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A
STUDY OF IDAHO BUTTER
WITH
SUGGESTIONS FOR
IMPROVEMENT

BY

G. E. FREVERT

DEPARTMENT OF DAIRY MANUFACTURING

IDAHO AGRICULTURAL EXPERIMENT
STATION

MOSCOW, - - IDAHO

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INTRODUCTION.

The many inquiries touching on the butter question as it exists in this state which have been received by this department from time to time have prompted the investigations and suggestions contained in this bulletin. These inquiries have come mainly from the ranch, but some have also come from butter dealers and creamery men. The fact that Idaho is producing a great quantity of ranch butter which ultimately is sold as packing stock to eastern renovating plants is sufficient to justify an investigation of the existing conditions and the suggestion of remedies for the existing evils.

The growing interest in the dairy industry in this state makes the above mentioned conditions of even greater importance to the state. There are excellent opportunities in this state for the development of dairying. If this development takes place as it undoubtedly will, Idaho should be able to supply her own markets with butter instead of shipping in thousands of dollars worth of dairy products from the east each year. In order to do this, however, the butter produced in this state must be as good or better than the butter shipped in from out side of the state. The butter studied in these investigations was from creameries and ranches in Idaho.

It is a well known fact that ranch butter on the average sells at from 10 to 15 cents per pound less than that received for creamery butter. Eastern butter as a rule compares favorably with the creamery butter of this state. The low grade ranch butter of course does not sell well on the market. For this reason it is often held at the store for a considerable length of time and is finally sold as packing stock at about 15 cents per pound. The fact that some of the ranch butter of this state is of high quality and sells readily on the market indicates that there is some trouble in the methods of producing the low grade butter, which might be remedied by improved methods of manufacture.

OBJECT OF INVESTIGATIONS.

The objects of the investigations reported in this bulletin were:

First: To make a study of the prominent defects in Idaho butter.

Second: To make a study of the comparison of ranch and creamery butter from the standpoint of quality and composition.

Third: To make a study of the relation between the composition and quality of Idaho butter.

Fourth: To determine the normal shrinkage of butter in prints.

That a great deal of Idaho butter has defects is a well-known fact among dealers in butter. This applies more especially to ranch than to creamery butter. For this reason the main study has been devoted to ranch butter. The object in investigating these defects was not only to point out the prominent defects but also to trace out their probable causes so that suggestions for the improvement of quality might be made.

In recent years some investigators have tried to measure the deterioration of butter by certain chemical tests. The total acidity of butter has been used by some to indicate the amount of deterioration that has taken place in a given sample of butter. The object in this investigation was to see whether there was any general relation between the score and the chemical composition of Idaho butter. The question arose as to whether, for instance, the flavor of butter is not at times affected by factors which do not necessarily affect the acidity of butter. For instance, if butter were kept in an atmosphere where it would assume a bad flavor due to the bad odors in the surrounding atmosphere, the bad flavor thus produced would not be due to excessive acidity. Such odors would not necessarily affect chemical changes in the butter to any great extent and yet it is a well known fact that butter kept under such conditions very readily assumes an undesirable odor and taste. Then again the question arises, "Do all chemical changes in the butter indicate deterioration?" or "Do chemical changes in the butter after it has been made improve the quality as is the case with cheese?"

Then the question arises, "Does the amount of casein in butter have any effect upon the quality or upon the chemical changes in butter?" It is a generally conceded fact among butter makers and dealers that the presence of a great deal of buttermilk, which determines the amount of casein in butter, has a very decided effect upon the keeping quality of the butter. The object

in these investigations is not only to compare the high scoring butter in its chemical composition with that which scores low, to determine, or at least secure an indication of, the effect of composition upon the score of the butter. Such information should not only indicate the effect of composition of the butter upon the quality, but also to suggest methods of manufacture which would tend to improve the quality of Idaho butter. This department has been asked repeatedly how much a print of butter would ordinarily shrink from the time it leaves the maker until it is sold in the store. Most of these questions have been asked about ranch butter that is usually placed on the market in parchment wrappers. The object in the shrinkage experiments was to give some data on the shrinkage of butter under the above mentioned conditions.

METHOD OF SECURING SAMPLES.

The samples of butter studied in the investigations here reported were samples of butter produced in this state, manufactured either on some ranch or in one of the creameries of the state. This method was followed in order to study the butter produced here rather than that which is being shipped in from the east.

The samples were secured from various parts of the state, usually from storekeepers and butter dealers. This was done in order to secure as good a representation from various sections of the state as possible, and also to secure an average of the Idaho butter on the market. There was comparatively little difference in the butter from different parts of the state. Good and bad samples of ranch butter as well as creamery butter were secured from the various sections in approximately equal proportions, showing that conditions regarding quality of butter are much the same the state over.

As this study reveals, the average ranch butter scores several points lower than the average of the creamery butter. Some sections of the state seem to produce a greater proportion of ranch butter to creamery butter than others. This does not necessarily mean, however, that such sections do not produce good butter, since some of the best samples of ranch butter compared very favorably with the best creamery butter.

SCORING.

The butter investigated was given a score by the writer and Mr. J. H. Trower as soon as it was received at the laboratory. The judges knew nothing of the history of the various samples of butter as they were placed be-

fore them for scoring. This was done in order to score each sample on its merits. The scores given in the tables that follow are in each case an average of the scores given by the two judges. The idea in having the butter scored by two judges was to overcome any prejudice which one judge might have against some one defect in the butter. The comments on the score as given in tables I and II are the principal comments made by the judges.

In scoring the butter the following score card was used:

Flavor	-	-	45	points.
Texture	-	-	25	"
Color	-	-	15	"
Salt	-	-	10	"
General appearance			5	"
Perfect score			100	"

FLAVOR.

Flavor is a quality in butter which is very difficult to describe and also difficult to judge. Certain flavors may be agreeable and desirable to one person but another might dislike the same flavor. Normal fresh butter has a flavor peculiarly its own. There is no flavor in other fats with which it can be compared. It is this particular quality that gives butter its advantage over other fats. The flavor of fresh butter has not been produced in other fats or combination of fats up to the present time and probably never will be.

In judging flavors it is necessary first of all to detect abnormal odor or taste. In order to do this the judge must know what constitutes a normal butter flavor and aroma. In describing off flavors a common practice among judges and buyers is to compare it with some common substance which has a taste or smell similar to the flavor to be described. For instance, "oily" flavor would mean that a sample of butter had a taste similar to that of machine oil.

Bad flavors may come from various sources, or causes. An oily flavor which was found to be quite common in creamery as well as ranch butter is usually caused by the decomposition of the butter fat in the butter. Some investigators have attributed this decomposition of the butter fat to micro-organisms. Others have given the oxidation due to contact with air as the causal agent. Barn or cow flavors are such as give forth an aroma which suggests the odor common to the cow stable or to the breath of the cow. High acid flavor is very similar to the flavor of metal. It is usually due to the presence of too much lactic acid in the butter which in turn is caused by over ripening of the cream.

As the score card indicates, the flavor was the greatest factor taken into consideration in the scoring. The flavor was judged both by the taste and the smell of the butter. Abnormal flavors were noted and taken into consideration in rating the different samples. In some instances samples were scored down on flavor, because of a lack of flavor rather than any abnormal taste or smell.

TEXTURE.

The terms commonly used in describing ideal texture in butter are "fine" and "waxy." A piece of butter which answers that description has a very appetizing appearance when placed on the table. Texture, as is indicated by the score card, is next in importance to that of flavor. If butter tempts the appetite by its waxy appearance, it sells much better on the market than butter which has a greasy or sticky appearance. As a general criticism of the texture of butter scored, the writer would state that a greasy, or salvy texture was very common. Some of the samples, having fairly good flavor, were scored low on account of poor texture. This was especially true in the case of ranch butter, indicating that there is a vast opportunity for improving ranch butter in this respect.

COLOR.

Next in importance to texture is color. Too high or too light a color is objectionable in most markets. The most objectionable fault in color, however, is that of unevenness of color. Waves, streaks, specks, or mottles of any kind in the butter give the appearance of a mixture of lard or tallow with the butter. This does not give the butter an appetizing appearance, and apart from that, it is a good indication that the butter has not been made properly and that the salt has not been evenly distributed throughout the butter. Some markets require a high colored butter, while others want the natural color. For this reason the shade of color was not considered in the scores given.

SALT.

The common defects of salt in butter are excess, insufficiency, uneven distribution, grittiness, and incomplete dissolving. Salt sometimes has an abnormal flavor. Quite often a good lot of butter is spoiled by the use of a poor grade of salt. The flavor usually caused by impure salt is that of a bitter nature and is very objectionable.

PREVENTING DEFECTS IN FLAVOR.

Flavor, as has been stated above, is the greatest factor in the quality of butter. Since this is true and since most of the ranch butter of the state has a bad or indifferent flavor, as shown in the samples of butter described in this bulletin, there certainly is a great deal of room for improvement in respect to flavor.

For convenience let us divide the causes of bad flavors in butter into three classes; (1) those due to the treatment of the cream before the butter is manufactured; (2) those due to improper methods of manufacture from the prepared cream; (3) and those brought about after the butter has been made.

Before taking up the causes of defects in flavor due to treatment of milk and cream previously to churning, it is quite important that we take notice of the composition of these products. Milk has about the following composition; water 87 per cent, fat 4 per cent, casein 3 per cent, albumen 4 per cent, milk sugar 4.9 percent, ash 7percent. The composition, of course, varies a great deal with different samples of milk, but the above mentioned are the constituents which we have to deal with when preparing the milk and cream for churning. In skimming cream from the milk the percentage of butter fat is greatly increased and the other constituents are necessarily greatly decreased in percentage.

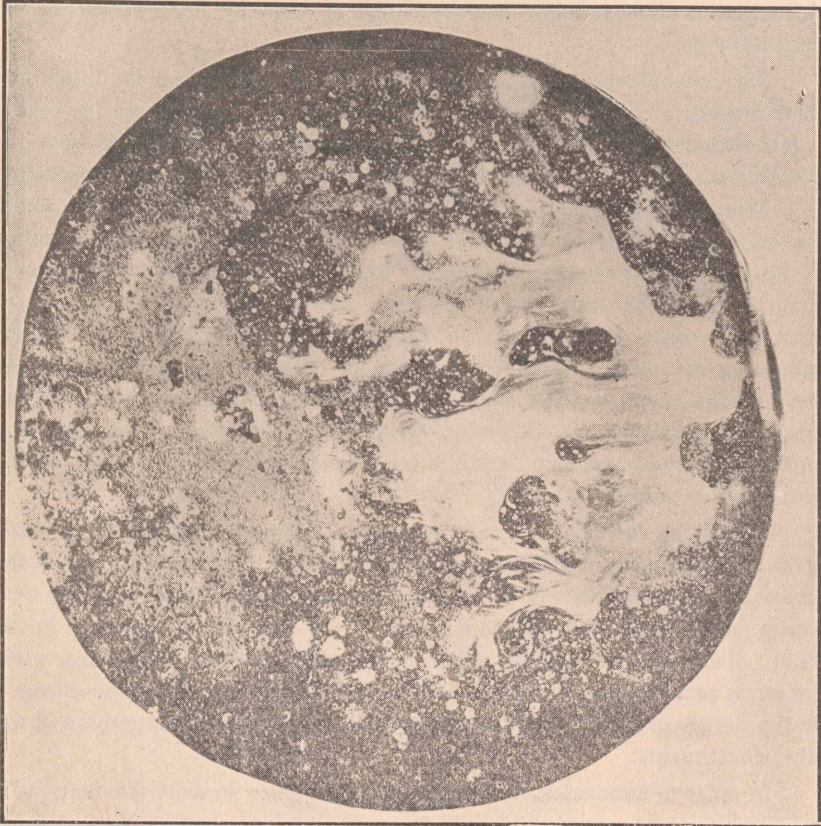
During the ripening of the cream, these different constituents are acted upon by the ferments which happen to be in the milk or cream. Of all the constituents, the milk-sugar is the first one to undergo a change. The next constituent to undergo a change is casein or the nitrogenous substance in the milk. Butter-fat decomposes rather slowly under ordinary conditions, while the ash is probably not attacked by any ferment directly, but may be changed by the action of some of the products formed from the decomposition of the other constituents.

