Not illustrated

TEXAS AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 11,

AUGUST, 1890.

EFFECT OF COTTON SEED AND COTTON SEED MEAL ON BUTTER PRODUCT.

QUALITY OF SWEET CREAM BUTTER

AS COMPARED WITH

BUTTER MADE FROM ACID CREAM.

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS.

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TEXAS AGRICULTURAL EXPERIMENT STATION.

PECULIAR EFFECTS OF COTTON SEED AND COTTON SEED MEAL AS FOOD STUFFS FOR THE DAIRY.

(GEO. W. CURTIS, M. S. A.)

EFFECT ON BODY OR FIRMNESS.

It has been currently believed among the more progressive farmers in the Southern States for many years that cotton seed and its product, cotton seed meal, make firmer butter than is obtained from the same cows when given food stuffs other than the peculiar substances named; also that the butter thus produced is of somewhat inferior quality. It is true that these facts have not been known to all, even where cotton seed and cotton seed meal have always formed the principal foods for cattle during the winter season; nor are they now, except among those who have been brought into close connection with the profit and loss sides of the dairy business, and have thus been compelled to investigate more closely the marked effect of food on the quantity and quality of butter produced through its agency in the bovine laboratory. If this is true, we should naturally expect to find some correlative facts in regard to the behavior of cream at the churn and the quality of butter, as determined by "butter experts" in the different parts of the commercial world. To establish or disprove the belief has been the basis of our work at this Station, both from a chemical standpoint as to exact melting point in degrees and relative proportion of volatile acids, and also from the practical side of the question, involving the temperature for churning cream from cows fed cotton seed or cotton seed meal, and especially condition of the butter and its market value, as determined by classification of butter experts. Whether the foods named have any bad effects on the quality of the butter made, and if so, to what extent they may be fed in mixture with other food substances without destroying or lowering too much the market value; whether the quantity of butter produced is increased or diminished by use of cotto seed or cotton seed meal, fed separately or in combination with other ods; whether there is any difference in action between cotton seed and cotton seed meal in this respect; and lastly, whether the increased firmness of butter stated as being due to the use of cotton seed or cotton seed meal is of sufficient importance in commercial handling to offset the lower price claimed for inferior quality, were questions we have sought to determine.

The chemical part of this work was inaugurated and carried out by the Station chemists—Profs. Harrington and Wipprecht—and the results obtained have already been published by Prof. Harrington in the public press and this Station's Annual Report for 1889. The facts as already published in detail are of great importance to science; but as we are chiefly concerned with the problems that lie nearest the farmers' and dairymen's daily operations, I shall simply state here the average results found as to melting point and volatile acids under different food conditions, and discuss briefly the relation of these facts to practical dairy issues. In each case throughout the tests reported the cows were allowed to run on the same food for a period of not less than twelve days before samples were taken as representing the effect of the food in ques-

tion; and as the cows were under my personal supervision closely, I was enabled to detect any material loss of appetite or tendency to be off condition, and in two or three instances to reject results as evidently due to trouble of this kind. In feeding, no certain quantity was given each cow or set of cows, but the amounts furnished varied according to size and appetite of cow—containing always the same proportion of ingredients, and had therefore the same nutritive or albuminoid ratio for each animal in the same test. When ensilage was given most of the cows ate about 15 to 17 pounds daily, and while some doubtless would have eaten more, possibly double, they were restricted to that amount for the sake of uniformity. When hay of good quality was given with ensilage, they ate about five pounds daily per head. The ground stuff given was fed dry, except in one or two cases where it was found necessary to moisten slightly for two or three feeds in order to hold the appetite. In the test for exclusive feeding of cotton seed meal and hulls, as compared with cotton seed, the cows fell off in milk quite materially, from the fact that it was practically impossible to get them to eat a sufficient amount for a full ration. Two cows concerned, one in each set, utterly refused the single diet presented, but these were withdrawn from the test, so that in each case results given represent normal action, as far as the animal is concerned, with different foods used in the several tests.

As a basis for comparison we present, first:

TABLE NO. 1.

Cows fed equal parts by weight of Corn and Cob Meal, whole Oats and Bran, with Ensilage and Sorgum and Pea Vine mixed Hay; allowed to run in pasture, but secured very little grass on account of season, most of the tests being in January and early February.

Sample Mark.	Melting point in Deg. F.	Volatile acids.
W	94.64	14.5
Wa	96.62	16.3
X	95.54	14.7
Xa	95.00	16.5
Y	95.00	14.4
Z	95.72	14.5
Za	94.82	17.0
Totals	667.34	107.9

Giving an average of 95.33 and 14.41 respectively for melting point and volatile acids, representing seven tests in January and early February; practically all dry feed except ensilage as noted. With this table as a basis for comparison, we may the more readily see the effect of cotton seed and cotton seed meal and hulls from the following:

TABLE NO. 2.

Cows confined in small pens and fed nothing whatever but Cotton Seed Meal and Hulls.

Sample Mark.	Melting point in Deg. F.	Volatile acids.
R	106.52	9.7
Ra	105.44	10.6
U	105.98	9.3
Ua	103.82	11.0
Totals	421.76	40.6

Giving an average of 105.44 and 10.15 for melting point and volatile acids respectively when the cows were fed exclusively on cotton seed meal and hulls. See also:

TABLE NO. 3.

