

# Effect of Salt Upon Oil Spoilage in Emulsions

By **LOWELL B. KILGORE**  
Colloid Research Laboratories, Washington, D. C.

## I. Cottonseed Oil

IT is a well known fact that up to a certain limit an increase in the salt content of a mayonnaise will cause an increase in the consistency of the finished product. Paustian<sup>1</sup> demonstrated this in his study of the effects which the various ingredients in mayonnaise had upon its physical properties. During the course of this investigation it was necessary (for other reasons) to make a series of mayonnaises which were identical in all respects except in regard to the salt content. Four mayonnaises were made having the range of salt contents shown in Table I. Since these samples were to be stored over a definite period of time, it was thought advisable to determine whether the increase in the consistency caused by an increase in salt content would continue during storage. Plumit tests were therefore run on the samples at three intervals as shown in the following table (I) and the accompanying curves:

TABLE NO. I  
Effect of Amount of Salt Upon Its Consistency

Per Cent Salt	Taste	Consistency on "Plumit" After		
		2 Days	14 Days	50 Days "Soupy"
0.5	Flat	3.2	4.0	
1.0	Bland	2.5	2.8	4.5
2.0	Good	1.3	1.5	2.4
3.0	Salty	0.7	1.3	1.8

In view of the above facts it is not difficult to understand why it might be attractive to a mayonnaise manufacturer to use as much salt as the flavor would stand.

The writer<sup>2</sup> pointed out sometime ago that the concentration of acetic acid present in an oil in mayonnaise influenced its keeping qualities. Since salt has a tendency to accelerate certain types of organic reactions, especially in the presence of an acid, the question arises whether or not salt will effect the rate of spoilage of an oil or fat. On the other hand salt has been used for centuries as a means of preserving fats against microorganisms. The following experiments were therefore conducted to determine what effect, if any, salt has upon the rate of oil spoilage.

Since salt does not dissolve in oil and also since an oil does not show the same spoilage reaction rate in bulk as it does in an emulsion, the oil was studied in two emulsions. The first was a 50 per cent oil and water emulsion using pectin as the emulsifying agent. The method of preparing these emulsions has been previously described by the writer (*loc. cit.*). The second emulsion was a conventional mayonnaise made according to the following formula:

	Per Cent
Egg yolk .....	5.5
Cottonseed oil .....	80.0
40 gr vinegar .....	9.5
Sugar .....	1.5
Mustard .....	0.5
Salt .....	0.5-3.0

The first set, the simple oil and water emulsions, were stored in test tubes in diffuse light at room temperature, e.g., about 70° F. The corresponding mayonnaises were stored in regular eight ounce jars along with the above test tubes of simple emulsions.

When making an examination the mayonnaises were tasted and then frozen for at least 48 hours, in order to break the emulsion. They were then thawed and the oil separated by centrifuging and examined for taste and flavor.

In the case of the oil and water emulsions, no attempt was made to taste the emulsions. They were frozen and the oils were recovered for taste and peroxide values.

By using this means of examining oils it is believed that a more accurate history of the aging of the oil is obtained than by aging the pure oil. Many additional factors appear to be operative in the spoilage reactions of an oil when it is contained in an emulsion, which factors are absent in bulk oil. This is probably due largely to the enormous surface the emulsified condition gives the oil. Also this surface is a water-solution interface which permits not only the moisture as such to accelerate the spoilage reactions, but brings any material which is soluble in the water phase into more intimate contact with the exposed oil surface. And finally, since the ultimate consumption of the oil is in some form of an emulsion in contact with water, aging tests should be conducted under similar conditions.

The peroxide values in millimoles, run according to Wheeler's<sup>3</sup> method on the cottonseed oils recovered from the simple emulsions after aging are shown in Table II. An attempt to record the results of a taste test are also included.

TABLE II  
Simple Emulsions Using Cottonseed Oil

Emulsion Series Number	Per Cent Salt	—Peroxide Values— Examination of Oil Removed from Emulsions (Millimoles) After			—Taste After—	
		14 Days	49 Days	80 Days	44 Days	80 Days
I	0.0	1.6	4.0	11.0	R	VR
II	0.1	2.3	1.6	3.5	SR	R
III	0.5	3.3	2.8	0.6	OK	R
IV	1.0	2.6	1.7	0.7	OK	R
V	3.0	2.2	..	1.0	OK	SR

The cottonseed oil used in the above emulsions was an unbleached, non-winterized oil which gave a peroxide value of 0.30 millimoles.

Attention by the writer,<sup>4</sup> has previously been called to the difficulties attendant upon following the rate of deterioration of oils in an emulsified condition. The results as expressed in peroxide numbers indicate an entirely different order of values in emulsified oils than in bulk oil, as shown by the above table.

