DOMINION OF CANADA

DEPARTMENT OF AGRICULTURE

BULLETINS 1 - 20

1905-1907

DAIRY AND COLD STORAGE COMMISSIONER'S SERIES

The bottles should be whirled for five minutes at the speed indicated on the machine. This will vary from 700 revolutions per minute for a machine twenty inches in diameter up to 1,200, for machines of smaller diameter.

Hot water, preferably rain water or condensed steam, at a temperature of 135 degrees F. must now be added to each bottle. Hard water may be used if about 10 c.c. of sulphuric acid is added to each gallon. A convenient method is to use a piece of rubber tubing, provided with a pinch cock and a glass tip like an eye dropper, leading from the hot water vessel placed slightly higher than the machine. Add enough water to bring the mixture up to the base of the neck and whirl for one minute. Then carefully add more water to about the 8 or 9 per cent mark on the neck of the test bottle and whirl for another minute. The fat should be quite clear and golden in colour when the test is finished. If the fat is very light coloured and there are specks of curd, use a trifle more acid, as it is probably weak. If the fat appears burnt or cloudy, use slightly less acid, and see that the temperatures of milk and acid are not too high.

READING THE TEST.

Hold the bottle level with the eye and perfectly upright. With a pair of dividers measure the extreme limits of the fat column· place one point on the zero mark, when the mark on the scale touched by the other point will indicate the percentage of fat.

Each large space on the graduated neck numbered 1, 2, &c., up to 10, represents one per cent of fat. Each small division represents two-tenths of one per cent. Thus, if reading without dividers and the top of the fat column is at 7·2 with the bottom at 3·3 the sample tested contains 3·9 per cent of fat. If there are many readings to take, keep the fat melted by placing the bottles in water at 130 degrees F. reaching to the top of the fat.

The bottles should be emptied before the fat solidifies, and always kept perfectly clean. A suitable brush may be obtained for cleaning the necks. Hot water and some common shot will scour the lower part of the bottle.

Copies of this bulletin, in English or French, may be procured, free of charge, by applying to the Dairy Commissioner, Ottawa, Ont.

DEPARTMENT OF AGRICULTURE
BRANCH OF THE DAIRY AND COLD STORAGE COMMISSIONER
OTTAWA, CANADA

SWEET-CREAM BUTTER

PART I.—A Critical Study of the Sweet-Cream Buttermaking Process

BY
FRANK T. SHUTT, M.A., F.I.C.,
Chemist, Dominion Experimental Farms

WITH THE ASSISTANCE OF
Mr. A. T. Charron, M.A.

PART II.—Directions for the Manufacture of Butter from Sweet or Unripened Cream

BY
J. G. BOUCHARD

BULLETIN No. 13
Dairy and Cold Storage Commissioner's Series

Published by direction of the Hon. SYDNEY A. FISHER, Minister of Agriculture, Ottawa, Ont.

FEBRUARY, 1907

LETTER OF TRANSMITTAL.

OTTAWA, February 27, 1907.

To the Honourable
The Minister of Agriculture.

SIR,—I have the honour to submit for your approval bulletin No. 13, Dairy and Cold Storage Commissioner's Series, entitled 'Sweet-Cream Butter' which has been prepared with the co-operation of Mr. F. T. Shutt, M.A., Chemist, Experimental Farms.

I beg to recommend that it be printed for general distribution.

I have the honour to be, sir,
Your obedient servant,

J. A. RUDDICK,
Dairy and Cold Storage Commissioner.

INTRODUCTION.

The writer's attention was first directed to the so-called 'sweet cream process of buttermaking' some three or four years ago, when acting as judge at several of the large exhibitions of butter, by the fact that on more than one occasion the first prize went to the St. Hyacinthe Dairy School Creamery, for butter which was said to have been made by this process. Mr. J. D. Leclair, the Superintendent of the School, published a brochure on the subject in 1904, giving some details of the process and a record of the buttermaking at the Dairy school for twelve months. Montreal butter exporters who have handled the butter from creameries which have adopted this process, have spoken very highly of the quality of the butter.

