

RENNET EXTRACTS OF COMMERCE.

A PRELIMINARY STUDY.

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In February of the present year the Station received from a cheese manufacturer of the State two samples of rennet extract, with request for analysis and an explanation of the superior efficiency of one of them, suggesting the possibility that an extra (added) amount of free acid might be the cause. In accordance with custom, the request was complied with so far as possible. In June the same gentleman sent two more samples, and in August several more. Some of the results of investigation were so remarkable that the writer, now interested and desirous of getting at the truth, suggested duplicate samples, to avoid the danger of erroneous conclusions from single samples. Most of the samples were sent by the same gentleman; a few were obtained from other reliable sources by the writer himself. Nearly all were received in pint jars or bottles, unsealed—"broken packages" in fact. The sender of these assured me by letter that he was "very particular about every one of them, and could swear that they were exactly as recorded," adding that they were taken from the original packages by himself and were "exactly as received." One sample came to the writer direct from the manufacturer; it was the best examined of that make.

Besides submitting these samples to a simple form of analysis, the writer made several trials of their relative coagulating powers upon milk. In each trial, usually eight samples were tested simultaneously, equal volumes of the same milk being used for each, under identical conditions as regards temperature and stirring (so far as this last was possible), and, of course, with the same volume of extract used in each case. Usually the amount of milk used was 200 c. c.,* and of

*In the first two trials 170 and 160 c. c. respectively.

extract. 1 c. c., making the ratio of extract to milk 1:2000. This small volume of extract was measured accurately by first diluting a portion of the extract with forty-nine times its volume of water and then measuring out 5 c. c. of this diluted extract; this volume of course contained .1 c. c. of the original liquid. These dilute solutions were freshly made for each trial.

In each trial the rennets were added simultaneously and the time required for each to induce coagulation, distinctly visible on the blade of the stirring spatula, was observed and recorded. These times are recorded in the table, and below them are given calculated figures showing the number of parts (by volume) of the milk used in each trial that would be brought to incipient coagulation by one part of each extract in *forty minutes*, at the temperature of the trial. The calculation, where the ratio of extract to milk was 1:2000 is this:

Observed time: 40::2000: { X, the amount that would be curdled in
forty minutes

Forty minutes as the basis of calculation is here employed because that is the custom in Germany, where, however, as in this country to some extent, the custom is to take as the end-point of the test the clear breaking of the curd, instead of the *beginning* of coagulation; for the present purpose, of exhibiting the relative strengths of the extracts here examined, the time of forty minutes as the basis of calculation will serve as well as any.*

*In Germany the tests are made upon sweet milk at a temperature of 35 deg. C. (= 95 deg. F.), because that is the temperature at which the rennet acts in the manufacture of Schweizerkase (Swiss cheese); and likewise the time, forty minutes, is about the time at which the curd in the vat is expected to reach the breaking point. The method adopted in the tests here reported—i. e. timing to the *beginning* of coagulation—is believed by the writer to be fully as reliable as the other for the comparison of rennets, and is very much easier, since the end-point can be determined with very great exactness, whereas by the other method there is often doubt as to the exact time at which the curd may be said to break "clear." Results by the two methods, with different rennets, bear approximately the same ratio to each other. Thus:

COMPARATIVE TESTS BY THE TWO METHODS.

I. Timing to incipient coagulation. Mean of the five last trials in the table. Temp. 95 degrees F.

II. Time to clear breaking of curd. Mean of four trials. Milk sweet. Temp. 85 degrees F.

Parts milk per one part extract, in forty minutes, at the temperature stated.

	A, No. 2	B, No. 2	C, No. 2	D, No. 2	E, No. 2	F, No. 2	G, No. 2	H, No. 2
I.	8100	15600	10100	12800	8500	10000	7300	6300
II.	3000	4900	3050	4100	3075	3460	2400	2120

That the results by the two methods, for the different extracts, bear approximately the same ratio to each other is readily seen by multiplying the second set of figures by three. The great difference between the figures of the two sets is largely due to the difference in temperature.

The results recorded in the table reveal wide differences among the different extracts, in regard to both composition and curdling power.

As regards composition, organic solids range, in seven of the varieties examined, from 2.28 to 5.32 per cent, while in the eighth (A in the table) it reached 10 per cent in one sample and 18.75 in the other (verified by duplicate analyses).

