it is entirely consumed. Herein the danger lies, for, as Professor E. E. Smith, of Fordham University, has shown in his experiments along this line, bacteria in an unpreserved product develop with amazing rapidity.* The exact figures may be interesting, and these are as follows:

Fresh ripe fruit, sterilized and sealed, was laid away for a period of three months. It was then opened and tested for bacteria. None was found. Three days later the bacterial presence was found to be 8,850 per

*Report to the Central Medical Society of Connecticut, delivered at Middletown, Feb. 8, 1909.

cubic centimetre (about a quarter of a teaspoonful); on the sixth day this amount had grown to 244,846,000 per cubic centimetre. This serves fitly to illustrate the situation where no preservative—chemical or condimental—is used. We have learned in an earlier portion of these pages that spices, etc., serve as preservatives, and yet when we buy certain brands of preserves we are informed upon the label that “no preservatives” are used. In the interpretation of the law this possibly is correct, for condiments are not classed as “preservatives,” but the fact remains that spices or condiments are chemicals and also drugs, and we find them so listed in the Pharmacopeia. The statement upon the label may then be called a technical evasion permitted by law.

THE MANUFACTURER'S VIEW

IN order to ascertain the commercial argument supporting the use of benzoate of soda a letter was addressed to a prominent firm of manufacturers asking their reasons. The reply was to the effect that during the time of their experimenting

and undertaking to get along without an added preservative, they found it was absolutely impossible to make a catsup that would keep sweet until entirely consumed, without the aid of some preserving agent. They did, however, discover that they could make catsup that would keep, and this manner of manufacture was the same as employed by our mothers, viz.: by cooking the whole substance down until it had entirely lost its original color and tomato flavor and then adding heavy quantities of spices and vinegar. They expressed the belief that there is no question but that these goods must have a preservative of some kind, whether it be benzoate of soda or excessive amounts of acetic acid (vinegar) and spice products, and from what they had learned these latter are more injurious to health than the former.

In this connection it is well to observe that the axis of the argument against benzoate of soda has been supported upon a wholesale declaration that benzoate of soda was and is used to conceal or cover up inferiority of material in the preparation

of various products, and that this was and is the sole and only reason for its use. Broadly stated, this assertion comes down to the charge that manufacturers are enabled to use skins, parings and refuse generally in the preparation of their products, and that this enables them to put forth a class of goods, bearing every outward appearance of the first-class article, at practically no initial cost for material, and, by inference, a class of articles that must of necessity be built upon filth and decay. No statement could be more diametrically opposed to the fact than this. With a preservative that has neither color nor odor, and with practically no taste, it is manifestly impossible to conceal either decay, offensive odor, or rotten taste.

CONCEALING IMPURITIES

IT would seem proper in this instance to make an inquiry. Which would be the more available to an unscrupulous manufacturer who had on hand a consignment of rotten or decayed fruit that he wished to preserve—a small quantity of a tasteless,

odorless and colorless salt, or abnormal quantities of heavy and pungent oils and spices together with long and continued boiling?

In a recent legal action in Indiana* an interesting experiment was reported in court. A food chemist in the employ of a large firm of manufacturers produced a considerable amount of tomato pulp that had been prepared for preserving, and which he testified was made of unfit material, partly decomposed,—the refuse of the factory.

This pulp had been divided into three parts. The first had been left untreated; to the second had been added an amount of benzoate of soda considerably in excess of that usually employed. To the third had been added vinegar that was strong in acetic acid and the essential oil of spices. The first remained in its previous inedible condition; the second showed no change, while the third had altered its color from

*In the Circuit Court of the United States for the District of Indiana, No. 10894, in equity.

a dirty brown to a bright red, and the offensive effluvia changed to an appetizing and pungent odor.

MEANING OF THE PURE FOOD LAW

THE Pure Food and Drug Law of 1906 went a long way toward insuring pure and unadulterated food products to the consumer. No honest manufacturer can raise any objection to its provisions, and investigation has shown that none such has been raised. The principal criticism that may be ventured is that the law is not sufficiently drastic as it stands, and that it offers loopholes for commercial misrepresentation, of which advantage has been taken. One scientist has said that "the food laws of this country are upside down. All manufacturers of food products, fruits, vegetables or meats, should be compelled to use a preservative substance and its omission should be made a criminal offense."

In this law a technical distinction has been made in the wording between "condimental" and "chemical" preservatives.

Speaking more exactly, the law says that any substance "added solely as a preservative" must be indicated upon the label. Vinegar and spices are not "added solely as a preservative." They are introduced ostensibly as condiment or flavor, but also because their use will have a preservative effect, and it is not legally compulsory to indicate upon the label the acetic acid that is found in such foods. It is under this technicality that the "no preservative" claim is made freely in advertising and other matter, which is, to a considerable extent, misleading.

A REVIEW OF THE FINDINGS

FOR many months a widespread agitation has been going on in this country over this question of preservatives. Stripping the discussion of unauthorized and unscientific statements, and eliminating from it all the inspired matter that has been published, the situation simmers itself down to the point of actual experimentation to ascertain the effects of benzoate of soda upon the human system. There have been two series in this country. The first was conducted by Dr. H. W. Wiley, Chief of the Bureau of Chemistry of the United States Department of Agriculture, and the second by the so-called Remsen Scientific Referee Board, appointed by Secretary of Agriculture Wilson, in accordance with instructions from President Roosevelt, and composed of five of the most eminent scientists in the country. The findings of both of these have been very largely misrepresented, for they are, in effect, not very widely apart.

In the original report of Dr. Wiley* it was shown, with every appearance of verity,

*Bulletin 84, Bureau of Chemistry, U. S. Dept. of Agriculture. Since recalled as unofficial.

that the experiments upon the twelve members of the "poison squad" who were subjected to the tests had indicated "strongly marked physiological modifications," and that the whole digestive system had been upset. By referring to the report we discover that these experiments were carried on for a period of only thirty days, which had been divided into three sub-periods. These consisted of a "fore period" of five days, in which no benzoate of soda was given to the subjects, but in which they were merely prepared for the test to come; then the actual period of the administration of the salt during twenty continuous days; and then an "after period" of five days, in which the system was supposed to readjust itself. This bulletin was issued without proper departmental authority, and, in fact, in opposition to direct instructions pending a review of the case. The belief, therefore, that the Department of Agriculture had prohibited the use of benzoate of soda as a preservative was consequently erroneous.

In a paper printed in the Medical Record of January 2, 1909, by Professor E. E.

Smith, that author says: "A careful and painstaking analysis of the work of the chief chemist of the Department of Agriculture shows that a curious condition existed at the time of the experiment. Of the twelve men who served as subjects eleven were suffering from some form of physical derangement before, during and after the experiments. The one who was free from any such indications was the only one reported who did not suffer from the so-called injurious effects of benzoate of soda, while each of the eleven others indicated exactly those symptoms which would have occurred as a natural result of their condition, whether the preservative had been administered or not."

The Remsen Scientific Referee Board, appointed by President Roosevelt to review the work of the Bureau of Chemistry because of the questions raised as to the scientific value and accuracy of the work of the bureau, consisted of Professor Ira Remsen, president of Johns Hopkins University; Professor Russell H. Chittenden, of Yale University; Dr. Christian A. Herter,

of the College of Physicians and Surgeons, Columbia University, New York; Professor John H. Long, of Northwestern University, Chicago, and Professor Alonzo E. Taylor, of the University of California.* This board conducted a series of experiments in three cities simultaneously, and covered a period of about three months.