In order to understand the changes taking place in dairy products, it is important that fermentation in milk be understood in a general way, at least.

In giving a definition of the fermentation processes, Conn states that in general, they are progressive chemical changes taking place under the influence of certain organic substances which are present in very small quantities in the fermenting mass. There are a great many different kinds of ferments commonly found in milk. A few of these are nearly always found in the milk when it is first drawn and others are introduced during the milking process and in the handling of the milk or cream.

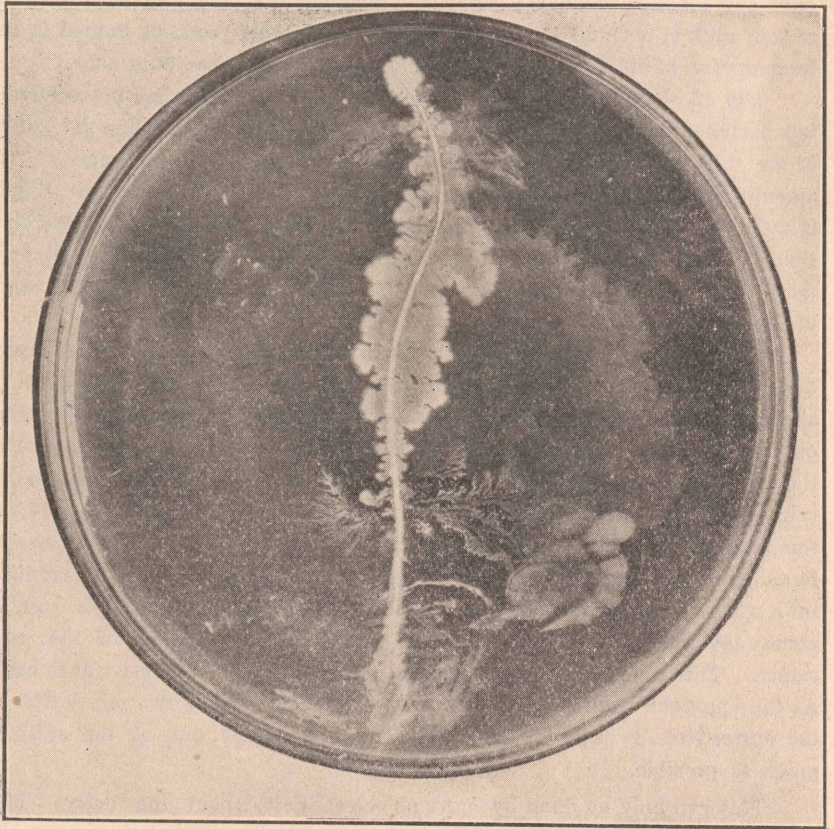
As stated above, the milk-sugar is the first substance to undergo marked

change. The ferments which change the milk-sugar are commonly known as lactic acid fermentations. Their chief effect upon the milk is that of converting milk-sugar into lactic acid which causes the souring of milk. Ordinarily, ferments of this class are in the milk in greater numbers than other kinds, un-



No. 1.—Growth of bacteria obtained from one drop of wash water after washing milk pail, emphasizing the importance of extreme care in rinsing and scalding milk utensils., (U. S. Dep't of Agr. Photo).

less filth has been introduced. Some writers have designated this class of ferments as those favorable to the butter makers. However, some investigators in recent years, have found that when cream is allowed to sour, the butter does not have so good a keeping quality as butter made from sweet cream. The



No. 2.—Growth of bacteria obtained from one cow hair on sterile plate of agar, showing the presence of bacteria on a comparatively clean cow hair. (U. S. Dept. of Agr. Photo).

writer has had similar results from experiments conducted during the past two years. However this may be, it is the writer's belief that lactic ferments are more desirable than any other kinds of ferments in milk or cream as far as developing desirable flavors in milk or cream is concerned. They usually produce a clean sour flavor in the cream or milk, while many other ferments produce abnormal, undesirable flavors in these products, which are later transmitted to the butter.

Lactic acid, however, is not the only product resulting from the above class of ferments. Van Slyke and Publow in their book, entitled "The Sci-

ence and Practice of Cheese Making," maintain that the sour smell of whey or sour milk is not due to the lactic acid, but to other products formed in the fermentation of milk-sugar. Pure lactic acid is quite free from odor.

Not all of the milk sugar in a sample of milk or cream can be converted into lactic acid by these ferments, as the fermentation ceases when the acidity of the milk has reached about nine tenths per cent. The presence of this amount of acid seems to check the growth of this class of ferments. There is quite a number of species of bacteria in this class. Some of them will continue to work on the milk-sugar in the presence of a higher per cent of acid than others. Some of them also seem to have some effect upon the casein of the milk.

The ferments which digest the casein of the milk or cream usually produce bad flavors and are undesirable from the butter makers standpoint in almost every instance. The growth of these ferments is checked by the presence of a moderate amount of acid in the milk or cream. Hence, as a rule, they are soon overcome by the acid-producing bacteria. These ferments develop best in a sweet cream or milk. Where cream or milk is held sweet at a low temperature these ferments are likely to produce bitter flavors. This class of ferments is very widely distributed in nature and it is very difficult to produce milk without getting some of them into it. They are found in the soil, in almost any kind of filth, or in the dust which may be in the air in the cow stable. This class of bacteria produces spores which are very resistant to heat. As they produce bad flavors in the milk and cream which are transmitted to the butter later, is quite important that they be kept out of the milk as much as possible.

This can only be done by extreme cleanliness about the dairy. The separator and milk utensils should be washed each time after being used. If the separator is not washed each time after it has been used, it imparts filth to the milk and cream. It might seem impossible that so small an amount of filth would be sufficient to have any effect upon the milk or cream coming from it, but only one small bit of this filth contains millions of germs which, when they enter the milk, multiply very rapidly. Cut No. 1 shows the growth of bacteria obtained from one drop of wash water from a milk pail, on a sterile plate of agar. Cut No. 2 shows the growth of ferments obtained from one single, comparatively clean cow hair. These cuts give some idea of the ease with which ferments may be introduced into milk and show the need of extreme care and cleanliness while handling cream or milk. The milker should wear a white apron or suit and should keep himself and especially his hands clean. The hands should never be wet when milking. Some milkers follow the prac-



No. 3.—A one piece milking suit. A clean white suit should be worn by the milker while milking.

tice of wetting their hands by dipping them into the milk. This is a filthy habit and introduces a great many bacteria into the milk. These bacteria have their effect first, upon the flavor of the milk and cream, and later upon the butter.

The most common source of filth in milk is the cow at milking time. If she has a cake of manure on her side, it is almost impossible to milk her without getting some of the manure in the milk. With this filth is not only introduced the bad flavor of the manure itself, but also innumerable bacteria which develop when they are in the milk at a favorable temperature very rapidly and bring about flavors in the milk similar to the flavor of the filth with which they were introduced.

There are now several types of milk pails on the market with covered or, at least, partly covered tops. These pails certainly are a great help to the

man who wishes to produce first class milk, cream or butter. By the use of these pails and by following the suggestions given above the writer believes that the flavor of Idaho butter can be very much improved.

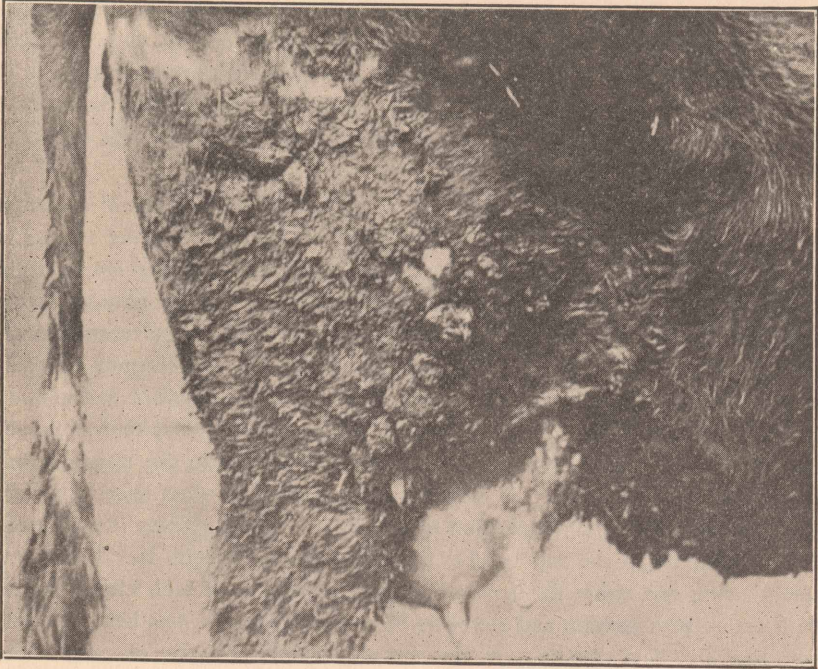


No. 4 and 5.—Types of Sanitary milk pails. The covered tops prevent filth from falling into the pail.

After these precautions have been taken there are still other factors to be considered in the production of good flavor. Cream which contains a high per cent of butter-fat and consequently a low percentage of milk-sugar and casein does not favor the growth of bacteria so much, nor does it reach so high a degree of acidity as cream containing a lower percentage of butter-fat. This fact is of practical value to anyone who wishes to keep cream sweet for a great length of time. This will remain sweet for a longer time under same conditions of temperature than a thin cream. If the separator is set to skim a thick cream, it is the writer's belief that many of the off flavors in butter are due to the fact that the cream was too sour when churned. Where such is the case the above remedy will help greatly to improve the flavor of the butter made from the cream.

In order to churn readily and without a great amount of loss of butter-fat in the butter milk, cream should be sour when churned, but the souring of the cream lessens the keeping quality of the butter provided the sweet cream is Pasteurized. The writer has found that Pasteurized cream churned sweet produces the best keeping butter. A lot of Pasteurized sweet cream was divided into two equal parts. The one part was cooled and churned immediately. To the other half of the cream a good starter was added and allowed to sour until it had reached an acidity of .4 per cent. It was then churned. Both batches of butter were washed, salted and worked to the same amount and in the same manner. A number of one-pound earthen bean-pots were sterilized and filled from each kind of butter. At the beginning four different judges pronounced the two batches of butter equal, except that the sweet-cream butter was rather flat in flavor. Some of the pots of each kind of butter were sealed with paraffin and stored at room temperature. Another set of pots were stored in cold storage. At the end of ten days one pot of each of the kinds of butter held at room temperature was scored by three judges, who knew nothing about the history of the butter. The judges all found the sweet cream butter to have a cleaner and more desirable flavor than the ripened cream butter. At the end of three months the samples in cold storage were also scored with similar results. At this same time one pot of each kind of butter held at room temperature was again scored and the judges who knew nothing about the history of the butter, picked the sweet-cream butter as having a far better flavor than that of the ripe-cream butter. A similar experiment was conducted with sweet raw cream in which the result was in favor of the butter made from ripened cream. The cream used in these experiments contained .12 % of acid which is much less acidity than can be tasted in the cream. The cream must contain about .3 % before the acidity can be

detected by the sense of taste. The buttermilk of the sweet cream in each case tested 2 % butter-fat, while that of the ripened cream tested .08 %. The butter milk from the sweet cream was very much the same as whole sweet milk. It was run through a separator and the cream thus obtained was very much the same as the sweet cream before it was churned. The skimmed but



No. 6.—The filthy cow, a common source of bad flavors in butter.

termilk contained .04 % butter fat, which goes to show that this sweet-cream buttermilk can be successfully separated and the butter fat thus recovered.

