

## THE COMPOSITION OF DUTCH CHEESE, AND THE SYSTEM OF CONTROL FOR WHOLE-MILK DUTCH CHEESE.

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*(Read at the Meeting, June 2, 1915.)*

DUTCH cheese was originally made in North and South Holland. The cheese made in the province of North Holland, having the shape of a ball, is commonly known as Edam cheese, the name being derived from the town Edam, which formed the centre of the North Holland cheese district. The cheese made in the province of South Holland is of a flat shape, and is known as Gouda cheese, after the principal town and market for the South Holland cheese district. Both varieties of cheese were originally made of whole milk. Edam cheese, however, is now mostly made from the mixture of the evening milk, from which a little cream has been taken off by hand, and the whole morning milk. Genuine Gouda cheese, on the other hand, is still nearly exclusively made from whole milk.

Both varieties as made in the provinces of North and South Holland are so-called "farmers' cheeses," although the making of Edam cheese in large collecting centres or factories is rapidly spreading.

Since the making of butter was transferred from the farms to large creameries, it was essential to find an outlet for the skimmed or separated milk, with the result that in the province of Friesland cheese is made from milk with different degrees of fat. The well-known shapes of the Edam and Gouda cheese varieties were chosen for making these skimmed cheeses, with the unfortunate result that it was not possible to differentiate from the appearance between the original full-cream article and the "half-meat" or skimmed imitation. I do not consider the making of the partly skimmed article objectionable. On the contrary, it has met a ready demand for a sound and nutritive article of food at a low price. I do not agree with those who object to the sale of cheese not made from whole milk on the ground that it is

difficult to digest. There is no evidence to that effect ; on the contrary, experiments made with skim cheese in suitable form have proved that the diminution of fat alone does not affect the digestibility of the cheese to an appreciable extent. Not all the fat should, however, be taken out, not so much for the nutritive value of the fat which is still left in the skim cheese, but for the fact that a cheese containing little or no fat has a different texture and soon dries out to a hard substance, which must be difficult to digest. It is for this reason that a skim cheese always contains, and should contain, more water to give it a soft texture, and it should be consumed while still young.

Cheese in Holland made in the Gouda and Edam shape may, therefore, be anything between the full-cream article and a product containing only a few per cent. of butter-fat.

As it is all made in Holland, it is difficult to deny the right to any of these varieties to be sold under the name of Dutch cheese as long as the makers or the authorities in Holland do not give exact definitions as to what it should be.

The indiscriminate use of the names Gouda or Edam cheese may, however, be contested if the composition of the cheese is not that of the genuine article.

From the fact that very little full-cream Dutch cheese is found in England it may be concluded that only a very small proportion of full-cream cheese is made in Holland. This, however, is not so, as the production of full-cream Gouda cheese amounts to about 40,000 tons per annum. The total production of cheese in Holland for the year 1913 amounted to 95,710 tons, out of which 32,318 tons, or one-third, were half-meat and skimmed cheese. It would be unjust, therefore, to take the composition of the skimmed article as a true representation of what Dutch cheese should be.

Only cheese made from whole milk should be sold as full-cream Dutch cheese, and no cheese should be passed by an analyst when sold under that description unless its chemical composition is in accordance with the results of the analysis of cheese, of which it can be proved that it was made of full-cream milk.

Since control stations have been established at The Hague and at Utrecht for full-cream Dutch cheese, thousands of samples of cheese, of which all particulars about its making were known, have been analysed.

Dr. H. van Gulik, director of the cheese control station at The Hague, has obtained interesting figures, which not only show the variations in the chemical composition of full-cream Gouda cheese, but also the relations between the fat contents of the milk and the fat contents of the cheese.

I may point out that the amount of fat in the cheese is expressed by the proportion of fat in the dry matter. This method of stating the result of the chemical analysis has been generally accepted in all other European countries, with the exception of Great Britain, as well as in America. It would be desirable if the custom of expressing the composition of cheese, by giving the percentage of fat in the dry matter, were also generally adopted here.

