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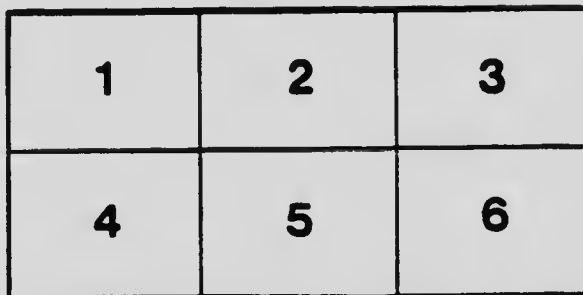
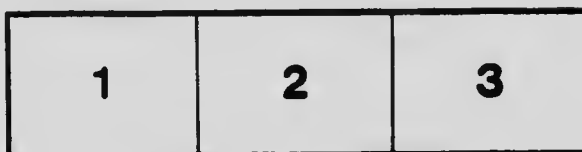
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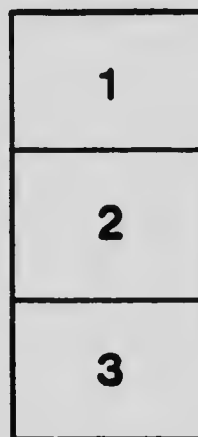
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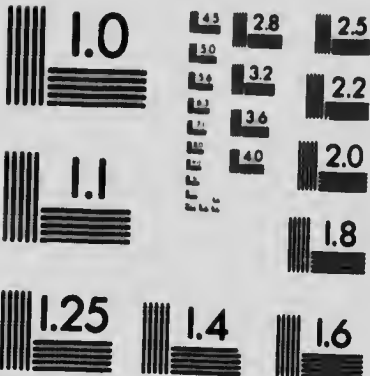
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THE MAKING
OF BUTTER

FROM

Sweet Cream



BY

J. D. LECLAIR

SUPERINTENDENT

OF THE DAIRY-SCHOOL AT ST. HYACINTHE

January 1904

MONTREAL.

THE MONTREAL PRINTING AND PUBLISHING COMPANY

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Introduction.



The students at the St. Hyacinthe Dairy School having earnestly besought me to give them a description of the way to make butter, as practised during their attendance on the courses, I send them these notes, hoping that they will prove useful to them.

They are not intended so much for the novice as for those who already enjoy a certain acquaintance with the art. Indeed, I dare not advise a neophyte, without a master over him, to follow this method of working for, not knowing the importance of each member of the work, he will meet with with recurrent disappointments, and those who witness his errors will probably imbibe prejudices against the system.

The terms employed are those used in the trade, and are familiar to all butter-makers, by whom I trust I shall be easily understood.



PASTEURISATION

Two things, in the making of butter in winter, demand consideration: Pasteurisation and the preparation of ferments. These two operations are, so to speak, the pivots on which success depends, and in the following chapters we shall inquire into their nature and how they are to be conducted.

In dairying, Pasteurisation may be defined as the application of a moderate degree of heat (140° to 175° F.) to milk, whether whole or skimmed, and cream, with a view to the prevention or the arresting of the development of injurious germs that may have been pre-existent in them or may have been introduced at the time of milking, or afterwards, owing to the accidents or to the operations to which they have been subjected. Heated up from 220° to 230° F., the milk or cream would be *sterilised*, i. e., the very spores having been destroyed, they would be safe from any multiplication of these germs, unless affected by a subsequent inoculation. As sterilisation is not practised in ordinary butter and cheese factories, we shall not enlarge upon it here.

Milk, when being pasteurised, should not be heated above 155° F., lest it acquire a burnt or cooked taste. Skimmilk, never being pasteurised except for the preparation of ferments, or for the prevention of the spread of some contagious disease among the cattle, is to be heated up to 175° F., and kept at that temperature for 20 minutes. As to cream, it is only necessary to raise its temperature to 140° F. for 20 minutes, bacteriological experiments having proved that to be sufficient to effect our purpose.

It is *absolutely necessary* that when milk or cream are pasteurised, they should be thoroughly and immediately cooled after the operation. Whole milk may be cooled down as low as 32° F., if it is desired; skimmilk, to 70° F., or 60° if required for ferments; and for butter, cream may be cooled to 50° or even 40°.

