Some Factors Affecting the Quality of Steam Rendered Lard

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IN SPITE of the recent popularity of hydrogenated vegetable fats and the curtailment of hog slaughter due to the drought and other causes, lard still remains preeminent in the shortening field. Its wide plastic range, high shortening power (the highest of any of the plastic fats), ease of digestibility, and the pleasing flavor which it imparts to the products in which it is used, place it in a unique position among the edible fats. It is doubtful if any other shortening may be successfully applied to as many and as diversified uses as lard. It has long been used in deep fat frying, in the making of pie crust, bread, biscuits, buns, and many kinds of cakes, as a constituent of oleomargarine and for numerous other purposes.

ABSTRACT

Data are presented which show the variation of free fatty acid content of steam rendered lard with rendering time, rendering pressure, and age of fat. Two rendering pressures were employed, 32 and 40 pounds gauge. Rendering time was varied from 7 to 10 hours in 1 hour increments. Fat held in the cooler for 24, 48, 72 and 96 hours was used as raw material. It was found that increasing any of the above factors results in increasing the free fatty acid content of the lard. Stability of the lard is not markedly influenced by the above factors within the limits given.

Although at present lard production is considerably below ordinary levels due to the factors already mentioned, this is unquestionably a temporary condition. There can be no doubt that within a comparatively short time hog slaughter will again increase to normal proportions and lard will resume its usual place on the market.

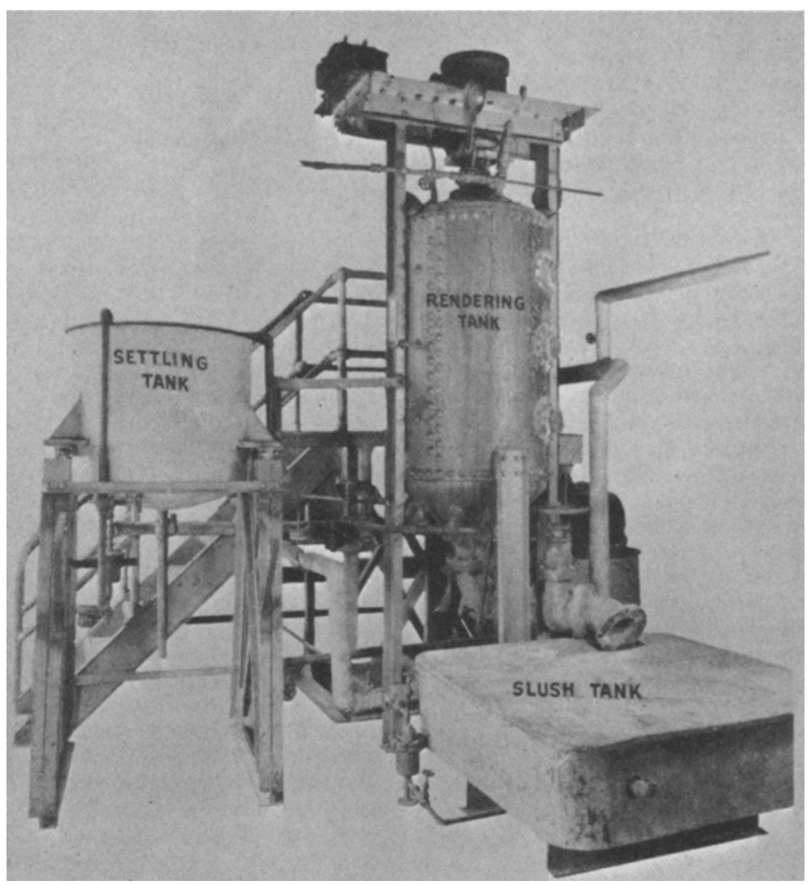
Lard offered for sale as such is produced by one of three general methods, i.e., open kettle, dry and steam or wet rendering. Although much can be said in favor of the first two methods, most of the lard offered on the market at the present time is produced by the latter process. This is due in a large measure to the fact that only prime steam lard is deliverable on the Chicago Board of Trade contracts.

