the Roese-Gottlieb and Modified Babcock method. The maximum variation on the three sets is considerable by both methods, showing that it is somewhat more difficult to obtain as uniform results as are obtained on fresh samples unless they have been kept at or below freezing temperature.

To eliminate this difficulty as much as possible, 18-gram charges are used. The method of mixing ice cream samples after standing some time was also given careful attention.

METHOD OF MIXING ICE CREAM SAMPLES AFTER STANDING SOME TIME

Ice cream samples which have been kept in a refrigerator or in cooling rooms for some time are not readily sampled for uniform charges unless some precautions are taken. This is especially necessary when the ice cream has melted somewhat and the cream risen to the top, forming a layer. Thus to obtain a uniform charge, the author found it convenient to dip the sample jar in a pan of hot water at about 70° to 80° C. with gentle shaking, until it had approximately attained the temperature, as felt by the hand, of freshly drawn milk (98° F.). Carefully shake and mix until of a uniform consistency. This occurs and will be shown when the mixture runs freely down the sides of the glass container and no lumps are seen.

There is danger of the fat separating and rising to the top of the sample if it is heated too long or much above 80° C. This condition makes uniform sampling impossible and is to be avoided.

SUMMARY

1. The ice cream itself may not be perfectly uniform. This may not be noticeable except on the paddles of the freezer. The extent of "churning" in these samples was, of course, small.

2. In taking charges from preserved ice-cream samples which have stood in a cooler so that the cream rises, not perfectly uniform charges can be obtained. This, it appears, causes a slightly greater variation in the fat reading with a tendency to run somewhat lower.

3. The mixing of ice-cream samples should be carefully performed, especially when they have stood so that the cream has risen to the top.

MISSOURI DEPARTMENT OF FOOD AND DRUG INSPECTION
COLUMBIA

SOME EFFECTS OF FEEDS UPON THE PROPERTIES OF LARDS. II

By C. L. HARE

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In a former paper¹ the writer described the effects of a number of different feeds upon the melting points and iodine values of lard. In the present paper are given results obtained during the examination of more than two hundred lards produced by feeds of different kinds. The lards are from six series of feeding experiments extending over a period of five

years and have been furnished by the Department of Animal Industry of the Alabama Experiment Station. These investigations have been conducted in coöperation with Prof. Dan T. Gray, of that department.

In continuing the investigations, attention has again been confined largely to melting points and iodine values as these are the two constants—so called—most affected by different feeds. The feeds used have been corn, cottonseed meal, tankage, wheat shorts, cowpeas and skim-milk for certain lots, while still other lots received a pasture ration of soy beans or peanuts *ad libitum*, accompanied or followed by a part ration of other feeds as indicated in the tables. In order to have the results comparable, the pigs throughout the experiment were selected with regard to uniformity of age, weight and breed, and all lards were rendered from the kidney fat.

For purposes of convenient comparison, the results published in the first paper have been placed beside the later results. The feeds used with each separate lot of pigs in each series are specifically set out in the tables of results. Results on the individual lards in each series have been condensed to the averages for the series and the tables show such averages. Each series represents the experimental work of one year.

It will be shown below that—within reasonable limits—the age of the pig has little effect upon the properties under consideration. The same may be said of the duration of the feeding test, though this is not true for all feeds. We are therefore warranted in accepting the average results as representative. Results reported on individual lards would merely multiply figures without giving additional information.

In every case melting-point determinations were made by the Wiley method while the Hanus method was used for the determination of the iodine values.

Lards from corn-fed pigs constitute the bulk of the pure lard on the market and are used here as the standard for comparison of lards from other feeds. In Table I are given results on lards from twenty corn-fed pigs.

TABLE I—RATION: CORN MEAL

Series	No. of lards	Melting points	Iodine values	
			Max.	Min.
1.....	5	42.6	56.92	58.68
2.....	5	43.7	54.05	56.57
3.....	3	43.4	62.65	64.79
4.....	2	43.3	57.01	57.87
5.....	5	42.6	60.94	65.04
Average of 20 lards,		43.1	58.08	
Maximum		45.6	65.04	
Minimum		40.5	51.50	

The iodine value 58.08, being the average of determinations on lards from 20 pigs, confirms the conclusion in the previous paper that corn does not produce abnormally soft lards. The variations in the iodine values from year to year may be possibly, though not probably, explained by variations in the composition of the corn. No analysis was made of the corn

¹ THIS JOURNAL, 2, 264.

fed. The differences due to the individuality of the animal are well known and the maximum and minimum results in each series show no greater divergence than might be expected.