Strictly speaking, it is not a sweet cream process, as the large amount of 'starter' or ferment added to the cream gives it an acidity of about ·3 per cent, or sufficient to be sour to the taste.

The theory on which the process is based seems to be sound. There is less danger of injury to the quality of butter from undesirable germs which may have been in the milk, if the cream is churned soon after separating, than if these germs are allowed to multiply during the ripening process. If the cream is pasteurized, the danger is lessened still more. The importance of acidity is recognized in the large amount of ferment added.

In the application of this process to ordinary creamery practice a number of things have to be considered. In the first place, a first-class pasteurizing and cooling outfit, especially the latter, is absolutely essential. Very few creameries are properly equipped in this respect. This implies also an ample supply of cold water and ice.

A practical objection to the process for hot weather is that the churning, working and packing of the butter is not completed until late in the afternoon, while in the ripened cream process the churning can be done in the early morning, and cooler part of the day.

This bulletin is not published with a view of advocating the adoption of the process, but simply for the purpose of giving information to those who may be interested in the subject.

Mr. J. G. Bouchard, who was buttermaker for several years at the St. Hyacinthe Dairy School Creamery, but who is now a member of my staff, was assigned to the duty of carrying out the practical buttermaking part of the investigation described in Part II.

J. A. RUDDICK,
Dairy and Cold Storage Commissioner.

SWEET-CREAM BUTTER.

PART I.—A CRITICAL STUDY OF THE SWEET-CREAM BUTTERMAKING PROCESS.

By Frank T. Shutt, M.A., Chemist, Dominion Experimental Farms,
with the assistance of A. T. Charron, M. A.

The claims for this process are, briefly, the avoidance of all foreign and bad flavors that might arise naturally in using cream from various sources; the production of an excellent butter, constant from day to day as regards flavour and aroma; a marked improvement in the keeping qualities of the butter; a considerable saving in the time of buttermaking; and that there is no greater loss of butter fat than by the ordinary method.

Manufacture of butter by the 'sweet-cream' method, may be described shortly as follows: The cream on being obtained from the separator is at once pasteurized (*) and then cooled. A certain quantity of ferment made with a pure culture is then added and the churning proceeded with. It will be seen that this process differs chiefly from that ordinarily in use in that spontaneous fermentation or ripening of the cream is not allowed, and that the butter can be made immediately after the separation of the cream, provided the necessary apparatus is available for the continuous working of the process.

The pasteurization of the cream arrests the development of all germs or microbes that may have found their way into the milk or cream, and which might impart a bad flavour to the butter and impair its keeping qualities. The subsequent sudden cooling of the cream with agitation effects the aggregation of the fat globules—thus facilitating the churning process—and gets rid of any foul odours that may be present, and which would taint the butter. (*) Finally, the introduction of the ferment made with a pure culture tends to ensure from day to day a butter of excellent and uniform quality, constant as regards flavour and aroma, and one which has a much longer 'keeping' period than butter ordinarily made.

Pasteurization.—This consists in raising the freshly separated cream to a temperature between 160° and 175° F. and maintaining it at that temperature for 20 minutes. If higher temperatures are employed there is danger of the cream taking on a 'cooked' taste. The temperature and period of pasteurization here given are quite sufficient to effect the purpose in view—a cream free from active germ life.

Cooling.—This must follow the pasteurization immediately and is effected by placing the vessel containing the cream in cold or iced water, stirring the cream constantly until it has reached a temperature of 40° F. It is now ready for the addition of the ferment and churning.

Preparation of the ferment.—For this purpose a 'pure culture,' as made and generally guaranteed by a reputable firm, is to be preferred to a culture prepared by the dairyman, for the reason that the latter is not able to exercise the same skill and care as the expert, nor has he at his command the bacteriological appliances so essential to the production of a culture containing only the desired bacteria.