Cows fed nothing whatever but Cotton Seed, either raw or cooked according as best eaten, and confined in small lot, as in Table No. 2.

Sample Mark.	Melting point in Deg. F.	Volatile acids.
Q	105.44	8.2
S	104.18	7.5
Totals	209.62	15.7

Giving an average of 104.81 and 7.85 respectively for melting point and volatile acids where the cows were fed exclusively on cotton seed, raw and cooked. Tests were taken from a single cow with same feed as noted in Table 3, but the results are not included in the table for the reason that the cow was out of condition, producing a marked unhealthy product, as shown by behavior at the churn of samples Qa and Sa, which are therefore not given. Considering Tables 2 and 3, it will be noticed that the cotton seed meal and hulls produced butter with slightly higher melting point and slightly higher volatile acids than cotton seed whole. The difference, however, is so slight that nothing definite can be drawn as a conclusion; it was furthermore very undesirable to repeat the experiment from the fact that our cows suffered materially by the unnatural conditions enforced in limiting them to the single food in question.

Table No. 4 gives more practical results as to the effect of cotton seed and cotton seed meal combined in a reasonable proportion with other food stuffs, as follows:

TABLE NO. 4.

Cows fed one part Cotton Seed Meal and three parts Whole Oats by weight, with Sorghum Hay and dry, poor, wild pasture November and December.

Sample Mark.	Melting point in Deg. F.	Volatile acids.
A	97.88	13.4
C	98.5	13.1
E	101.12	12.72
Totals	297.5	39.42

Giving an average of 99.17 and 13.14 respectively for melting point and volatile acids when the cows were fed a ration containing cotton seed meal in moderately large proportion. See also:

TABLE NO. 5.

Cows fed equal parts by weight Whole Oats and Cotton Seed, access to pasture same as Table No. 4.

Sample Mark.	Melting point in Deg. F.	Volatile acids.
B	98.06	13.8
D	94.3	13.9
F	101.12	12.46
Totals	293.48	40.16

Giving an average of 97.83 and 13.39 respectively for melting point and volatile acids when the cows were fed a moderately large proportion of cotton seed in combination with other food.

The practical effect of all this must be found, if at all, in the increased firmness of butter for handling and shipping in hot weather. Before considering this, it may be mentioned that unfortunately all of the heavy feeding of cotton seed and cotton seed meal is and must of necessity be done in cool weather, on account of health of animals fed, and this fact alone would estop us from hardening butter by very strong feeding of cotton seed and cotton seed meal in summer. That a medium ration can be fed with perfect safety to the health of cattle during the hottest portion of the year has, however, been proven by practical experience as thoroughly as the first proposition; hence if it may be possible to use the food stuffs named up to this limit without affecting the quality of the butter in any detrimental manner, we may certainly be able to harden the product slightly at least for summer handling.

EFFECT ON QUANTITY.

Leaving the question of quality for the present, let us notice the effect of cotton seed and cotton seed meal on the milk yield, and especially its per cent of fat, as shown by the records for our herd at the creamery at different seasons, classed in accordance with food given by months:

(About one-half of the milk from Holstein-Friesians, pure and grade, the other half from pure and grade Jerseys. Calves dropped mostly December, January, and February of each year, but some at all seasons. Herd freshest in February and March.)

September, 1889, to make one pound of butter required.....22.23 lbs. milk.
October, 1889, to make one pound of butter required.....20.36 lbs. milk.
November, 1889, to make one pound of butter required.....17.27 lbs. milk.
December, 1889, to make one pound of butter required.....18.9 lbs. milk.
January, 1890, to make one pound of butter required.....17.25 lbs. milk.
February, 1890, to make one pound of butter required.....17.73 lbs. milk.
March, 1890, to make one pound of butter required.....21.6 lbs. milk.
April, 1890, to make one pound of butter required.....21.33 lbs. milk.
May, 1890, to make one pound of butter required.....22.2 lbs. milk.
June, 1890, to make one pound of butter required.....23.07 lbs. milk.

Cotton seed and cotton seed meal were fed very lightly in September, the proportion slightly increased for October, and a still larger proportion during November, December, January, and February; slightly dropping off in March and April, and diminishing gradually to a very light proportion in June. Our pasture gives the most abundant feed from the last of February to the first of May, when the grass is tender and juicy; as also shown by the fact that the yield of milk from the herd was very largely increased during that period. The effect of the cotton seed and meal, however, was so marked as to keep down the proportion of milk to butter made to about 21 pounds as against 22 and 23 pounds in May and June, when the cotton seed and meal were practically withdrawn, the grass much dryer, and the herd not fresher than in preceding months.

Winter before last we fed cotton seed meal and cotton seed in considerably heavier proportions than we fed this winter, with result of bringing down the amount of milk required to produce a pound of butter as low as fourteen and a half to fifteen pounds average for the entire (same) herd. It has also been our observation in some seven years feeding at this place that by the addition of cotton seed meal in moderate quantities to the daily feed the yield

of milk has almost always been directly increased as a result of such addition; the best results, as to yield of both milk and butter, being from feeding ground stuff, say narrowed to about one to four (1:4), with cotton seed meal, and the cows allowed in addition all the fresh pasture grass or soiling crops they would eat. And now as to

EFFECT ON QUALITY.