Where butter is to be used immediately it will probably be advisable to ripen the cream. If butter is to be stored away for winter, it will keep much better if made from sweet Pasteurized cream. By Pasteurization is meant, the heating of the cream to from 150 to 170 degrees F. and cooling it to a low degree of temperature suddenly. It should be held at a low temperature for several hours before churning after Pasteurization. The sweet cream butter has rather a sweet flavor to begin with, which to some persons is agreeable,

while others prefer butter with a more pronounced flavor. The souring of cream develops or brings out the flavor in the butter. In case of the sweet-cream butter the flavor becomes more pronounced and more desirable after the butter has been held in cold storage for a week or ten days, whereas in the case of ripened cream butter the flavor is inclined to become oily or fishy upon being stored.

The temperature at which milk or cream is held before churning also has a marked effect upon the butter produced. High temperature up to a 100 degrees F. favors the growth of the ferments which may happen to be present in the milk. As stated before it is impossible under ordinary conditions to



No. 7.—Hind quarter of a clean cow a source of clean milk and good flavored butter.

prevent the introduction of some ferments into the milk during the milking process. If the milk or cream is cooled immediately down to 50 degrees F or lower, these ferments grow very slowly, and cream can be held for some

time without becoming sour or developing bad flavors to any great extent. As there are some kinds of germs that grow at low temperatures, it is not advisable to hold cream more than two or three days even at a low temperature, since bitter flavors are likely to result. Morning's cream should not be poured into the evening's cream until it has been cooled to about the same temperature. The warming up of the evening's cream by pouring in the warm morning's cream gives the ferments a start and the souring process begins at once.

Another important factor in keeping cream in a good sweet condition, is that of the percentage of butter fat in the cream. Cream containing a high percentage of fat necessarily contains a lower percentage of milk sugar, casein and water. As these three constituents are the main food for the ferments, their limitation will naturally retard fermentation in the cream. This explains the well known fact that cream containing a high percentage of butter-fat keeps sweet and holds its good flavor longer than cream containing a low percentage of butter-fat. 35 percent is about the right richness of cream for butter making purposes. If a thicker cream than that is skimmed in the winter, it is very difficult to pour from the can. In the summer the richer cream can be handled to better advantage.

Where cream is to be soured for churning, as is advisable in most instances, great care should be taken to sour it through the agency of the kind of ferments which give the cream clean, sour flavor. If filth has been introduced into the cream, this is a very difficult task. In order to control these bad fermentations a starter should be added to the cream in order to sour it quickly.

By a starter is meant a medium, usually skimmed milk, which contains a preponderance of the kind of germs which produce the flavor desired in sour cream for butter-making purposes. Commercial cultures may be secured from Elov Ericsson at St. Paul, Minnesota, or through the agency of almost any creamery-supply house at a small cost. On the farm cream may be soured by adding a starter in the form of butter milk. About ten per cent of the starter should be added to the cream. After mixing thoroughly, cream should then be set at a temperature of from 55 to 65 degrees F for from 8 to 16 hours. When butter-milk is used, in order to produce good flavor in the butter it should have a clean flavor and should not be extremely sour. An off flavor starter is worse than none at all, because instead of introducing the ferment desired, one producing bad flavors may be introduced. If buttermilk is to be held for several days to be used as a starter, it should be kept in a cool place that it may not become too sour. Care should also be taken not to

sour the cream too much. Farrington's alkali tablets and outfit for testing the sourness of cream may be secured from almost any dairy supply house at very little expense. Cream should not contain over .5 per cent acid at churning time. Higher acidity than this invariably introduces a less desirable flavor in the butter.

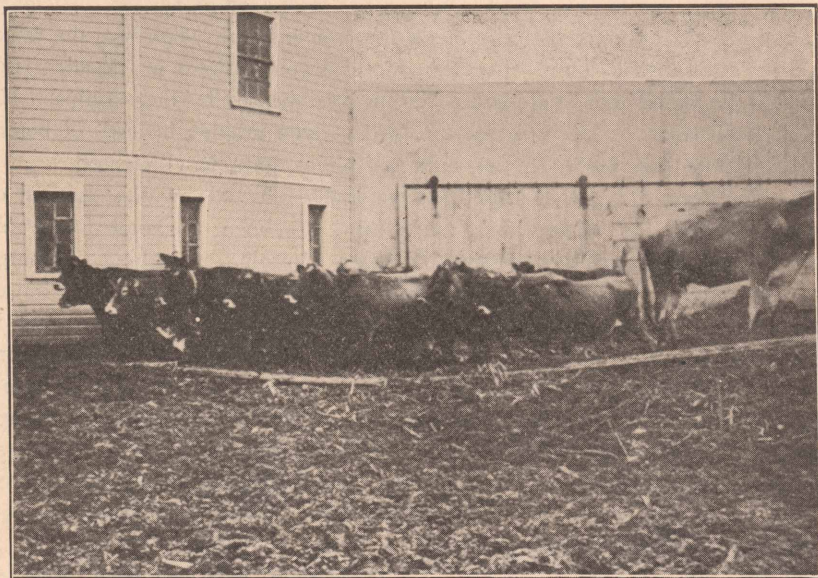
The feeding of certain feeds to the cattle has an undesirable effect upon the flavor of milk, cream, and also upon the butter made from it. Among the most common feeds which produce undesirable flavors are cabbage, turnips, rape, and, in fact, almost any strongly flavored vegetable or feed. There are a few remedies for milk thus affected. The bad flavor can be overcome to some extent by aerating the milk soon after it has been drawn by pouring from can to can, or by running the milk over an aerator. Pasteurization is also a very good remedy for removing the taint from the milk. Dean, of Canada, found that the use of a good starter in ripening the cream overcame the undesirable flavors produced by feeding turnips. He also found that by feeding the turnips just after milking instead of before milking, the bad flavor in the milk was almost entirely eliminated.

The flavor of butter is sometimes materially affected by the method of manufacturing the butter after the cream has been prepared for churning. This manufacturing process includes churning, washing, salting, and working of the butter. The kind of salt used in salting the butter often affects the flavor. Only clean, pure dairy salt should be used. It is the writer's opinion that many of the bitter and other abnormal flavors found in the ranch butter described in the fore part of this bulletin is caused by a poor grade of salt being used in salting the butter. It is also quite apparent that one of the factors which caused the difference in the score between ranch and creamery butter is that on the ranch almost any kind of salt is often used, while the creamery man almost invariably uses salt especially adapted for butter salting.

The churn should always be kept in a good clean condition. Where it is used only once every few days, it is sometimes difficult to keep it from becoming musty. This musty flavor is very readily taken up by the butter, and may spoil the flavor of a batch of butter which would otherwise have been good. Scalding the churn with hot water is quite effective in removing the musty condition. However, the churn should be cooled with cold water before the cream is placed into it in order not to raise the temperature of the cream too much. Another very good method of purifying the churn is by slaking a lump of lime in the churn. Sufficient water should be added to make the lime about the consistency of whitewash. The cover should then

be placed on the churn, leaving the small air-vent open and the lime water should be churned for a short time. If the churn is very musty, this operation should be repeated each day for several days in succession, leaving the whitewash in the churn an hour or so each time and then rinsing out the churn with pure water. Salt water also tends to remove the musty condition of the churn, but where there is any metal in the churn the brine is likely to cause these parts to rust.

The water used in washing the butter is sometimes the cause of bad flavors. This is especially true of shallow well-water. The bad flavor may not be in the water itself, but the water may contain germs which develop later in the butter and cause it to spoil very rapidly. If bad well-water must



No. 8.—Clean milk and good flavored butter cannot be produced from cows when the yard is not well drained and free from manure. (U. S. Dept. of Agr. Photo.)

be used in washing butter, it should first be boiled so as to destroy nearly all the germs in it. Too much attention cannot be given to the sanitation of the water supply for the dairy, as disease germs are liable to find their way into dairy products through this agency, as well as germs that may produce bad flavor.

In order to make a good flavored butter it is quite important that as much as possible of the buttermilk be removed from the butter. The average percentage of casein in ranch butter which indicates the amount of buttermilk was very high compared with that of creamery butter. Again, in both the ranch and creamery butter a high percentage in casein almost invariably went with a low score. The more complete removal of the buttermilk from the butter, is undoubtedly one of the means by which Idaho ranch butter may be improved in flavor.

One of the common causes of an excess of buttermilk in the butter, is too high a churning temperature. When cream is churned at a



No. 9.—Currying the cow, an important part of the dairy man's work if he wishes to produce a good grade of butter.

(U. S. Dept. of Agr. Photo)

high temperature so that the butter comes soft, it does not come in a granular condition as it should, but forms in large lumps, from which it is almost impossible to remove the buttermilk even with excessive working. On the other hand, when the cream is churned at a low temperature and the butter comes in granules about the size of a wheat kernel, or a little larger, the buttermilk can be washed out quite readily. In sweet, or nearly sweet cream, these granules are more difficult to get, consequently such cream

should be churned at a lower temperature. The temperature at which to churn varies with the kind of feed the cows are given and also on the breed and individuality of the cow. In the spring when the cows first go out to grass, the butter has a tendency to be soft and, the cream should be churned at a lower temperature than usual. This is due to the fact that the butter-fat produced from fresh grass contains a large percent of those glycerides of fat which have a low melting-point rather than to the excess of water, as some might suppose. Churning temperature may vary from 48 degrees to 60 degrees F. according to the sourness of the cream, the breed and individuality of the cows and the kind of feed which the cows are fed. A good rule to follow is that of churning at a low enough temperature to have the butter come in a firm condition and in a granular form.

Overchurning will also cause the granules to unite and thus incorporate the buttermilk in such a way that it cannot be removed. The churn should be stopped as soon as the small particles about the size of a pinhead have gathered. So long as these small particles of butter adhere to the glass on the churn, the churning is not complete. To continue churning after these have gathered is to over churn the butter and incorporate an excessive amount of buttermilk in such a way that it cannot be washed out. Underchurning means loss of butter-fat in the buttermilk.

After the butter has reached this granular condition and the buttermilk has been drawn out, the wash water should be added to the butter. It should be about the same amount and about the same temperature as the buttermilk which was removed. If the butter is inclined to be soft, it is advisable to have the temperature of the water a few degrees lower than that of the buttermilk in order to obtain the best results. The churn should then be turned a dozen revolutions, churning the butter in the water. This water should then be drawn off and the operation repeated in the same manner. Two washings are sufficient. In some instances, one washing would remove nearly all of the buttermilk. Excessive washing has a tendency to remove the desirable flavor from the butter, causing it to taste rather flat.

One of the great disadvantages experienced by the Idaho ranch butter is the treatment it receives from the time it is manufactured until it reaches the consumer. The practice of holding butter for a great length of time on the ranch before it is taken to market is the cause of many bad flavors. The writer also believes this to be one cause of the high acidity of ranch butter compared to that manufactured in the creamery.

