THE RELATIVE COMPOSITION OF MILK, CREAM, AND SKIMMED MILK.

BY NORMAN LEONARD, B.Sc., F.I.C., AND HARRY M. SMITH, F.I.C.

As a layer of cream gradually forms on the surface of milk, the composition of the liquid varies at different levels. The upper layers contain a larger proportion of fat, and a smaller proportion of other constituents, than the original milk, while in the lower layers these conditions are reversed. If the change which takes place during the rising of the cream consist solely in the ascent of fat globules, it is clear that the relation between the amounts of water and of solids-not-fat will be the same in the cream and in the skimmed milk as it was in the original whole milk. The lower layers, in fact, may be regarded as an aqueous solution of milk-sugar, casein, and other substances, containing little fat in suspension, while the upper layers consist of a precisely similar solution, with a larger amount of suspended fat.

Wanklyn, in his book on milk analysis, adopts this view, and gives a few perhaps not very conclusive figures in support of it. He states, however, that rich town-fed milk is apt to throw up a little casein with the cream, and points out at the same time that any imperfection in the analysis of cream tends to raise the solids-not-fat. H. Droop Richmond, in giving results of analyses of cream, has also referred to this point on various occasions. In the rich so-called "Devonshire" creams there seems to be little doubt, judging from the many recorded analyses, that there is a larger amount of solids-not-fat, in proportion to the water, than is to be found in ordinary whole milk. The heat commonly applied to assist the separation of these rich creams may possibly be the cause of this "incipient coagulation."

The question is obviously of some importance to those connected with the working of the Sale of Food and Drugs Act; for if casein be thrown up with the cream, a sample of milk taken from a vessel, the contents of which have been imperfectly mixed, cannot by analysis afford any trustworthy evidence either as to the addition of water or deficiency in fat. If, however, the relation between the water and the solids-not-fat be undisturbed, the analysis will show the presence or absence of added water, although, of course, no conclusion can be drawn as to the fat. It was a discrepancy between the analyses of samples stated to have been drawn from the same churn at different times which induced us to make some experiments with a view to determining whether Wanklyn's theory held good or not. That it does hold, under ordinary conditions and so far as the usual analytical methods are capable of deciding, is, we think, proved by our results, which are given in the following table :

						Calculated on Water.	
						Solids-not-Fat.	Ash.
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A ...						12.66	3.68
A 1	$\frac{1}{3}$	...	...	...	...	8.98	0.75
A 2	$\frac{2}{3}$	...	...	...	...	0.71	84.05
A 3	$\frac{2}{3}$	...	...	...	...	10.28	0.84
A 4	$\frac{1}{3}$	...	...	...	...	10.21	0.84
B ...						13.67	4.83
B 1	$\frac{1}{3}$	...	...	...	...	1.91	9.14
B 2	$\frac{1}{3}$	...	...	...	...	0.78	88.95
B 3	$\frac{1}{3}$	...	...	...	...	10.28	0.88
C ...						10.63	1.58
C 1	$\frac{1}{3}$	...	...	...	...	8.84	0.74
C 2	$\frac{2}{3}$	...	...	...	...	0.76	89.37
D ...						10.24	0.83
D 1	$\frac{1}{3}$	...	...	...	...	10.13	0.85
D 2	$\frac{2}{3}$	...	...	...	...	9.60	3.07
D 3	$\frac{1}{3}$	...	...	...	...	6.53	0.54
D 4	$\frac{1}{3}$	...	...	...	...	0.45	83.56
D 5	$\frac{1}{3}$	...	...	...	...	7.52	0.54
D 6	$\frac{1}{3}$	...	...	...	...	7.24	0.59
D 7	$\frac{1}{3}$	...	...	...	...	7.32	0.60
E ...						11.60	2.98
E 1	$\frac{1}{3}$	...	...	...	...	12.39	7.71
E 2	$\frac{2}{3}$	...	...	...	...	0.64	79.90
E 3	$\frac{1}{3}$	...	...	...	...	9.65	0.80
E 4	$\frac{1}{3}$	...	...	...	...	9.57	0.86

The samples of milk were allowed to stand in separators for about eighteen hours at the temperature of the laboratory. Measured portions were then drawn off successively from the bottom and submitted to analysis. In the first experiment a milk yielding on analysis the results given at A (see Table) was thus divided into two portions, an upper portion (A 1) forming one-third, and a lower portion (A 2) forming two-thirds of the original volume. In a second experiment, made with the same milk, the upper and lower portions (A 3 and A 4) formed respectively two-thirds and one-third of the whole. Another sample of milk (B) in the third experiment was divided into three portions, upper, middle, and lower, each of which was analysed; while in the last experiment on a milk (C) only the upper and lower portions, each forming one-seventh of the whole, were examined.

The numbers in the seventh and eighth columns of the table are obtained by dividing the percentages of solids-not-fat and of ash respectively by the percentage of water in the various samples, and multiplying the quotients by 100. The numbers in the seventh column are practically identical in each of the three sets of analyses. What variations there are exhibit no regularity, and are such as might be expected to be due to experimental error. The figures in the eighth column show a less satisfactory agreement. In each case the skimmed milk yields a higher proportion of ash than the cream. This is probably due to the subsidence of suspended mineral impurities (dust) in the milk.

The conclusion we draw from our experiments is, that at the ordinary temperature no disturbance of the relation between water and solids-not-fat takes place when milk is allowed to stand at rest, even when the upper layer contains twenty times as much fat as the lower. We would further suggest that, in estimating the amount of added water (if any) present in samples of milk containing an abnormally high or low proportion of fat, it is desirable to take as a basis for the calculation the percentage of solids-not-fat in the *water* instead of in the *milk*. The percentage of

solids-not-fat contained in the water of milk of average quality is, of course, taken as a standard for comparison.

We have to express our thanks to Dr. Stevenson, in whose laboratory these experiments were carried out.

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