Each sample representing a certain food was churned and worked by itself in quantity large enough for normal churn conditions. The feeding and milking were done under my personal supervision and the separation and churning done by myself. The conditions in all were made as nearly perfect as possible, the object being always to secure uniformity of manipulation for all samples, and thus set out whatever difference might be noted in the classification as strictly due to food concerned. All of the samples sent on for classification were produced from the mixed milk of a number of cows, never less than four nor more than six; and on the appearance of anything abnormal in the condition of a cow, as lack of appetite or unhealthy appearance of milk, she was instantly withdrawn from the test. The separation was done by centrifugal process, using a hand De Laval, vertical, which takes out the fat uniformly to a small fraction of one per cent. The number of cows used in the test is a good practical guarantee against individual variation which so frequently vitiates results in single cow tests; and to still further overcome this source of error, in one case five cows were fed for three weeks on one kind of food, and a second set of five cows were fed for the same length of time on a food entirely different. At the end of this period duplicate tests were taken and butter sample made from each, after which the two sets of cows were reversed as to feed—the second set receiving a ration exactly the same as had been given the first set during the first period, and vice versa. In this way it is believed individual variation is as nearly overcome as is possible in experimental test work, and the uniform results noted in the gradations of butter samples demonstrate the success of the plan. Each sample when complete was divided into six parts, one of which was sent to the chemical laboratory for determination of the melting point and volatile acids, one part retained by myself for further examination, and four parts wrapped up each separately in parchment paper and immediately shipped under private seal to well known butter experts, resident respectively in Illinois, Iowa, Louisiana, and New York, who had previously kindly consented to examine and grade the samples sent.*

In the tabular results given herewith the gradations of the several experts

*In Illinois, Mr. T. C. Moore, inspector of butter and cheese, Chicago Produce Exchange. Mr. Moore's experience is of especial value to us, since he had long handled butter for southern markets in Tennessee before serving as expert with P. Moran & Co., of Chicago, and more lately opening business as produce commission broker on his own account under the firm address, T. C. Moore & Son, 109 South Water Street.

In Iowa, Mr. H. D. Sherman, of Monticello, State Dairy Commissioner. Mr. Sherman has for years been recognized as among the leading creamery men of the west, and his peculiar fitness for the position was gracefully acknowledged by Governor Larrabee in his appointment as State Commissioner.

In Louisiana, Messrs. C. H. Lawrence & Co., of New Orleans, 68 Tchoupitoulas Street. These gentlemen have handled the select New Orleans butter trade for years, and retain a competent expert in their employ constantly.

In New York, Mr. L. S. Hardin, of the *American Dairyman*, kindly consented to pass opinion on samples, but begged to be excused from percentage gradation. On this account I have not been able to tabulate Mr. Hardin's opinions, and did not send to him as many duplicate samples as were sent to the others named. Mr. Hardin's judgment, as expressed, confirms in the main the tabular gradations, and thus adds to the weight of opinion there given.

are averaged for each sample, and the total number of samples representing a particular kind of food, again averaged as representing the normal quality strictly due to food influence. For several reasons one or other of the four experts who kindly consented to examine and classify samples sent failed to report on one or more samples. Nearly all the samples, however, received the grade of three judges, and no sample was graded by less than two. It will be understood that the only difference possible in the division of each sample sent to the experts must be accounted for solely by the small chance of one or at most two days difference in length of time required for transit, and the results of the grading are not such as to show any difference whatever due to this cause. That different judges have different opinions, and sometimes very decidedly different, has long been known, and that so-called "quality" of butter is nothing more than an expression of the individual expert's impressions received from the exercise of the three senses—taste, smell, and sight—is also known. With all due deference to the opinion of every good judge of butter, it must be admitted that equally good judges will give quite different classifications of exactly the same sample. This being true, the judges will, I trust, agree that a more uniform grade is reached by an average of their results as stated and as herein given.

The "scale of points" used in grading butter is something which admits of decidedly different arrangement to suit the opinion of different judges. More than this, such points as coloring and salting, which are usually marked quite highly by the butter men, are points which can be absolutely controlled by the butter maker, and consequently have no bearing whatever on food effect, which was especially desired in this test. I have, therefore, eliminated these two factors from the scale and reduced the gradations of all the judges to a standard, including only those points which would probably be affected by the food given, viz., flavor, grain or texture, and body or firmness, and have assumed for these points a relative importance represented by the following standard: Flavor, 45; grain or texture, 30; firmness or body, 25; total for perfect product, 100.