During the heating of cream or milk, as well as during their cooling, they should be kept in motion to prevent them from sticking to the side of the vessel containing them.

Pasteurising, or the application of heat, and the subsequent cooling are to be done in a "bain-marie", i. e., by the use of hot or cold water. For pasteurising cream, the bain-marie water should not be allowed to go above 160° F. if possible.

If pasteurisation arrests the development of the germs or microbes of the milk, during the rapid cooling there may be perceived a considerable amount of evaporation and the dispersal of a great deal of the bad smells that were previously confined in it; the milk is thus brought to a condition better fitted for the making of butter as well as for ordinary family use.

FERMENTS

The natural ferments are peculiar germs absorbed by the milk after it is drawn from the cow, or perhaps, even pre-existent in their udder; in their development lactic acid is produced. The want of uniformity in the aroma and quality of butter is indisputably due to the variety of the kinds of lactic bacteria, which are developed under analogous conditions, and it must not be forgotten that they do not all give the flavour sought after.

What we shall call cultivated ferments are the germs that are suited to the production of the required aroma, and are propagated expressly for that purpose.

In ordinary practice there are three sorts of these ferments according to this method employed in their preparation:

1st. The *pure culture* or *trade* ferments, so called because, in addition to the care taken in the selection of the first seed, they are cultivated and propagated in *sterilised* media. Sterilisation being conducted only in closed vessels, under pressure, requires special care and apparatus; and this preparation has been carried on by chemists who put these products on the markets under their personal guarantee. The greater the care, the better the culture.

2nd. Ferments prepared from new-milk: It is a matter of importance that a judicious selection be made, and, as far as possible, the following conditions should be combined. A cow that gives very well flavoured milk should be taken; one that has recently calved and whose health is perfect. Before and after milking great cleanliness must be observed; the milk

should be received in a vessel that has been well washed and steamed, and the air of the place must be perfectly pure. If a disinfectant or powerful germicide can be had, formaline for instance, it would be worth while to sprinkle the clothes of the milker with it and to reject the first jets from the cow's teats. The maker now sets the milk at once in a pan of iced water, or, if no ice, in the coldest water he can get, having previously covered the milk with a clean linen cloth; 12 hours afterwards, he skims the milk and leaves it to sour and curdle in a temperature of 70° F., keeping it well covered. The curd will be pretty firm when it leaves the sides of the vessel; and there it is, a *mother-ferment* which you may use as you would a *pure* or *trade culture*.

3rd. Ferments made from good skimmilk.—Pasteurise the milk at 175° F. for 20 minutes, cool it quickly down to 70°, and keep it so until it curdles like the former one: there will be your "mother-ferment", to be used as above.

These three kinds of ferments are propagated in the following manner. The medium used is always good skimmilk pasteurised at 175° F. for 20 minutes and rapidly cooled down to 70°, for the first time, and to 60° for all the subsequent propagations, so long as no recourse is had to a fresh "mother-ferment".

From five to seven pounds of ferment to a hundred pounds of pasteurised milk, will always give a good curd in twenty hours, if the temperature has been kept uniform.

If you do not need the ferment so soon as it is made, keep it, well covered, in the coolest place you have at a temperature below 40° F. to stop the fermentation. A good cover is made by a sheet of wadding with a linen cloth over it.

In every instance, you must not forget to take off the top of the curd to about an inch in depth, before using it, whether for propagating or for putting into cream. It should be very finely divided so as to insure its thorough mixture of with the skimmilk or the cream.

All the vessels and utensils, such as the skimmers, stirrers, etc., that have been used in the preparation of these ferments, must be invariably steamed, so as to be sterilised.

The pure or trade culture ferment is preferable to the other

kinds; the difficulty of finding proper or suitable milk, and of getting a good first fermentation, will always cause a want of uniformity in the flavour of the "mother" ferments and consequently in the products. The cost of such is light, and by their propagation and proper care there will be no need to resort to the *pure culture* more than once a month. This rule is not without exceptions for as soon as the flavour is not to your taste, the preparation you have been using must be rejected, and a fresh start be made.



WINTER BUTTER

The making of butter in winter cannot be done in the same manner as is the practice in summer. The production of the milk (the feeding, housing, time for calving of the cows) and the keeping, are so different and so faulty in winter, that we cannot succeed in making export butter, or even butter for the home-market, by following the rules that guide us in the process used for butter-making in summer.