The first step consists in the pasteurization of a quantity of freshly separated skim-milk. This is effected by 'thoroughly heating the milk to a temperature between 180° F. and 200° F. and keeping it at that temperature for at least one hour, preferably two hours; it is then cooled as rapidly as possible to 75° F. The pure culture

* In some dairies, where the the milk is obtined under the best sanitary conditions, the pasteurization is omitted.

* When a "cooler" is used no subsequent agitation is necessary and the process is practically continuous.

is now added in the proportions indicated in the directions accompanying the preparation (*) and well stirred into the milk. During the first few hours the treated milk is occasionally stirred. It is then left to curdle, the curdling being complete in from 18 to 24 hours, provided the temperature is maintained about 75° F. The surface of the curdled milk is now skimmed and the skimmings rejected. Three to five pounds of this preparation are now added to each 100 lbs. of pasteurized skim-milk, well stirred in and the whole maintained at a temperature of from 60° F. to 70° F. When curdled this 'starter' is ready to use.

The amount of 'starter' to be employed per 100 lbs. of cream will depend on two factors; the acidity of the cream and the acidity of the starter, the object being to have the cream as ready for the churn always at the same degree of acidity or approximately so.

Acidity in cream or milk is determined by titration with a standard alkali solution, using phenolphthalein to indicate the point when the lactic acid is neutralized. Acidity is expressed in terms of lactic acid. Having found the acidity of the cream and of the starter, the following rule is used to ascertain the amount of starter required. To every 100 pounds of cream with an acidity of ·14, add 20 pounds of a starter, the acidity of which is 1·0. From this standard the proportion or percentage of starter to be used, when acidities are other than those here stated, may be readily calculated, as follows:—

EXAMPLE.

Standard—	
Acidity of starter	1·0
Acidity of cream	·14
Percentage of starter	20·0
Trial—	
Acidity of starter	·86
Acidity of cream	·10

Calculation—

$$\frac{\cdot 14 \times 1 \cdot 00 \times 20}{\cdot 10 \times \cdot 86} = 32 \cdot 5$$

Therefore, for every 100 pounds of this cream, 32·5 pounds of the starter are added.

The Investigation.—In order to ascertain the correctness of the claims made for this process, and which have already been enumerated in the opening paragraph of this bulletin, six churnings were made, three with sweet cream, and three with ripened cream, equal quantities of the same cream being used for each process in three separate trials.

A quantity of cream freshly obtained from the separator was mixed and samples taken for estimation of its fat content. Equal weights were now put into separate vessels, to one of which was now added a small quantity (5 per cent) of 'starter' and set aside to ripen in the ordinary way. To the other, after cooling to 40° F., the required amount of starter, obtained by calculation from the acidity of both cream and starter, was added. The churning of this cream was at once proceeded with, that of the 'ordinary' ripened cream being made on the following day.

Every effort was made to have the details of the manufacture of the butter—*e.g.* temperature of churning, of wash water, and size of granules, &c.—the same in both processes, so that in these particulars the trials would be strictly comparative. Any differences, either in economy or quality of the products from these two processes would be due, therefore, to the treatment of the cream before churning, viz.:—that in one case the cream was not allowed to ripen, but was prepared for the churn by a pure culture, and in the other the cream was ripened in the ordinary way.

* In this research Chr. Hansen's Lactic Ferment Powder was used.

The rate of salting was half ounce to the pound, the amount to be added being ascertained from the weight of butter as taken from the churn. There was only one working of the butter, consisting of from 9 to 11 passages of the roller. The butter was then weighed, samples taken for analysis and the remainder put in prints and bottles and stored away for future examination.

The butter as soon as made was placed in the cool storage room of the Experimental Farm Dairy until the first examination, June 6. (*) After scoring, one sample from each churning was put in the Ottawa Cold Storage warehouse, where the butters were kept at a temperature of 24° F. until October 15, when they were brought back to the farm for examination and comparison with duplicates which had been meanwhile kept in the cool room at the farm dairy.