Open kettle lard is rendered, as the name implies, in an open, steam jacketed kettle, equipped with an agitator. The fat is cooked until light brown cracklings float to the top of the rendering kettle. When fresh, high grade fats are used a high quality lard may be produced by this method.

Dry rendering is really a modification of the open kettle process. The raw material is cooked in a horizontal steam-jacketed tank equipped with rotating arms or paddles for the purpose of agitating the fat during the rendering process and to keep it from sticking to the inside of the shell. The moisture in the fat is exhausted to the atmosphere or drawn off under vacuum. In one modification of the dry rendering method, the vents are closed for a time to permit steam pressure to build up inside the tank. This steam pressure disintegrates the adipose tissue and sets free the fat. The moisture is then removed by venting and finally by the application of vacuum. If this method is properly controlled an excellent product will result.

Other variations of the dry rendering method have been introduced, among them being the so-called "circulating method," and the "drip methods." Both of these have been described elsewhere. (1, 2, 3.) So far as is known neither has yet met with wide acceptance in the industry.

Steam rendered lard is produced by cooking the fats by direct appli-



VIEW OF RENDERING APPARATUS

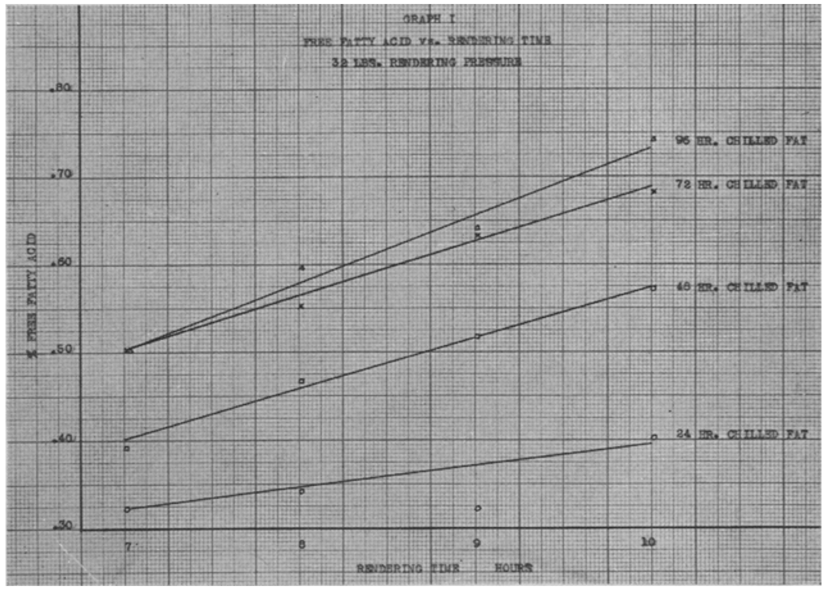
cation of steam under pressure in a tank with a cone-shaped bottom. When the charge has been completely rendered (in 7 to 10 hours depending upon the size of the charge, steam pressure used and other factors) the steam is shut off, the pressure slowly exhausted, and the contents of the tank allowed to settle. (Caution must be exercised at this point not to release the pressure too rapidly as this may cause a condition known as rolling which prolongs the settling operation and makes it difficult to obtain a clean cut separation of the lard and the tank water.) The settling operation requires from two to three hours for completion during which time the lard rises to the top and water and residual tissue sink to the bottom. The lard is then drawn off, extreme care being taken to avoid contamination with tank water. Properly settled lard will not contain more than 0.2-0.3% of moisture. Steam lard may be further processed before packaging but this is not properly considered a part of the rendering process.

Since the greater proportion of lard produced at the present time is steam rendered, and there seems to be little likelihood of much change in the near future, it is evident that the control of quality of such lard is a matter of the greatest importance to lard producers. While it is recognized that the quality of lard is a function of a number of factors, some of the more important are the age of fat, rendering time and rendering presssure.