1st. The need of destroying by pasteurising the greater part of the noxious germs of fermentation is absolute. Immediately after the skimming, which may be fairly well done at 90° F., the cream is to be warmed in the bain-marie for 20 minutes, keeping it stirred almost continuously, and then cooled down to 50° F., as fast as possible, so as to prevent any fermentation during the lowering of the temperature. During the passage through this scale of temperature, there is produced, by the exposure to the free air, a vast evaporation that carries off from the cream an almost incredible quantity of smells of all kinds that have lain imprisoned in the milk under the layer of cream. The cream becomes completely changed and returns almost to its neutral condition, thereby becoming through its absorbing power more easily impregnated with any flavour or smell that may be presented to it. The ferment, whose preparation and use we studied in the last chapter, is the matter on which we reckon to impart to the butter the specific flavour that proceeds from the acidulation of the cream and which is required by the market.

The cream is kept at 50° F., for 3 hours that the fatty matter may become thoroughly cool. This cooling gives its firmness, permits the aggregation of the fat-globules by the action of the churn, and enables us to secure as complete an extraction of the butter as we have any right to expect.

Between whiles, the maker can devote himself to his ordinary work, such as the washing, cleaning up of the machinery, utensils, pumps, pasteurisers, etc., he ought also to see that the churn is cooled, to hinder, in some degree, the rise in temperature of the cream.

The cream is now ready for the churn, and is poured into it without any more preparation. A certain quantity of the ferment is added, which is strongly charged with lactic acid, and will replace with the fatty matter the lactic acid which would have been developed by the spontaneous fermentation of the cream. We know that this acid is needed to secure that the fatty matter gathered together under the name of *butter* should possess that special flavour which the consumers, our customers, cannot do without.

This ferment is added in a certain proportion as mentioned below. For this proportion we have first of all established a type or standard of acidity for cream and one for the ferment, as well as the typical or standard proportion the best fitted, under these conditions, to attain the best results. And in all our daily work, we vary this proportion, or percentage of ferment, according as we find that the acidity of the cream and the ferment of the day approach or recede, more or less, from these types. In this way, we preserve the same proportion of lactic acid with the fat, and we find a great uniformity of flavour in our butter one day with the other. The buttermilk besides, when tested by the acidimeter, shows the presence of a quantity of acid obviously the same, the variation not being more than .05 of 1 per cent.

A wooden stirrer minutely divides the ferment, and when pouring it into the churn, it is strained through a cheese-cloth, that it may be thoroughly mixed with the serum, and that not a trace of it may be found in the butter. The churning should occupy about 50 minutes, and the rest of the work is carried out as in the ordinary process in the summer.

By spontaneous fermentation, even when aided by the use of a pretty large percentage of ferment, say, 5 or even 10 per cent, we have never succeeded in getting the same richness and uniformity of flavour that this process of non-acetified cream always gives us.

The averages of the tables to which the reader is requested to refer, are taken from official record of the St. Hyacinthe Dairy-School for the years 1902, 1903.

The ferment has always been added to the cream in conformity with the *standards* given in the appendix.

RESULTS

DATE	Fat					Acidity of the butter milk	Lbs of milk per lb of butter	Lbs of butter per 100 lbs of milk	Lbs of butter per 100 lbs of fat	ICE
	In milk		Lost							
	Unmed	Of butter	Total	Per cent	Total					
	Total	Per cent								
May....	15.50	.178	8.08	1.28	23.77	.30	24.19	4.13	.....	34 lbs per 1000 lbs of milk
June....	28.18	.11	4.90	1.72	35.75	.33	22.70	4.41	.....	41 " " " " " "
June....	27.85	.15	6.12	1.65	34.65	.325	22.11	4.58	.....	40 " " " " " "
July....	24.28	.30	15.06	1.60	40.70	.385	22.23	4.30	.....	53 " " " " " "
August	8.84	.15	5.20	.91	14.10	.41	21.90	4.53	.....	18 " " " " " "
Septemb.....	.....	.....	.....	.....	.....	.....	20.90	4.77	.....	.....
October.....	.....	.....	.....	.....	.....	.....	19.43	5.14	.....	.....
AVER.....	.....	.16	.....	1.43	.....	.36	22.30	4.48	.....	41 lbs per 1000 lbs of milk
(a) July	1.50	.12	.37	.82	1.09	.65	.....	82	.....	119 " " " " " "
Nov....	2.02	.08	.40	1.23	2.44	.3025	19.83	5.64	110.90	
Dec....	1.05	.08	.22	.79	1.17	.3800	17.90	5.56	113.20	
Jan....	1.66	.09	.29	1.30	1.97	.4100	17.64	5.66	.....
Feb....	1.06	.08	.18	1.34	1.24	.3942	19.60	5.00	113.52	
March	.67	.13	.31	.98	.99	.3057	24.12	4.14	111.90	
April..	.88	.15	.42	1.21	1.30	.3825	24.98	4.	112.54	
AVER	1.22	.10	.30	1.14	1.53	.3889	20.68	4.91	113.79	