For the sake of greater accuracy, the amount of butter fat in the cream and in the buttermilk was determined by gravimetric analysis, it having been found that the results obtained by the Babcock method were not sufficiently exact for the purposes of this investigation. The samples of butter were subsequently submitted to a complete chemical examination.

For brevity and convenience of reference, the various details and data are presented in tabular form.

TABLE A.—BUTTER FAT: IN CREAM, BUTTER AND BUTTERMILK.

Trial.	Process.	Date of Churning.	Butter Fat.			
			In the Cream.		In Butter.	In Buttermilk.
			Per Cent.	Total.		
				Ozs.	Ozs.	Ozs.
1	Sweet cream	May 9	34·44	277	275·3	1·2
	Ripened cream	" 10..	34·44	277	275·8	1·1
2	Sweet cream	" 11..	28·40	274·6	273·2	1·5
	Ripened cream	" 12..	28·40	274·6	271·4	1·5
3	Sweet cream	" 14..	23·64	226·9	222·1	2·6
	Ripened cream	" 15..	23·64	226·9	225·1	1·3

This table has been constructed with the object of showing at a glance the relative economy of the two processes. In the first column of figures we have the percentage of butter fat in the cream. This indicates the thickness or richness of the cream used —a rather important matter. The weight of the butter fat employed in each churning is next given. In the two remaining columns the weight of butter fat in butter and buttermilk, respectively, are presented.

It will be observed that in the first pair of churnings the loss of butter fat in the buttermilk was practically the same from both methods, while in the second pair of churnings it was identical.

In the third pair of churnings the loss of fat in the buttermilk by the sweet cream method, though not large, was twice that from the ripened cream. This is accounted for by the fact that after the addition of the requisite amount of the starter to the sweet cream the latter was too thin for the best results. It is stated that in order to avoid any excess of fat in the buttermilk the cream should test between 28 and 35 per cent.

The sum of the fat in the butter and buttermilk does not equal the amount of fat originally in the cream. In the majority of instances the difference is scarcely appreciable and may be attributed to unavoidable experimental errors. In the churning of the sweet cream on May 14, the somewhat larger loss is undoubtedly due to the richness in fat of the wash water and of the drainings from the worker.

* The churnings were made on May 9th, 10th, 11th, 12th, 14th and 15th.

As regards butter-fat, these data show that there is no greater loss by the sweet cream process than by the ordinary method, provided the cream used in the former is of the requisite richness.

TABLE B.—YIELD OF BUTTER AND OVER-RUN.

Trial.	Process.	Weight of Butter-fat in Cream.	Weight of Butter obtained		Over-run.	Percentage of Water in Butter.	Relative Quantity of Butter of same Water content.	
		Ozs.	Lbs.	Ozs.	p.c.		Lbs.	Ozs.
1	Sweet cream	277	20	$3\frac{1}{2}$	16·8	11·68	20	$7\frac{1}{2}$
	Ripened cream	277	20	$6\frac{1}{2}$	17·8	12·78	20	$6\frac{1}{2}$
2	Sweet cream	274·6	20	$2\frac{1}{2}$	17·4	11·98	20	$3\frac{3}{4}$
	Ripened cream	274·6	20	3	17·6	12·33	20	3
3	Sweet cream	226·9	16	5	15·1	12·24	16	7
	Ripened cream	226·9	16	$11\frac{1}{2}$	17·9	12·87	16	$11\frac{1}{2}$

In this table data are presented to show the relative yields of butter from the two processes. That from the ordinary ripened cream seems to be slightly the higher. This increase, however, is easily accounted for by the larger percentage of water in the ripened cream butter. When the quantity of butter obtained is calculated in each case on the basis of the same water-content (see last column of table) the apparent superiority in the matter of yield of the ordinary method over that of the cream process vanishes. When this is done it is only from the third trial, in which, as already noted, the cream was too thin, that the yield was greater from the ripened cream. (*)

* The greater viscosity of the ripened cream may possibly account for the higher water content of its product, but whatever may be the cause it would seem that under similar conditions of manufacture the sweet creeam butter is the drier. The water-content of a butter may to a very large extent be controlled by the butter-maker, as has been very clearly shown in Bulletin No. 8, Dairy Commissioner's Branch.