On the ranch the butter is usually held at rather a high temperature,

as the rancher seldom has ice available with which to cool it. This favors the growth of organisms in the butter. There is, of course very little food for the bacteria except the butter fat, unless an excessive amount of buttermilk has been incorporated. There are some germs, however, according to Jenson, which act upon butter-fat, breaking up its chemical combination and producing fatty acids and glycerol. These fatty acids increase the acidity of the butter and usually give the butter a more or less oily taste, which some writers have seen fit to call rancidity. These flavors are very common in the ranch butter we have examined, which fact indicates that the ferments were not only present in butter but were given a favorable condition for growth. This condition is high temperature for a considerable length of time. The amount of other fermentations such as affect milk-sugar and casein in the butter depends to a great extent upon the amount of these constituents present in the butter. This again emphasizes the importance of removing all the buttermilk from the butter. The decomposition of the casein in the butter usually gives it a bitter or cheesy flavor.

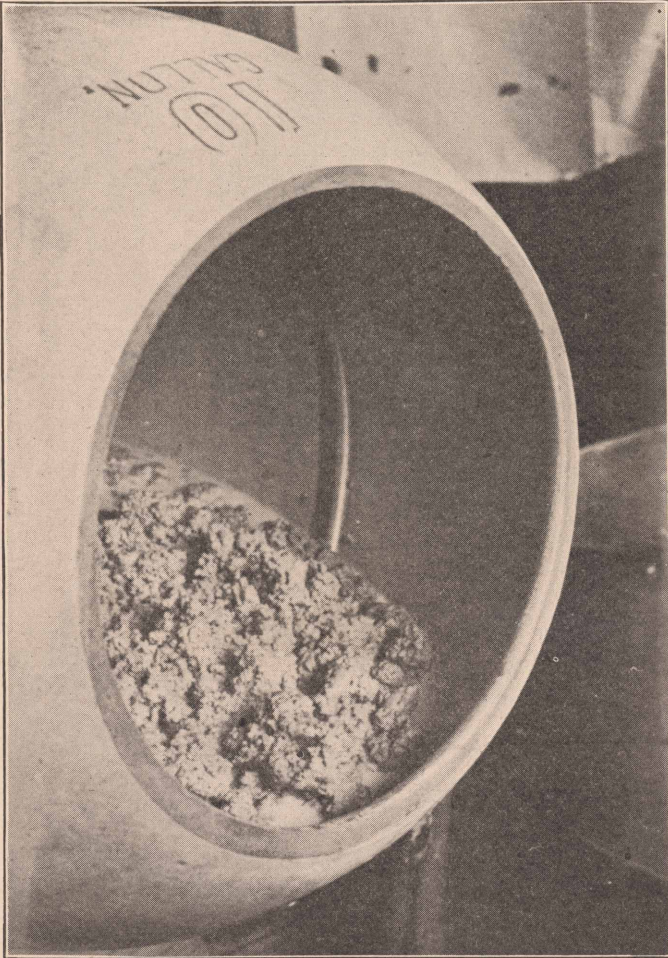
The presence of casein, as shown in tables Nos. 9, 10, 18 and 19, seems to be favorable to the development of acidity in the butter. This may be due to the fermentations of the milk-sugar incorporated in the buttermilk, or the casein and milk-sugar thus incorporated may aid the development of the germs which decompose the butter-fat.

These ferments may be checked, however, by holding the butter at a low temperature and placing it on the market before it has had time to decompose. In the creamery the butter is usually exposed to a freezing temperature in a refrigerator before it is placed on the market. This brings it to the consumer in better condition than is usually the case with the ranch butter. This is an important difference between ranch and creamery butter, especially during the warm season of the year.

Another factor which is likely to affect the flavor of butter during storage is that of keeping it in a place where there are foul odors or odors which will probably give it an undesirable flavor. Butter takes up flavors from its surroundings very easily. Too often butter is kept in a cellar with vegetables. This is especially detrimental when some of the vegetables are in a decaying condition. Butter should never be stored with vegetables, meats, or anything of the kind. The practice of butcher shops keeping butter in the same refrigerator with meats should not be tolerated by our state laws. Quite often the flavor of the butter is spoiled in the grocery store or butcher shop where it is held for sale.

PREVENTING DEFECTS IN TEXTURE.

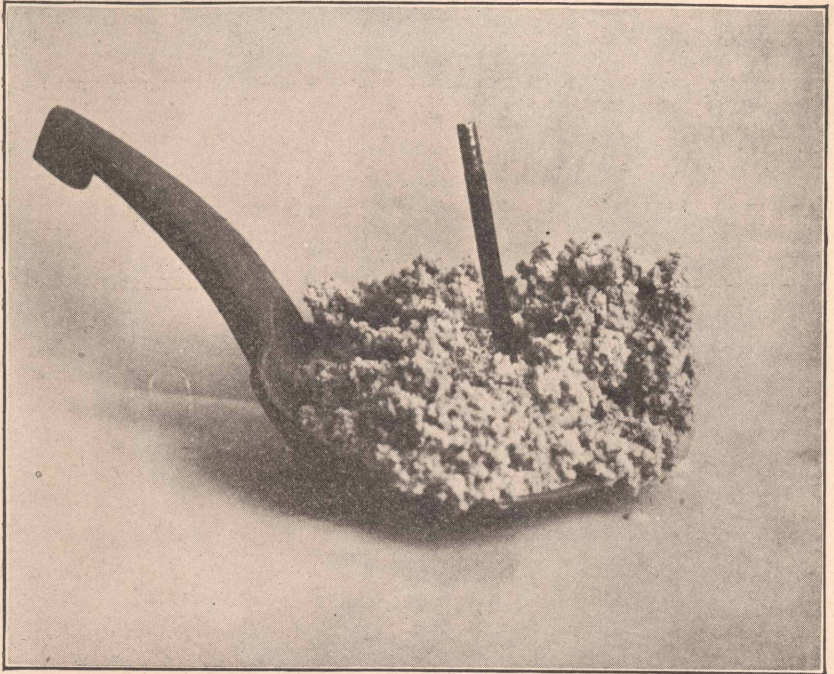
There are many factors influencing the texture in butter. As has been stated butter should have a texture similar to that of wax. In order to secure



No. 10.—Showing butter slightly overchurned. The butter-milk does not readily wash out of butter in this condition.

this condition it is quite necessary that extreme care be taken in the process of manufacture of the butter. Sudden changes in temperature during the manufacturing process are likely to produce either a crumbly, tallowy condition, or a sticky, greasy appearance. Churning at high temperature so that the

butter comes soft is also a very frequent cause of any of the above named defects. The temperature of the cream previous to churning has its effect upon the hardness or softness of butter-fat at churning time. The writer has found that if cream is held at a low temperature for some time previous to churning butter comes firmer than is the case where cream is cooled to churning temperature and churned at once, even though it were churned at the same temperature.



No. 11.—Showing the condition granules of butter should be in when churn is stopped.

The room in which the butter is worked should be cool if possible. Sometimes butter becomes soft while it is being worked, due to the warm room in which it is being worked. This is difficult to overcome on the ranch in many instances on account of the lack of cooling facilities. In such instances the butter should be worked quickly.

The amount of washing and working, as well as over churning, also have their effect upon texture. If the butter is churned excessively in the wash

water, it becomes sticky and greasy and upon being placed in cold storage is likely to become crumbly. The same thing also applies to overworking or overchurning. The working should be sufficient to distribute and dissolve the salt but should not exceed that.

PREVENTING DEFECTS IN COLOR.

Defects in shade of color are not so objectionable, as a rule, as those of mottles and streaks. After some experiments, the New York Experiment Station, at Geneva, in bulletin No. 263 attributes mottles in butter to the presence of buttermilk. Salt is also considered as a factor in that it has an effect upon the color of the casein. It was found that the lighter-colored portions of the butter contained a lower percentage of salt than the darker portions. Where butter was not salted, mottles were not produced.

In order to prevent the mottles, then, it is important that the buttermilk be removed as much as possible and that the butter be worked sufficiently to distribute the salt evenly throughout the butter. The high percentage of casein in ranch butter undoubtedly explains why so many samples are mottled.

PREVENTING DEFECTS IN SALT.

In the first place, as has been suggested, only a good grade of salt should be used. Butter-fat is too high-priced and the difference in the price of salt too small to justify the use of any but a good grade of salt. Not only is the flavor often injured by poor salt, but the inferior grades of salt are difficult to dissolve in the butter. As has been suggested before, it is important that the salt be well distributed and that it be dissolved. When a small piece of butter is bitten between the teeth there should be no gritty condition there.

The amount of salt used in salting butter depends to some extent upon the market. Some markets want a high percentage of salt, while others want little or no salt. From $\frac{3}{4}$ to $1\frac{1}{2}$ ounces of salt per pound of butter are very commonly used.

COMPARISON OF RANCH AND CREAMERY BUTTER FROM THE
STANDPOINT OF COMPOSITION AND QUALITY.

METHOD OF ANALYSIS.

In order to compare the composition with the score and criticism of the butter, a chemical analysis was made of each sample. The following chemical determinations were made: Salt was determined volumetrically by titrating with a standard silver nitrate solution. Acidity was determined by the alcohol and ether method. Ten grams of butter were weighed into a beaker and treated with 20 cc of alcohol and 10 cc of ether. After thorough mixing, the mixture of butter, alcohol, and ether was titrated with a tenth normal sodium hydroxide solution. The number of cc of tenth normal sodium hydroxide required to neutralize the 10 gram sample was designated as so many degrees of acidity. For the casein determination the total percentage of nitrogen was determined by the Kjeldahl method, and this result was multiplied by 6.25 in order to ascertain the percentage of casein, or total proteid. Moisture was determined by the official method, using aluminum dishes, a chemical balance, and a hot water oven. The following is the result of the scoring and analyses of 49 samples of ranch butter.

TABLE NO. 1.
COMPOSITION OF RANCH BUTTER.

Sample number.	Score.	Comments on flavor, texture, etc.	Percent of salt.	Deg. of acidity.	Percent of casein.	Percent of moisture.
1.	91.	Stable, high, acid, bitter	2.21	5 0	1.01	12.28
2.	91.5	Oily, acid, bitter	2.44	3.5	1 73	11.90
3.	88.	Bitter, mottled	1.96	5.8	1.07	11.69
4.	90.	Stable, acid, weak body	1.72	7.	1.02	10.43
5.	89.5	Curdy, oily, weak body, mottled	1.79	3.8	1.65	13.63
6.	84.	Oily, bitter, greasy	2.80	4.4	1.94	10.67
7.	80.	Oily, high acid, weak body	1.67	6.4	1.82	12.01
8.	92.	Greasy, mottled	1.74	3.7	1.92	12.99
9.	95.	Curdy, briny, mottled	2.08	2.3	1.32	13.39
10.	92.	Oily, weak body, mottled	4.04	2.1	.98	13.84
11.	86.	Oily, greasy, mottled	2.64	5.5	1.72	16.77
12.	90.	Flat, not clean, overworked	2.48	2.8	.58	9.07
13.	87.	Tallowy, mottled, gritty	2.40	3.6	1.04	11.59
14.	91.	Clean, leaky, mottled	2.79	2.3	.88	11.19

COMPOSITION OF RANCH BUTTER.

[Continued.]