The questions put to the board were:

(1) "Does a food to which there has been added benzoic acid, or any of its salts, contain any added poisonous or other added deleterious ingredient which may render the said food injurious to health?"

(2) (a) "In large quantities? (b) In small quantities?"

(3) "If benzoic acid or any of its salts be mixed or packed with a food, is the quality or strength of said food thereby reduced, lowered or injuriously affected? (a) In large quantities? (b) In small quantities?"

The general conclusions of the board were:

(1) "Sodium benzoate in small doses (under 0.5 gram per day) mixed with the food is without deleterious or poisonous action and is not injurious to health.

*Prof. Taylor did not participate in the experiments, but travelled in Europe searching the foreign literature.

(2) "Sodium benzoate in large doses (up to 4 grams per day) mixed with the food has not been found to exert any deleterious effect on the general health, nor to act as a poison in the general acceptation of the term. In some directions there were slight modifications in certain physiological processes, the exact significance of which modifications is not known.

(3) "The admixture of sodium benzoate with food in small or large doses has not been found to injuriously affect or impair the quality or nutrient value of such food."

As a result of this the following decision was made by the Department of Agriculture, under date of March 3, 1909:

FOOD INSPECTION DECISION 104

Amendment to Food Inspection Decisions No. 76 and No. 89,
Relating to the Use in Foods of Benzoate of Soda.

The Referee Board of Consulting Scientific Experts, composed of Dr. Ira Remsen, Dr. Russell H. Chittenden, Dr. John H. Long, Dr. Alonzo E. Taylor, and Dr. C. A. Herter, have reported upon the use of benzoate of soda in foods. The board reports, as a result of three extensive and exhaustive investigations, that benzoate of soda mixed with food is not deleterious or poisonous and is not injurious to health. The summary of the report of the Referee Board is published herewith.

It having been determined that benzoate of soda mixed with food is not deleterious or poisonous and is not injurious to health, no objection will be raised under the Food and Drug Act to

the use in food of benzoate of soda, provided that each container or package of such food is plainly labeled to show the presence and amount of benzoate of soda.

Food Inspection Decisions 76 and 89 are amended accordingly.

GEORGE B. CORTELYOU,

Secretary of the Treasury.

JAMES WILSON,

Secretary of Agriculture.

OSCAR S. STRAUS,

Secretary of Commerce and Labor.

This, then, is all that stands as authority on this subject in this country, either governmental or scientific. In reaching its conclusions, however, the Remsen Board was not content to rest upon its own original investigations, for a careful search was made of the European authorities, one hundred and twenty-seven in all, some in the form of complete works, some in the form of special articles in the technical press, and others as Government reports. Many of these experiments were performed upon animals, a considerable number upon human beings; some others had for their object the determination of the actual effect of the salt upon bacteria. One discussed

the treatment of tuberculosis by benzoic inhalation, and the rest merely considered the reports of others.

Others who may be considered as authorities have touched the subject in its various details, and their opinions are here appended.

The Two Preservative Methods Compared

Statement of HENRY W. FRAUENTHAL, A.C., M.D.

Surgeon-in-Chief, Hospital for Deformities and Joint Diseases, New York,
and President of the National Association for the Promotion of Public Health

Regarding the methods of preservation to-day, it may be said that there are two and two only in use by reputable manufacturers, and around them a considerable war is being waged by commercial interests in which I have no part. I regard both as good, under reasonable use. The first of these is as old as civilization and, with some modifications, is the method used by the Egyptians to preserve their dead. They used the essential oil of spices. The "home" method or process used by some manufacturers is the same, with the addition of vinegar; the whole, during the process of cooking—which is purely a chemical operation—resulting in the creation within the food itself of the chemical known as acetic acid.

The other method is that evolved by the modern chemist to take the place of the boiling and spicing. Various chemicals have been used—some too powerful in retarding fermentation to be advisable—until, after much experiment, benzoate of soda was considered to be harmless, or, at least, so infinitesimally harmful that it could not be measured. There is really no difference of opinion between authorities upon this point. The array includes practically all chemists of note, even

including the chief chemist of the food concern which is most prominently in opposition. It even includes Dr. H. W. Wiley, of Washington, who has gone on record in sworn testimony* not only that in certain classes of foods a preservative is needed, but also that benzoate of soda is the least to be feared.

For myself there is very little choice, since either method will preserve the food and give the protection that is needed. Both methods may undoubtedly be abused by unscrupulous manufacturers. The heavy odor and taste of the spices and condiments make it possible to deceive the nose and make palatable the use of food material that would otherwise be rejected. Benzoate of soda, on the other hand, is as transparent as a piece of plate glass, and, while it will keep partly decayed food from getting any worse, it will not make bad food any better or conceal its use by the addition of another taste or odor. Another point in favor of the latter method is, it seems to me, that it would require a far heavier dose of benzoate of soda to produce an appreciable effect upon the system than of acetic acid. The amount of acetic acid in a bottle of catsup, for instance, if separated and taken clear, would produce most painful results. Moreover, foods that are preserved by this method will be found to contain an amount of acetic acid from three to five times greater than those which depend upon the amount of benzoate of soda sanctioned by the Government.

*Hearings before the Committee on Interstate and Foreign Commerce of the House of Representatives, Washington, 1906. (See page 38).

BENZOATE OF SODA *vs.* ACETIC ACID

It has been stated in the foregoing that where benzoate of soda was not employed as a preservative a far greater amount of acetic acid would be found to be contained in the goods. For purposes of experiment four leading brands of catsup were purchased in the open market and submitted for analysis to the Lederle Laboratories in New York and to Dr. S. P. Sharples in Boston. Following are the results:

Sample.*	Label Statement.	Acetic Acid.		Benzoate of Soda.	
		New York	Boston	New York	Boston
A.....	Preserved with 1-10 of 1 per cent of B. of S.....	.68	.66	.0133	.01
B.....	Contains no chemical preservative.	2.11	1.08	.007	.000
C.....	Prepared only with vinegar, spices, onions and garlic	1.21	1.14	.007	.000
CC.....	(Same manufacturer.) Contains 1-10 of 1 per cent. of B. of S.6601
D.....	Prepared without a chemical preservative.....	1.30	1.32	.000	.000

It is perfectly clear from the above that where one-tenth of 1 per cent benzoate of soda has been used the amount of acetic acid has been reduced materially. That is to say, in comparison between samples A and B, we find that sample A, which contained benzoate of soda, showed but .68 per cent of acetic acid, as against 2.11 per cent of acetic acid in sample B. Comparing the two samples C and CC, the one containing benzoate of soda and the other not, we find that where it was omitted the amount of acetic acid rose to 1.14 per cent.

*Names will be furnished on application.

The Necessity of Some Preservative

GLEN. F. MASON
Chemist for H. J. Heinz Company

Extracts from Address at Eighth Annual Convention of the National Association
of State Dairy and Food Departments, St. Louis, Mo.

