

RELATION OF FATS TO MOISTURE CONTENT OF BUTTER.

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IMPORTANCE OF MOISTURE CONTENT OF BUTTER.

The two principal constituents of butter are the fats and the water. The average sample of butter contains about 83.5 per cent fats and 13.5 per cent water; the remainder being made up of salt, curd, ash, sugar and acid.

The more water butter contains the lower is its per cent of fats, and the more butter can, therefore, be made from a given amount of fats. It did not take the alert butter maker, the creamery operator, the commercial man very long to appreciate the financial significance of this fact. In many instances the process of butter making was so modified as to increase the per cent of moisture to the extent where as high as 130 to 150 pounds of butter were made from 100 pounds of fats, while under normal conditions 100 pounds of fats yield between 116 to 122 pounds of butter. The result was that, up to a few years ago, the American markets were flooded with water-soaked butter.

Butter containing an excess of moisture is inferior in quality; its keeping quality is poor and its food value is low. So, in order to save the butter industry of the country from certain ruin and to protect the consumer from buying his drinking water in the form of water-soaked butter, a law was passed by act of Congress in 1902 and revised in 1904, classifying as adulterated butter all butter containing 16 per cent or more of water and placing a fine of 10 cents per pound of butter and a special tax of \$50 per month on the manufacturer of adulterated butter.

When this law was put in force by the Internal Revenue Department it was found that, in certain localities and at certain seasons of the year butter makers experienced difficulties in keeping the moisture content below the legal maximum of 16 per cent, and the question naturally arose as to the practicability and justice of this standard and as to the advisability of modifying it.

EXPERIMENTS CONCERNING THE FACTORS INFLUENCING THE MOISTURE CONTENT OF BUTTER.

Accurate data concerning the moisture content of butter were meager, and it seemed obvious that this question could be satisfactorily settled only by means of careful experiments. So, about two years ago, the Dairy Department at Purdue University started investigations concerning the variations of the moisture content of butter and the causes of these variations.

Analyses of butter of the Purdue Creamery and of about 30 creameries in the State showed that in spring and early summer there was a rapid and decided increase in the per cent of water in butter. Analyses of the composition of the butter fats in the same butter showed a decided increase in the per cent of volatile and soft fats (fats of a low melting point) and a corresponding decrease in the per cent of hard fats in spring and early summer.

These results suggested the possibility that the composition of the fats may, in a measure, control the per cent of moisture incorporated in butter. On the strength of this assumption the pure butter fat was extracted from various lots of butter, and by means of fractional crystallization at different temperatures the soft and the hard fats were separated from one another as completely as was possible with this method. The two classes of fats were then churned separately and under identical conditions as to the moisture present and temperature. The analyses of these churnings showed that the butter made from the soft fats contained about 50 per cent more water than the butter made from the hard fats.

The uniformity of the results of repeated experiments justified the conclusion that, other conditions being equal, the relation of soft to hard fats controlled the moisture content of butter.

EXPERIMENTS CONCERNING THE CAUSES OF VARIATIONS IN THE PER CENT OF VOLATILE, SOFT AND HARD FATS.

The results just described naturally lead to the question, What are the causes underlying the variation in the proportion of soft and hard fats?

It is an established fact that certain feeds, when fed in excess, have a tendency to produce an excess of soft or hard fats in butter. Thus, for instance, cotton-seed meal, bran, corn, overripe foddors, etc., tend to

increase the per cent of hard fats, while linseed meal, gluten feeds, succulent pasture grasses, etc., are conducive to raising the per cent of soft fats. It is by no means established, however, that the feed is the only nor even the chief factor controlling the proportion of fats in milk. Thus at the time when the soft fats increase in milk and butter produced in this section of the country most of the cows are fresh, and it is quite possible that the period of lactation exerts an important influence on the fats. It was, therefore, deemed expedient to investigate in how far the period of lactation does affect the fats in milk.