Experimental

Bearing these facts in mind a series of experiments was performed with the intention of studying the effect of these three factors on the resulting prime steam lard. The work was done on a semi-plant scale in a rendering tank of approximately 600 pounds capacity located in the Chemical Research Laboratories of Armour and Company. This tank is an exact replica of larger scale equipment except that it is fitted with an agitator. The agitator was not used during these experiments, however. The illustration on page 60 shows a general view of the rendering tank and auxiliary equipment.

As was previously stated the conditions varied were age of fat, rendering pressure and rendering time. Two rendering pressures were used, 32 and 40 pounds gauge. Rendering time was varied from 7 to 10 hours in 1 hour increments. The following runs are reported:



GRAPH I

24-hour chilled fat—1 run each at 32 and 40 pounds pressure and rendered for 7, 8, 9 and 10 hours respectively.

48-hour chilled fat—2 runs each at 32 and 40 pounds pressure and rendered for 7, 8, 9 and 10 hours respectively.

72-hour chilled fat—2 runs each at 32 and 40 pounds pressure and rendered for 7, 8, 9 and 10 hours respectively.

96-hour chilled fat—2 runs each at 32 pounds pressure and rendered for 7, 8, 9 and 10 hours respectively.

To make every run as nearly comparable as possible the same kind of fat was used in each case. Following is the mixture of cutting fats used:

Belly fat	250 lbs.
Back fat	125 lbs.
Shoulder fat	100 lbs.
Tail and Flank fat	100 lbs.
Loin fat	25 lbs.
Total	600 lbs.

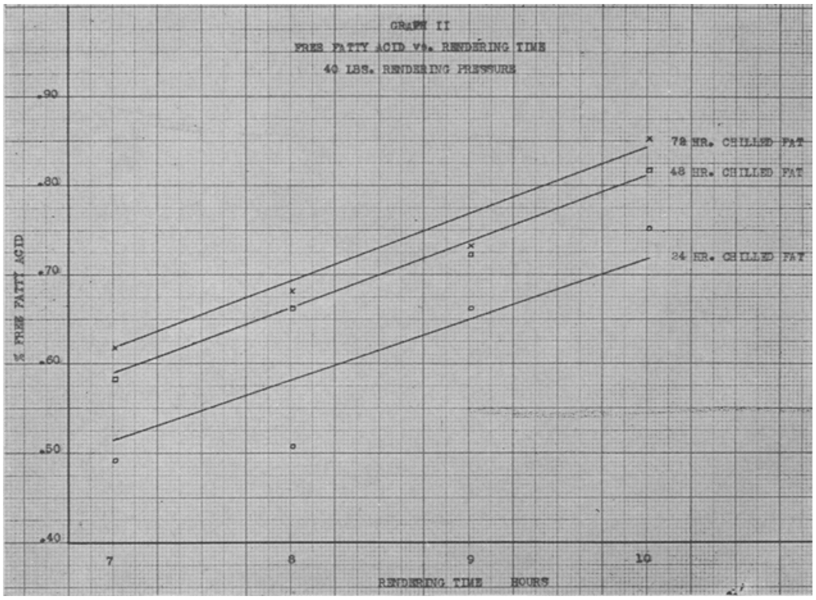
This mixture was selected for convenience and because it contained the commoner cutting fats in representative proportions.

Throughout this work every effort was made to simulate as closely as possible actual plant conditions. It will be noted that more runs are reported with 48 and 72-hour chilled fats than with 24 and 96-hour fats. This is due to the greater availability of the former. In usual packing house practice hog carcasses are chilled from 48 to 72 hours and consequently most of the cutting lard is produced from fats of this age. It was necessary to chill a number of hog carcasses specially in order to obtain the fat for each of the 24-hour batches. The 96-hour fat was obtained whenever available and enough was secured throughout the duration of these experiments to make two complete sets of runs at 32 pounds pressure.

After the lard was rendered holding test samples were put down on one representative batch from each group except the 24-hour chilled fats. The samples were stored at average room temperature (70-80° F.) in two-pound slip cover pails and one-pound hermetically sealed cans. After one month the samples were inspected weekly until definitely rancid to the taste and smell. Results are recorded to the nearest five days. At least two persons inspected each sample and an agreement was reached before grading. An accelerated rancidity test was also made on each of these samples and a good correlation of results obtained.