(a) Making butter from sweet cream.

ST. HYACINTHE DAIRY SCHOOL

DAIRYMENS ASSOCIATION, P. Q.

FOR THE YEAR

BUTTER

RECORD OF MONTHS

DATE	MILK		SEPARATOR			SKIMMING				Pasteurisation			FERMENT			ACIDITY	
	WEIGHT	Acidimeter	Pace	Quantity per hour	Temperature of the milk	Quantity of cream	Per cent of cream	Temperature of cream		Temperature (normal 50°)		Duration	Sort	Rates %	Quantity	Of the cream	Cream and ferment
								At starting	Cooled	Cooled to	Maintained at						
May.....	50008	.....	0400	3009	81	5444	10.73	81	45	.....	.....	.....	* C.P.	24	1186	.10	.30
June.....	53010	.....	0275	3105	70	5536	10.32	70	41	.....	.....	.....	.....	20	1082	.15	.28
June.....	50930	.....	0200	3233	71	5325	10.45	70	42	.....	.....	.....	.....	20	1010	.15	.27
July.....	64000	.....	0200	3112	74	6470	10.06	74	42	.....	.....	.....	.....	21	1355	.10	.33
August....	43373	.....21	0250	2982	69	4684	10.80	69	40	.....	.....	.....	.....	26	1150	.....	.30
September..	41610	.....	0300	2942	08	4604	11.06	69	42	.....	.....	.....	.....	20	.....	.....	.....
October.....	1062	.....	0300	2817	75	270	13.62	74	40	.....	.....	.....	.....	30	.....	.....	.....
AVERAGE	.....	.....	0275	3037	73	.....	10.56	72	42	.....	.....	.....	.....	24	.....	.1530	.31
(a) July.....	3879	.....	0400	3236	70	592	10.07	70	43	Rip'n'd at 65°f	.....	.....	.....	.....	.....	.50	night
Nov.....	4204	.1350	.....	2983	89	557	13.2	87	.....	50	50	2.30h.	.....	23	153	.1475	.297
Dec.....	2597	.1750	.....	2831	89	348	11.65	87	.....	50	50	2.30	.....	27	93	.1306	.304
Jan.....	3141	.1050	.....	2987	90	382	12.17	89	.....	50	50	2.30	.....	28	104	.14	.340
Feb.....	2039	.1885	.....	2630	86	237	11.61	87	.....	50	50	2.30	.....	30	72	.1428	.325
March.....	2685	.2014	.....	2983	89	264	9.85	87	.....	50	50	2.45	.....	29	76	.1485	.307
April.....	3237	.2134	.....	3082	88	330	10.20	96	.....	50	50	3.	.....	30	86	.1585	.310
AVERAGE	0000	.1980	.....	2866	89	356	11.45	87	.....	50	50	2.30	.....	28.97	.....	.1456	.315

(a) This make was registered to establish the difference between the quantity of ice used in making butter from cream
 * "Pure culture."