To many who are not familiar with the peculiar effect of cotton seed, it may seem that texture is dependent on manipulation solely, and not on food; but it is well known among handlers of cotton seed butter that its effect on texture is quite similar to the effect of overworking. In fact, in sending cotton seed samples to Northern butter handlers not acquainted with this peculiarity, they reported on cotton seed butter as "overworked," when, as a matter of fact, the butter so marked was scarcely worked at all—not nearly so much as other samples produced without cotton seed, and to which was given a much better grade on texture. That firmness or body is largely dependent on food has been shown conclusively by the investigation of Profs. Harrington and Wipprecht, tabular results of which appear on preceding pages. It is not claimed or believed that this standard is perfect, or even the best that could be devised to represent comparative food effects on butter, but it is believed to be relatively an approximate standard, and one which is sufficiently accurate to serve as a basis for comparative examinations.

In the following tables I have arranged the different samples—each with its grade, representing the joint opinion of at least two, and in most cases three, expert handlers of butter—together in accordance with food given, and in such a way that each table shows at a glance the quality of the butter produced by the particular food used.

TABLE NO. 6.

Cows fed no Cotton Seed or Cotton Seed Meal in any form, otherwise varied within limits of nutritive ratio from 4 to 6, using Oats, Bran, Corn Meal, Corn and Cob Meal, Ensilage, and Sorghum, Pea Vine, and Millet Hay.

(Scale used: Flavor, 45; Grain or Texture, 30; Body or Firmness, 25. Total Grade per cent, 100.)

Sample Mark.	Flavor.	Grain or texture.	Body or firmness.	Total Grade per cent.
2A	41.25	26.8	22.92	90.97
2C	39.00	25.00	21.5	85.5
2G	39.375	25.95	21.375	86.7
2J	37.95	25.5	22.083	85.533
2L	37.92	26.3	22.583	86.803
N	38.925	22.5	20.625	82.05
O	38.25	22.2	22.5	82.95
W	37.8	24.75	22.5	85.05
X	38.97	24 00	21.87	84.84
Y	41.17	26.7	23.5	91.37
Z	41.18	25.5	23.12	89.8
Totals	431.79	275.2	244.576	951.566
Average	39.25	25.02	22.24	86.51

Which compare with following where the ratio is narrowed by a quite liberal use of cotton seed meal:

TABLE NO. 7.

Cows fed daily ration made up as follows: Millet and Pea Vine Hay, 5 lbs.; Bran, 5 lbs.; Corn Meal, 6 lbs.; Cotton Seed Meal, 4 lbs. Free access to fresh, native pasture during the day. Nutritive ratio—exclusive of grass—a little under one to four (1:4).

(Scale used same as in Table 6.)

Sample Mark.	Flavor.	Grain or texture.	Body or firmness.	Total Grade per cent.
2I	39.00	25.7	22.083	86.783
2K	36.783	25.00	22.083	83.866
2D	39.00	25.5	22.00	86.5
2J	38.025	26.25	22.625	86.9
2H	37.8	24.75	22.375	84.925
Totals	190.608	127.2	111.166	428.974
Average	38.12	25.44	22.23	85.79

Since this table (No. 7) shows the result of narrowing the ratio by use of cotton seed meal, it may more properly be compared with the following, where the ratio was narrowed to the same as in Table 7, but by using bean and linseed instead of cotton seed meal. Hence see

TABLE NO. 8.

Cows fed daily ration having same nutritive ratio as in Table 7, but without any Cotton Seed Meal, as follows: Millet and Pea Vine Hay, 5 lbs.; Bran, 5 lbs.; Corn Meal, 5 lbs.; Bean Meal, 2 lbs.; Linseed Meal, 3 lbs. Free access to fresh native pasture during the day.

(Scale used same as in Table 6.)

Sample Mark.	Flavor.	Grain or texture.	Body or firmness.	Total Grade per cent.
2A	41.25	26.8	22.92	90.97
2C	39.00	25.00	21.5	85.5
2G	39.375	25.95	21.375	86.7
2J	37.95	25.5	22.083	85.533
2L	37.92	26.3	22.583	86.803
Totals	195.495	129.55	110.461	435.506
Average	39.099	25.91	22.092	87.101

It will thus be seen that a moderate use of cotton seed meal in the daily ration, when cows are on grass, as in Table 7, need not result in any great detriment to the quality of the butter produced. Flavor seems to suffer a little, and the total grade per cent is thus reduced somewhat, but beyond this, in the opinion of the gentlemen acting as judges, there was little if any observable difference in quality due to the feeding of cotton seed meal. This is an important fact, as it strikes at the basis of Southern trade objections to cotton seed and cotton seed meal butter. That cotton seed and cotton seed meal make a lighter colored butter when fed in large quantities, especially if winter fed without grass, no one denies. But the color of butter can be regulated at will by the butter maker to suit the demands of the market to which he caters. So it is with the salt question. If therefore we can feed the products named without serious detriment to quality as expressed in flavor, texture, and body, the last remaining objection to the use of cotton seed and cotton seed meal in the dairy will be overcome. As a matter of fact, many people who claim to dislike the flavor of cotton seed and cotton seed meal butter, and are quick to detect it in a sudden change from butter produced without these food stuffs, will not object if they are furnished butter successively representing a gradual change in the food from no cotton seed or cotton seed meal up to quite a relatively large portion in the daily ration.