The necessity of a preservative in fruit and vegetable products has been called to my attention upon numerous occasions in connection with work in the laboratory during the past year. Tomato products were used as a basis for research in a great many instances. Every possible means of preserving with none but natural agencies were used, but without satisfactory results. Tomatoes were pulped in the laboratory, the bottles thoroughly sterilized, and then filled to top with pulp, corked and sealed. These kept for about sixty hours and then one after the other blew out the cork and a rapid fermentation set in. The same scheme was tried again, the pulp being put in cold storage. In a comparatively short time this lot also fermented.

* * * * *

When the question of which preservative should be used I think all agree on benzoate of soda. Most of the ordinary chemical preservatives which have the power to preserve these articles are more or less injurious to the human system.

* * * * *

I know of no case on record where death or even serious illness was caused by benzoate of soda, and

I see no reason why it should not be preferable to any other chemical preservative.

* * * * *

It has been stated by competent authority that salicylic acid produces chronic dyspepsia. No such results have ever been tabulated against benzoic acid. Numerous other preservatives have all such records, but nowhere will you find benzoic acid spoken of as a poison.

* * * * *

In case a preservative was not used in an easily fermentable article, what would be the result? The consumer would be eating various moulds and introducing bacteria into his system by the millions. Every one knows that a human being cannot relish moulds such as are formed upon various fruits. But you say these are of no importance, as they are on the top and can be removed without any injurious effect upon the preserves or other product on which they grew. This may be true in the case of "home-made" preserves where it remains in the cellar or pantry without being molested until ready for consumption.

* * * * *

The commercial preserves are shipped from one climate to another, usually going through somewhat sudden changes of temperature and shaken up in every conceivable way; and in the meantime the mould, if any, which has been resting peacefully on top, is mixed thoroughly with the rest of the fruit. Fermentation will soon set in by the constant, or almost constant, circulation of air, through the preserves, caused by constant changing of box from one spot to another.

* * * * *

Then you have the absolutely pure preserves, free from preservatives, as they would very often reach the consumer. No one would take them in preference to the nice, clean-looking preserves, absolutely free from fermentation, containing only a very small amount of benzoate of soda. Although none of the moulds found upon fruits have as yet been proven as poisons in the strictest sense of the word, yet none of them is considered perfectly harmless, and all know them to produce digestive disturbances. They are not pleasing to the eye by any means. I have collected moulds grown upon fruits, free from preservatives, which have been kept in screw-top jars. A person would not have to look long at them to lose his appetite, and merely from appearance would reject the fruit. Would it not be better to use a little benzoate of soda, and do away with these objectionable things?

* * * * *

It seems to me that benzoate of soda in such quantities as consumed by an individual in condiments can not be injurious to the human system; and we can all be positive it would not be near as injurious as condiments put up without benzoate of soda, which are usually kept on the table for some time, producing ferments and moulds, and, not having proper attention paid to them, are often consumed in that state.

The Use of Essential Oils

Statement of Dr. CLEMONS KLEBER

Clifton Laboratories, Passaic, N. J.

It has been charged that the use of a preservative such as benzoate of soda has a harmful effect upon the process of digestion by retarding the action of the natural chemical ferments of the stomach, but I have found it possible to prove, and have absolutely proved that these natural ferments were not really harmed at all by proper quantities of the preservative, but that on the contrary a large number of foreign and dangerous bacteria present, were so modified in their action as to give the digestive juices proper and sufficient time to conquer them.

There are still many secrets in digestion, of course, especially with regard to the part played by so-called "beneficent" bacteria, but I am convinced that any possible injury done to these doubtful friends of the stomach is far outweighed by the protection against injurious forms of disease germs afforded by proper quantities of benzoate of soda such as are introduced into the system in the eating of preserved foods. And this, of course, does not take into consideration the protection given the food itself which is of inestimable value. Experiments have demonstrated over and over again that the chemical preservative I have named is effective as a preventative against dangerous conditions when used in reasonable quantities, and it has the

additional advantage of being colorless and tasteless. It is thus not possible to disguise with it the flavor of food which has begun to putrefy.

The essential oils of spices are, of course, all slightly antiseptic, and they would be exceedingly serviceable as food preservatives were it not for the fact that they are so pungent and powerful in their flavor. In not a single case, save perhaps that of pickles, when a mild thymol can be used, can they be effective as preservatives unless so much of them is used that their flavor is not only unpleasantly strong but possibly highly dangerous. I may add for the information of the non-technical that the essential oils themselves are the only antiseptic elements of spices; the natural spices themselves having no such qualities whatever, though I am aware that an attempt has been made to convey that impression. The process of obtaining or extracting the oils from the natural condiment is only possible by means of an acid process.

Apart from these facts my chief reason for the advocacy of benzoate of soda as a preservative of foods is its value to the poorer people. There is no doubt that preserving may be done by "appertization"—that is, by air-tight sealing of jars, the contents of which have been heated to the boiling point in the fashion of our home preserving—but experience has taught all of us the uncertainties of this process by many an unnecessary death, and it has this great economic disadvantage, that such goods must be eaten within forty-eight hours at most of opening. With benzoate of soda, however, the period of safety is enormously extended, and while to the person of comfortable means this may not be important, to the small wage earner without refrigerating conveniences it is very seri-

ous indeed. It is obvious, of course, that manufacturers are not going to add more of a comparatively expensive preservative than is needed. Personally I shall continue to demand its use in all such materials I purchase for my own table.

THE PRESERVATIVE PROPERTIES OF SPICES

In reply to a question as to the digestive quality of spices, Dr. S. P. Sharples, of Boston, one of the editorial contributors to the American Edition of the Encyclopedia Britannica, said: "Infinitely bad. In my opinion far worse than benzoate of soda or salicylic acid, and their influence on the digestive functions is highly deleterious. I have known this for years. Spices themselves are the most powerful known preservatives, and have been known as such for thousands of years. The ancient Egyptians knew this and used them for embalming their dead. This was done so perfectly by these spices that the mummies have lasted until this time."

Dr. J. N. Hurty, of the Indiana State Board of Health, said in the Journal of the American Medical Association, under date of January 30, 1909: "I believe also that spices are irritants and highly injurious. Acetic acid extract of spices is strong vinegar percolated over a mixture of cloves, pepper, cinnamon, etc., and there results a powerful antiseptic which is injurious."

Holes in the Pure Food Law

(From *Springfield* [Mass.] *Union*, March 19, 1909)

As a result of his experiments Professor Smith has announced before the Central Medical Association that: "The Pure Food and Drug Law of 1906 has done much by demanding honest labeling of products, but vinegar and spices are condiments, and therefore do not require statement on the label. Acetic acid, however, is not a condiment, but a chemical preservative of dangerous quality and should be so labeled, and now that by the findings of the Referee Board of Chemists benzoates are found to be harmless, I suggest that the efforts of the proper authorities be directed toward properly labeling the products containing acetic acid, and a rigid inspection of the raw material to see that it is of the proper quality."

Read Gordon, B.S., a food chemist of national reputation, who last October debated the Pure Food law with Dr. H. W. Wiley before the Chemical Society in New York, has just expressed a precisely similar opinion. In an interview he has said: "It is highly important that, if the public is to be forced to consume large quantities of acetic acid, it should be informed of the fact on the label, and the law is not definitely and sincerely effective until this is done. The present condition permits the use of embalming methods with acetic acid and essential oils and spices that are no whit better than, and just as offensive as, that employed by the ancient Egyptians."