YEAR 1902-3

BUTTER

OF MANUFACTURE

ACIDITY			CHURNING			WORKING OF THE BUTTER			RESULTS										ICE
Cream and ferment	Of the ferment		Temperature		Time "in minutes"	Temperature of water (if washed)	How much salt p. c.	Weight of butter	Fat						Acidity of the butter milk	Lbs of milk per lb of butter	Lbs of butter per 100 lbs of milk	Lbs of butter per 100 lbs of fat	
			At starting	At the end					In milk				Lost						
								Per cent	Total	Per cent	Total	Per cent	Total						
.90	.99		51	56	38	51	4.5	2600	.034	15.50	.178	8.08	1.28	23.77	.30	24.19	4.13	.....		34 lbs per 1000 lbs of milk
.28	1.04		49	57	48	52	4.5	2362	.058	28.18	.11	4.00	1.72	35.75	.33	22.70	4.41	.....	41 " " " " " "
.27	1.05		50	57	48	51	4.5	2334	.06	27.85	.15	6.12	1.65	34.65	.325	22.11	4.58	.....	40 " " " " " "
.33	1.06		51	50	53	45	4.	2878	.04	24.28	.30	15.00	1.00	40.70	.385	22.23	4.30	.....	53 " " " " " "
...	.30	1.03	48	56	50	46	4.	1976	.025	8.84	.15	5.20	.91	14.10	.41	21.90	4.53	.....	48 " " " " " "
.....	.....	.....	52	57	44	46	4.	1985	.025	.....	.....	.....	.....	.....	.....	20.90	4.77	.....	.....
.....	.....	.....	50	57	40	46	4.	102	.....	.....	.....	.....	.....	.....	.....	10.43	5.14	.....	.....
0	.31	1.03	50	57	49	48	4.2	.....	.045	.....	.16	.....	1.43	.....	.36	22.30	4.48	.....	41 lbs per 1000 lbs of milk
ght	.....	.....	55	59	30	48	4.	231	.03	1.50	.12	.37	.82	1.93	.65	20.75	4.82	.....	119 " " " " " "
5	.2975	1.08	50	57	50	55	4.00	212	.062	2.02	.08	.40	1.23	2.44	.3025	19.83	5.64	110.00	
6	.3044	1.11	50	58	60	55	3.50	144	.052	1.05	.08	.22	.79	1.17	.3806	17.96	5.56	113.20	
	.3406	1.00	50	57	48	55	3.50	178	.06	1.66	.09	.20	1.30	1.97	.4100	17.64	5.66	.....
8	.3257	1.05	51	60	75	55	4.	104	.059	1.06	.08	.18	1.34	1.24	.3042	19.60	5.09	113.52	
5	.3071	1.10	52	57	45	55	4.50	111	.027	.67	.13	.31	.98	.99	.3057	24.12	4.14	111.90	
5	.3109	.97	51	56	33	54	4.	129	.03	.88	.15	.42	1.21	1.39	.3825	24.98	4.	112.54	
6	.3153	1.05	50	57	52	55	4.	146	.048	1.22	.10	.30	1.14	1.53	.3889	20.68	4.91	113.79	

cream spontaneously ripened, and the process of making butter from sweet cream.

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The acidity of the buttermilk will be seen to have varied but very little, which leads to the conviction that the flavour of the butter must be undoubtedly uniform, always presuming that the flavour of the ferments is also uniform.

This process, with some trifling variations, may be advantageously followed in other seasons besides winter. We can affirm, without fear of contradiction, that it imposes no extra work on the maker, and involves no extra outlay on the part of the proprietor. The first objection brought against it is the vast quantity of ice it demands: a study of the table of record of manufacture, col. "ice", will show, at a glance, without other arguments, that, given the general necessity of the rapid and instant cooling of the cream, about which there can be no doubt, there is, in following our plan, a considerable saving in ice, instead of an extra expenditure of that article.

The second objection, on the part of the proprietor, is the need of buying a refrigerator. Formerly, although it was admitted, as the reports of the Dairy-men's Association of the Province of Quebec testify, that the practice of a rapid and pressing cooling of the cream produced a butter of very superior flavour, the difficulty of lowering the temperature was so great and required so much time and labour, that this practice was utterly neglected. Now that the trade has placed upon the market a special apparatus, of great cooling power, and of sufficient capacity to equal the hour's work of our largest separators, this relative impossibility has become one of the easiest of things and within the reach of any one's purse.

As to the maker, all he has against it is the force of deep-seated habit, and the dislike of having to make a ferment every day. If he would only give a fair trial to this method, he would soon find that this preparation would almost make itself, while he was attending to the washing up, etc., of the factory.