TABLE C.—DETAILS OF MANUFACTURE.

Trial.	Process.	Date of Churning.	Acidity of				Temperature			Time of Churning.	Size of Granules.	
			Cream at time of Separation.	Ferment or Starter.	Cream ready for Churn.	Butter-milk.	Before Churning.	After Churning.	Wash Water.			
							°F.	°F.	°F.	Min.		
1	Sweet cream..	May 9..	·10	·85	·29	·35	49	54	39	17	Clover....	
	Ripened " .	" 10..	·10	·85	·53	·45	49	54	42	27	"	About 20 lbs. water added to reduce cream.
2	Sweet cream..	" 11..	·10	·86	·28	·34	48	55	42	30	"	
	Ripened " .	" 12..	·10	·86	·35	·46	47	54	41	40	Corn.....	
3	Sweet cream..	" 14..	·09	·84	·25	·30	51	55	40	28	Clover....	Cream too thin for best results.
	Ripened " .	" 15..	·09	·84	·39	·48	51	55	41	28	"	

Very little need be said with regard to the particulars given in Table C. They comprise data of acidities and temperatures observed at the various stages of the process.

The acidity of the cream previous to the addition of the starter may seem rather low; it is to be accounted for by the specially good conditions under which the milk was kept previous to separation.

In trial I. the ripened cream was so thick that it was found necessary to dilute it with about 40 per cent of its weight of water before churning could be proceeded with.

That the trials have been conducted under similar conditions (temperatures, &c.) will be evident from the above data and, therefore, it is felt that the comparison has been a fair one to both processes. Every effort was made to eliminate factors which might exert an undue influence upon the results.

TABLE D.—COMPOSITION OF THE BUTTER.

Trial.	Process.	Date of Churning.	Composition of the Butter			
			Water.	Fat.	Curd.	Salt.
1	Sweet cream	May 9..	11·68	85·08	1·20	2·04
	Ripened "	" 10..	12·78	84·49	1·52	1·21
2	Sweet cream	" 11..	11·98	84·67	1·34	2·01
	Ripened "	" 12..	12·33	84·02	1·31	2·34
3	Sweet cream	" 14..	12·24	85·09	1·19	1·48
	Ripened "	" 15..	12·87	84·17	1·53	1·43
Average—						
	Sweet cream		11·97	84·95	1·24	1·84
	Ripened "		12·66	84·23	1·45	1·66

Lastly, we present the composition of the butters. It has already been observed that the butter from the sweet-cream process is somewhat drier than that made in the usual manner; averages from the three trials show ·69 per cent more water in the ripened cream butter. As the result of the presence of more water, and also to a certain degree, of more curd, the percentage of fat in the ripened cream butter is slightly lower than that in the sweet cream butter.

In so far as the keeping qualities of butter are dependent upon its composition, it might be safely adduced that the butter by the sweet cream process would be the better, since these analyses show it to be the drier and to have the less curd.

The first examination of these butters as to 'quality' was made on June 6, the samples (pound prints) then being between 3 and 4 weeks old and having been kept from the time of churning in the cool room of the farm dairy. The judging was undertaken by Messrs. J. A. Ruddick, Dairy Commissioner, and J. H. Grisdale, Agriculturist, Experimental Farms, and J. G. Bouchard, of the Dairy Division, Department of Agriculture, Ottawa. The scoring was made according to a scale of points, but the differences between the samples were so extremely small that it was subsequently decided that it would be fairer to omit the ratings thus obtained and make a general pronouncement to the effect that all the butters, both from sweet and ripened cream, were excellent and practically equal as regards quality.