Several Mooted Questions Answered

Extracts from an Article by Dr. E. E. SMITH, Professor of Physiological
Chemistry, Fordham University, and Director of Research,
Red Cross Hospital, New York

WHY AND WHEN IS A PRESERVATIVE NECESSARY IN FOOD?

Vegetable products, like tomatoes, after being sterilized, may be kept sealed indefinitely without a preservative. If eaten immediately after opening, no preservative is necessary; if kept for more than a few hours they must have a preservative or they will spoil, exactly as fresh, ripe vegetables decay.

WHAT PRESERVATIVES SHALL BE USED?

Acetic acid and spices may be used; so may benzoate of soda. The objection to acetic acid and spices is that they cover the real taste and are far more likely to be injurious than benzoate. When acetic acid is used it requires as much sugar as in syrup to cover the strong acid taste.

HOW CAN DECAY IN MATERIAL BE CONCEALED?

Decayed raw material has a bad flavor. To cover bad taste substances must be added which have a taste stronger than the decayed material. Benzoate of soda, in one-tenth per cent. strength, has no taste at all. Even the novice knows that acetic acid and spices obscure the flavor of raw material, while benzoate of soda does not. It

merely preserves. If the original raw material is good it keeps it good; if it is bad it keeps it bad and does not cover the bad taste. It leaves the product so that the consumer may know precisely what the flavor is.

WHAT IS "DOPE" IN FOOD?

When sugar is used for medicine it becomes a drug. When onion syrup is given to the baby for cold in the throat the onion is a drug. When glacial acetic acid is used to eat off warts it becomes a drug. When allspice is given to prevent griping it is a drug. When benzoic acid is inhaled to soothe a hoarse throat it becomes a drug. Because sugar, onions, vinegar, spices and benzoic acid may be used as drugs is no reason why they should not be eaten in food.

WHENCE IS DERIVED BENZOATE OF SODA?

Not a single pound of benzoate of soda made from any animal excretion is to be found in the markets of this country at the present day. Benzoate of soda is common soda, treated with benzoic acid. It is true that years ago, before the discovery of the present method of manufacture, a poor grade of benzoic acid was made in Germany in the way criticised, but the practice is absolutely obsolete. There is no reason to believe that a pound of it was ever made into benzoate of soda. One reason why it is not used is because of the poor quality, and another equally practical is the big price. Benzoic acid thus obtained is not only inferior, but it costs more than ten times as much as the clean, pure benzoate from toluene.*

*A coal-tar product.

What Various Authorities Say

WILEY, Dr. HARVEY W., Chief of the Bureau of Chemistry, United States Department of Agriculture, in his sworn testimony before Committee on Interstate and Foreign Commerce of the House of Representatives on the Pure Food Bill, February 26, 1906:

“I want to point out how they have misunderstood the efforts which have been made to ascertain certain facts relating to the effect of preservatives, coloring matters and other substances added to foods on health and digestion; how they have misunderstood the purpose and scope of the food standards which have been proclaimed by the Secretary of Agriculture in accordance with an act of Congress, and have, as a result of these erroneous views, created what seems to them a demon of future dangers, but which is nothing more than a phantom of a perturbed imagination.

* * * * *

“Prof. Kremers states his position on page 37, where he says:

x “ ‘I know that salicylic acid has been used to a considerable extent; boracic acid also has been used. There are worse things than that by far that have been used. The question is, I suppose, of finding a preservative that, if it is not absolutely harmless, will do the least harm.’

“I must acknowledge my gratitude to Prof. Kremers for thus stating in his own language a position which I regard as wholly irrefutable in respect to the use of benzoic acid in foods.

* * * * *

“I am not advocating the prohibition of the use of benzoic acid by anybody who wants to use it. I would be in favor of putting benzoic acid in a little salt cellar, the same as is used for salt and pepper, and letting the people use it if they want to. I think benzoic acid would not hurt me, or be injurious to my system.”

MUELLER, SEBASTIAN, Vice-President of the H. J. Heinz Company, in an address at the eighth annual convention of the National Association of State and Food Departments, at St. Louis, Mo.:

✕ “Mould and fermentation are frequently found by the housewife in the goods which she herself has put up, and when the home articles are finally taken into use the mould is removed and the good part underneath is eaten. When the home product is found to be fermented it is boiled over and then used, but while the housewife may be willing to remove the mould from her own goods and boil over the fermented goods which she herself has made, she is not likely to buy mouldy or fermented goods from the grocer. When goods are made on a large scale, although with the same care and cleanliness, you can readily see what will happen when they are shipped over long distances and transported from one climate to another. If any mould has formed before the goods are

shipped, the mould will become mixed with the entire contents of the package during transit, and if complete spoilage did not take place on this account, the consumer would be eating mould, which, in my opinion, is more objectionable than to eat the small and harmless quantity of added preservative required to prevent its formation. Again, if goods were slightly fermented on the top of the package, the bacteria of fermentation would become mixed with the balance during transit, and the whole package would go up in fermentation.

* * * * *

x “Now let us come to the preservative itself. The least objectionable one in use to-day seems to be benzoate of soda. It is non-poisonous and does not accumulate in the human system.”

KREMERS, Prof. EDWARD, of the University of Wisconsin, in his testimony before the Committee on Interstate and Foreign Commerce of the House of Representatives on the Pure Food Bill, February 15, 1906:

x “I have examined the best literature in the three languages, English, French and German, and have yet to find a statement that benzoic acid administered even in medicinal doses would produce harm.”

KEDZIE, Dr. FRANK S., professor of chemistry of the Michigan Agricultural College, testifying before the same committee on the same day:

“I eat catsup (naming the brand) that I know contains benzoic acid, and I have it on my table every day. I do that in preference to taking the catsup bottle, as I used to do when I was a boy, and running to the refrigerator every time after it was used and putting it there so that it would not sour and the cork would not pop out.”

VAUGHAN, Prof. VICTOR C., of the University of Michigan, also testifying:

“I am sure that benzoic acid, in the quantities in which it is used in tomato catsup, sweet pickles, etc., one part in 1200 or 2000, does not do any harm.

* * * * *

“Why ought we to use preservatives in foods at all? The use of preservatives in foods is to prevent the growth of bacteria. Doctor Wiley is a good chemist, and the Bureau of Chemistry is doing excellent work; but how in the world can any one ~~expect~~ an expert bacteriologist to decide how much of a preservative is necessary to preserve a given food? If you want to get a patent, you would not go to a criminal lawyer in order to get it. If you wanted to defend some one on a charge of murder, you would not go to a patent lawyer. And I must say, with all due respect to the agricultural chemists of this country, many of whom are great men and doing splendid work, that men who all their lives have been assaying soils and estimating the value of fertilizers are not fitted by education to determine the effect of anything upon the animal body.”

except
determine

KELLER, Prof., writing in Liebig's Annual of Chemistry (German), Vol. XLIII:

"The author took 2 grams of benzoic acid without other effect than a nightsweat which may have been due to the acid. The next day the same dose was taken three times, making a total of 8 grams in twenty-four hours, and no other effects were noticeable or observed."

MARCHAND, Prof., in a paper contributed to The Journal of Chemical Practice (German), Vol. XXXV:

"In experiments continued over a period of ten days, during which 30 grams of benzoic acid were administered, we were unable to observe any ill effects whatever."