Just to what extent the seed or meal may be used and still hold with the butter product an appreciative and discriminating market, is a question we have sought to determine. Practical experience has demonstrated, to my own satisfaction at least, that if a considerable amount of green stuff, whether of soiling crops, grass, or ensilage, forms part of the daily ration, we may add cotton seed or cotton seed meal in a larger proportion without destroying quality than is possible when the cows are on dry feed entire. In Table 7 I have shown that we used cotton seed meal strongly when the cows had plenty of grass, without greatly injuring quality of the butter. In Tables 9 and 10 are presented the results as to quality of butter produced from heavy feeding respectively of cotton seed meal and cotton seed mixed with other food stuffs when the cows ran in pasture, but of a very dry and poor quality, amounting practically to hay instead of grass.

TABLE NO. 9.

Cows fed a daily ration made up as follows: 11 lbs. Oats, 4 lbs. Cotton Seed Meal; allowed free access to pasture, but the grass scant and very dry, not materially differing from poor hay.

(Scale used same as in Table 6.)

Sample Mark.	Flavor.	Grain or texture.	Body or firmness.	Total Grade per cent.
A	32.12	20.00	19.86	71.98
C	34.75	22.8	20.8	78.35
E	33.92	22.2	20.97	77.09
Totals	100.79	65.0	61.63	227.42
Average	33.59	21.67	20.54	75.80

See also

TABLE NO. 10.

Cows fed a daily ration made up as follows: 11 lbs. whole Oats, 11 lbs. Cotton Seed; the seed mostly cooked, but a little raw seed used in order to hold the appetite of some of the cows that seemed to prefer it in this way; free access to pasture, dry and scant as in Table 9.

(Scale used same as in Table 6.)

Sample Mark.	Flavor.	Grain or texture.	Body or firmness.	Total Grade per cent.
A	34.75	22.8	20.8	78.35
F	34.96	21.8	20.42	77.18
K	33.75	21.00	20.625	75.375
Totals	103.46	65.6	61.845	230.905
Average	34.48	21.87	20.61	76.96

It will be seen from these two tables (9 and 10) that the effects of cotton seed and cotton seed meal are practically identical when fed in corresponding proportions; and it will also be seen that the limit for quality had been passed in each case, and yet the proportion was little, if any, larger than that used in the ration for Table 7. In our practical experience at this Station with butter commercially, these results are exactly sustained. We find that our winter butter shows effect of cotton seed or meal in a really small proportion, while in the spring with abundant grass the proportion may be very largely increased without detriment to the quality of butter or health of cows. In summer again, as the grass dries down and we are compelled to feed soiling crops, we find it advisable to reduce the quantity of cotton seed or meal, not so much on account of the quality of butter as on account of the health and general condition of the herd.

We are feeding now, as bye-ration, bran and cotton seed meal in proportion four parts bran to one part cotton seed meal, and soiling heavily with corn and sorghum. In this manner we have been able to keep up the yield of milk and butter, and at the same time not only hold a market already established, but establish new demand for more butter than we can supply. To show still further the effect of cotton seed on quality, compare following, where cows were fed exclusively on cotton seed, part cooked and part raw—mostly cooked, but some raw used to hold appetite of certain cows.

TABLE NO. 11.

Cows fed nothing whatever but Cotton Seed, raw and cooked.

(Scale used same as in Table 6.)

Sample Mark.	Flavor.	Grain or texture.	Body or firmness.	Total Grade per cent.
Q	30.37	18.5	21.25	70.12
S	31.5	18.5	21.25	71.25
Totals	61.87	37.0	42.5	141.37
Average	30.93	18.5	21.25	70.68

From the tables relating to the quality of butter it will be seen that the feeding of cotton seed or cotton seed meal beyond a certain limit injures more or less the quality of butter produced in direct ratio with the quantity fed. The limit, with cows on abundant grass or heavily soiled with green stuff, seems to be about reached in a reduction of the ratio of albuminoids to starchy matters in the bye fodder to about one to four (1:4) or four and one-half (1:4½) with cotton seed meal or cotton seed. This means, when bran is used

with cotton seed meal that the ration may be made up as strongly as one part cotton seed meal to three parts bran by weight. If oats are used in addition, say two parts bran and one part each oats and cotton seed meal by weight. If corn meal and bran be used, say equal parts by weight corn meal, bran, and cotton seed meal. This latter will give not quite so narrow a ratio as the two preceding; but where corn is cheap, as in North Texas and Western States, it may be found advisable to widen the ratio with corn meal considerably—say even as much as one to six (1:6). Where cotton seed is used instead of cotton seed meal, substitute about three times the weight of cotton seed in place of cotton seed meal, other proportions remaining the same.