Sample number.	Score.	Comments on flavor, texture, etc.	Percent of salt.	Deg. of acidity.	Percent of casein.	Percent of moisture.
15.	87.	Tallow, bitter, stable, mottled	1.15	6.0	1.21	10.20
16.	83.	Rancid, not clean, mottled	2.63	8.6	.99	10.80
17.	87.	Flat, mottled	1.30	2.0	.89	10.70
18.	87.	Not clean, bitter, mottled	2.16	4.2	1.24	11.20
19.	83.	Not clean, fishy, old and stale	1.26	12.4	1.09	7.79
20.	87.	Stable, not clean, overworked	.88	6.0	1.03	11.60
21.	94.	Clean, slightly overworked	2.15	4.4	.96	9.01
22.	86.	Flat, fishy, overworked	.92	6.8	.82	11.50
23.	86.	Flat, stale, oily, overworked	5.37	8.7	1.30	10.30
24.	84.	Fishy, not clean, mottled	2.02	4.6	.93	13.16
25.	91.	Mottled, gritty	3.40	2.3	.90	11.40
26.	89.	Vegetable flavor, oily	1.10	2.7	.81	14.30
27.	92.	Flat and mottled	2.10	3.8	.51	9.00
28.	92.	Oily, overworked	1.79	4.2	.82	10.40
29.	87.	Not clean, stable	1.08	2.1	.63	13.70
30.	87.	Flat, bitter, mottled	1.07	9.2	1.00	13.70
31.	89.	Stable, mottled	2.05	3.7	.85	8.96
32.	87.	High acid, oily	4.47	5.0	.82	11.30
33.	83.	Cheesy and rancid	1.09	11.8	1.52	10.40
34.	80.	Very cheesy and rancid	1.74	11.8	1.38	10.20
35.	85.	Oily, overworked	3.57	2.3	.79	9.90
36.	90.	Oily and overworked	1.42	5.1	.97	11.10
37.	83.	Rancid and bitter	.60	14.9	1.65	9.50
38.	81.	Rancid and cheesy	.70	15.4	.92	11.30
39.	89.	Rancid	1.47	5.0	.62	11.10
40.	85.	Cheesy and slightly rancid	1.30	4.4	1.54	10.70
41.	88.	Bitter and stale	7.00	4.1	.81	13.40
42.	83.	Bitter and very stale	1.39	6.0	1.11	10.30
43.	80.	Cheesy and rancid, gritty	4.26	9.0	.61	8.20
44.	70.	Very bitter, rancid and cheesy	.70	25.5	1.40	12.00
45.	85.	Stale and gritty	3.56	1.9	.89	7.00
46.	85.	Cheesy and bitter	1.44	5.8	.85	12.60
47.	88.	Stale and cheesy	1.28	3.3	1.45	9.14
48.	80.	Stable, cheesy	.65	3.9	.80	10.70
49.	86.	Cheesy, oily	1.81	5.6	.81	12.90
Av.	86.6		2.13	5.92	1.09	11.25

The following tables are the result of the analyses of samples of creamery butter. This butter was scored and analyzed the same as the foregoing samples of ranch butter.

TABLE NO. 11
COMPOSITION OF CREAMERY BUTTER.

No.	Score.	Comment on score.	Salt.	Acidity.	Casein.	Moisture.
1.	90.0	Over ripe cream.	2.76	3.0	.53	9.55
2.	92.0	High acid, stale	1.15	3.4	.51	12.37
3.	93.0	Old cream flavor, mottled	2.23	2.4	.46	13.33
4.	88.0	Metalic bitter, mottled	1.22	3.0	.54	12.17
5.	89.0	Over ripe cream, bitter	2.74	3.3	.52	13.80
6.	93.0	Flat and Greasy	1.89	2.2	.71	15.09
7.	89.0	Old, stale, not clean	2.70	3.1	.65	14.58
8.	85.0	Old, stale, rancid, cheesy	2.64	3.5	1.72	16.77
9.	90.0	Fishy, oily, greasy	.94	3.0	.80	11.95
10.	88.0	Old, over ripe cream	1.68	4.5	.50	14.90
11.	92.0	Flat, low salt, greasy	1.41	2.7	.71	12.23
12.	91.0	High acid, bitter	2.22	2.0	.43	10.63
13.	94.0	Flat but clean	2.18	2.6	.71	11.81
14.	86.0	Old, over ripe cream	3.87	5.3	.61	8.34
15.	85.0	Over ripe cream, bitter	1.40	6.6	.43	12.97
16.	89.0	Bitter, cheesy	2.67	4.0	.54	14.47
17.	94.0	Clean but flat	1.76	2.8	.42	11.54
18.	89.0	Old, stale, high acid	2.58	3.6	.92	8.13
19.	96.0	Slight stable flavor	2.50	1.8	.49	14.00
20.	97.0	Light flavor	2.50	1.5	.80	13.51
21.	92.5	Metalic light flavor	1.19	3.4	.51	10.51
22.	90.0	Kerosene	1.80	3.0	.64	15.35
23.	91.5	Stable flavor	1.80	2.3	.56	14.13
24.	90.0	Old over ripe cream	1.51	2.2	.60	12.70
25.	94.5	Flat, mottled, too much brine	2.27	1.4	.47	13.52
26.	88.0	Metalic, cloudy, brine, sour	1.72	1.8	.92	13.90
27.	93.5	Burnt flavor, too much salt	4.08	2.0	.79	13.18
28.	94.0	Clean but flat flavor	4.54	1.2	.52	13.04
29.	93.5	Light flavor, too much salt	4.03	1.9	.54	13.49
30.	93.0	Weak body, flat flavor	2.99	2.3	.29	10.25
31.	90.0	High acid, bitter	1.65	3.7	.54	10.94

COMPOSITION OF CREAMERY BUTTER.

[Continued.]

No.	Score.	Comment on score.	Salt.	Acidity.	Casein.	Moisture.
32.	91.5	Mottled, slightly oily	2.49	2.5	.76	10.18
33.	95.0	Flat but clean	1.95	1.5	.21	11.84
34.	91.0	Flat, stable	2.43	2.5	.91	10.45
35.	93.0	Bitter, mottled	1.19	1.6	1.02	11.75
36.	94.0	Not clean, lacks salt	1.00	1.6	.78	12.61
37.	94.5	Flat flavor	1.56	1.9	1.14	12.83
38.	90.0	High acid, old cream	2.51	3.6	.71	14.57
39.	91.5	Not clean, slightly oily flavor	2.49	2.6	.76	10.18
40.	93.0	Flat flavor, lacks salt	1.56	1.5	.21	11.84
41.	91.0	Very flat flavor	2.43	2.6	.40	10.45
42.	94.0	Low salt, mottled	1.19	1.5	1.02	11.75
43.	91.0	Low salt, mottled	1.03	3.5	.72	11.82
44.	91.0	Low salt, not clean	.98	2.8	.91	12.19
45.	92.0	Clean but rather flat	1.66	2.2	.99	11.79
46.	92.0	Light flavor, weak body	1.91	2.2	.59	13.18
47.	87.0	Not clean, leaky	1.84	3.0	.58	13.90
48.	85.0	Slightly oily, not clean	2.16	2.9	.47	14.83
49.	95.0	Clean but lacks flavor	2.31	1.1	.81	15.32
50.	93.0	Slight stable flavor	1.31	1.7	1.20	13.22
Av.	91.1		2.27	2.66	.67	12.57

The average composition of ranch and creamery butter as shown in the following summary of the foregoing tables indicates the relative standing of ranch and creamery butter from the standpoint of composition and quality.

Summary of Score and Analysis of Ranch and Creamery Butter.

	Av. Ccore	% Salt	Acidity	% Casein	Moisture
Ranch	86.6	2.13	5.92	1.09	11.25
Creamery	91.1	2.27	2.66	.67	12.57

From the above the fact may be noted that ranch butter, on the average, contains 2.13% salt, 1.09% casein and 11.25% moisture. These percentages added together amount to 13.47%, which represents the percentage of substances other than butter-fat in the butter. In other words, in 100 lbs. of ranch butter there are 13.47 lbs of salt, casein and moisture and 100 lbs. - 13.47 lbs. or 86.53 lbs. of butter fat. In comparison to

this, the sum of the substance other than butter fat in creamery butter amounts to 15.51%, leaving 84.49% of butter fat in the butter or in each 100 lbs. of creamery butter, there are 15.51 lbs of substances other than butter fat and 84.49 lbs. of butter fat, or in other words, creamery butter contains 86.53 - 84.49 or 2.4 lbs. less butter fat per 100 lbs of butter on the average. As casein, salt and moisture cost comparatively little, it will be very readily seen that the rancher does not receive the same price for his butter-fat in butter, as does the creamery even though both butters were selling at the same price. In other words, butter-fat is the costly constituent of butter and the creamery man is making 100 lbs. of butter from 2.4 lbs less of butter fat than the rancher. 2.4 lbs. at 30c per lb. amounts to .72 extra profit for the creamery man over the ranch butter-maker on every 100 lbs. of butter. A glance at the foregoing tables 1 and 11 will show that many samples of ranch butter contain moisture sufficient to bring them close to the 16 % mark, which is the legal limit of moisture for creamery butter, while many samples run extremely low in percentage of moisture and salt,

The average score of ranch butter is so low that almost 50 % of it is inedible and unfit for human food unless it be put through a process of renovation. This is a deplorable condition and one which could undoubtedly be corrected by modernizing the methods of manufacture and by improving the marketing system. The fact that some samples of ranch butter compared very favorably with the best creamery butter indicates that it is possible to produce good butter on the ranch as well as in the creamery, if the proper attention is given to the matter.

The average score of creamery butter 91.1 is very good. Some of the samples, however, showed considerable age by their stale flavors. On the whole the samples of creamery butter manufactured in this state is sold in a fresh condition. This, of course, is not generally true of the butter shipped in from the east. For this reason Idaho creamery butter should have a preference over most butter shipped in from the East.

In the above summary as well as in the tables which follow later the fact should be noted that high acidity is almost invariably associated with low quality. As has been indicated this acidity is due in part to the lactic acid incorporated with buttermilk in the butter and to the presence of free fatty acids which are a result of the decomposition of butter fat. These fatty acids do not necessarily always cause a bad flavor in butter until they have been oxidized by being exposed to the air. When exposed to the air the fatty acids become oxidized and become very strong in odor and acid in taste.

This condition of the butter is usually termed rancidity. The presence of a moderate amount of acidity does not necessarily mean that a butter is rancid. This probably explains why acidity does not always correspond to score.

RELATIONSHIP BETWEEN COMPOSITION AND SCORE.

In order to study the relationship between the score and composition of ranch butter the samples were classified according to their score. Class I included those samples scoring 90 or above; Class II scoring from 85 to 90; Class III scoring 85 or under.

TABLE NO. 2.
SCORE — CLASS I. Score 90 and over.

No.	Score	Acidity	Salt	Casein	Water
1.	91.0	5.0	2.21	1.01	12.82
2.	91.5	3.5	2.44	.73	11.90
4.	90.0	7.0	1.72	1.02	10.43
8.	92.0	3.7	1.74	.92	12.99
9.	95.0	2.3	2.08	1.32	13.39
10.	92.0	2.1	4.04	.99	13.84
12.	90.0	2.8	2.48	.59	9.07
14.	91.0	2.3	2.79	.88	11.19
21.	94.0	4.4	2.15	.96	9.01
25.	91.0	2.3	3.40	.90	11.40
27.	92.0	3.8	2.10	.51	9.00
28.	92.0	4.2	1.79	.82	10.40
36.	90.0	5.1	1.42	.97	11.10
Av.	91.65	3.73	2.33	.89	11.27

TABLE NO. 3.
SCORE—CLASS II. Score 85 to 90.