KLEBS, Prof., quoted in The Correspondence of Swiss Physicians, Vol. VIII:

"There are absolutely no disagreeable effects whatever when sodium benzoate is administered for long periods of time, even in doses up to 25 grams per day. In medical practice it has been found that a dose of from 10 to 15 grams per day gives no harmful results."

SENATOR, Dr. H., in a contribution to The Journal of Clinical Medicine (German), Vol. I:

ERRATA

Page 42, lines 21-22 should read:

'—the world can anyone EXCEPT an expert bacteriologist determine how much," etc.—

"I eat catsup (naming the brand) that I know contains benzoic acid, and I have it on my table every day. I do that in preference to taking the catsup bottle, as I used to do when I was a boy, and running to the refrigerator every time after it was used and putting it there so that it would not sour and the cork would not pop out."

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SENATOR, Dr. H., in a contribution to The Journal of Clinical Medicine (German), Vol. I:

"The author administered sodium benzoate in doses of 4 to 6 grams per day without the slightest ill effect, and then increased the dose to 11 and 12 grams. In cases of acute rheumatism, as much as 70 grams of sodium benzoate were administered in eleven days without any disturbing symptoms whatever."

SCHUELLER, Prof. MAX, writing in *The Experimental Pathological and Pharmacological Record* (German), Vol. XI:

“It is quite possible for an adult to ingest from 20 to 30 grams of sodium benzoate per day without any injurious effect.”

DEMME, Dr. R., in a communication to *Smith's Year Book of the Summary of Medicine* (German), Vol. CLXXXIII:

“Diphtheria has been treated with from 5 to 20 grams of sodium benzoate per day, besides local treatment with it, and subcutaneous injections of a 50 per cent. solution in retro- and sub-maxillary region and the tonsils. There was no drop in temperature, and the heart action was materially improved.”

ROKITANSKY, Dr., in *Wiener's Medical Press* (German), Vol. XX:

“Inhalations of sodium benzoate are of great value in phthisis. A patient weighing 50 kilograms must use at least 50 grams in 5 per cent. solution each day—the dose being determined by the body weight.”

WINTER, Prof., in an article contributed to *Smith's Year Book of The Summary of Medicine* (German), Vol. CLXXXVI:

“The author has invariably failed to observe any ill effects after the use of the benzoates. In all cases they are found to be strongly diuretic.”

VON JAKSCH, author of "The Poisons:"

"Perhaps benzoic acid and its salts are the least injurious of the whole aromatic series (*including the essential oils of spices*)* for the human organism. I have repeatedly given in rheumatism as high as 24 grams of sodium benzoate per day without observing any injurious effect. Cases have come under my knowledge where as high as 60 grams per day have been given."

SIRECI, Prof., writing in Maly's Year Book of Animal Chemistry (German), Vol. XXVII:

"Even with high doses of benzoate acid, it was not possible to exceed the capacity of the body to transform all the benzoic acid."

LEFFMAN, Dr. H., in The Journal of the Franklin Institute (American), Vol. CXLVII:

"Benzoic acid and sodium benzoate are practically without influence on the digestive power of the enzymes. * * * Sodium benzoate has been given internally in doses amounting to 5 to 20 grams a day. * * * Physiologically, sodium benzoate is about as harmless as a drug can be."

WOOD, Dr. H. C., in "Therapeutics," 12th Ed.:

"The local action of benzoic acid, unless in large quantities, is scarcely irritant to mucous membranes. * * * The contradictory testimony regarding the influence upon nutrition indicates that it had no constant powerful action."

*Italics added.

Bibliography*

- KELLER.**—Über Verwandlung der Benzoeaure in Hippursäure. *Liebig's Annalen der Chemie*, 1842, XLIII, 103.
- MARCHAND.**—Über die Oxydationsproducte des Leims durch Chromsäure. *Journal für praktische Chemie*, 1845, XXXV, 309.
- WOHLER AND FRERICHS.**—Über die Veränderungen, etc. *Liebig's Annalen der Chemie*, 1848, LXV, 335.
- KUHNE AND HALLWACHS.**—Über die Entstehung der Hippursäure, etc. *Virchow's Archiv für pathologische Anatomie*, 1857, XII, 386.
- LUCKE.**—Über die Anwesenheit der Hippursäure, etc. *Virchow's Archiv für pathologische Anatomie*, 1860, XIX, 196.
- LAUTEMANN.**—Über die Reduction der Chinsäure, etc. *Liebig's Annalen der Chemie*, 1863, CXXV, 9.
- MATTSCHIEWSKY.**—Zur Entstehung der Hippursäure. *Virchow's Archiv für pathologische Anatomie*, 1863, XXVIII, 538.
- MEISSNER AND SHEPARD.**—Untersuchungen über das Entstehen der Hippursäure im thierischen Organismus. Hannover, 1866.
- HOFMEISTER.**—Beobachtungen über Hippursäurebildung im Pflanzenfresserharn. *Landwirthschaftliche Versuchsstationen*, 1871, XVI, 458.
- BUCHHOLTZ.**—Antiseptica unter Bacterien. *Archiv für experimentelle Pathologie und Pharmacologie*, 1875, IV, 1.

*This is the bibliography consulted by the Remsen Board in reaching its findings.

- WEISKE.—Untersuchungen über die Hippursäurebildung im Körper des Herbivoren bei Verabreichung verschiedenartiger Futtermittel. (Unter Mitwirkung von Kellner und Wienand.) Zeitschrift für Biologie, 1876, XII, 241.
- E. OKOŁOW.—Über die Einwirkung der Salicyl- und der Benzoesäure auf Faulniss und Gährung. Centralblatt für Chirurgie, 1876, P. 777. (Abstract by W. Grube. Original Russian.)
- E. SALKOWSKI.—Zur Wirkung des benzoesauren Natrons. Virchow's Archiv für pathologische Anatomie, 1877, LXXVIII, 53.
- A. HOFFMAN.—Über die Hippursäurebildung in der Niere. Archiv für experimentelle Pathologie und Pharmacologie, 1877, VII, 239.
- F. WALTER.—Die Wirkung der Säuren auf den tierischen Organismus. Archiv für experimentelle Pathologie und Pharmacologie, 1877, VII, 148.
- BUNGE AND SCHMIEDEBERG.—Über die Bildung der Hippursäure. Archiv für experimentelle Pathologie und Pharmacologie, 1877, VI, 233.
- SALKOWSKI.—Vorgang der Harnstoffbildung in Tierkörper. Zeitschrift für physiologische Chemie, 1877-1878, 111.
- LAUDER BRUNTON.—Text Book on Pharmacology, Therapeutics and Materia Medica. London 1878, edition, 78.
- G. BROWN.—Zur Therapie der Diphtheritis. Archiv für experimentelle Pathologie und Pharmacologie, 1878, VIII, 140.
- KLEBS.—Über einige therapeutische Gesichtspunkte welche durch die parasitäre Theorie der Infectiouskrankheiten geboten erscheinen. Prager medizinische Wochenschrift, 1878, III, 5, 16, 41, 54.