The following figures show the average fat contents of whole-milk Gouda cheese for seven subsequent years and the number of samples which in 1913 fell within certain limits :

## AND SYSTEM OF CONTROL FOR WHOLE-MILK DUTCH CHEESE 393

*Average Fat Contents in the Dry Substance of Whole-Milk Gouda Cheese.*

1907. Per Cent.	1908. Per Cent.	1909. Per Cent.	1910. Per Cent.	1911. Per Cent.	1912. Per Cent.	1913. Per Cent.
48.5	48.8	48.9	49.1	50.6	49.7	50.3

*Fat in Dry Matter of Whole-Milk Gouda Cheese during 1913.*

Percentage of fat ...	...	45.46	46.47	47.49	49.51	51.53	53.57
Number of samples	...	2	5	191	254	155	39
Percentage of samples	...	0.3	0.8	29.5	39.3	24.0	6.0

It is evident that whole-milk cheese with less than 46 per cent. of fat in the dry matter is found very rarely, and it may be mentioned that in 1911 only three samples were found with less than 45 per cent. of fat in the dry matter, and none in 1913.

Experience has shown that every cheese-maker is capable of making cheese with at least 45 per cent. of fat on the dry matter if he works according to well-established rules. It will be shown later that he is in this respect independent of the amount of fat in the whole milk.

Although in the figures cited above the highest percentage of fat is given at 57 per cent. on the dry matter, I may mention that Dr. van Gulik found in 1911 that 26 out of 799 cheeses showed an amount of fat varying from 58 to 64 per cent. on the dry matter.

In Table I. some figures are given relating to the composition of cheese between July 1 and 15, 1909, as well as of the milk of which it was made. I have taken these figures from another publication by Dr. H. van Gulik, and they show clearly, whilst there is no direct relation between the amount of fat in the milk and in the cheese, it is possible to guarantee a minimum of fat when the cheese is properly made from whole milk.

Rich milk, however, does not necessarily mean a high percentage of fat in the cheese, even when carefully made and when little fat is lost in the whey. In taking, for instance, samples Nos. 1, 9, 12, and 31, with respectively 49.6, 49.5, 50.6, and 49.1 per cent. of fat, it will be found that they were made from whole milk, with respectively 2.51, 2.95, 3.03, and 4.18 per cent. of fat, whereas the amount of fat left in the whey varied only between 0.27 and 0.35 per cent.

It is clear from the table that the variation in the percentage of non-fatty solids does not account for the differences in the amount of fat in the cheese made from milk with varying amounts of fat. For various reasons Dr. van Gulik came to the conclusion that those cases where milk with a relatively low percentage of non-fatty solids gave a cheese with less fat than might be expected, were due to the fact that such milk did contain a relatively high percentage of casein. On the other hand, where milk with high non-fatty solids gave a cheese with relatively a great amount of fat, the percentage of casein in the non-fatty solids must have been low.

That the amount of non-fatty solids in milk is relatively a more constant factor

than that of fat is shown in the table, where it can be seen that the ratio between fat and non-fatty solids diminishes when the percentage of fat in the milk rises.

TABLE I.