Tables II and III illustrate the notable effect of cottonseed meal upon the melting points and iodine values.

TABLE II—RATION: CORN 2/3, COTTONSEED MEAL 1/3

Series	Number of lards	Melting point	Iodine value	
			Max.	Min.
1.....6	48.6	56.14	61.00	53.57
2.....4	49.9	50.37	51.60	48.44
Average 10 lards,	49.1	53.83		

TABLE III—RATION: CORN 9/10, COTTONSEED MEAL 1/10

Series	No. of lards	Melting point	Iodine values	
			Max.	Min.
2.....5	48.7	52.85	53.80	50.60
3.....1	48.4	49.23		
4.....4	49.1	55.31	60.56	51.28
Average 10 lards,	48.8	53.47		

A review of the figures in the two tables indicates that a high cottonseed meal ration produces no greater changes in the characteristics of the fat than does a low ration of this feed. Both tables might well be grouped in one. The average of the melting points of the 20 cottonseed meal lards is about 6° C. higher than the average for the 20 corn lards, while the iodine values average nearly five points lower.

Another high protein ration which contributes to lards properties similar to those conferred by cottonseed meal is tankage.

In Tables IV and V are found results on 39 lards from pigs fed on a ration made up in part of tankage.

TABLE IV—RATION: CORN 4/5, TANKAGE 1/5

Series	No. of lards	Melting point	Iodine values	
			Max.	Min.
4.....4	44.5	57.08	63.98	52.75
4a.....5	43.7	57.52	60.16	52.70
5.....3	44.1	56.15	59.22	54.28
Average 12 lards,	44.1	57.03		

TABLE V—RATION: CORN 9/10, TANKAGE 1/10

Series	No. of lards	Melting points	Iodine values	
			Max.	Min.
1.....5	43.6	56.46	59.08	50.06
2.....6	42.5	55.15	58.80	49.85
3.....4	44.4	56.04	61.29	52.26
4.....25	43.5	57.85	71.79	53.48
5a.....7	44.8	56.89	65.04	54.54
Average 27 lards,	43.9	56.58		

This ration produces scarcely so great a hardening effect upon the lards as does cottonseed meal. In fact there is no great difference between the lards produced from corn alone and those from corn with tankage. The tankage lards have a better appearance and are somewhat firmer, despite the nearness of the melting points and iodine values of the two sets. As was the case with cottonseed meal, small quantities of tankage in the ration—within the limits used—seem to bring about almost as great changes in the properties as do larger amounts.

The influence of still another ration relatively high in protein, cowpeas, was tested in one series of feeding experiments. Three pigs were slaughtered from

a ration of corn and cowpeas. The number of pigs is too small to justify definite conclusions, but the results are given below:

TABLE VI—RATION: CORN 4/5, COWPEAS 1/5

Series	Lab. No.	Melting point	Iodine values
5.....	160	42.9	60.86
	161	44.8	53.95
	165	42.2	58.23
Average,		43.3	57.35

In this experiment there was also carried a lot of five pigs pastured on corn and cowpeas.

The results on lards from these pigs are shown in Table VII:

TABLE VII—RATION: PASTURE OF CORN AND COWPEAS

Series	Lab. No.	Melting point	Iodine values
5a.....	1	45.4	53.95
	2	42.5	57.42
	3	44.8	56.59
	4	43.0	56.59
	44	46.4	57.25
Average 5 lards,		44.4	56.36

These figures confirm other experiments which indicate that cowpeas contribute firmness to lards. It was thought that the pastured corn and peas would perhaps yield softer lards than the same ration fed as grain, but the lards from the two rations possess essentially the same properties. The average of the melting points and iodine values of the eight lards is 44 and 56.73. These results are nearly the same as the corresponding results for the 20 corn lards, the slight differences being in favor of the lards from the cowpea ration.

In Table VIII are given some inconclusive figures illustrating the effect of wheat products:

TABLE VIII—RATION: CORN 2/3, WHEAT SHORTS 1/3

Series	Lab. No.	Melting point	Iodine values
4.....	2	42.0	59.51
	17	41.5	60.00
	16	42.8	58.26
	67	43.4	57.29
		Average,	58.74
5.....	166	41.6	65.40
	176	40.0	64.02
	180	40.3	63.96
	181	40.1	64.02
	183	42.0	62.64
		Average,	64.00
5a.....	4	43.9	57.25
	1	44.3	56.23
		Average,	56.74
Average 11 lards,		42.4	60.78

It is probable that the results in Series 4 and 5a represent most nearly the true effect of the wheat in the ration. The average iodine value of the lards in these two series is practically the same as that of the 20 corn lards. Those in Series 5 are unquestionably high. Three of the corn lards in this series gave an average iodine value of 64.70. No attempt is made to explain these abnormally high figures. As has already been suggested, there may be some connection between them and the composition of the corn used in the feeding experiments of that year. Although such necessarily slight differences as would occur in the composition of corn from different sections or of

different years growth would hardly be expected to make so great a difference in the characteristics of the lards produced therefrom. In this connection it is noted that the pigs in each series of the corn and shorts experiments received corn from different sources.