- KLEBS.**—Über einige therapeutische Gesichtspunkte welche durch die parasitare Form der Infectionskrankheiten geboten erscheinen. Prager medizinische Wochenschrift, 1878, III, 1, 2, 5, 6.
- KLEBS.**—Natrium benzoicum. Correspondenzblatt für Schweizer Aerzte, 1878, VIII, 313.
- SALKOWSKI.**—Über den Einfluss der Verschlüssung des Darmkanals, etc. Virchow's Archiv für pathologische Anatomie, 1878, LXXIII, 421.
- E. SALKOWSKI.**—Über das Vorkommen von Allantoin und Hippursaure im Hundeharn. Berichte der deutschen chemischen Gesellschaft, 1878, XI, 500.
- WINTER.**—Zur therapeutischen Verwendung des benzoesauren Natrons. (Abstract) Schmidt's Jahrbucher für die gesammte Medizin, 1879, CLXXIV, 121.
- NAUMANN.**—Über die therapeutische Verwendung des benzoesauren Natrons. (Nach Schuller, Klebs, Letzerich, Hoffman.) Schmidt's Jahrbucher für die gesammte Medizin, 1879, CLXXXII, 125.
- SENATOR.**—Über die Wirkung der Benzoesaure bei der rheumatischen Polyarthrits. Zeitschrift für klinische Medizin, 1879, 1, 243.
- FRITSCHÉ.**—(In a discussion of a paper on inhalations of sodium benzoate in tuberculosis of the lungs.) Berliner klinische Wochenschrift, 1879, XVI, 762.
- M. SCHULLER.**—Über therapeutische Versuche bei mit tuberculösen, scrophulösen, septischen Massen inficirten Tieren. Archiv für experimentelle Pathologie und Pharmacologie, 1879, XI, 84.
- F. KROCZAC.**—Vorläufige Mitteilung über Natronbenzoicum Inhalation am Krankenbette. Wiener medizinische Presse, 1879, XX, 1178.

- SOLOMON.—Über den Ort der Hippursäurebildung beim Pflanzenfresser. *Zeitschrift für physiologische Chemie*, 1879, III, 365.
- VON SCHRODER.—Über die Bildung der Hippursäure im Organismus des Schafes. *Zeitschrift für physiologische Chemie*, 1879, III, 323.
- R. DEMME.—Sechzehnter mediz. Bericht über die Thatigkeit des Jennerschen Kinderhospitals in Bern im Laufe des Jahres 1878. *Schmidt's Jahrbuch für die gesammte Medizin*, 1879, CLXXXIII, 218.
- STADELMANN.—Über die Umwandlung der Chinasäure in Hippursäure im Organismus der Säugetiere. *Archiv für experimentelle Pathologie und Pharmacologie*, 1879, X, 317.
- ROKITANSKY.—Zur Behandlung der Phthise mittelst Inhalationen von Natrium benzoicum. *Wiener medizinische Presse*, 1879, XX, 1330.
- W. KOCHS.—Über eine Methode zur Bestimmung der Topographie des Chemismus im tierischen Körper. *Pflüger's Archiv für die gesammte Physiologie*, 1879, XX, 64.
- JAARSVELD AND STOKVIS.—Über den Einfluss von Nierenaffectionen auf Bildung von Hippursäure. *Archiv für experimentelle Pathologie und Pharmacologie*, 1879, X, 268.
- WEISKE.—Über Hippursäurebildung im tierischen Organismus. *Zeitschrift für Biologie*, 1879, XV, 618.
- WINTER.—Zur therapeutischen Verwendung der Benzoesäure und des benzoesauren Natrons. (Abstract) *Schmidt's Jahrbuch für die gesammte Medizin*, 1880 CLXXXVI, 121.
- R. KOBERT.—(Nach eigenen im Verein mit Dr. Schulte angeführten Untersuchungen.) Zur Kenntniss der Wirkung der Benzoesäure. *Schmidt's Jahrbuch für die gesammte Medizin*, 1880, CLXXXV, 12.

- WEYL AND ANREP.—Über die Ausscheidung der Hippursäure und Benzoesäure während des Fiebers. *Zeitschrift für physiologische Chemie*, 1880, IV, 169.
- E. SALKOWSKI.—Notizen. *Zeitschrift für physiologische Chemie*, 1880, IV, 135.
- SCMIEDEBERG.—Über Oxydationen und Synthesen im Tierkörper. *Archiv für experimentelle Pathologie und Pharmacologie*, 1881, XIV, 288.
- SCMIEDEBERG.—Über Spaltungen und Synthesen im Tierkörper. *Archiv für experimentelle Pathologie und Pharmacologie*, 1881, XIV, 379.
- C. VIRCHOW.—Über die Einwirkung des benzoesauren und salicylsauren Natrons auf den Eiweissumsatz in Körper. *Zeitschrift für physiologische Chemie*, 1882, VI, 78.
- SALKOWSKI.—Weitere Beiträge zur Kenntniss der Harnstoddbildung. *Zeitschrift für physiologische Chemie*, 1882-1883, VII, 93.
- J. SCHIFFER.—Weitere Beiträge zum Verhalten des Sarkosins im tierischen Organismus. *Zeitschrift für physiologische Chemie*, 1882-1883, VII, 479.
- E. SALKOWSKI AND H. SALKOWSKI.—Über das Verhalten der aus dem Eiweiss durch Faulniss entstehenden aromatischen Säuren im Tierkörper. *Zeitschrift für physiologische Chemie*, 1882-1883, VII, 161.
- E. BAUMANN.—Zur Kenntniss der aromatischen Substanzen des Tierkörpers. *Zeitschrift für physiologische Chemie*, 1883, VII, 553.
- SCHOTTEN.—Über die Quelle der Hippursäure im Harn. *Zeitschrift für physiologische Chemie*, 1883, VIII, 60.
- KRONECKER.—Über die Hippursäurebildung beim Menschen in Krankheiten. *Archiv für experimentelle Pathologie und Pharmacologie*, 1883, XVI, 344.

- MINKNOSKI.—Über Spaltungen im Tierkörper. Archiv für experimentelle Pathologie und Pharmacologie, 1883, XVII, 455.
- VAN DE VELDE AND STOKVIS.—Experimentelle Beiträge zur Frage der Hippursäurezerlegung im lebenden Organismus. Archiv für experimentelle Pathologie und Pharmacologie, 1883, XVII, 189.
- E. SALKOWSKI.—Über das Vorkommen der Phenacetursäure im Harn und die Ensreihung der aromatischen Substanzen beim Herbivoren. Zeitschrift für physiologische Chemie, 1885, IX, 229.
- E. SALKOWSKI.—Zur Kenntniss der Eiweissfaulniss III. Über die nicht hydroxylierten aromatischen Säuren. Zeitschrift für physiologische Chemie, 1885, IX, 491.
- NOEL PATON.—On the relationship of urea formation to bile secretion. Journal of Anatomy and Physiology. 1886, XX, 114, 267.
- F. BAUMAN.—Die aromatischen Verbindungen im Harne und die Darmfaulniss. Zeitschrift für physiologische Chemie, 1886, X, 123.
- BAAS.—Über das Verhalten des Tyrosins zur Hippursäurebildung. Zeitschrift für physiologische Chemie, 1887, II, 485.
- M. KUMAGAWA.—Über die Wirkung einiger antipyretischer Mittel auf den Eiweissumsatz im Organismus. Virchow's Archiv für pathologische Anatomie, 1888, CXIII, 134.
- MOERNER.—Eine Vergiftung durch Natrium benzoicum. Centralblatt für die medizinische Wissenschaften, 1888, XXVI, 545.
- R. COHN.—Über das Auftreten von Bensamind, etc. Zeitschrift für physiologische Chemie, 1890, XIV, 202.