*Composition of Full-Cream Gouda Cheese, Milk and Whey.*

	Water in Cheese.	Fat in Cheese.	Fat in Dry Substance of Cheese.	Fat in Milk.	Fat in Whey.	Non-Fatty Solids in Milk.	Relation between Fat and Non-Fatty Solids in Milk.
1	42.7	28.4	49.6	2.51	0.27	8.28	1 : 3.30
2	43.3	25.1	44.3	2.58	0.38	8.31	1 : 3.22
3	42.8	26.1	45.9	2.68	0.20	8.48	1 : 3.17
4	43.0	26.2	46.0	2.69	0.63	8.16	1 : 3.02
5	45.3	25.4	46.4	2.74	0.20	8.46	1 : 3.08
6	44.2	27.5	49.3	2.80	0.31	8.35	1 : 2.98
7	41.5	27.5	47.2	2.89	0.43	8.35	1 : 2.94
8	43.4	27.3	48.2	2.90	0.35	8.34	1 : 2.88
9	38.8	30.3	49.5	2.95	0.35	8.37	1 : 2.84
10	40.8	29.0	48.9	3.00	0.34	8.43	1 : 2.81
11	43.0	25.2	44.2	3.00	0.45	8.52	1 : 2.84
12	44.5	28.1	50.6	3.03	0.28	8.51	1 : 2.78
13	40.8	29.2	49.2	3.08	0.47	8.38	1 : 2.72
14	42.2	28.9	50.0	3.12	0.30	8.38	1 : 2.69
15	43.4	27.8	49.1	3.13	0.33	8.47	1 : 2.70
16	43.5	29.1	51.5	3.14	0.28	8.32	1 : 2.65
17	44.0	27.5	49.1	3.17	0.44	8.44	1 : 2.66
18	43.5	25.2	44.5	3.21	0.84	8.35	1 : 2.60
19	43.3	25.5	45.0	3.25	0.40	8.47	1 : 2.61
20	39.9	31.2	51.9	3.28	0.36	8.18	1 : 2.50
21	40.0	29.4	49.0	3.35	0.51	8.58	1 : 2.56
22	40.7	30.2	50.9	3.45	0.60	8.51	1 : 2.47
23	41.4	28.4	48.5	3.46	0.43	8.50	1 : 2.65
24	43.2	27.0	47.5	3.54	0.50	8.35	1 : 2.36
25	42.5	30.4	52.9	3.62	0.49	8.31	1 : 2.30
26	43.5	27.9	49.4	3.65	0.65	8.49	1 : 2.33
27	39.8	31.3	52.0	3.65	0.38	8.47	1 : 2.32
28	41.9	30.9	53.2	3.80	0.40	8.45	1 : 2.22
29	43.1	27.7	48.7	3.88	0.43	8.58	1 : 2.16
30	42.2	30.3	52.5	4.06	0.32	8.44	1 : 2.08
31	45.0	27.0	49.1	4.18	0.35	8.34	1 : 1.99
32	41.7	31.5	54.1	4.22	0.86	8.19	1 : 1.94

As an interesting result of the investigations of Dr. van Gulik, I may also mention that the amount of fat in the milk was much higher after cold and rainy days, and that in such cases the amount of fat in the dry matter of the cheese made from such milk was also higher.

*System of Control.*—It is impossible to recognise from the external appearance whether a cheese in Gouda shape is made from whole milk or from milk of which

## AND SYSTEM OF CONTROL FOR WHOLE-MILK DUTCH CHEESE 395

more or less cream has been removed. For this reason the Holland Agricultural Society first established a control station, in order to guarantee the genuineness of such cheese. The control station is an institution organised by private individuals under supervision of the Government, and an official mark has been established which for whole-milk cheese is stamped in blue ink on a transparent disc of casein. In the open space under the arms a letter and figures are printed which enable the officials responsible for the control to trace the origin of each cheese.

The cheese is guaranteed to have been made of whole milk, to contain not less than 45 per cent. of fat on the dry matter, and not more than the normal amount of moisture. It should be pointed out that the figure 45 per cent. must not be considered as a standard as it is generally understood, but that it is only a limit for fat in whole-milk cheese under which the cheese may not be sold with the Government control mark, even when made from unskimmed milk. If for some reason or other, due to a defect in the making, whole-milk cheese would have less than 45 per cent. of fat in the dry substance, it cannot be sold under the official guarantee.

The control stations are established by associations of interested persons. Only such persons can be admitted to these control stations who are of good repute and who are not connected with the manufacturing of, or the trade in margarine (margarine as meant by the Butter Act) or other fats or oils which either in its pure state or mixed with other substances are edible or can be used for the adulteration of cheese. The control includes the supervision of the process of manufacturing, and is based upon the examination—(a) of the quantity and the composition of the milk used; (b) of the composition and the quantity of the cheese and the whey butter obtained therefrom; and (c) of the quantity of fat left in the whey.

The Netherlands Government has fixed rules to which the control stations for whole-milk cheese and their members must submit before they are allowed to use the Government mark; it also prescribes the analytical methods to be used and sees that such rules are strictly followed.