The excellence, both theoretical and practical, of this method, for winter butter-making, having been fully demonstrated in the three years' consecutive work of the St. Hyacinthe Dairy-School, in the presence of five or six hundred students, we have had it put in practice at that school during the summer of 1903. To show how easy the work is I have not many testimonies to adduce, but the witnesses, servants at the school, may be con-

sulted at any time, and nothing would induce them to return to the old process of working.

As for the superiority of the product, it will be enough to do away with all doubt on the subject, if we mention the honours won at the Sherbrooke, Toronto, and Ottawa Exhibitions, in September last, by M. J. G. Bouchard, our maker at the School for the last three years:

SHERBROOKE EXHIBITION			Points	Acron	Grain	Color	Saltiness	Fines
1902								
Butter in boxes	First Prize	\$100.00	97	11	23	15	10	5
TORONTO EXHIBITION			Points	Acron	Grain	Color	Saltiness	Fines
1903								
Butter in boxes	Second Prize	\$52.50	97	43½	21	15	10	14
Butter in tubs	First Prize	30.00	97	11	23	15	10	5
OTTAWA EXHIBITION			Points	Acron	Grain	Color	Saltiness	Fines
1903								
Butter in boxes	First Prize	\$42.50	97	13½	23½	15	10	5
Butter in tubs	First Prize	\$11.32	98	13	23½	15	15	4½
For the best lot of butter. The Gold-Medal.								

I might also bring forward, in proof of its superiority, the premium of one cent a pound for all the butter made at the Dairy-School, but as it might be said that this premium was, perhaps, due to the name and reputation of the Institution itself, I will not take advantage of it.

The process, as I said just now, applies to summer-making with a few variations, and they are mere trifles, for they are merely these: the cancelling of the pasteurising and the reduction of the percentage of the ferment

The good quality of milk in summer and a commencement of fermentation in it while in the farmer's hands, are factors that are not without their importance; and if to those points we add the great evaporation from the cream the moment it leaves the

separator, we can easily apprehend that the flavour may be sufficiently obvious with a less quantity of ferment.

As to the other variation, I owe it to the truth to say that we have abolished pasteurising at the risk of offending several persons. I am a fervent believer in the good effects of that process, but for the first year of the regular practice of this method I thought it better to test the results practicall before proceeding to rely up the logical argument of "*a fortiori*". The present state of our butter trade is absolutely abnormal; and judging even the absence of discrimination in the different qualities of the article, I do not think we can reckon on the full adoption of this process, with pasteurisation, in the factories of this Province. When the necessity of coding shall be thoroughly felt, the road will be completely drawn out, and pasteurisation will become the ordinary practice, as the process of spontaneous maturation is to-day.

Having done away with the acetification of the cream, can we hope for the complete extraction of the butter in the cream? I cannot guarantee economy in the loss of fat, but I can certify that the better the process of churning is managed, the less will be the loss, just as in the ordinary making of butter with sour cream.

Another question often asked is the following: is it necessary to keep the cream at a temperature of 50° F., for three hours? The reply is in the affirmative, if you can not reduce it lower; but, if you lower it to 40°, you may then pour it into the churn as fast as it comes from the refrigerator, and set the churn to work as soon as the skimming and cooling are done. The record-tables that follow later will show all the phases of this way of butter-making far more clearly than I can describe them in words.

Some makers, having heard of this process, have hastened to tell me that they have tried it without finding any great difference of flavour in the butter thus made and the butter of superior quality made by the fermentation of the cream. Neither do our claims extend so far. But we do assert that, when compared with what is called "*spontaneous fermentation*", it possesses genuine advantages, sufficiently proved to entitle it to the preference.

In both processes, immediately after skimming the cream must be rapidly cooled. Starting from this point, common to both, it is necessary, in the "spontaneous" process to : 1st.—Settle, by smell or taste, or by the acidimeter, the degree of acidification reached by the cream; 2nd.—to judge and decide on the proper degree for acidification; 3rd.—To stir the cream so thoroughly that the temperature may be equalised throughout the whole mass; 4th.—to maintain that uniformity until the acidity reach about 50° (acidimeter), i. e., until the evening. And during this time, what care must be taken to protect the cream from all the vile and dangerous odours from the factory and its surroundings? 5th.—In the evening, the work of the morning must be repeated (a work that is not so trifling as it may be thought to be) to lower *uniformly* the temperature of the cream and to prepare it for the churn; 6th.—and after all this trouble, well or badly managed according to the skill and industry of the maker, we have only reached the churning which will yield neither more nor less butter than the churning of sweet cream.