The effect of skim-milk in producing firm pork and firm lard is well known. The figures in the following table are in accord with previous results on lards produced by a ration containing that food:

TABLE IX—RATION: CORN 1 LB., SKIM-MILK 2 1/4 LBS.

Series	Lab. No.	Melting point	Iodine values
5.....	119	43.0	58.26
	177	42.8	57.92
	179	40.3	65.40
	182	42.8	57.25
Average.		42.2	59.71

No. 179 yielded abnormal results, which may be explained by individual characteristics of the pig.

In Chart No. 1, below, is shown the course of the curves of the iodine values and melting points of lards from the six feeds considered to this point, using the corn lards as the standard.

The curves represent the assembled results obtained from 97 lards, all of which were examined under similar conditions. They constitute a good illustration of the relative courses of the curves for melting points and iodine values. It is probable that the curve of the skim-milk lards does not represent a normal lard produced by that feed, as the iodine values are perhaps too high for such a lard. The striking effect of soy beans in producing oily lards is shown in the three following tables:

TABLE X—RATION: SOY BEAN PASTURE AND CORN 1/4 RATION

Series	Lab. No.	Melting point	Iodine value	Feeding period Days
2.....	34	....	100.50	35
3.....	76	....	94.86	75
4.....	10	....	113.31	81
Average 3 lards,			102.89	

TABLE XI—RATION: SOY BEAN PASTURE AND CORN 1/2 RATION

Series	Lab. No.	Melting point	Iodine value	Feeding period Days
1.....	125	....	71.09	35
2.....	23	....	80.60	35
3.....	87	....	82.70	75
4.....	23a	....	86.20	81
Average 4 lards,			80.18	

TABLE XII—RATION: SOY BEAN PASTURE AND CORN 3/4 RATION

Series	Lab. No.	Melting point	Iodine value	Feeding period Days
2.....	15	....	79.00	35
3.....	68	....	84.32	75
4.....	35	....	65.69	81
Average 3 lards,			76.34	

Inspection of the three tables reveals the fact that soy beans yield lards with much higher iodine values and degrees of fluidity than have been found recorded in the literature of the subject. Only a small amount of solid fat separates from the lard possessing an iodine value of 113.31.

The results further show in a striking manner that diminishing the corn ration rapidly increases the oiliness of the lards. This is well illustrated in the curves charted below. The curves also illustrate the remarkable effect of this food in producing fats containing large amounts of unsaturated acids.

The value of corn as a corrective for oiliness is further demonstrated in the following table, which includes (1) lards from one lot of pigs off soy bean pasture and 1/4 ration of corn and (2) lards from a second lot fed on the same ration for the same length of time but afterwards finished on corn:

TABLE XIII—PRELIMINARY RATION: SOY BEAN PASTURE AND 1/4 CORN

Series	No. of lards	Melting points	Iodine value	Finishing ration	Feeding period Days
2, 3 and 4.....	3	....	102.89		35-75
3 and 4.....	7	40.7	75.24	corn	28-73

The pigs on the preliminary ration produced extraordinarily soft lards. Following this a full corn ration has, at the end of one month, materially hardened the fat, and the average iodine values of the 7 lards from pigs finished on corn is 25 per cent lower than that of the soy bean lards. The hardening effect on lards of cottonseed meal as a finishing ration for pigs pastured on soy beans is not as striking as would be expected from results on lards produced from a simple ration of corn and cottonseed meal. Comparative figures are given in Table XIV.