Apart from the cheese control stations for whole-milk cheese at The Hague and at Utrecht, one has been established at Leeuwarden. The object of this station is to establish marks for the different grades of skimmed cheese made in the province of Friesland, in order to enable purchasers to recognise by such marks the approximate fat contents of the cheese and also to control the makers of cheeses of Cheddar and Cheshire types at the present time.

No Government guarantee mark is given for these varieties. The Association of Co-operative Creameries in Friesland, in which province Cheddar and Cheshire cheeses are made, has prohibited the making of such cheeses from milk with less than  $1\frac{1}{2}$  per cent. of fat, and has compelled its members to mark all Cheddar and Cheshire cheeses made of whole milk with the words, "Full Cream," "Dutch Produce," and all Cheddar and Cheshire cheese made of milk of which even the slightest amount of fat has been taken off with the words "Half-Meat" and "Dutch Produce."

Mr. de Kruffy, Director of the Friesian Control Station, has analysed several

samples of full-cream Cheddar and Cheshire cheeses which were made under his control, and the results are given in Table II.

It is clear that no fixed relation exists between the amount of fat in milk and in the cheese, although some of the cheeses with the greatest amount of fat are at the bottom of the tables, where also the highest figures for fat in milk are found.

TABLE II.

Full Cream—					
Dutch Cheddar Cheese.			Dutch Cheshire Cheese.		
Fat in Milk.	Fat in Cheese.	Fat in Dry Substance of Cheese.	Fat in Milk.	Fat in Cheese.	Fat in Dry Substance of Cheese.
2.75	30.2	49.9	2.60	25.9	48.6
2.80	31.8	52.7	2.65	27.1	49.5
2.85	30.4	51.2	2.75	26.3	47.9
2.90	31.3	52.6	2.85	25.0	48.4
2.95	31.6	50.1	2.90	28.2	50.4
3.0	31.5	52.8	3.05	27.2	49.7
3.0	28.9	49.7	3.10	20.3	51.0
3.05	32.2	53.1	3.25	27.1	50.6
3.05	31.1	51.8	3.30	27.8	52.1
3.10	31.9	52.0	3.45	28.2	51.3
3.10	30.5	49.4	3.50	27.1	51.7
3.15	33.5	53.3	3.55	27.2	50.4
3.20	32.0	51.9	3.70	28.1	52.7
3.20	32.9	53.8	3.80	30.8	53.4
3.25	34.3	54.5			
3.25	33.0	51.4			
3.30	33.1	53.0			
3.40	31.2	53.1			

The figures show that the amount of fat in the dry substance of Cheddar and Cheshire cheese made of whole milk is always well over 45 per cent., even when the amount of fat in the milk was low.

*The Influence of skimming the Milk.*—Mr. De Kruffyff has analysed many cheeses in Gouda and Edam shape, made from milk which was skimmed in different degrees so that the milk contained from 0.5 per cent. to 2 per cent. of fat. The results of these investigations show that the increase in the percentage of fat in *skimmed milk* has a very marked effect on the increase of the amount of fat in the cheese.

Cheese made from skimmed milk with 0.5 per cent. fat showed an average percentage of fat on the dry matter of the cheese of 12.45 per cent. When the fat in milk was increased to 0.65 per cent., the fat in the cheese rose to 15.8 per cent.; fat in milk 0.90 per cent., fat in cheese 21.3 per cent.; fat in milk 1.0 per cent.,



## AND SYSTEM OF CONTROL FOR WHOLE-MILK DUTCH CHEESE 397

average fat in cheese 24.1 per cent.; fat in milk 1.20 per cent., fat in cheese an average of 28.6 per cent.; fat in milk 1.40 per cent., fat in cheese 31.5 per cent.; fat in milk 1.5 per cent., average fat in cheese 33.6 per cent.; fat in milk 1.65 per cent., average fat in cheese 35.3 per cent.; fat in milk 1.8 per cent., fat in cheese 36 per cent.; fat in milk 2 per cent., fat in cheese 38.65 per cent. These figures show that an increase of 0.1 per cent. in the amount of fat in skimmed milk gives on an average an increase of 1.75 per cent. of fat on the dry substance of the cheese.