- C. BINZ.—Vorlesungen über Pharmacologie, zweite Auflage, 1891. Berlin, Hirschwald, p. 594.
- R. COHN.—Über das Auftreten, etc. Zeitschrift für physiologische Chemie, 1892, XVII, 310.
- VOGL.—Realencyclopädie der gesammten Heilkunde (Eulenburg) 3. Auflage. Leipzig, 1894, III, 229.
- VON JACKSCH.—Die Vergiftungen. Specielle Pathologie und Therapie (Nothnagel) Vienna, 1897, I, 357.
- SIRECI.—Über die Ausscheidung der Hippursäure. Maly's Jahresbericht für Thierchemie, 1897, XXVII, 325.
- SIRECI.—Sulla eliminazione dell' acido hippurico. Gazzetta degli Ospedali e delle cliniche, 1896, XVII, 496.
- WEHMER.—Einige vergleichende Versuche über das antiseptische Verhalten der Benzoesäure, etc. Chemiker Zeitung, 1897, XXI, 73. Chemisches Centralblatt, 1897, 1, 548.
- PFEIFFER AND EBER (in Verbindungen mit Gotze und Müller).—Beitrag zur Frage über die Bildung der Hippursäure im tierischen Organismus. Die Landwirtschaftliche Versuchsstationen, 1898, XLIX, 97-144.
- J. POHL.—Über Synthesenhemmung durch Diamine. Archiv für experimentelle Pathologie und Pharmacologie, 898, XLI, 97.
- WEINER.—Über das Glykojoll als intermediäres Stoffwechselproduct. Archiv für experimentelle Pathologie und Pharmacologie, 1898, XL, 313.
- KUNKLE.—Handbuch der Toxikologie. Jena, G. Fisher, p. 550.
- K. SPIRO.—Über Nachweis und Vorkommen des Glykojolls. Zeitschrift für physiologische Chemie, 1899, XXVIII, 174.

- H. LEFFMANN.—Digestive ferments, with special reference to the effect of food preservatives. *Journal of Franklin Institute*, 1899, CXLVII, 97.
- SALKOWSKI.—Über die antiseptische Wirkung von Salicylaldehyd und Benzoesaureanhydrid. *Virchow's Archiv für pathologische Anatomie*, 1899, CLVII, 416.
- ASHHURST.—Certain effects of benzoic acid upon the urine. *Philadelphia Medical Journal*, February 24, 1900.
- BLUMENTHAL.—Zur Methode der Hippursäurebestimmung. *Zeitschrift für klinische Medizin*, 1900, XL, 339.
- M. LEWANDOWSKY.—Versuche über den Einfluss der Benzoesäure auf die Harnsäurebildung. *Zeitschrift für klinische Medizin*, 1900, XL, 202.
- ABELOUS AND RIBAUT.—Sur l'existence d'un ferment soluble opérant la synthèse de l'acide hippurique aux dépens du glycocole et de l'acide benzoïque. *Comptes Rendus de la Société de Biologie*, June 9, 1900.
- WEINTRAUD.—Über den Anbau des Nucleins im Stoffwechsel. *Centralblatt für innere Medizin*, 1900, XXL, 464.
- PARKER AND LUSK.—On the maximum production of hippuric acid in rabbits. *American Journal of Physiology*, 1900, 111, 472.
- E. CURTIS.—Benzoic acid and benzoates. *Reference Handbook of the Medical Sciences*, 1900, Vol. I.
- R. COHN.—Über den Glykokollvorrath des tierischen Organismus. *Festschrift für N. Jaffe*, Braunschweig, 1900 or 1901, p. 319.
- H. ULRICHI.—Über pharmacologische Beeinflussung der Harnsäureausscheidung. *Archiv für experimentelle Pathologie und Pharmacologie*, 1901, XLVI, 321.

- BERNINZONE.—Sulla sintesi fisiologica dell' acido ippurico. *Boll. d. R. Accad. med. di Genova*, 1901, 16 No. VI, 47.
- K. SIEBERT.—Über die nach Benzaldehyd und Benzoesäure darreichung im Harn auftretenden reduzierenden Stoffe. *Inaugural Dissertation, Königsberg*, 1901.
- C. LEWIN.—Beiträge zum Hippursäurestoffwechsel des Menschen. *Zeitschrift für klinische Medizin*, 1901, XLII, 371.
- Report of the Department Committee appointed to inquire into the Use of Preservatives and Coloring Matters in the Preservation and Coloring of Food (together with minutes of evidence, appendix and index), London, 901.
- WEITZEL.—Über die Labgerinnung der Kuhmilch unter dem Einfluss von Borpräparaten und anderen chemischen Stoffen. *Arbeiten aus dem kaiserlichen Gesundheitsstand*, 1902, XIX, 126.
- REM-PICCI.—Über eine neue Methode für die Bestimmung der Hippursäure im Menschenharn. *Maly's Jahresbericht für Thierchemie*, 1902, XXXII, 316. (From *Archivio di farmacia, sperimente e science affini*, 1902, I, 7.)
- R. COHN.—Zur Frage der Glykokollbildung aus Leucin im tierischen Organismus. *Archiv für experimentelle Pathologie und Pharmacologie*, 1902, XLVIII, 177.
- E. BASHFORD AND W. CRAMER.—Über die Synthese der Hippursäure im Tierkörper. (Preliminary Report) *Zeitschrift für physiologische Chemie*, 1902, XXXV, 536.
- F. SOETBEER.—Kontrolle der Blumenthalschen Methode der Hippursäurebestimmung. *Zeitschrift für physiologische Chemie*, 1902, XXXV, 538.
- SALKOWSKI.—Über die Stoffwechselwirkung der Benzoesäure, etc. *Internationale Beiträge für innere Medizin. Festschrift für v. Leyden*, Berlin, 1902, II, 27.

- HUPFER.—Einwirkung von Chinsäure auf Harnsäure und Hippursäureausscheidung. *Zeitschrift für physiologische Chemie*, 1902-1903, XXXVII, 302.
- A. KANGER.—Zur Frage über die chem. Zusammensetzung und die pharmakologische Wirkung der Preiselbeere (*Vaccinium vitis idaea* L.). *Archiv für experimentelle Pathologie und Pharmacologie*, 1903, L, 46.
- REM-PICCI.—Über die Umwandlung der Benzoesäure in Hippursäure bei Nierenkranken. (*Bollettino della R. Accademia Medica de Roma*, XXX, 1-21). *Maly's Jahresbericht für Tierchemie*, 1903, XXXIII, 102.
- PFEIFFER, BLOCH AND RIECKE.—Eine neue Methode zur Bestimmung der Hippursäure. *Mitteilungen des landwirtschaftlichen Instituts der Universität Breslau*, 1903, II, 273.
- MOOSE AND NEUBERG.—Über den physiologischen Abbau von Jodalbuminen. *Zeitschrift für physiologische Chemie*, 1903, XXXVII, 427.
- R. KOBERT.—Lehrbuch der Intoxikationen. II. Band. Spezieller Teil. I. Hälfte, p. 115. Stuttgart, Ferdinand Enke, 1904.
- E. PRIBRAM.—Zur Lehre von den physiologischen Wirkungen carbocyclischer Säuren. *Archiv für experimentelle Pathologie und Pharmacologie*, 1904, LI, 372.
- GERHARDT.—Über Darmfaulnis. *Ergebnisse der Physiologie*, 1904, III, 138.
- BLUMENTHAL AND BRAUNSTEIN.—Über die quantitative Hippursäurebestimmung beim Menschen. *Hofmeister's Beiträge zur chemischen Physiologie*, 1904, VI, 150.
- KNOOP.—Der Abbau aromatischer Fettsäuren im Tierkörper. *Hofmeister's Beiträge zur chemischen Physiologie*, 1904, VI, 150.