With us cotton seed and cotton seed meal form our cheapest foods, and corn is about the most expensive, rarely falling below 30 cents per bushel, and commonly selling as high as 40, 45, and 50 cents. Bran costs, laid down at our Station, $14 to $18 per ton, and cotton seed meal costs about $17 to $20 per ton delivered. Cotton seed sells usually for from $6 to $7 per ton, and at these prices is undoubtedly fully as cheap for feeding purposes as cotton seed meal at the figures given. As before stated, cotton seed and cotton seed meal have quite a noticeable

EFFECT ON COLOR OF BUTTER,

Rendering the product very much lighter if cotton seed or meal is used. The addition of cotton seed meal or seed to summer ration, with cows on grass or soiling crops, lightens color from one to three or four shades, according to quantity added. In the winter, with cows on dry feed and allowed cotton seed heavily, the butter becomes very much lighter—sometimes almost white. This effect was very strongly shown in the case of a fresh Jersey cow which we placed in the test for exclusive feeding of cotton seed last winter. As is well known, cows fresh in milk yield butter of much higher color than later, although the food remains exactly the same. This cow's calf was about one month old at the time of the test, and the mother had been making butter nicely, even highly, colored for the season, on food with no trace of cotton seed or meal, and dry with exception of ensilage. After two weeks' feeding exclusively on cotton seed, the butter from this cow became almost as white as tallow, and when afterwards taken off cotton seed and fed as above, her product again resumed its normal good color, subject, of course, to natural change due to period of lactation. Whenever we feed heavily with cotton seed or cotton seed meal, we use coloring in greatly increased quantities—more or less, according as the cows are allowed mainly dry food or grass and soiling crops. It has been our experience that the best markets demand a uniform color regardless of season, and this can only be accomplished by the use of artificial coloring matter, a practice so generally and favorably known among commercial dairymen as to need no comment.

EFFECT ON TEMPERATURE FOR CHURNING—"CHURNABILITY."

A further item of interest in regard to the effect of cotton seed or cotton seed meal on butter product is found in the decided effect on so-called "churnability." The old ideas on churnability and injuring grain by too rapid churning have necessarily undergone a radical change on account of the successful introduction of the butter extractor in this country, and the reported success from across the waters of the new De Laval Instantaneous Churn for attachment to the De Laval Separators now in use. A discussion, however, of two methods of churning—sweet and acid cream—will be found in the next topic, which

see. To those who now use the ordinary churn, and doubtless will continue to use for many years on account of high price of both separator and extractor, I may explain that churnability as here used means simply comparative length of time required for churning different lots of cream under exactly similar conditions, so far as we are able to influence them after receiving the milk from the cow. Considered in this sense, the effect of cotton seed and cotton seed meal is very marked, requiring in brief a higher temperature for churning than is necessary when neither cotton seed nor cotton seed meal is used. In other words, if two lots of cream, the first produced by heavy feeding of cotton seed or meal, the second produced without these substances, both ripened to the same degree of acidity, or both churned direct from the separator sweet, same relative quantity in churns of the same kind operated at exactly the same speed, with exactly the same temperature at starting, and in the same room, the first will require much longer for perfect churning than the second. Further, if the starting temperature be as low as 60 or 62 degrees in a room that will not permit the temperature to run above 64 at any time, it is a practical impossibility to churn the cotton seed cream successfully in any of the ordinary box or barrel churns. As a matter of satisfaction on this point a number of such tests were actually churned four or five hours continuously with no more appearance of butter than when the churn was started. At the end of this time the cream was raised about 10 degrees in temperature, when the butter came in each case in from 20 to 30 minutes—exactly the time it would have required for churning if originally started at the higher temperature noted.

Temperature for churning involves so many other conditions that it is always unwise to set any definite, rigid limit in degrees. Length of time the cows have been giving milk, relative quantity of cream in the churn, degree of acidity or ripeness of the cream, speed at which churn is operated, and thinness of the cream, all affect and influence aside from temperature the length of time required for churning. In our tests, therefore, I took particular pains to see that each lot of cream representing cotton seed or cotton seed meal was compared in churning under conditions exactly similar with another lot representing food with neither cotton seed nor cotton seed meal. The two churns used in comparison were of the "Acme" barrel pattern, exactly the same size, and practically the same quantity was placed in each. The ripening for acid churning was carried to as nearly the same limit as practical test and observation could determine, and both churns were operated at the same speed. In other words, it is believed that the conditions were as closely similar, except temperature, as it was possible to make them. In my opinion the length of time required for perfect churn action is the best criterion for determining proper churn temperature. By perfect churn action is meant such action as produces the finest butter in the best granular form with the ordinary churns now in use. Twenty to fifty minutes should be the extreme limits, and I believe it still better to narrow these as close as twenty-five to forty minutes. In the tests made, therefore, I have striven to find that temperature which would bring the best granular butter from cream produced by feeding cotton seed or cotton seed meal within limits of time stated, and to compare this cream under otherwise exactly similar conditions with cream produced without the use of cotton seed or meal in any form.

The ordinary churn temperature to which I was for many years accustomed in higher latitudes (about 42 degrees north) was 62 or 63 degrees at starting, butter to come in about 30 minutes with temperature at close 65 degrees, never starting lower than 60 degrees for acid cream, to be 64 at closing; and in winter with cows on dry food and many of them farrow, 65 to 66 degrees