This does not mean that it is possible to calculate exactly the amount of fat which will be found in the dry matter of the cheese when the percentage of fat in the skimmed milk is known. Just as we have seen with cheese made of whole milk, differences are found in the composition of cheese made from milk with the same amount of fat. These differences may even be very large when a great number of samples are analysed from different creameries. Mr. De Kruyff mentions in his report that the amount of fat on the dry substance of eighty different cheeses all made from skimmed milk containing 1.55 per cent. of fat, varied from 30.2 per cent. to 39.4 per cent. The extreme figures were only found once, and only two samples were found containing more than 37 per cent., or less than 31 per cent. of fat. The great majority was near the average of 33.6 per cent.

*Edam Cheese.*—As already mentioned, Edam cheese in the province of North Holland is now mostly made of a mixture of partly hand-skimmed evening milk and whole morning milk. For this reason Edam cheese is not considered a whole-milk cheese, but only a fat cheese. It is generally agreed that Edam cheese should not contain less than 40 per cent. of fat on the dry substance.

## DISCUSSION.

The PRESIDENT remarked that he understood the figure of 45 per cent. for fat on the dry substance to be a minimum limit, and that even full-cream cheese falling below that limit might not be sold under the Government mark. There was, however, a considerable margin between this and the highest figure—namely, 57 per cent.—which might afford some inducement to partial skimming of the milk. On the other hand, the verification, by analysis of the milk, cheese, and whey, of the title of each cheese to be stamped with the Government mark, must involve an enormous amount of work. A striking point in connection with these figures was that, as Dr. van Rijn had mentioned, there was no sort of connection between the percentage of fat in the dry cheese and the percentages of fat and non-fatty solids in the milk. Another noticeable point was the lowness of the non-fatty solids in the majority of the milk samples.

Mr. F. J. LLOYD said that, although Dutch cows sometimes gave milk of excellent quality, it was generally characteristic of them to give milk that was poor in fat and in non-fatty solids. As a rule, however, this was compensated for by the large quantity of milk yielded. In deciding whether a given cheese was or was not made from whole milk, his custom was to determine the ratio of fat to casein. Milk almost invariably contained more fat than casein. He should have liked to see the percentage of casein in Dr. van Rijn's samples, but he thought that where the fat was

low the casein would be found to be low also. In the early part of the year, when the percentage of fat in the milk was usually low, the casein was as a rule under 3 per cent. ; but later on, when the percentage of fat increased, the increase in casein was not correspondingly great, so that at that time of year there was a wide difference between the fat and the casein. Invariably in a whole-milk cheese the percentage of fat was greater than the percentage of casein.

Dr. RIDEAL pointed out that in three of the thirty-two samples of cheese referred to, the fat in the dry substance was not up to the Dutch Government's standard of 45 per cent.

Dr. VAN RIJN, in reply, said that the Government system of control was very elaborate. A cheese was not stamped with a Government mark merely because its dry matter contained 45 per cent. of fat, that figure being merely fixed as the limit below which the fat should not fall, even though the cheese might be made from unskimmed milk. In some cases, it would be noticed, the fat in the whey was rather high, and cases had occurred in which it was as much as 1 per cent. In such a case the farmer could make a good deal of whey butter, and although the milk itself would not have been skimmed, the cheese could not be regarded as genuine. As Mr. Lloyd had explained, the milk of Dutch cows was sometimes low in fat, but this was really due to want of attention to the breeding of the cows. Those Gouda cheeses, under the control station at The Hague, were all made in a certain district round Gouda, where the farmers, although the best cheese-makers, were not the best breeders in the country. In other districts where care had been taken in recent years to improve the cattle, it was difficult to find a herd yielding milk with an average less than 3 per cent. of fat. The samples referred to in the tables were from different farms, but were all taken within a period of fourteen days, so that the differences between them had nothing to do with the time of year. They were, however, taken in 1907, when the control system was just started, and in the course of the investigations which were then undertaken with a view to ascertaining what the proper composition of the cheese should be. Since then the quality of the cheese had improved, and in 1913 no sample was found to fall below the 45 per cent. limit. Mr. Lloyd was quite correct in his remarks as to the importance of the ratio of fat to casein.