- PFEIFFER, REICKE AND BLOCH.—Die Muttersubstanzen der im Organismus Pflanzenfresser erzeugten Hippursäure. Mitteilungen des landwirthschaftlichen Instituts der Universität Breslau, 1904, II, 695-728.
- R. COHN.—Zur Frage der Glykokollbildung im tierischen Organismus. Archiv für experimentelle Pathologie und Pharmacologie, 1905, LIII, 435.
- MAGNUS-LEVY.—Über die Herkunft des Glykokolls in der Hippursäure. Vorläufige Mitteilung. Münchener medizinische Wochenschrift, 1905, LII, 2168.
- H. C. WOOD.—Therapeutics. Principles and Practice, 12th edition. Philadelphia, 1905, p. 895.
- G. ASTOLFONI.—Recherches concernant l'action de quelques substances diurétiques sur la synthèse de l'acide hippurique. (Resume de l'auteur.) Archives italiennes de biologie, 1905, XLIII, 373.
- G. ASTOLFONI.—Recherche intorno all' azione di alcune sostanze diuretiche sulla sintesi dell' acido ippurico. Rivista veneta di Scienze med., 1905, XLII, 57.
- G. ASTOLFONI.—Recherche intorno all' azione di alcune sostanze sulla sintesi dell' acido ippurico.
- R. HEINZ.—Handbuch der experimentellen Pathologie und Pharmacologie, I. G. Fischer, Jena, 1905.
- McGILL.—Report on Preservatives. Laboratory of the Inland Revenue Department, Ottawa, Canada. June, 1905. Government Printing Bureau, Ottawa, 1905.
- J. SCHMID.—Über die quantitative Hippursäurebestimmung nach Pfeiffer, etc. Centralblatt für innere Medizin. 1905, XXVI, 81.

- PINCHAS FEIGIN.—Über die Hippursäureausscheidung beim hungernden Menschen. Inaugural Dissertation, Berlin, 1906.
- A. BEHRE AND A. SEGIN.—Über die Wirkung der Konservierungsmittel. Zeitschrift für Untersuchung der Nahrungs und Genussmittel, 1906, XII, 461.
- W. WIECHOWSKE.—Die Gesetze der Hippursäuresynthese. (Zugleich ein Beitrag zur Frage der Stellung des Glykokolls im Stoffwechsel. Hofmeister's Beiträge zur chemischen Physiologie, 1906, VII, 204-275.
- ADDERHALDEN AND TERUUCHI.—Studien über die proteolytische Wirkung, etc. Zeitschrift für physiologische Chemie, 1906, XLIX, I.
- BRUGSCH AND HIRSCH.—Hippursäuresynthese und Ausscheidung der Benzoesäure beim Hunde. Zeitschrift für experimentelle Pathologie und Therapie, 1906, III, 663.
- B. von FENYVESEY.—Über den Einfluss experimentell erzeugter Krankheitsprozesse auf biochemische Synthesen. Maly's Jahresbericht für Tierchemie, 1906, XXXVI, 633.
- F. GLADI.—Contributo alla studio dell' acido ippurico dell' organismo umano. II Policlinico, Sez. med. 1907, No. 6. (Abstract in Centralblatt für die gesammte Physiologie und Pathologie des Stoffwechsels, 1907, II, 748.
- MAGNUS-LEVY.—Über das Auftreten einer Benzoesäure-Glycuronsäure Verbindung im Hammelharn nach Benzoesäure Fütterung. Biochemische Zeitschrift, 1907, VI, 502.
- MAGNUS-LEVY.—Über die Neubildung von Glykokoll, etc. Biochemische Zeitschrift, 1907, VI, 523.

S. AMBERG AND A. LOEVENHART.—Further observations, etc. *Journal of Biological Chemistry*, 1908, IV, 149.

LEWINSKI.—Über die Grenzen der Hippursäurebildung beim Menschen. *Archiv für experimentelle Pathologie und Pharmacologie*, 1908, LVIII, 397.

SEO.—Über die Hippursäurespaltung durch Bacterien, etc. *Archiv für experimentelle Pathologie und Pharmacologie*, 1908, LVIII, 440.

H. W. WILEY, with the collaboration of W. D. Bigelow, F. C. Weber and others.—Influence of Food Preservatives and Artificial Colors on Digestion and Health. IV. Benzoic Acid and Benzoates. United States Department of Agriculture, Bureau of Chemistry. *Bulletin No. 84, Part VI, 1043-1294*, 1908. (Withdrawn.)


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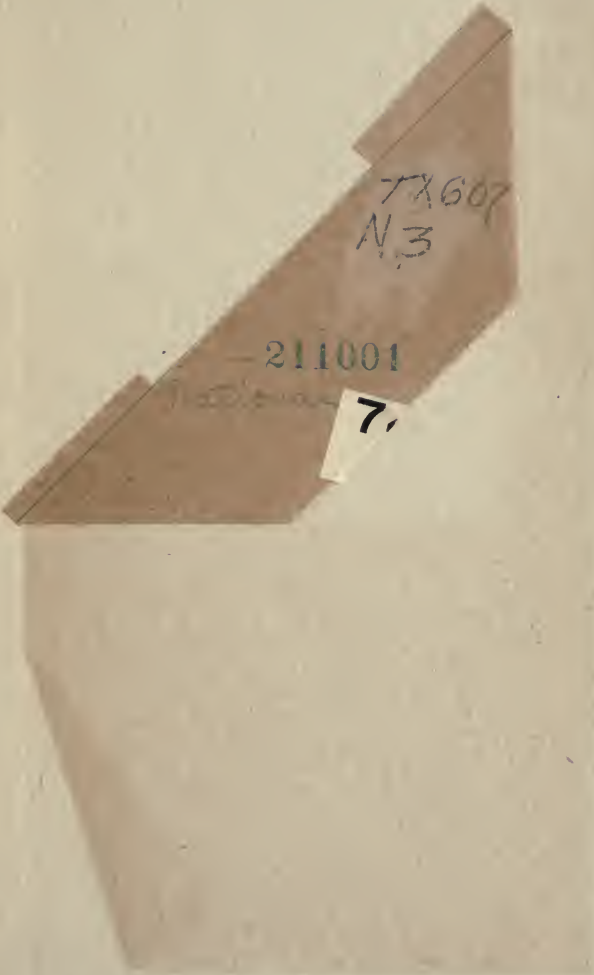
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