S. No.	Score	Acidity	Salt	Casein	Water
3.	88.0	5.8	1.96	1.07	11.69
5.	89.5	3.8	1.78	.65	11.63
11.	86.0	5.5	2.64	1.72	16.77
13.	87.0	3.6	2.40	1.04	11.59
15.	87.0	6.0	1.15	1.21	10.20
17.	87.0	2.0	1.30	.89	10.70
18.	87.0	4.2	2.16	1.24	11.20
20.	87.0	6.0	.28	1.03	11.60
22.	86.0	6.8	.92	.82	11.50
23.	86.0	8.7	5.37	1.30	10.30
26.	89.0	2.7	1.10	.81	14.30
29.	88.0	2.1	1.08	.68	13.70
30.	87.0	9.2	1.07	1.00	13.70
31.	89.0	3.7	2.05	.80	8.96
32.	87.0	5.0	4.47	.84	11.30
39.	89.0	5.0	1.47	.62	11.10
41.	88.0	4.1	7.00	.81	13.40
47.	88.0	3.3	1.28	1.45	9.14
49.	86.0	5.6	1.81	.81	12.90
Av.	87.44	4.90	2.17	.99	11.88

TABLE NO. 4
SCORE—CLASS III. 85 and under.

No.	Score	Acidity	Salt	Casein	Water
6.	84.0	4.4	2.80	1.94	10.67
7.	80.0	6.4	1.67	.82	12.01
16.	83.0	8.6	2.63	.99	10.80
19.	83.0	12.4	1.26	1.09	7.79
24.	84.0	4.6	2.02	.93	13.16
33.	83.0	11.8	1.09	1.52	10.40
34.	80.0	11.8	1.74	1.38	10.20
35.	85.0	2.0	3.59	.79	9.90

TABLE NO 4—Continued.
SCORE—CLASS III. Score 85 and under.

No.	Score	Acidity	Salt	Casein	Water
37.	83.0	14.9	.60	1.65	9.50
38.	81.0	15.4	.90	.92	11.30
40.	85.0	4.4	1.30	1.54	11.70
42.	83.0	6.0	1.39	1.11	10.30
43.	80.0	9.0	4.26	.61	8.20
44.	70.0	25.5	.70	1.40	12.00
45.	85.0	1.9	3.56	.89	7.00
46.	85.0	5.8	1.44	.85	12.60
48.	80.0	3.9	.65	.80	10.70
Av.	82.00	8.75	1.85	1.07	10.48

SUMMARY OF SCORE CLASSES

Class I—91.65	3.73	2.33	.89	11.27
Class II—87.44	4.90	21.7	.99	11.88
Class III—82.00	8.75	1.85	1.07	10.48

From the above summary the following facts are to be noted:

- 1st. Low acidity goes with high score.
- 2nd. Acidity increases in almost uniform ratio as score decreases.
- 3rd. High salt appears with high score.
- 4th. Salt decreases with score.
- 5th. Casein increases with decrease in score.
- 6th. Moisture content does not appear to hold any direct relationship to score.

In order to ascertain whether the same relationship between score and composition existed in creamery as in ranch butter, the creamery butter samples were also classified according to their score. It was necessary to adopt a new scale for classifying on account of the fact that creamery butter had a higher score. and in order to make somewhere near an equal number of samples in each they were classified as follows: Class I Score over 93; Class II Score 90 to 93; Class III Score 90 and under.

TABLE NO. 12.
SCORE—CLASS I—Score over 93.

No.	Score	Salt	Acidity	Casein	Water
13	94.	2.18	2.6	.71	11.81
17	94.	1.76	2.8	.42	11.54
19	96.5	2.50	1.8	.49	14.00
20	97.	2.50	1.5	.80	13.51
25	94.5	2.27	1.4	.42	13.52
27	93.5	4.08	2.0	.79	13.18
28	94.0	4.54	1.2	.52	13.04
29	93.5	4.03	1.9	.59	13.49
33	95.0	1.95	1.5	.21	11.84
36	94.0	1.00	1.6	.78	12.61
37	94.5	1.56	1.9	1.14	12.83
42	94.0	1.19	1.5	1.02	11.75
49	95.0	2.31	1.1	.81	15.32
Av.	94.5	2.45	1.75	.66	12.95

TABLE NO 13.
SCORE—CLASS II—90 % to 93 %.

No.	Score	Salt	Acidity	Casein	Water
2	92	1.15	3.4	.51	12.37
3	93	2.32	2.4	.46	13.33
6	93	1.89	2.2	.71	15.09
11	92	1.41	2.7	.71	12.23
12	91	2.22	2.0	.43	10.63
21	92.5	1.19	3.4	.51	10.51
23	91.5	1.80	2.3	.56	14.13
30	93.0	2.99	2.3	.29	10.95
32	91.5	2.49	2.5	.76	10.18
34	91.0	2.43	2.5	.91	10.45
35	93.0	1.19	1.6	1.02	11.75
39	91.5	2.47	2.6	.76	10.18
40	93.0	1.65	1.5	.21	11.84
41	91.0	2.43	2.6	.40	10.45

TABLE NO. 13—Continued.
SCORE—CLASS II—90 % to 93 %.

No.	Score	Salt	Acidity	Casein	Water
43	91.0	1.03	3.5	.72	11.82
44	91.0	.98	2.8	.91	12.19
45	92.0	1.66	2.2	.99	11.79
46	92.0	1.91	2.2	.54	13.18
50	93.0	1.31	1.7	1.20	13.22
Av.	92.0	1.81	2.44	.67	11.85

TABLE NO. 14
SCORE—CLASS III—Score 90 % and under

No.	Score	Salt	Acidity	Casein	Water
1	90	2.76	3.0	.53	9.55
4	88	1.22	3.9	.54	12.17
5	89	2.74	3.3	.52	13.80
7	89	2.70	3.1	.65	14.58
8	85	2.64	5.5	1.72	16.77
9	90	.94	3.0	.80	11.95
10	88	1.68	4.5	.50	14.90
14	86	3.87	5.3	.61	8.34
15	85	1.40	6.6	.43	12.97
16	89	2.67	4.0	.54	14.47
18	89	2.58	3.6	.92	8.14
22	90	1.80	3.0	.84	15.35
24	90	1.51	2.2	.60	12.70
26	88	1.72	1.8	.92	13.90
31	90	1.65	3.7	.54	10.94
38	90	2.51	3.6	.71	14.57
47	87	1.84	3.0	.58	13.90
48	85	2.16	2.9	.47	14.83
Av.	88.2	2.13	3.66	.68	12.99

SUMMARY.

	Score.	Salt.	Acid.	Casein.	Water.
Class I	94.5	2.45	1.75	.66	12.95
Class II	92.0	1.81	2.44	.67	11.85
Class III	88.2	2.13	3.66	.68	12.99

From the above summary the following facts may be noted:

1st. High score goes with low acid and acidity increases as score decreases.

2nd. The highest scoring class had the highest percentage of salt, although class II had a lower percentage of salt than class III.

3rd. There was no appreciable difference in percentage of casein in the different classes.

4th. Score bears no direct relationship to moisture.

5th. Moisture and percentage of salt seem to bear a close relationship to each other.

CLASSIFICATION OF RANCH BUTTER ACCORDING TO ACIDITY

Larson, Lund, and Miller of the South Dakota Experiment Station found that acidity was a reasonable test of the deterioration of butter. After testing a considerable number of samples of fresh butter for acidity the writer has found that the acidity seldom is higher than about two degrees, most of the samples tested having from one to two degrees acidity. This was found to be true even where the cream had been ripened to an unusually high degree. The writer has also found that if butter is held at room temperature there is almost always a decided increase in the degree of acidity. This increase was found to be less where cream for buttermaking had been Pasteurized than where some of the same cream had been churned raw. If acidity above two degrees means that the butter has deteriorated in quality, as it undoubtedly does in most instances, then the acidity of the butter should give some indication of its age and of the temperature at which it has been kept. In order to make further comparison between acidity and score the samples were classified according to their acidity. Class I, those samples having less than 3 degrees of acidity; Class II, those samples having from three to five degrees of acidity; Class III, samples having from five to ten degrees of acidity; Class IV, over ten degrees of acidity.

TABLE NO. 5.
ACID — CLASS I.
Less than 3 degrees acidity.

No.	Acidity.	Score.
9.	2.3	95.0
10.	2.1	92.0
12.	2.8	90.0
14.	2.3	91.0
17.	2.0	87.0
25.	2.3	91.0
26.	2.7	89.0
29.	2.1	88.0
35.	2.3	85.0
45.	1.9	85.0
Av.	2.28	89.3

TABLE NO. 6.
ACID — CLASS II.
3-5 degrees acidity.

No.	Acidity.	Score.
2.	3.5	91.5
5.	3.8	89.5
6.	4.4	84.0
8.	3.7	92.0
13.	3.6	87.0
18.	4.2	87.0
21.	4.4	94.0
24.	4.6	84.0
27.	3.8	92.0
28.	4.2	92.0
31.	3.7	89.0
40.	4.4	85.0
41.	4.1	88.0
47.	3.3	88.0
48.	3.9	80.0
Av.	3.97	88.2

TABLE NO. 7.
ACID — CLASS III.
5-10 degrees acidity.

No.	Acidity.	Score.
1.	5.0	91.0
3.	5.8	88.0
4.	7.0	90.0
7.	6.4	80.0
11.	5.5	86.0
15.	6.0	87.0
16.	8.6	83.0
20.	6.0	87.0
22.	6.8	86.0
23.	8.7	86.0
30.	9.2	87.0
32.	5.0	87.0
42.	6.0	83.0
43.	9.0	80.0
46.	5.8	85.0
49.	5.6	86.0
Av.	6.65	85.8

TABLE NO. 8.
ACID — CLASS IV.
Over 10 degrees acidity.

No.	Acidity.	Score.
19.	12.4	83.0
33.	11.8	83.0
34.	11.8	80.0
37.	14.9	83.0
38.	15.4	81.0
44.	25.5	70.0
Av.	15.3	80.0

SUMMARY.

Class I.	Acid 2.28.	Score 89.3.
Class II.	“ 3.97.	“ 88.2.
Class III.	“ 6.65.	“ 85.8.
Class IV.	“ 15.3.	“ 80.0.

The summary of tables 5, 6, 7 and 8 shows that there is a general relation between the score and acidity of butter. As butter deteriorates it almost invariably increases in acidity. In other experimental work which the writer has carried on, this increased acidity seemed to come almost entirely from the decomposition of the butter fat. Some scientists have attributed this decomposition of butter to the action of micro organisms, while others maintain that air and light play a role in the splitting of the butter fat. However this may be, the increased acidity in most every instance was accompanied by a low score. These changes in the butter fat have been found by the writer to take place very slowly where the butter is made from pasteurized cream or where it is held at a low temperature. Where bad flavors have been introduced into the butter by the introduction of some badly flavored substance or from having been kept under conditions where the butter has been allowed to take up undesirable odors from the atmosphere in which it has been kept, the decrease in score would probably not be accompanied by the corresponding increase in acidity.

CLASSIFICATION OF CREAMERY BUTTER ACCORDING TO ACIDITY.

Here again it was necessary to adopt a new scale for classifying. The following scale was used. Class I, less than 2 degrees acidity. Class II, 2 to 3 degrees acidity. Class III, 3 degrees and over.

TABLE NO. 15.

CLASS I.

Acidity less than 2°.

No.	Acidity	Score
19	1.8	96.5
20	1.5	97.0
25	1.4	94.5
26	1.8	88.0
28	1.2	94.0
29	1.9	93.5
33	1.5	95.0
35	1.6	93.0
36	1.6	94.0
37	1.9	94.5
40	1.5	93.0
42	1.5	94.0
49	1.1	95.0
50	1.7	93.0
Av.	1.57	93.9

TABLE NO. 16.

CLASS II.

Acidity 2° to 3°.

No	Acidity	Score
3	2.4	93.
6	2.2	93.
11	2.7	92.
12	2.0	91.
13	2.6	94.0
17	2.8	94.0
23	2.3	91.5
24	2.2	90.0
27	2.0	93.5
30	2.3	93.0
32	2.5	91.5
34	2.5	91.0
39	2.6	91.5
41	2.6	91.0
44	2.8	91.0
45	2.2	92.0
36	2.2	92.0
48	2.9	85.0
Av.	2.32	91.6

IDAHO EXPERIMENT STATION

ACID TABLE NO. 17.