The second examination was made on October 15, the butter then being 5 months old. A series of samples, one from each churning, and preserved in glass-stoppered bottles, had been kept in the cool room of the Farm Dairy, a duplicate set having been stored at a temperature of 24° F. in Ottawa Cold Storage Company's establishment. By this examination, which was made as thorough and searching as possible it was found that of the samples from the cool room at the dairy, those from the 'sweet'

cream process were without exception distinctly superior to those made by the ordinary ripened cream method, several of which by this date had become stale or slightly rancid.

The samples kept in a temperature of 24° F. were all in good condition and the differences between the samples not so great as in those referred to in the preceding paragraph. It was, however, generally agreed upon by the judges that the sweet cream butter had kept much better than that made from the ripened cream.

In conclusion, it may be stated, judging from the results obtained in this investigation: 1st, that by the sweet cream process there is no greater loss of butter fat than in the ordinary method with ripened cream; and 2nd, that the keeping qualities of the butter by the sweet cream butter are distinctly superior to those of the ripened cream butter.

PART II.—DIRECTIONS FOR THE MANUFACTURE OF BUTTER FROM SWEET OR UNRIPENED CREAM.

(By J. G. Bouchard.)

The making of butter from so-called 'sweet' cream differs from other methods in that it excludes the ripening of the cream.

Briefly described, the process is as follows : The cream is cooled as soon as it comes from the separator,—a fairly large quantity of pure culture, used as a starter, is added to it, and churning is begun at once.

Simple as that method of buttermaking may seem, satisfactory results will not be obtained by it, unless certain rules are strictly adhered to, and judiciously applied according to changing conditions.

Thickness of the cream.—The percentage of fat in the cream must be high enough to allow of churning within a reasonable time at a low temperature. It must be varied according to the season of the year, the more or less advanced period of lactation of the cows, and the quantity of starter to be added. In springtime when the cows are newly calved, and when churning is relatively easy, the proportion of fat may be made as low as 28 per cent, but during winter and fall, when the viscous condition of the cream prevents the rapid agglomeration of the fatty globules, it may run as high as 40 per cent. A safer rule to follow would be to separate in such a way as to have in the cream two and a half to three and a half times the percentage of fat contained in the milk. Thus, 100 pounds of milk containing 4 per cent fat should give from 10 to 14 pounds of cream.

Cooling of the cream.—The cooling of the cream is one of the most important operations in this process of buttermaking. Its main object is to insure the complete agglomeration of the globules of fat by churning and to prevent the development of certain germs that would destroy, or at least endanger, the keeping qualities of the butter. A special cream cooler should be connected with the separator, to receive the cream as it issues from it. If the churning is to be done immediately after skimming, the cream must be cooled to 40° or 42° ; but if churning is to begin only two or three hours afterwards it will be sufficient to carry the cooling process to 50° or 52°, provided that temperature is maintained up to the time of churning.

It must be understood that if the cream is cooled to 40° or 42°, it must be churned at once, for if it is kept too long at that low temperature, its fatty globules will become so hard as to render agglomeration much more difficult.

The cream issuing from the cooler at 40° or 42° is immediately poured into the churn which should have been cooled previously. When the skimming is completed, the required quantity of starter is added to the cream and the churning is proceeded with. The amount of starter to be added varies from 20 per cent in summer, to 30 per cent in winter. That proportion of starter should also be varied according to its own acidity and that of the cream, in order that the greatest possible uniformity of flavour may be obtained.

The temperature of the starter, as prepared every day should be between 60° to 65° when ready to be used. When added to the cream in that condition it will raise the temperature of the mixture to about 50°, which is a proper temperature for churning. If it is not convenient to churn immediately after skimming, it is desirable to store the cream in a ripening vat kept cool by water and ice. If it is impossible to cool the cream below 50° when skimming, and if churning must take place within two hours after, it will be necessary to cool the starter to about the same temperature.