Free fatty acid was also determined as shown in Tables 1 and 2 (page 62).

Graph I shows the free fatty acid content plotted against rendering time in hours for 32 pounds rendering pressure. Graph II shows the same data for 40 pounds rendering pressure. Each of the points on the curves for 48 and 72-hour fats is the average of two determinations. Each of the points on the 96-hour curve is also the average of two determinations. The points on the 24-hour curves represent single determinations. The reasons why more runs were made



GRAPH II

on some types of fat than on others have been explained previously.

It will be noted that the trend of the free fatty acid content is upward in each case as the rendering time increases. Also in almost every case the older the fat the higher is the free fatty acid content. It will also be observed that in general the free fatty acid content is considerably higher when 40 pounds pressure is used instead of 32 pounds.

With regard to stability however, the same correlation cannot be found. There does not seem to be any definite relationship between any of the factors outlined above and stability as measured by actual holding tests. While it is admitted that individual peculiarities of the observer may influence the results somewhat we believe that actual holding tests constitute the best method of measuring the stability of any fat.

Conclusions

From a study of the foregoing data the following conclusions were drawn:

1. The free fatty acid content of prime steam lard is a function of three factors, rendering time, rendering pressure and age of fat.

2. The longer a batch of fat is rendered the higher will be the free fatty acid content of the lard. Apparently for best results the rendering time should be no longer than is compatible with satisfactory yields.

3. Increasing the rendering pressure results in increasing the free fatty acid content of the lard.

4. Age of fat is an important factor in the free fatty acid content of steam rendered lard. Other things being equal, the longer the hog is held in the cooler after slaughter, the higher will be the free fatty acid content of the lard rendered from the fat.

5. The stability of steam rendered lard does not seem to be greatly influenced by any of the above mentioned factors.

BIBLIOGRAPHY

1. Wurster, Soap 7, 79-82, 93 (No. 12, 1931).
2. Wurster, Oil & Fat Ind. 7, 432-6 (1931).
3. Anon., Nat. Prov. 91, 7-9, 22 (1934).

TABLE NO. 1
32 Lbs. Rendering Pressure

Run No.	Rendering Time Hours	% F.F.A.	Stability* Slip Cover Pails	Stability* Hermetically Sealed Cans
		24 Hour Chilled Fat		
69	7	0.32		
70	8	0.34		
71	9	0.32		
72	10	0.40		
		48 Hour Chilled Fat	Days	Days
9	7	0.38	45	90
10	7	0.40		
12	8	0.46	45	85
49	8	0.48		
13	9	0.50	45	105
51	9	0.55		
16	10	0.60	40	95
41	10	0.54		
		72 Hour Chilled Fat	Days	Days
33	7	0.50	60	85
34	7	0.50		
3	8	0.56	45	80
4	8	0.54		
6	9	0.64	40	80
37	9	0.62		
8	10	0.68	55	115
47	10	0.68		
		96 Hour Chilled Fat		
56	7	0.50		
57	7	0.50		
54	8	0.61		
55	8	0.58		
29	9	0.68		
30	9	0.60		
45	10	0.70		
46	10	0.78		

*Approximate number of days required for rancidity to develop.

TABLE NO. 2
40 Lbs. Rendering Pressure

Run No.	Rendering Time Hours	% F.F.A.	Stability Slip Cover Pails	Stability Hermetically Sealed Cans
		24 Hour Chilled Fat		
73	7	0.49		
74	8	0.51		
75	9	0.66		
76	10	0.75		
		48 Hour Chilled Fat	Days	Days
19	7	0.58	60	110
20	7	0.58		
21	8	0.66	50	110
62	8	0.65		
23	9	0.76	45	100
64	9	0.68		
79	10	0.82	60	130
80	10	0.82		
		72 Hour Chilled Fat	Days	Days
18	7	0.62	60	75
59	7	0.61		
25	8	0.66	45	80
26	8	0.70		
27	9	0.72	50	95
68	9	0.74		
32	10	0.98	65	100
78	10	0.72		