CLASS III.

Acidity 3° and over.

No.	Acidity	Score
1	3.0	90.0
2	3.4	92.0
4	3.9	88.0
5	3.3	89.0
7	3.1	89.0
9	3.0	90.0
10	4.5	88.0
14	5.3	86.0
15	6.6	85.0
16	4.0	89.0
18	3.6	89.0
21	3.4	92.5
22	3.0	90.0
31	3.7	90.0
38	3.6	90.0
43	3.5	91.0
47	3.0	87.0
Av.	3.75	89.1

SUMMARY.

	Acidity	Score
Class I	1.57	93.9
Class II	2.32	91.6
Class III	3.75	89.1

The above summary indicates about the same result as obtained in case of ranch butter so far as the relationship between acidity and score is concerned.

CLASSIFICATION OF RANCH BUTTER ACCORDING TO CASEIN

It is a generally conceded fact among butter makers that the presence of buttermilk in butter decreases its score and especially its keeping quality.

In order to ascertain to what extent this is true the samples were classified according to the percentage of casein found in them.

TABLE NO. 9.

CLASS I.

Casein less than 1 %.

No	Casein	Scores	Acidity
2	1.73	91.5	3.5
5	.65	89.5	3.8
6	.94	84.0	4.4
7	.82	80.0	6.4
8	.92	92.0	3.7
10	.99	92.0	2.1
12	.59	90.0	2.8
14	.88	91.0	2.3
16	.99	83.0	8.6
17	.89	87.0	2.0
21	.96	94.0	4.4
22	.82	86.0	6.8
24	.93	84.0	4.6
25	.90	91.0	2.3
26	.81	89.0	2.7
27	.51	92.0	3.8
28	.82	92.0	4.2
29	.68	88.0	2.1
31	.85	89.0	3.7
32	.84	87.0	5.0
35	.79	85.0	2.3
36	.97	90.0	5.1
38	.92	81.0	15.4
39	.62	89.0	5.4
41	.81	88.0	4.1
43	.61	80.0	9.0
45	.89	85.0	1.9
46	.85	85.0	5.8
48	.80	80.0	3.9
49	.81	86.0	5.6
Av.	.85	87.36	4.59

TABLE NO. 10.

CLASS II.

Casein 1 % and over.

No.	Casein	Score	Acidity
1	1.01	91.0	5.0
3	1.07	88.0	5.8
4	1.02	90.0	7.0
9	1.32	95.0	2.3
11	1.72	86.0	5.5
13	1.04	87.0	3.6
15	1.21	87.0	6.0
18	1.24	87.0	4.2
19	1.09	83.0	12.4
20	1.02	87.0	6.0
23	1.30	86.0	8.7
30	1.00	87.0	9.2
33	1.52	83.0	11.8
34	1.38	80.0	11.8
37	1.65	83.0	14.9
40	1.04	85.0	4.4
42	1.61	83.0	6.0
44	1.40	70.0	25.0
47	1.45	88.0	3.3
Av.	1.20	81.58	8.05

SUMMARY OF CASEIN

CLASSES.

	Casein	Score	Acidity
Class I	.85	87.36	4.59
Class II	1.20	81.58	8.05

From the summary the percentage of casein in butter seems to affect its score to a slight extent at least. This does not hold true in all cases, however,

as a few of the samples comparatively high in score are also fairly high in percentage of casein. There seems to be a relation between casein and acidity as shown in the above table. This would indicate that the presence of buttermilk had a tendency to increase the acidity of the butter.

CLASSIFICATION OF CREAMERY BUTTER ACCORDING TO CASEIN

TABLE 18.

Class I, less than .70 % casein.

No.	Casein	Score	Acidity
1	.53	90.0	3.0
2	.51	92.0	3.4
3	.46	93.0	2.4
4	.54	88.0	3.0
5	.52	89.0	3.3
7	.65	89.0	3.1
10	.50	88.0	4.5
12	.43	91.0	2.0
14	.61	86.0	5.3
15	.43	85.0	6.6
16	.54	89.0	4.0
17	.42	94.0	2.8
19	.49	96.0	1.8
21	.51	92.5	3.4
22	.64	90.0	3.0
23	.56	91.5	2.3
24	.60	90.0	2.2
25	.47	94.5	1.4
28	.52	94.0	1.2
29	.54	93.5	1.9
30	.29	93.0	2.3
31	.54	90.0	3.7
33	.21	95.0	1.5
40	.21	93.0	1.5
41	.40	91.0	2.6
46	.59	92.0	2.2
47	.58	87.0	3.0
48	.47	85.0	2.9
Av.	.49	90.7	2.8

TABLE 19.

Class II, .70 % and over.

No.	Casein	Score	Acidity
6	.71	93.0	2.2
8	1.72	85.0	5.5
9	.80	90.0	3.0
11	.71	92.0	2.7
13	.71	94.0	2.6
18	.92	89.0	3.6
20	.80	97.0	1.5
26	.92	88.0	1.8
27	.79	93.5	2.0
32	.76	91.5	2.5
34	.91	91.0	2.5
35	1.02	93.0	1.6
36	.78	94.0	1.6
37	1.14	94.5	1.9
38	.71	90.0	3.6
39	.76	91.5	2.6
42	1.02	94.0	1.5
43	.72	91.0	3.5
44	.91	91.0	2.8
45	.99	92.0	2.2
49	.81	95.0	1.1
50	1.20	93.0	1.7
Av.	.90	91.9	2.4

SUMMARY

	% Casein	Score	Acidity
Class I	.49	90.7	2.8
Class II	.90	91.9	2.4

The fact should be noted here that in case of creamery butter, which contains a much lower percentage of casein than ranch butter, the same relationship between percentage of casein and score does not hold true. The lower percentage of casein in this case has the lower score. The cause for this is probably that the most of the samples containing a small amount of casein had been washed excessively, thus taking away the desirable flavors as well as the casein.

MISCELLANEOUS SUBJECTS.

DIFFICULT CHURNINGS

Occasionally the butter maker has difficulty in getting butter to come, even with a great amount of churning. The difficulty may come from one or more of various causes. Only the more common causes will be taken up.

As has been mentioned, sweet cream is difficult to churn. This is especially true when it is churned at a low enough temperature to cause the butter to come in a granular condition. Souring the cream will of course overcome the trouble. If it is not desired to ripen the cream the addition of a starter and churning immediately will cause the butter to come more readily. Churning should not require more than thirty minutes in ripened cream, but if sweet cream is to be churned successfully it should be at a lower temperature than ripe cream and will require more time.

One common trouble in churning is the frothing of the cream when it should churn. In some cases the whipped cream is sufficient to fill the churn. This does not allow sufficient agitation and the churning becomes very slow and difficult. This trouble sometimes arises when cream is rather sweet. Ripening with a good starter will usually overcome the difficulty. Warming the cream to a higher temperature will usually bring the butter, but it is quite certain to make the butter extremely soft. Sometimes this frothy condition is due to certain ferments in the cream. These may usually be overcome by ripening with a good starter as suggested above.

Extremely thick cream sometimes adheres to the inside of the churn so as to prevent a sufficient amount of agitation to cause the butter to come. In this case the churn should be run at a slower rate of speed.

Sometimes the cream from certain cows does not churn readily. This may be caused by an unhealthy condition of the cow. In this, as well as in most other

cases of difficult churnings, the ripening of the cream will usually overcome the trouble. Cows well advanced in lactation period occasionally produce cream that will not churn readily. Such cases are difficult to remedy, as the cause lies in the fact that the fat globules are small and do not gather so readily as is the case when the cow is fresh. From such cream there is liable to be a greater loss of fat in the buttermilk than is the case with ordinary cream. This condition of the fat globules cannot be very materially changed except by allowing the cow to go dry until she becomes fresh again.

CONTROLLING MOISTURE IN BUTTER.

In the creamery and also on the ranch, the profit in butter-making depends to a great extent upon the percentage of water incorporated in the butter. The higher the percentage of moisture, so long as it does not exceed the legal limit, the greater the profit will be. A great many creameries in the United States have lost large sums of money by having to pay a fine for exceeding the legal limit of 16 percent of moisture, while others have lost money by not holding the moisture content up close to the legal limit of 16 percent.

From the above, the ability to control the percentage of moisture in the butter has a great deal to do with profit and loss in the butter-making business. The creamery man who can control this factor is worth more to the creamery than the man who goes at butter making in a hit or miss sort of way. The control of moisture requires experience and study on the part of the butter maker.

The factors affecting the percentage of moisture in butter are quite numerous. The condition of the fat is perhaps the most important factor. Fat with a low melting point takes up moisture more readily than that with a high melting point at the same temperature. The melting point of the fat in turn depends upon the individuality of the cow, the breed of cow, the time of lactation period and the feed which the cow receives. The percentage of moisture is also affected by the temperature at which it is churned, washed and worked. Moisture may be incorporated into butter by excessive churning either in the buttermilk or in the wash water. The more excessive the churning the higher the percentage of moisture in the butter. Working the butter in the presence of a small amount of water before salting tends to increase the percentage of moisture in the butter. The salt seems to keep the fat from taking up moisture. The writer has found it rather difficult to increase the moisture in butter by working in presence of water after salting, except when the butter is in a very soft condition. Butter comes in a firmer

condition when cream is held at a low temperature for some time previous to churning than when it is churned immediately after being cooled to churning temperature, even though the churning temperature is the same in both cases.

By keeping the above facts in mind and by testing the butter from each churning for percentage of moisture the butter-maker can gradually learn by experience just what treatment to give the butter in order to incorporate the greatest possible amount of moisture without exceeding the legal limit of 16 percent.

On the question of moisture the ranch butter maker has an advantage over the creameryman in that there is no legal limit to the amount of moisture which may be incorporated in the butter. McKay of the Iowa Experiment station found that moisture-content had but little to do with quality, except where moisture became very excessive. Excessive moisture is likely to produce a weak body in the butter. From the analysis it will be seen that ranch butter contains less moisture on the average than creamery butter. The percentage of moisture in creamery butter is also quite low, being 3.43 percent under the 16 percent mark on the average. This means that about 3 percent more butter could be made from the same amount of butter fat. This certainly would be a great gain in profits of the creameries selling butter in this state. In the case of ranch butter, this could be increased to 5 percent without very materially affecting the quality of butter. Outfits for testing moisture in butter can be purchased from any of the creamery supply companies. Full directions for operating the test are usually sent with the outfit.

SELLING CREAM VS. BUTTER MAKING ON THE RANCH.

This is a question which cannot be answered in the same way for all conditions. There are certain factors, however, which should guide in answering this question on each ranch.

In order to compare the price secured for butter fat sold in the form of cream with that sold in the form of butter, it is necessary that the relation between the two be clearly understood. From the analysis of butter it will be seen that beside butter fat in butter, there is also moisture, casein and salt. In selling butter therefore, the rancher is selling not only butter fat but also the other constituents found in butter, which have little value compared with butter. On the other hand, when the creamery buys butter-fat in the form of cream the price is so much per pound for pure butter-fat. This difference between butter and butter fat is known as 'overrun.' As shown in the analysis of ranch butter, the difference between butter and butter fat is that in 100 pounds of butter there are 86.53 pounds of butter fat and 13.47

pounds of substances other than fat. By dividing the former into the latter and multiplying by 100 we have the theoretical percentage of overrun which in this case amounts to 15.56 percent. The overrun should pay for the cost of manufacture in most instances.