Therefore it is highly probable that the splitting of the moloxide occurs at a lower level than in the bulk

<sup>1</sup>Paustian, A. F., *The Glass Packer* XII, 446-48, July, 1933.

<sup>2</sup>Kilgore, L. B., *The Glass Packer*, November, 1931, pp. 585-88.

<sup>3</sup>Wheeler, D. H., *OIL AND SOAP* 9, 89-97, 1932.

<sup>4</sup>Kilgore, L. B., *The Glass Packer*, May, 1933.

oil. Whether this is caused by the influence of the water-oil interface or by the large amount of oxygen immediately available or both, is only a speculation. The writer<sup>5</sup> has shown that a rancid flavor may develop at a very low peroxide value under certain conditions, particularly in the presence of limited amounts of oxygen. Unpublished data from this laboratory conclusively show that a relation between the peroxide value and rancidity exists under these conditions and even at these lower values. In other words, the development of taste rancidity is here preceded by a definite rise in the peroxide value of the oil, just as in the case of the oils aged as homogeneous compounds. This applies, of course, only to oils which do not contain an added chemical inhibitor which influences the course of the peroxide reactions.

Almond	Cottonseed, Re-	Perilla
Apricot Kernel	fined	Safflower Seed
Brazil Nut	Gorli Seed	Sesame
Beef Tallow	Hazel Nut	Shark Liver
Castor	Lard	Soy Bean
Chinese Vegetable	Lard Oil	Sunflower Seed
Tallow	Neatsfoot	Tea Seed
Corn, Crude	Olive	Tomato Seed
Carpotroche	Ergot	Pimento Seed
Chaulmoogra	Hempseed	Rapeseed
Cherry Kernel	Horse	Rapeseed, Blown
Chia Seed	Menhaden	Rice
Coconut	Mustard Seed	Rubberseed
Cod Liver	Linseed	Sardine
Cohune Palm	Palm Kernel	Seal
Cottonseed, Crude	Parsley Seed	Tung
Grapefruit Seed	Peanut	Wheat Germ
Almond	Linseed	Rapeseed
Carpotroche	Menhaden	Sardine
Chaulmoogra	Palm	Tea Seed
Cod Liver		

"Manufacture of chewing gum has been simplified through use of air conditioning. Vaults where postage stamps are stored have been air conditioned to eliminate loss through stamps becoming gummy and sticking together. Chickens kept in air conditioned houses increase in weight, lay more eggs. Candy companies use air conditioning in order to properly make certain candies. The uses are endless. We are amazed by the different utilizations of our units."

The results shown in the accompanying curves, drawn from the data presented in Table II, show that the presence of above three per cent of salt in the emulsions has a tendency to inhibit the spoilage of cottonseed oil. A high salt content appears to be desirable in that respect. It was also noted that those emulsions having little or no salt darkened much more than those having a high salt content; in fact, the series having the highest salt content, three per cent, did not darken at all and showed no surface polymerization.

The taste tests appear to correlate rather well with the change in peroxide values. Those oils which had been removed from the emulsions having a low salt content were markedly different in taste from the oils from the salty emulsions. In the case of "A," the lowest in salt

content, the oil had a bitter, rancid flavor, while the salty emulsions gave sweet oils.

The results which were obtained by using mayonnaises, checked very closely with the data obtained from the above simple oil and water emulsions. As previously shown, the mayonnaises were made according to a commercial type formula. All four were identical in all respects composition except that the amount of salt used was varied from 0.5-3.0 per cent as in the simple emulsions.

The mayonnaises were examined for development of rancidity after they had been stored for 52 days in 8 oz. jars in cartons in a laboratory closet. Three jars of each mayonnaise were used for the examinations. The results are given in the following table:

TABLE III  
Condition of Cottonseed Oil Mayonnaises After 52 Days

Sample No.	Per Cent Salt	Mayonnaise		Oils Recovered by Freezing
		Top Layer	Center	
A	0.5	Very Rancid	Rancid	Very Rancid—Inedible
B	1.0	Very Rancid	Rancid	Rancid—Bitter
C	2.0	Rancid	Slightly Rancid	"Off"—Edible
D	3.0	Rancid	Slightly Rancid	"Off"—Edible

The top layer, about one-fourth inch of each jar, was included as the top layer. In the case of 922 A, all three jars had a "crust" of deep yellow gum or polymerized material on the top. This "crust" was noted above in the case of the simple emulsions when no salt was used.

In conclusion, attention is called to the fact that the experiments here reported were conducted using cottonseed oil only. Although other vegetable oils are similar in their major deterioration reactions they do not appear to react alike to all types of preservative and stabilizing agents. Therefore the above results should not be construed to apply to other oils than the one used in this work.

