

## QUANTITATIVE ESTIMATION OF ADULTERANTS IN LARD.

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THE progress of qualitative analysis has rendered it possible for the skilled analyst at the present time to detect with certainty every commercial adulteration of lard. It is probably true that laboratory adulterations amounting to only 2 or 3 per cent. may escape the quest of the skilled chemist ; but when adulterations are made for commercial purposes the amount of adulterant added is always in sufficient quantities to render its qualitative detection easy. For quantitative purposes, however, the matter is not so readily determined. For practical purposes the two adulterants which are used in making compound lards are cotton oil and the stearines derived by pressing partially crystallised lard or tallow. The first of these stearines is usually called prime lard stearine, and the second oleo-stearine. The following methods have been proposed for the quantitative detection of these adulterants.

1. *The amount of insoluble residue obtained upon treating the samples with a mixture of ether and alcohol.*—This method, as was shown in the celebrated trial of McGeoch, Everingham & Co., against Fowler Bros., in Chicago, was wholly unreliable, and it may be dismissed from the category of useful methods.

2. *The specific gravity.*—This method has great value, and may be relied upon to give approximate results.

3. *Absorption of iodine.*—This method would be an excellent one for determining the amount of cotton oil added to a lard, provided that no stearine was present; but the careful addition of cotton oil and stearine will enable the mixer to make a lard whose iodine number is almost identical with that of the pure article.

4. *The rise of temperature which samples undergo when mixed with sulphuric acid.*—This process, devised by Maumené, may give valuable information in regard to the quantity of adulterants added. Unfortunately, however, it is open to the same objection as lies against the iodine method, viz., the rise of temperature with the stearine is much less than that with lard, so that by the addition of stearine and cotton oil a mixture can be made in which the rise of temperature is not very much greater than that produced by lard itself.

5. *Melting point of the samples.*—This method is of but little practical benefit when taken alone. Mixtures of lard and cotton oil do not show a mean melting point as indicated by theory. Cotton oil melts one or two degrees below zero, while pure lard melts at about 40°. A mixture of equal quantities of these two substances shows a theoretical melting point of 20°. Such a mixture, however, will melt only a few degrees below the fusing point of pure lard.

6. *Refractive index.*—I am not aware that the refractive index has been used as a method of quantitatively approximating the amounts of cotton oil and stearine added, and I propose to say a few words in regard to its value in this respect. Fourteen samples of lard, known to be pure hog-grease, examined in my laboratory, gave the following mean data:—

Refractive index	..	..	..	..	..	1.4620
Percentage of iodine absorbed	..	..	..	..	..	62.48
Specific gravity at 35°	..	..	..	..	..	.9053
Rise of temperature with sulphuric acid	..	..	..	..	..	41.5°
Melting point	..	..	..	..	..	40.7°

Eleven samples of steam lards passed by the Chicago Board of Trade gave as a mean the following data:—

Refractive index	..	..	..	..	..	1.4623
Percentage of iodine absorbed	..	..	..	..	..	62.86
Rise of temperature with sulphuric acid	..	..	..	..	..	39.9°
Specific gravity at 35°	..	..	..	..	..	.9055
Melting point	..	..	..	..	..	37°

Thirteen samples of Armour's mixed lards gave the following data:—

Refractive index	..	..	..	..	..	1.4634
Percentage of iodine absorbed	..	..	..	..	..	63.58
Rise of temperature with sulphuric acid	..	..	..	..	..	46.5°
Specific gravity at 35°	..	..	..	..	..	.9060
Melting point	..	..	..	..	..	40.6°

Sixteen samples of Fairbank's mixed lards gave the following data :—

Refractive index	..	..	..	..	..	1.4651
Percentage of iodine absorbed	..	..	..	..	..	85.31
Rise of temperature with sulphuric acid	..	..	..	..	..	57.9°
Specific gravity at 35°	..	..	..	..	..	.9095
Melting point	..	..	..	..	..	38.1°

Sixteen samples of purified cotton oil gave the following data :—

Refractive index	..	..	..	..	..	1.4675
Percentage of iodine absorbed	..	..	..	..	..	106.84
Rise of temperature with sulphuric acid	..	..	..	..	..	83.7°
Specific gravity at 35°	..	..	..	..	..	.9145