Pasteurization.—The object of pasteurization is to kill almost all the germs which the cream contains. It is a matter of heating the cream to a temperature of 140° to 185° F. Twenty minutes exposure in a water bath to a temperature of 140° will produce the required results, but as this process of pasteurizing is not very practicable, unless a very small quantity of cream is to be treated, it will be necessary, in a large creamery, to use some type of pasteurizer in which the process is continuous. As cream will be subjected to heat for only a few moments, the temperature should be raised to 185° in order to obtain the same results as those of the preceding method. When such extreme high temperatures are employed, great care must be exercised and first-class pasteurizers used in order to avoid giving a burnt flavour to the cream. This treatment should destroy the germs of nearly all undesirable fermentations without affecting the taste or the appearance of the cream, or that of the butter. By the use of a good starter a butter more uniform in flavour and in keeping qualities will be obtained.

To obtain the best results from pasteurization, the cream must be cooled as soon and as rapidly after heating as possible and it is of great importance that the pasteurized cream be kept for two hours at a temperature not higher than 50°, so that churning may be done under good conditions. In winter, pasteurization is of the highest importance and becomes almost an absolute necessity, in producing butter of acceptable quality. It decreases the bad effects of the defective feeding of cows, of the contaminated air of the stables, of milking done under wrong conditions and of keeping the milk many days before it is brought to the creamery.

Churning.—The thickness of the cream, the quantity of cream to be churned, and the speed of the churn will determine the length of time necessary for churning. If the rules given above for the treatment of the cream are observed (from 48° to 50° in springtime or at the beginning of the period of lactation of cows, and 50° to 52° at other times) and churning is carried on in a temperate place, it will not take longer than 45 minutes. The temperature at the end of churning varies according to the place in which it is done; generally it is between 54° and 58° degrees, and this should never be exceeded. As a rule the butter will be found to be colder than the buttermilk.

To obtain a butter of delicate flavour and of good keeping quality, churning must be stopped when the granules of butter are about the size of clover seeds. If larger granules are allowed to form, more casein and water will be retained in the butter, and its keeping quality is thereby impaired.

When the churning is completed the buttermilk is immediately drawn off and passed through a strainer so as to retain the butter granules. The buttermilk being very fluid flows away readily, and a draining of half an hour will usually render washing unnecessary. However, if salting and working are to be done immediately after churning a light washing must be given. Water of about 50° F. is added in sufficient quantity to float the butter, and it is drawn off after a few revolutions of the churn. If the purity of the water used cannot be depended upon, it is preferable not to wash the butter. If the butter has been washed, it must be drained for a few minutes after the water has been drawn off and before salting. Otherwise a considerable quantity of salt would be wasted.

Salting.—The quantity of salt to use depends on the requirements of the market. In this respect the process does not differ from the methods practiced in the making of ripened cream butter.

The Starter.—In view of the large proportion of starter used in this process, it is of the utmost importance that it should be carefully prepared, but as the directions are not different to what is required for any other process of butter-making, we shall not go into details at this time.

In order that the cream may always have the same degree of acidity at the time of churning the following standard, giving the best results, has been adopted. By means of this standard it is very easy to add to the cream the quantity of starter

necessary to obtain a uniform acidity at the time of churning and consequently a uniform quality of butter.

ADOPTED STANDARDS.

Summer make—	
Acidity of the cream	·14
Acidity of the starter	1·00
Quantity of starter to be used	20·0
Winter make—	
Acidity of the cream	·14
Acidity of the starter	1·00
Quantity of starter to be used	30·0

Solution.—The product of the three standards divided by the product of the acidity of the cream and the acidity of the starter will give the quantity of starter to be used.

Thus in summer the standards are ·14, 1·00 and 20·0 and their product ·14 x 1·00 x 20·0 = 2·8.

Supposing the acidity of the cream to be ·15, and that of the starter ·90, the whole operation will become:—

$$\frac{\cdot 14 \times 1 \cdot 00 \times 20}{\cdot 15 \times \cdot 90} = \frac{2 \cdot 8000}{1 \cdot 350}$$ or 20:7 per cent to be added to the cream.

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1350)28000(20·7
     2700
     ----
    10000
     9450
     ----
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