#### Employment Service for the American Oil Chemists' Society?

THERE have been several requests for the appointment of an employment service for the American Oil Chemists' Society, and this is no new venture for technical societies and chemical groups.

Among those groups sponsoring service actively are the New York Chemists Club group, which has been outstanding in successful placement of men, and the Chicago section of the American Chemical Society.

Suggestion has been made that a small committee be appointed consisting of a member from the East, one from the Middle West and one from the South, allowing the applications and requests to clear through the chairman of the committee. A regular card system could thus be available for anyone in need of assistance, and members of the A. O. C. S. would have this service available to them without additional cost beyond the membership fee.

The president and the members of the governing board will particularly appreciate an expression from other members of the Society, covering such a service, and also suggestions as to the way that it may best be administered. If there is a sufficient demand for such a service, it will be inaugurated by the incoming president, following the meeting at New Orleans. It is believed that this service may become an asset to the Society.

<sup>5</sup>Kilgore, L. B., OIL AND SOAP, April, 1933, pages 66-68.

## Chicago—1934

A Century of Progress Exposition will re-open its gates to the world on June 1, 1934. It promises to be in every way a better and more spectacular Exposition than its 1933 predecessor which attracted nearly 22,500,000 visitors.

Improvements resulting from the experience of a previous year's operation will make it a more effective and smoothly functioning spectacle. Novelties and innovations unthought of a year ago will add freshness and new fascination to the Exposition.

A Century of Progress exerted such a profound influence during its 1933 operation that a demand for its continuance in 1934 was made by civic bodies, business organizations and leading citizens not only in Chicago, but elsewhere in the United States. The Exposition had the effect of encouraging education on a widespread scale. It benefited business materially; and was an important contributor to the nation's economic upturn.

More than \$38,647,836 was invested in the construction of buildings, the preparation and installation of exhibits, attractions and organization expense prior to its opening in 1933 by the Exposition and by governments, exhibiting corporations and concessionaires who participated.

A total of \$37,270,000 was spent by visitors for gate admissions and concessions. The Exposition sold 22,565,859 admissions, of which 245,403 tickets were unredeemed. The average expenditure per visitor on the grounds, exclusive of the 50 cent gate admission was about \$1.17.

The Exposition's physical plant, including all its unique buildings on Chicago's lake front, stands unimpaired.

The story of scientific discoveries that had such beneficial consequences will be told again. Man's increasing mastery over disease and milestones in the detection, cure and prevention of disease, will be dramatized. The development of modern housing and its possibilities of further adaptation will be shown in the Home and Industrial Arts exhibit.

Pavilions of foreign governments will house striking exhibits telling of their contributions to the progress of world science and industry, of the development of their arts and handicraft and their achievements in the advancement of culture and education. The resources, scenic attractions and industrial development of various states of the Union will again be interestingly depicted.

Every detail for the comfort, convenience, entertainment and amusement of the visitors at the lowest cost possible, is being given expert attention. The experience of operating the Exposition in 1933 has taught many valuable lessons. Wherever it is possible to do so, improvements are being made. Features which proved objectionable in last year's Fair are being eliminated in 1934.

All comfort stations and toilet facilities throughout the Exposition grounds will be free to the visiting public. During the 1933 Exposition a certain percentage of the toilet accommodations were operated by a concessionaire. The Exposition management has acquired control of all these conveniences, and is thus making certain that they will be free to visitors.

An improved and expanded system of transportation on the Fair grounds will be available to visitors. Buses, launches, gondolas and other picturesque craft on the lagoons, and roller chairs and jinrikishas manned by college boys will provide the major means of transportation.

Restaurant and eating facilities are being expanded. Establishments which proved popular in 1933 are being preserved and in addition numerous other attractive restaurants are being provided. These are planned to meet every taste and purse. Visitors are assured that they will be furnished food of the highest quality at reasonable prices and in pleasing surroundings.

Virtually the entire transportation system of the United States is cooperating in reduced rates to the Exposition again this summer.

All rail lines entering Chicago have terminals within a short distance of the grounds. During the 1933 Exposition the railroads brought 4,000,000 visitors to Chicago.

For motorists who drive to the Exposition, the parking and service accommodations will be the equal if not the superior of those which were available last year. Parking areas close to the various entrances will be in operation. The same courtesy and consideration which won friendship from the visitors last year will be extended again in 1934.

Adequate and comfortable hotel accommodations and quarters in private homes, and clubs will be available again for out-of-town visitors at economical rates. Meals in restaurants and hotels will likewise be priced within reach of the Exposition visitors.