at starting, butter to come in about 40 minutes at temperature 66 or 67 degrees at most. Sweet cream, even from the gravity process, of course required a lower temperature, say 55 to 57 degrees. When our college creamery was first started at this Station (winter of 1887–8) I soon found that a higher temperature was demanded for churning. The only radically different foods used were cotton seed and its product, cotton seed meal, and to these I turned my attention for something definite in regard to a cause for the observed difference in churn temperature. The results of the tests made during the past 12 months give some idea as to the proper churning temperature when cotton seed or cotton seed meal is used, and furnish conclusive evidence as well that there is a decided difference between this temperature and that commonly given as the proper degree limit for churning where little or no cotton seed or meal is used. The condensed summary of all tests made in this line shows following results: When the cows had cotton seed or cotton seed meal with nothing else, six tests where the churn was started at 68 to 70 with a temperature at closing of 74 to 76 degrees gave an average time required to bring butter in granules size of quail shot of one hour and 56 minutes; while under exactly similar conditions, except temperature, in three churnings, temperature at start ranging from 73 to 78 and at closing 75 to 80 degrees, the average time required was 33 minutes. When the cows were fed a ration made up largely but not entirely of cotton seed and cotton seed meal, two tests—starting in each case at 64 and closing at 68 and 70 degrees—gave an average time required of one hour and 18 minutes; while under exactly similar conditions except temperature an average of six tests with temperature ranging at start from 68 to 71 degrees and closing at 70 to 75, shows 38 minutes as the time required. In the spring, when the cows were on grass and allowed no cotton seed or cotton seed meal whatever, in eight tests with temperature at start ranging from 62 to 64 and at close from 66 to 68 degrees, the average time required was 30 minutes, which you will notice is about the temperature for work in equal time farther north.

These results have been exactly borne out by the large churn in the creamery, our common practice being in winter, when we feed a certain portion of cotton seed meal and cotton seed, to start the churn at 67 to 69 degrees, and obtain butter in the granular state in 35 to 40 minutes. In summer, with our cows on grass and soiled heavily in addition with sorghum, cow pea vines, and green corn, with only a trace at most of cotton seed meal, and no cotton seed at all in the ration, we start the churn at 62 or 63 degrees, and obtain butter in 27 to 30 minutes. From this we may safely conclude that the proper churn temperature, when cotton seed or cotton seed meal is used in the food ration, is about 4 to 8 degrees (Fahrenheit) higher than the proper temperature for cream produced without these highly nitrogenous bye foods, at least for acid cream. With separator cream, perfectly sweet—churned, in fact, as soon as it comes from the separator, within one hour after being drawn from the cow—the difference is still there, but much narrower, say not more than 1 to 3 degrees (Fahrenheit). For example, in churning sweet cream without cotton seed or meal in the food, we obtained best results at 55 to 57 degrees constant temperature, while in churning sweet cream with cotton seed or cotton seed meal in the food, we reached same limit of time and completeness by maintaining temperature at about 57 to 59 degrees.

QUALITY OF SWEET CREAM BUTTER AS COMPARED WITH ACID CREAM BUTTER.

During the past year the butter extractor has made long strides towards successful and permanent introduction in this country, and still more recently comes a report that the De Laval people have invented and successfully operated across the water a new instantaneous churn, which may be attached to any of their machines already in use. These facts have brought to the surface all the old opposition to sweet cream butter, as statements that it is wanting in flavor, and that the people must be educated up to an appreciation of its merits. For myself, I have never believed that the statements had any particular ground in fact, and to convince myself of my own error or establish the correctness of my opinion, I undertook to make comparative tests and submit samples—without mention as to whether produced from sweet or acid cream—to the experts noted on preceding pages of this Bulletin. Each test was conducted in double, as follows: The cream taken from the separator was at once thoroughly mixed and quickly and accurately divided into two equal portions by weight, taking especial care that the division was so managed as to secure a uniform quality in the two samples. One of these lots was churned immediately and the other allowed to "ripen" to slight acidity, generally standing in cool room 12 to 24 hours, according to weather, before churning. The fact that we obtained within very close limits the same amount of butter from each of the two lots goes far toward proving accuracy in division of lots for sweet and acid churning. All butter samples were immediately forwarded under private seal for expert opinion, and results are here given:

TABLE NO. 12.

Comparing quality of Sweet Cream Butter with that made from Acid Cream.

(Scale used same as in Table 6.)

Sample Mark.		Flavor.		Grain or texture.		Body or Firmness.		Total grade per ct.	
Sweet.	Acid.	Sweet.	Acid.	Sweet.	Acid.	Sweet.	Acid.	Sweet.	Acid.
I		29.25		18.00		21.25		68.5	
	K		33.75		21.00		26.25		75.375
2C		39.00		25.00		21.5		85.5	
	2A		41.25		26.8		22.92		90.97
2D		39.00		25.5		22.1		86.6	
	2B		34.53		23.6		22.08		80.21
2G		39.375		25.95		21.375		86.7	
	2E		36.00		21.00		18.735		75.735
2H		37.8		24.75		22.375		84.925	
	2F		38.025		26.25		22.625		86.9
2I		39.00		25.7		22.083		86.783	
	2K		36.783		25.00		22.083		83.866
2J		37.95		25.5		22.083		85.533	
	2L		37.92		26.3		22.583		86.803
Totals		261.375	258.258	170.4	169.95	152.766	151.651	584.541	579.859
Average		37.339	36.894	24.343	24.279	21.824	21.664	83.506	82.837