TABLE XIV—PRELIMINARY RATION: SOY BEAN PASTURE AND 1/2 RATION OF CORN

Series	No. of lards	Melting point	Iodine values	Finishing ration	Feeding period Days
2, 3 and 4.....	4	....	80.18		35-81
3 and 4.....	4	45.2	72.61	corn and cottonseed meal	28-64

Cottonseed meal in the finishing ration seems, in this case, to have no greater influence in changing the nature of the fat than does corn. The same statement may be made with regard to tankage and is borne out by the figures given below:

TABLE XV—PRELIMINARY RATION: SOY BEAN PASTURE AND 3/4 RATION OF CORN

Series	No. of lards	Melting point	Iodine values	Finishing ration	Feeding period Days
2, 3 and 4.....	3	.....	76.34		35-81
3 and 4.....	7	42.5	71.93	corn and tankage	35-75

It was to be expected that either cottonseed meal or tankage in the finishing ration would have influenced the properties of the lards more decidedly than corn as the finishing ration. Such would probably have been the case if the fats finished on these rations had been as strikingly soft as the fats finished on corn.

The softening effect of peanuts is well known. The relative effects of soy beans and peanuts is in some measure indicated by the figures in Table XVI. The first lot of 10 lards are from pigs slaughtered from soy bean pasture and a part ration of corn. The second lot of three lards are from pigs fed the same ration followed by peanut pasture and 1/2 ration of corn.

TABLE XVI

No. of lards	Melting point	Iodine values	Ration
10		85.84	Soy beans and corn 35 days
3		85.49	{ Soy beans and corn 35 days Peanuts and corn 35 days

These figures would seem to indicate that peanuts have nearly the same effect as soy beans. The physical appearance of the lards in the two sets is much the same, all being nearly fluid or semi-fluid. Investigation showed that the properties of such lards may be readily changed under the influence of rations of corn, cottonseed meal or tankage.

This is indicated by the figures given in Table XVII.

TABLE XVII—PRELIMINARY RATION: SOY BEAN PASTURE AND PART CORN 35 DAYS, FOLLOWED BY PEANUT PASTURE AND PART CORN 35 DAYS

Series	No. of lards	Melting point	Iodine values	Finishing ration	Feeding period Days
2.....	4	.....	85.49		
2.....	3	37.6	75.61	corn	14-64
2.....	3	41.2	75.64	corn and cotton-seed meal	14-64
2.....	3	41.5	72.26	corn and tankage	15-64

Only the averages of the three lards in each set are given. The melting points and iodine values of the individual numbers in each set indicate increasing firmness with length of time fed, the greatest relative increase being noted in the first fourteen days. It may be said here that this is true in every case where a ration is used to finish and firm the fat.

Throughout these experiments observations have been made as to the influence of age of the pig upon the properties of lard. It is perhaps the general belief that young pigs yield lards which vary materially in properties from those produced from older animals. Records have been kept upon lards from 85 pigs varying in age from four to eight months at time of

slaughtering and the results seem to indicate a fair degree of uniformity in the lards produced by the same feeds, without regard to age of the animal. The influence of age can scarcely be measured where such feeds as soy beans and peanuts have been used as they produce lards which are in every respect abnormal. Detailed results on the 85 lards are set forth in the following tables. The lards are grouped in each table in accordance with feed from which they were produced:

TABLE XVIII—CORN LARDS

AGE OF PIG											
4 mo.			5 mo.			6 mo.			7 mo.		
M. P.	I.	Val.	M. P.	I.	Val.	M. P.	I.	Val.	M. P.	I.	Val.
43.1	56.50	43.5	43.8	53.87	43.4	58.68	44.2	57.60	41.6	57.37	
.....		44.8	51.50	44.0	49.70	43.0	56.00	40.5	57.10		
.....		42.8	64.79	42.1	57.87	44.4	63.08	43.0	60.07		
.....			45.6	53.98	44.5	56.16	.....	56.57			
.....					43.0	58.56	.....	.....			
.....					41.5	64.98	.....	.....			
.....					43.2	65.04	.....	.....			
.....					40.5	64.02	.....	.....			
.....					42.0	59.28	.....	.....			
Av.	43.1	56.50	43.8	56.69	43.8	55.06	43.0	60.52	41.7	57.77	

TABLE XIX—CORN AND COTTONSEED MEAL LARDS

47.7	61.00	49.8	53.57	49.3	53.57	48.3	57.58	50.0	55.16	
49.2	48.44	50.8	51.20	....	....	49.6	50.22	46.8	55.95	
....	....	48.6	53.80	50.0	51.60	47.6	55.00	49.0	52.00	
....	....	....	....	48.4	50.60	48.8	56.89	48.8	60.56	
....	....	....	....	48.4	49.23	49.1	52.50	....	....	
....	....	....	....	49.6	51.28	....	....	....	....	
Av.	48.5	55.31	49.7	52.86	49.2	51.22	48.7	54.44	48.7	55.92