Three cows of the university herd were selected and fed during their respective periods of lactation on an uniform ration, evading such feeds as would tend to materially influence the hard or soft fats. The milk from each cow was separated, the cream ripened and churned separately, and the butter analyzed for volatile, soft and hard fats.

The generally accepted classification of milk fats is as follows:

Glycerides of $\left\{ \begin{array}{l} \text{a. volatile or soluble fatty acids.} \\ \text{b. insoluble fatty acids.} \end{array} \right.$

The glycerides of the insoluble fatty acids are subdivided into hard and soft fats. The dairy literature, in dealing with the soft fats and their relation to the melting point of butter, gives consideration to the glycerides of the insoluble fatty acids alone. Inasmuch as the glycerides of the volatile or soluble fatty acids have a very low melting point as compared with that of insoluble fats, a comparatively slight change in the per cent of the volatile fatty acids must greatly influence the hardness or softness, as well as the melting point of butter. In determining the variations of the soft fats in butter it is necessary, therefore, to take into consideration the soluble as well as the insoluble fats.

The following charts show the results of analyses of butter made from the milk of the three cows under experiment:

TABLE I.—COWS 1 AND 2.

SHOWING THE EFFECT OF THE PERIOD OF LACTATION ON THE MILK FATS.

TIME.	Reichert- Meissl Number.	Soluble Acids.	Insoluble Acids.	Iodine Number.	Melting Point.
1st month	32.41	7.39	87.26	29.96	36.2
2d month	29.48	7.07	87.99	30.05	36.1
3d month	29.95	7.08	87.90	29.98	36.4
4th month	29.97	7.11	87.72	30.16	36.3
5th month	29.56	7.00	87.72	31.88	35.9
6th month	29.21	6.82	88.19	34.54	34.4
7th month	28.06	6.45	88.4	36.15	35.0
8th month	25.32	5.84	88.6	38.20	25.4
9th month	25.45	6.01	88.5	36.4	35.5
10th month	27.45	6.26	88.1	34.21	34.2

TABLE II.—COW 3.

SHOWING EFFECT OF THE PERIOD OF LACTATION ON THE MILK FATS.

TIME.	Reichert- Meissl Number.	Soluble Acids.	Insoluble Acids.	Iodine Number.	Melting Point.
1st month	36.68	8.20	86.76	34.20	34.1
2d month	35.75	8.09	86.74	34.25	34.2
3d month	33.19	7.59	86.99	33.36	34.3
4th month	33.80	7.56	86.95	33.83	34.0
5th month	33.63	7.47	87.10	32.73	33.5
6th month	32.57	7.55	86.94	31.02	33.7
7th month	32.72	7.49	86.99	33.32	34.0
8th month	31.63	7.25	87.41	33.59	33.92
9th month	31.98	7.10	87.50	34.05	33.9
10th month	32.03	7.12	87.46	33.22	33.8
11th month	26.64	6.50	88.20	35.8	34.5
12th month	30.48	6.86	87.69	32.05	34.3

These charts bring out the following facts:

1. The Reichert-Meissl number and the per cent of soluble fatty acids were highest at the beginning of the period of lactation; slight irregularities excepted, they decreased as the period of lactation advanced and were lowest towards the close of the period of lactation.

2. The insoluble fatty acids were lowest at the beginning, gradually increasing during and were highest at the end of the period of lactation.

3. The fact that the Reichert-Meissl Number, the soluble and the insoluble fatty acids bear a definite relation to one another shows clearly that the per cent of soluble and insoluble acids is affected by the period of lactation, and that the soluble acids decrease while the insoluble acids increase as the period of lactation advances.

4. The results concerning the iodine number are irregular, and, considering the relatively small number of data, do not warrant the drawing of definite conclusions as to the effect of the period of lactation on the per cent of olein in butter.

5. The relation of the per cent of soluble fats and olein to the melting point emphasizes that the olein is not the only factor controlling the melting point or softness of butter, but that the volatile or soluble fats play a part in the determination of the softness of butter.