And besides all this, have not all the chances offered to bad ferments to develop themselves and hinder the action of the good ones to be reckoned with? Now, I say that, in ordinary practice, the dangerous smells from the factory are very numerous; that the development of noxious ferments in cream is often very considerable, and that frequently the negligence and ignorance of the maker, together with the misleadings due to sudden changes of temperature, are the reasons why butters even of the same factory, are rarely uniform in quality. Now, uniformity is the characteristic the most essential in export butter; wanting this, the export-trade will be always unsteady, and this I may add is the great defect of the export-butter of the present day.

On the other hand, in the churning of sweet cream, what remains to be done of the cooling of the cream? —if the temperature has been lowered to 50° F., to keep it there in a vat for three hours, and then put it into the churn. If it has been lowered to 40°, churn at once; in both cases, let the churn steep in cold water lest the cream get too warm; 2nd—add the proper percentage of ferment and then go to work: it would be as well

for the ferment itself to be cooled that the churning may do exhaustive work by keeping the fat in a proper state of firmness. In both processes, the finishing of the making being the same, we need say nothing about it, the scope of this pamphlet only extends to that part of the work that is peculiar to the making of butter from sweet cream.

A look at the table shows us:

1. That the acidity of milk in winter is about .1930; on account of the low temperature of that season, very little acidity is developed, and we may regard those figures as the normal point of good milk.

2. That in winter, the percentage of cream being 11.45, and that 4.38, the volume of the cream per 100 lbs. of milk is 2.61 times that of the fat of the milk. In summer, this proportion is 2.75.

3. That in winter the acidity of the cream is .1456, in summer, .1530; we may say that had we been dealing with a milk in a perfectly normal state, this acidity would have been .14, a standard that we have adopted.

4. That although the percentage of ferment employed be, in summer 24 per cent, and in winter 28.97, the standard, until further orders, may be left as it is in summer and raised to 30 per cent in winter.

5. That the acidity of the ferment being 1.03 in summer, and 1.05 in winter we may place the standard at 1.00.

6. That the acidity of the cream and the ferment, as mixed in the churn, being in summer .3 and in winter .3153; that the acidity of the buttermilk being in summer .36 and in winter .3889, we can judge of the uniformity of the butters by submitting them to these averages.

7. That pasteurisation may be practised with results as satisfactory as in the usual process of soured cream.

8. That the daily record of butter-making during part of July and August, teaches that cream cooled down to 40° F. and poured into the churn at once, gave perfect results.

9. That cream must not be kept less than three hours at a temperature of 50°, except it be lowered to 40°.

10. That in pasteurising cream, immediate churning cannot be done with a satisfactory extraction (of all the butter), even if the cooling is carried as low as 40° F.

11.—That the yields by this process are as satisfactory as can be desired.

12. Lastly, that the expenditure of ice in the process of butter-making from sweet cream being 41 lbs. per 1000lbs. of milk, and the expenditure of ice in the soured cream process being 119 lbs. per 1000 lbs., the saving in favour of the former process is almost in the proportion of 1 to 3. Beside, in these will be found on an attentive examination of and pondering over this table, and on comparing these figures, a trustworthy guide that may be applied to the process; for it offers a number of practical data sufficient to serve as models in almost any case that can confront the maker.

APPENDIX

In order to facilitate the apprehension of the record-table, I thought it might be well to place before the makers some instances of the problems with their solutions, which will be found very useful by those that are not familiar with mathematics.

No. 1. To find the % of ferment to be added to the cream:

Standards:	ACIDITY	PERCENTAGE
Cream	Ferment	
.14	1.00	30 p. c.

Solution: Multiply the standards together and divide by the acidities of cream and ferment also multiplied together.

Example: The acidity of cream being .15, and that of the ferment .95; to find the percentage of the ferment:

$$\begin{array}{r} .14 \times 1.00 \times 30 = 4.20 \\ \hline .15 \times .95 = .1425 \end{array}$$