Ash, mainly common salt, ranges from 10.45 to 19.75 per cent; and acidity, calculated as lactic acid, from .16 to 1.65 per cent.

In the record of coagulation test, two samples of each of the extracts, save three, are included; in these three cases the first samples received were misused by being allowed to stand in a warm room, exposed to the sun, during the summer months, and hence were rejected. All other samples were kept in a cool room at the creamery from the time of their arrival.

Each brand of extract received from seven to ten tests (all told for both samples) by the method mainly employed, and four more by the other method, as recorded in the foot note, p. 846. The time required to induce curdling, and the parts of milk curdled per one part of extract, show wide differences in curdling power.

By the method mainly used, the average results on time required (see table) range from 5.8 to 13.4 minutes; and on parts of milk per one of extract, from 6300 to 13700.

Regarding the degree of uniformity attained by the several makers in the preparation of their goods, of course no sweeping conclusions can be drawn from so limited a number of samples; but so far as they go the results of this preliminary study indicate much greater variations in some extracts than in others. Thus, the figures for organic solids in the two samples of extract A, exhibit a difference of over 8.7 per cent. Extract H shows wide differences considering its low percentage of organic matter. Those showing very moderate differences—indicating, as far as so few figures can, a commendable degree of uniformity—are extracts B, C, E and F.

<i>Extracts, arranged in order of organic solids.</i>	SAMPLES.																	
	A		B		C		D			E		F		G		H		
	1	2	1	2	1	2	1	2	3	1	2	1	2	1	2	1	2	3
Organic solids, per cent.....	18.75	10.02	5.16	5.32	4.00	4.10	3.59	3.95	.....	3.90	3.91	3.35	3.16	2.75	3.06	2.44	2.28	3.06
Ash, mainly common salt, per cent....	10.45	13.32	17.24	17.00	11.32	11.15	17.06	16.37	.....	14.00	13.97	17.45	17.62	19.75	19.55	18.83	19.65	11.88
Total solids, per cent.....	29.20	23.34	22.40	22.32	15.32	15.25	20.65	20.32	.....	17.90	17.88	20.80	20.78	22.50	22.61	21.27	21.93	14.94
Acidity, as lactic acid, per cent.....	1.65	.97	.73	.66	.46	.20	.30	.37	.....	.50	.16	.30	.30	.19	.37	.27	.35	.26

COAGULATION TESTS.

Sept. 23. Milk sweet. Temp at start, 82 deg. F.; cooled somewhat during the trial*.....	15½	.....	8	.....	.....	11	.....	11	.....	.....	12	12	.....	.....	19½	.....	21	.....	Minutes.
Sept. 23. Same milk, one hour later Conditions same as before*.....	13½	.....	7	.....	.....	10½	.....	10	.....	.....	10½	11	.....	.....	17	.....	18½	.....	Minutes.
Nov. 11. Milk a little ripened. Temp. at start, 95 deg; cooled during trial. Temp. of room, 54 deg.*.....	10½	11½	6	5½	.....	7½	.....	7	.....	.....	14	10½	9	.....	11	.....	15	10½	Minutes.
Nov. 13. Temp. of milk at start, 95 deg., at finish, 85 deg. Temp. of room, 79 deg.....	.....	8	.....	4½	.....	6	.....	6	.....	.....	7½	.....	6½	.....	9½	.....	10½	.....	Minutes.
Nov. 15. Milk sweet. Temp. kept constant at 95 deg. throughout the trial.....	.....	8½	.....	4½	.....	6½	.....	6	.....	.....	3½	.....	7½	.....	10	.....	11½	.....	Minutes.
Dec. 4. Milk sweet. Temp. kept constant at 95 deg. throughout the trial.....	.....	11	.....	5½	.....	9½	.....	6	8½	.....	9½	.....	9	.....	12½	.....	13	9	Minutes.
Dec. 4. Same milk; same conditions... ..	.....	11	.....	5½	.....	12½	.....	7	10	.....	10	.....	9	.....	12½	.....	14½	10½	Minutes.
Mean	11.2		5.8			9.1		7.9			10.2		9.3		13.1		13.4		Minutes

CALCULATED: Parts of milk brought to the curdling point by one part of extract in 40 min., at the stated temperatures.