TABLE XX.—CORN AND TANKAGE LARDS

43.1	59.08	45.6	50.06	42.5	56.59	41.6	57.80	45.1	57.77	
....	49.85	43.0	56.80	42.9	56.53	42.6	61.29	45.4	53.61	
47.2	55.21	43.0	57.92	42.2	52.40	44.5	52.26	41.3	63.98	
44.4	54.54	44.9	54.86	41.4	58.80	44.9	55.67	42.0	61.17	
43.1	65.09	45.0	55.56	45.1	57.02	45.9	52.75	43.3	57.78	
46.2	54.88	....	....	45.9	55.92	45.3	53.48	43.6	59.77	
....	....	....	....	45.7	56.41	40.9	60.32	....	....	
....	....	....	....	44.0	54.28	46.0	52.70	....	....	
....	....	....	....	....	....	43.8	57.29	....	....	
....	....	....	....	....	....	41.6	60.16	....	....	
....	....	....	....	....	....	43.3	54.94	....	....	
....	....	....	....	....	....	45.0	59.22	....	....	
....	....	....	....	....	....	....	56.53	....	....	
Av.	44.8	56.44	44.3	55.04	43.7	56.00	43.8	56.60	43.5	59.01

TABLE XXI—CORN AND SHORTS LARDS

43.9	57.25	44.3	56.23	42.0	59.61	42.8	58.26	43.4	57.29
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It is seen from the results on the individual lards as well as from the averages, that pigs eight months old yield lards with essentially the same melting points and iodine values as those from pigs four months old. The number of four-month old pigs in each set is small but the total recorded number is 10 and only two lards in the lot of ten show higher iodine values than the lards from older pigs in the same sets. The influence of age is well illustrated in the curves plotted in the charts on page 414.

In addition to the study of influence of age, the following notes have been made upon the effect of high, medium and low protein rations upon the lards produced from each. The feeds were made up so as to contain about 10 per cent, 15 per cent, and 20 per cent protein. Results on the lards from low protein rations are not altogether comparable with those from the medium and high protein rations for the reason that the nature of the feed furnishing the protein

is different. However, the results on the medium and high protein feeds are entirely comparable, as

the same food materials were used in mixing the rations. Lards from 77 pigs have been tabulated.

TABLE XXII—LARDS PRODUCED FROM HIGH, MEDIUM AND LOW PROTEIN RATIONS

Percentage of protein	No. of lards	Melting point	Iodine values	Ration
10	20	43.1	58.08	Corn
10	6	42.8	58.09	Corn and shorts
15	10	48.7	52.47	Corn and cottonseed meal
20	10	49.3	53.15	Corn and cottonseed meal
15	25	43.9	56.58	Corn and tankage
20	12	44.1	57.03	Corn and tankage

Comparing the 10 per cent protein rations with the others, it is found that the melting points are

lower and the iodine values higher than in the other sets. This, however, is to be expected from the nature of the feeds used.

Examining next the medium and high protein rations, comparison shows that lards from a 15 per

cent protein ration composed of corn and cottonseed meal possess essentially the same melting points and

iodine values as do the lards from a mixture containing 20 per cent protein from the same source. The same is found to be true of lards produced by 15 per cent and 20 per cent protein rations made up from corn and tankage.

Before making any positive statements it would be

desirable to secure results from a series of experiments designed to include a larger number of rations with varying amounts of protein from the same source. The data recorded, however, strongly indicates that the amount of protein in the feed has little influence upon the properties here studied.

SUMMARY

A general review of the information here presented leads to the following conclusions:

1. Corn, and mixed feeds containing corn with wheat shorts, skim-milk, or cowpeas, produce fats which possess like properties.

2. Tankage produces a slightly firmer fat, while cottonseed meal produces fats which contain small amounts of unsaturated acids and which may remain solid at temperatures of 100° F. or above.

3. The two legumes, soy beans and peanuts, produce lards which contain extreme amounts of unsaturated acids and are fluid at ordinary temperatures.

4. Fats change in composition with remarkable readiness under the influence of certain feeds, small amounts of these feeds producing striking changes in the properties of the fats.

5. Between the ages of four months and eight months, age of the animal has essentially no influence upon the properties of the lard.

6. Using feeds differing as much as 5 per cent in protein content, there is observed no change in the properties of the lards produced therefrom.

7. With the advent of the various new feeds used in pork production, the iodine absorption number of a lard possesses no value as a means of detecting adulteration.

Acknowledgment is made to G. H. Marsh and J. B. Jackson, of this laboratory, for the large amount of analytical work performed during these investigations.