The admission price to the grounds will again be 50 cents for adults and 25 cents for children. Admission to the concessions will be popular in price.

### Turpentine Cups Improved

Turpentine cups of clay, aluminum, or zinc have little if any effect in darkening the gum as it is collected, or the rosin made from the gum. This is one of the results of the first year of work at the Naval Stores Station at Lake City, Fla., the Bureau of Chemistry and Soils reports.

The station compared different types of cups, their deterioration, and the use of various protective coatings to prevent deterioration of new cups and restore the serviceability of old cups. The effect of metal dissolved from the cups on other properties of rosin remains to be studied.

No type of coating so far tested, whether of paint, varnish, lacquer or metal has entirely prevented contamination and darkening of the gum and rosin. This work, which will be continued, is part of the program to develop better turpentine cups from the standpoint of effect upon gum and rosin, initial cost, length of life, cost of handling, and rate of evaporation of turpentine from the cup. Operators are invited to visit the Naval Stores Station at Lake City and obtain first hand information on turpentine cups.

### New Device Removes Water from Turpentine

Turpentine should be "dried"—that is, the water should be removed from it—as soon as it is distilled. At the Naval Stores Station of the U. S. Department of Agriculture at Lake City, Fla., chemists have devised a simple and inexpensive apparatus which does this effectively. This turpentine dehydrator is made from an ordinary turpentine barrel filled with coarse salt, or "ice cream salt." The turpentine is run direct from the still into this apparatus and comes out dry, bright and clear. Turpentine dried in this way will not affect the glue of a storage barrel, and if stored in metal tanks the product will not be discolored by rust. Turpentine users prefer a product from which the water has been removed.

These dehydrators have already been installed by several producers who have reported to the Bureau of Chemistry and Soils that they are having less trouble with leakage and fewer turns at the ports. The Bureau estimates that general use of dehydrators is going to be worth \$100,000 annually to the turpentine producers of the South. A mimeographed circular showing how to make the turpentine dehydrator, and another showing how to install it with the covered separator may be obtained on request to the Naval Stores Station, Lake City, Fla., or to the Bureau of Chemistry and Soils, U. S. Department of Agriculture, Washington, D. C.

Since March 1, Darco Sales Corporation, formerly located at 45 E. 42nd St., New York, N. Y., has been occupying its new quarters on the fourteenth floor in the Lincoln Building, 60 E. 42nd St. The move was necessitated by the need for more commodious offices to handle the company's growing business.

Darco has pioneered many new developments in uses for its products not only in the oil and fat industries but also in many other fields, and the history of its success is a striking tribute to the painstaking research and persistent effort, which have characterized the Darco organization since its inception, to extend the application of its products.

### New Plant to Be Erected

Prompted by an increasing demand for Filtrol from both American and foreign sources, Filtrol Company of California has announced its plan for the construction of a new plant to be located in the Mid-Continent area. According to Lester L. Robinson, Chairman of the Board, and G. Howard Hutchins, President of the Filtrol organization, the exact site of the new plant has not been definitely determined yet, although there are three under consideration. Plans and specifications for the plant, which will have a larger capacity than the present California setup, are nearing completion. Bids on equipment and material will be called for in the near future.

Messrs. Robinson and Hutchins, in speaking of this contemplated expansion program, said: "The increasing demand for various brands of Filtrol not only in the Mid-Continent area, but on the Atlantic Seaboard, has necessitated this move on our part. The source of supply for the raw material from which Filtrol is manufactured is such that it will readily lend itself to delivery in the Mid-Continent section."

Filtrol is an acid-activated clay possessing high absorptive and decolorizing properties. It is sold under several brand names, two of which include Filtrol and Neutrol; the first for use in the refining of mineral oils; the second for the refining of animal and vegetable oils. Its use in the refining and bleaching of all types of animal, mineral and vegetable oils has proven so advantageous that it is being used by oil refiners on a world-wide basis.

### New Vice-President for C. P. P. Co.

J. A. Coulter, formerly general superintendent of the Colgate-Palmolive-Peet Company, has been elected vice-president in charge of production and a member of the company's board of directors, according to an announcement by S. Bayard Colgate, president. Mr. Coulter succeeds N. N. Dalton, who resigned on December 31, 1933.

Mr. Coulter has been connected with the company since 1923. He was located in the Milwaukee office until the time of the Palmolive-Peet merger, after which he became general superintendent.

### Paper Processing for Package Purposes

We regret the necessity of making some correction in the captions covering the machinery and equipment used in the above article by T. Linsey Crossley. The cuts were not labeled and we apparently put too much trust in the knowledge of a paper salesman and used the captions suggested by him.