	A		B		C		D			E		F		G		H		
	1	2	1	2	1	2	1	2	3	1	2	1	2	1	2	1	2	3
Sept. 23. Temp. of milk at start, 82 deg.; cooled during trial. Temp. of room not taken*	4,400	.....	8,500	.....	.....	6,200	.....	6,200	.....	.....	5,700	5,700	.....	.....	3,500	.....	3,300	.....
Sept. 23. Same milk one hour later; conditions same as before*	4,700	.....	9,100	.....	.....	6,100	.....	6,400	.....	.....	6,100	5,800	.....	.....	3,800	.....	3,500	.....
Nov. 11. Temp. of milk at start, 95 deg.; cooled during trial. T. of room 54 deg.*	7,600	7,000	.....	14,500	.....	10,700	.....	11,400	.....	.....	5,700	7,600	8,900	.....	7,300	.....	5,300	7,600
Nov. 13. Temp. of milk at start, 95 deg.; at finish, 85 deg. T. of room, 79 deg. ....	.....	10,000	.....	17,700	.....	13,300	.....	13,300	.....	.....	10,700	.....	12,300	.....	8,400	.....	7,600	.....
Nov. 15. Temp. kept constant at 95 deg. throughout the trial.....	.....	9,400	.....	16,800	.....	11,900	.....	13,300	.....	.....	9,700	.....	11,000	.....	8,000	.....	7,100	.....
Dec. 4. Milk sweet. Temp. kept constant at 95 degrees throughout the trial.....	.....	7,300	.....	14,500	.....	8,400	.....	13,300	9,400	.....	8,400	.....	8,900	.....	6,400	.....	6,200	8,900
Dec. 4. Same milk same conditions.....	.....	7,300	.....	14,500	.....	6,400	.....	11,400	8,000	.....	8,000	.....	8,900	.....	6,400	.....	5,500	7,600
Mean	7.200		13.700		9.000		10.300		7.800		8.600		6.300		6.300			

*Where the temperature falls during the trial the real differences between the extracts would naturally be exaggerated in the results obtained.

As regards uniformity in coagulating power (among different samples of the same extract), the data in the table are very scant. In the cases of D and H the two samples examined showed rather wide differences.

The table shows that the amounts of organic matter in rennet extracts do not always furnish a true measure of their relative coagulating powers. This would be expected where the modes of preparation and ages of the samples are liable to be different. Evidently extract A, with its enormous percentage of organic matter, is prepared in a very different manner from the rest; for its load of *inert* extracted matter is much greater, as proved by its comparatively low coagulating power. Leaving this extract out of account, it is true that among the others the one containing the most organic matter (B) was decidedly the most efficient, and the two lowest in organic matter (G and H) were the least efficient; but among the intermediate members, where the differences are less marked, the two factors do not follow the same order.

The most efficient extract of the lot (*viz.*, B, and this applies to samples 1 and 2 equally) contained a trifle over 5 per cent organic matter, 17 per cent of ash, with acidity equivalent to about .7 per cent lactic acid, or .3 per cent hydrochloric. [Multiplying any of the lactic acid figures by two-fifths will give the equivalent in hydrochloric.]

Age affects the strength of a rennet extract, very greatly during the first few weeks after making. A high German authority, Soxhlet, says a newly made extract will lose 30 per cent of its strength in the first two months, after which it will remain nearly constant for at least eight months—beyond which time his experiments did not extend. Another authority puts the loss of strength during the first two months at four-ninths of the original strength. Of course a rennet extract should not be placed on the market until this rapid reduction is over. One of the samples examined in this work, *viz.*, No. 2 of extract C, appeared to lose strength appreciably during the time covered by the tests.

CONCLUSIONS.

1. Among the rennet extracts examined there were found wide differences in composition and in coagulating power.

It would seem that the cheese maker might make intelligent choice among the extracts offered for sale, by making comparative tests of their curdling powers, after one of the two modes described above.

2. Considering the form in which the samples came to the Station, and also the small number of each kind examined, the writer thinks it would not be justifiable to report the trade names of the extracts. The present study is merely preliminary. The intention is to pursue the subject further, with samples from original packages, of which the identity can be made a matter of affidavit if necessary. Both modes of testing relative coagulating powers will be employed.