The difference is scarcely noticeable, what little there is being in favor of the sweet cream butter by about $\frac{7}{10}$ of 1 per cent on the total grade, and coming almost entirely from flavor, a significant fact since the voices of nearly all the

sour cream advocates are raised in protest against what they choose to term the "flatness" or "want of flavor" of the sweet cream butter. I doubt very much if more than one man out of every ten can tell the difference between two ordinary samples otherwise equally good—one made from sweet cream, the other made from acid cream—if he is not given some hint in advance. I have always thought I could tell sweet cream butter from that made from acid cream, at least if the latter was quite strongly acid, and still believe that the difference can be told by long practice; but that there is any such marked difference as to necessitate "educating the people up to an appreciation of its merits" before it can be successfully placed on the market, I most emphatically do not believe, and the classification of above samples by such judges as Sherman, Moore, and Lavelle (the latter of C. H. Lawrence & Co.), as well as the opinion of Mr. Hardin of the *American Dairyman*, whose word grading agrees closely with the figures of the other three, goes far to show that my judgment has not been seriously at fault.

The real trouble in introducing sweet cream butter was found in the fact that it was openly advertised as such, and the people were afraid to try it for fear it might be found "flat" in flavor, and the further fact that most of the parties attempting its introduction were new at the business, and had not at first the reputation which is so essential to securing good market demand for any product.

Let any first-class creamery, that has an established reputation as making "extras" or even "extra firsts" in creamery goods, put out a shipment of equally well made sweet cream butter without saying anything about the change, and it may be safely assumed that no objections will be heard from its patrons.

The separator is without doubt a great blessing, especially to Southern dairymen, enabling us to save ice largely, and not only that, but obtain practically all of the cream from the milk, something which has never yet been accomplished by any known manipulation of the gravity process, even the addition of iced water directly to the milk when first set, as lately announced, or the other plan of adding hot water to insure a certain fall in temperature; while either doubtless helps much in the saving of ice, it does not pretend to secure the cream as closely as does the centrifuge.

The extractor and the De Laval centrifugal churn, if successful, doubtless mark another step in our progress, but on account of high prices it must be years at least before either of these machines can be very widely introduced. In my opinion, the hand separators, if reduced in price about one-half, and a perfected centrifugal churn attached at a reasonable figure, or a hand extractor complete at same terms, would rapidly reach most of the smaller dairies throughout the United States. It is not the quality of butter produced, but the small fortune required as first cost which will keep hundreds of men from investing in these machines.

INDEX.

To JULY, 1890.

BULLETINS ISSUED SINCE RECEIVING BENEFIT OF HATCH FUND.

Mailed free on application.

BULLETIN No. 1, MARCH, 1888.—Plan of Organization. (A number on hand.)

BULLETIN No. 2, MAY, 1888.—Cattle feeding: Value of cob and shuck in feeding corn, cob, and shuck ground together. Analyses of food stuffs and fertilizers. Statements of Director, Horticulturist, and Meteorologist. (A limited number on hand.)

BULLETIN No. 3, OCTOBER, 1888.—Root Rot of Cotton or Cotton Blight: Preliminary bulletin. (Edition exhausted.)

BULLETIN No. 5, MARCH, 1889.—Creameries for Texas: Plans and specifications in full for cheap and effective creamery building and outfit. Some points in butter making. (A number yet on hand.)

BULLETIN No. 6, JUNE, 1889.—Cattle Feeding: Effects of dehorning, shelter, and different rations. Analyses of ensilage. (A number yet on hand.)

BULLETIN No. 7, NOVEMBER, 1889.—Cotton Root Rot (cotton blight): Concluded from Bulletin No. 4. (A large number on hand.)

BULLETIN No. 8, DECEMBER, 1889.—Diseases of Grapes. Notes on Varieties: grapes, strawberries, blackberries, and grasses. Best varieties of fruits for the different sections of the State. List of fruits growing on experiment grounds. (A large number on hand.)

BULLETIN No. 9, MAY, 1890.—Pear Stocks: Illustrations showing manner of growth and union of scion and stock. Some Parisitic Fungi of Texas. (A number yet on hand.)

BULLETIN No. 10, MAY, 1890.—Cattle Feeding: Comparison of different rations for profitable feeding. Continuation of the work reported in No. 6. (A number yet on hand.)

NOTE.—The old series of bulletins issued by the Agricultural Department of the College prior to the establishment of the Experiment Station in 1888, comprises: No. 1. Preliminary Statements; No. 2. Pig Feeding, tests of age and breed—Dairy Tests; No. 3. Effect of salt in pig feeding—Notes on Grasses; No. 4. Acclimating Cattle ("Texas Fever"); and No. 5. Acclimating Cattle—Fertilizer Tests—Feeding, cooked vs. uncooked food for cows and hogs.

Of these, Nos. 2 and 4 are practically exhausted; but there is yet on hand a limited number each of Nos. 1, 3, and 5, *copies of which will be mailed on receipt of postage—1 cent for each copy requested.*

ERRATA.

In place of "BULLETIN No. 3, OCTOBER, 1888," read "BULLETIN No. 4, DECEMBER, 1888."

BULLETIN No. 3, OCTOBER, 1888.—Grasses and Forage Plants: Descriptive notes. (Edition exhausted.)