Making use of these data, we reach the following results :—

Determined by the rise of temperature with sulphuric acid, Fairbank's lards contained 32.80 per cent. of cotton oil, and Armour's 11.39 per cent. Calculating from their respective specific gravities, Fairbank's lard contained 45.65 per cent. of cotton oil, and Armour's 7.60 per cent. Determined by the iodine absorption alone, Fairbank's lard contained 52.29 per cent. cotton oil, and Armour's 3.6 per cent. As determined by the refractive index, Fairbank's lard contained 56.36 per cent. cotton oil, and Armour's 25.45 per cent.\* The unknown quantity, however, is the effect which the stearines employed had upon the data given. An oleo-stearine examined in my laboratory had an iodine absorption of 18 per cent.; a prime lard stearine an iodine absorption of 44 per cent. Thus more than twice as much of the oleo-stearine could be used as of the lard stearine without perceptibly influencing the percentage of iodine absorption. The specific gravity of the lard stearine used was about the same as that of the lard, viz., .905; although a larger number of determinations might show a lower specific gravity.

The refractive index of one sample of oleo-stearine calculated at 25° was 1.4646. Before formulating any rule in regard to the matter I readily admit that a much larger number of samples of stearine should be examined, and their refractive indices determined. I think, however, it will appear finally that both the specific gravities of the stearines employed, and the refractive indices will be found not to vary greatly from the numbers for pure lard; the specific gravities being somewhat lower. It is seen by the above result that the approximate quantity of cotton oil in lard, as indicated by the refractive index, is much nearer the true proportion for the Fairbank and Armour samples than that given by any of the other methods employed. For instance, let us suppose that the Fairbank samples were composed of 60 per cent. cotton oil, 20 per cent. pure lard, and 20 per cent. lard stearine; the quantity of iodine absorbed by such a lard would be as follows :—

60 × 107 =	6420	
20 × 62 =	1240	
20 × 44 =	880	
100 parts =	8540	
Iodine absorption theoretical	.. ..	85.40 per cent.
Actual iodine number obtained by analysis	85.31	„

Thus from the above theoretical calculation the amount of cotton oil added was 60 per cent., which as indicated by the refractive index was 56.36 per cent., by the specific gravity 45.65 per cent., and by the rise of temperature with sulphuric acid 32.80 per cent.

\* The above numbers are calculated from the mean data for the fourteen samples of pure lard and the sixteen samples of purified cotton oil.

In the case of Armour's lard take the following :—

				Ingredients, Per Cent.		Iodine Number.		Total
Pure lard	..	..	..	70	×	62	=	4340
Cotton oil	..	..	..	20	×	107	=	2140
Oleo-stearine	..	..	..	10	×	18	=	180
				100			=	6660
Theoretical iodine number	..	..	..			66.60	per cent.	
Actual iodine number	..	..	..			63.58	„	

Let us suppose again that the compound was made with prime lard stearine, in which case we have the following computation :—

				Ingredients, Per Cent.		Iodine Number.		Total.
Pure lard	...	..	..	70	×	62	=	4340
Cotton oil	..	..	..	15	×	107	=	1605
Lard stearine	..	..	..	15	×	44	=	660
				100			=	6605
Theoretical iodine number	..	..	..			66.05	per cent.	
Actual iodine number	..	..	..			63.58	„	

From the above computations the value of the refractive index in determining approximately the respective quantities of cotton oil and stearine in mixed lards is apparent. It is true that in individual cases the variation might be very much greater than indicated above, but as an expression of the mean result it appears to me that the refractive index is fully as valuable if not more so than the specific gravity in the quantitative determination of mixed lards.

I propose to push this investigation somewhat further by more extensive examinations of the specific gravities and refractive indices of lard, oleo-stearine, prime steam lard, and mixed lards.

The refractive index of pure water at 25° as indicated by the instrument employed (Abbe's large model) was 1.3300. When the index of water at the above temperature is taken at 1.3330, .0030 should be added to the numbers given in the above paper.