From the above it is quite apparent that if the price for butter-fat is about the same as the price received for the ranch butter, little is gained by churning on the farm when labor involved is taken into consideration. However, if the ranch butter can be sold for five cents per pound more than the price of butter-fat, it will undoubtedly pay the rancher to make butter, provided he has his dairy conveniently arranged for manufacturing the butter with the least possible labor.

The ability of the rancher to sell his butter at a good price will depend upon his ability to secure and satisfy a special market for his butter. There is no reason why the best possible butter could not be manufactured on the ranch provided there were cooling facilities, cleanliness, and care in the manufacture of the butter. On many ranches it is possible to put up ice in the winter at a very low cost. Too often the rancher places his butter on the general market where it is allowed to lie around for some time before it reaches the consumer. Butter should be sold to the consumer in as fresh a condition as possible in order to obtain the best results. If the butter can be sold directly to the consumer as soon as it has been churned and cooled down with ice, or in a cool cellar, it can not fail to bring a good price provided it has been properly made. Grocers who are eager to secure the farmers' trade often pay more for ranch butter in trade than they can secure for it. This butter accumulates during the winter and often lies around the store until spring, at which time it must be sold for packing stock. Certainly the store keeper could not afford to do business in this way if he were not making excessive profits on the goods given in exchange for the butter. A large percentage of Idaho ranch butter is sold for packing stock to be shipped east, where it is sold for the manufacture of process or renovated butter. This packing stock brings from 12 to 18 cents per pound. This condition is certainly a disgrace to the state.

The question arises, "Who is to blame for existing conditions?" Perhaps the rancher is mainly to blame for producing a low grade of butter, but so long as the store keeper continues to buy this butter at a loss simply to hold the farmers' trade, he certainly should receive his share of the condemnation. Of course so long as one grocer in a small town takes the butter from the rancher, the rest must do so in order to hold their trade. In many instances the trouble might be overcome if the grocer would buy cream and

ship it to some reliable creamery, rather than to buy the butter on which he is bound to lose money unless he is making considerable profit on the goods which he gives in exchange. Of course there might be trouble in keeping cream in good condition at the store; but the same thing usually applies to butter also. A convenient sanitary department for cream could be included in almost any grocery store at a comparatively low cost. This should be a room separate from the store room, and should have some facilities for cooling the cream so that it can be shipped in good condition.

The writer does not make the above statements to discourage those who are making a good salable grade of ranch butter and are getting it to the consumer in a good fresh condition. As stated before, there is no reason why the rancher should not be able to make a good grade of butter on the ranch. Butter-fat is too valuable and we are forced to ship in too much of it from the middle west to justify the present practice of shipping out tons of it in the form of packing stock at a greatly reduced price. It is time that the butter-makers as well as the butter-dealers of Idaho take steps toward improving the existing conditions.

In many localities of this State it is possible to sell sweet cream to ice-cream makers and confectioners at a price that far exceeds the price that could be secured for the butter-fat in the form of sour cream or butter. The production and marketing of sweet cream requires a great deal of care in that it must be delivered to market more often than is the case with sour cream or butter. If the ranch is located near town or railroad station so that the cream can be shipped to reach the consumer or manufacturer in a few hours from the time it leaves the ranch, it will probably pay to sell the butter fat in the form of sweet cream. Each rancher must figure out this problem for himself. In some instances the extra effort required may not be repaid by the increased returns.

SHRINKAGE OF BUTTER IN PRINTS.

Many dairymen and retail stores in this State have been prosecuted for selling butter that was short in weight. This shortage is often accounted for by the possibility of the butter shrinking *sufficiently* from the time that it comes from the mold until it is sold to the consumer. In order to answer the many inquiries received by the Department of Dairying regarding the amount that a print of butter will shrink while on the market the experiments herein reported were conducted. The result of the experiments are an indi-

cation of how much a print of butter may shrink in a given length of time so that the producer may standardize his mold so as to have sufficient over weight in each print to be certain that it will not shrink sufficiently to make him subject to a fine by the State Dairy and Food Commissioner.

The experiments here reported have been carried on at various seasons of the year so as to give results for the dry summer months as well as for the wet weather in the winter. The average humidity of the room in which the prints were kept during the experiment was such as to compare favorably with ordinary grocery store conditions. The prints were placed two inches apart so as to allow a circulation of air around them. They were handled with extreme care so as not to be damaged in the weighing process. A pair of scales sensitive to 1-100 oz. was used in the weighing so as to detect even the very slight losses.

TABLE NO. 20.
RANCH BUTTER SHRINKAGE, EXPERIMENT "A"

Date of weighing	Days stored	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Total weight	Total shrinkage	Average shrinkage
		No. 1	No. 2	No. 3	No. 4			
Nov. 29		16.53	15.56	17.47	33.31	82.87		
Dec. 1	2	16.47	15.50	17.41	33.29	82.67	.20	.05
" 4	5	16.37	15.41	17.31	32.25	82.34	.33	.08—
" 6	7	16.34	15.38	17.28	32.32	82.22	.12	.03
" 8	9	16.31	15.33	17.28	33.22	82.14	.08	.02
" 11	12	16.31	15.25	17.23	33.19	81.98	.16	.04
" 14	15	16.28	15.19	17.17	33.17	81.81	.17	.04—
" 18	19	16.25	15.16	17.15	33.14	81.70	.11	.03—
" 21	22	16.25	15.14	17.15	33.14	81.68	.02	.005
" 29	30	16.22	15.11	17.12	33.09	81.54	.04	.035
						In 30 days	1.23	.31—

TABLE NO. 21—Experiment "B"

Dec. 6		16.47	16.60	16.70	16.37	66.14		
" 8	2	16.44	16.49	16.51	16.28	65.72	.44	.105
" 11	5	16.26	16.22	16.32	16.25	65.05	.67	.17—
" 13	7	16.18	16.10	16.23	16.15	64.66	.38	.10—
" 18	12	16.15	16.00	16.20	16.15	64.53	.13	.03—
" 21	15	16.14	16.00	16.17	16.12	64.43	.10	.025
" 27	21	16.12	15.97	16.14	16.09	64.32	.11	.03
" 30	24	16.09	15.94	16.11	16.06	64.20	.12	.03
Jan. 2	27	16.08	15.91	16.06	16.06	64.11	.09	.02—
" 6	31	16.08	15.91	16.04	16.06	64.09	.02	.005
						In 31 days	20.6	.51

TABLE NO. 22.
RANCH BUTTER SHRINKAGE, EXPERIMENT "C."

Date of weighing	Days old	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Total weight	Total shr'ge	Av. shr'ge
		No. 1	No. 2	No. 3	No. 4	No. 5			
Dec. 8		16.34	16.72	17.28	15.81	33.50	99.70		.17
" 11	3	16.15	16.53	17.06	15.75	33.34	98.83	.87	.17—
" 15	7	16.06	16.47	16.97	15.72	33.19	98.41	.42	.08—
" 18	10	16.06	16.47	16.88	15.70	33.08	98.19	.22	.04—
" 21	13	16.05	16.45	16.88	15.69	33.02	98.09	.10	.02
" 27	19	16.02	16.44	16.84	15.69	32.95	97.94	.15	.03
" 30	22	16.00	16.41	16.81	15.69	32.89	97.80	.14	.03—
Jan. 2	25	16.00	16.41	16.80	15.64	32.89	97.74	.06	.01—
" 6	29	15.98	16.41	16.78	15.64	32.84	97.65	.09	.02—
" 8	31	15.97	16.39	16.78	15.64	32.81	97.59	.06	.01—
							In 31 days	2.98	.59

TABLE NO. 23—Experiment "D."

Dec. 8		32.87	30.09	32.31	32.15	30.03	157.45		
" 11	3	32.78	29.86	32.12	32.06	29.72	156.54	.91	.18—
" 15	7	32.69	29.70	32.00	32.00	29.56	155.95	.59	.12
" 18	10	32.63	29.62	31.92	31.94	29.47	155.58	.37	.07—
" 21	13	32.61	29.59	31.91	31.91	29.44	155.46	.12	.02—
" 27	19	32.56	29.53	31.81	31.88	29.38	155.16	.30	.06
" 30	22	32.53	29.47	31.76	31.84	29.33	154.93	.23	.05—
Jan. 2	25	32.48	29.47	31.75	31.81	29.31	154.82	.11	.02—
" 6	29	32.47	29.42	31.72	31.80	29.28	154.69	.13	.03—
" 8	31	32.47	29.39	31.69	31.68	29.25	154.58	.11	.02—
							For 31 days	2.78	.69

TABLE NO 24.

CREAMERY BUTTER SHRINKAGE. EXPERIMENT "A"

Stored at Room Temperature.

Date of weighing.	Days old	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Total weight	Total shr'ge	Av. shr'ge
		No. 1	No. 2	No. 3	No. 4	No. 5			
Sept. 3		15.97	16.60	16.41	16.11	16.08	81.17		
" 10	7	15.74	16.40	16.21	15.90	15.84	80.09	1.08	.22 —
" 17	14	15.69	16.25	16.12	15.80	15.73	79.63	.46	.99
Oct. 1	28	15.59	16.15	16.01	15.75	15.64	79.14	.49	.10—
" 29	56	15.38	16.04	15.86	15.64	15.57	78.43	.71	.14
Dec. 21	119	14.93	15.74	15.55	15.30	15.15	76.67	1.76	.35
Apr. 4	182	14.66	15.54	15.33	15.01	14.92	75.46	1.21	.24
May 12	251	14.60	15.48	15.26	14.94	14.87	75.15	.31	.06
Aug. 4	335	14.31	15.16	14.89	14.71	14.45	73.52	1.63	.32—
								7.65	1.53

TABLE NO. 25—Experiment "B."

Dec. 6		16.06	16.21	16.23	16.07	15.98	80.95		
" 13	7	15.73	16.38	15.92	15.75	15.57	79.35	1.60	.32
" 18	12	15.68	13.33	15.72	15.68	15.48	78.90	.45	.09
" 31	25	15.58	16.24	15.66	15.55	15.33	78.36	.54	.11
Feb. 4	60	15.39	16.09	15.53	15.35	15.06	77.42	.94	.19—
Apr. 8	123	15.25	15.98	15.38	15.23	14.92	76.76	.66	.13
June 9	185	15.13	15.87	15.27	15.13	14.76	76.16	.60	.13
Aug. 4	241	14.91	15.64	13.02	14.91	14.60	75.08	1.08	.22
								5.87	1.17

TABLE NO. 26—Experiment "C."

May 12		15.92	15.92	16.18	15.56	15.49	79.07		
" 19	7	15.71	15.68	15.95	15.28	15.20	77.82	1.25	.25
" 26	14	15.64	15.63	15.89	15.23	15.15	77.55	.27	.05
June 9	28	15.54	15.55	15.78	15.12	15.11	77.10	.45	.09
July 7	56	15.22	15.31	15.52	14.85	14.87	75.77	1.33	.26—
Aug. 4	84	15.04	15.06	15.25	14.57	14.64	74.56	1.21	.24—
								4.51	.90—

TABLE NO. 27.
CREAMERY BUTTER SHRINKAGE EXPERIMENT "D"

Stored at Room Temperature—Continued.

Date of weighing	Days old	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Total weight	Total shr'ge	Av. shr'ge
		No. 1	No. 2	No. 3	No. 4	No. 5			
May 19		16.21	15.62	16.43	16.74	16.22	81.22		
" 26	7	16.09	15.50	16.25	16.59	16.04	80.47	.75	.15
June 2	14	16.06	15.45	16.20	16.54	16.00	80.25	.22	.04—
" 16	28	15.96	15.34	16.09	16.43	15.88	79.70	.55	.11
July 14	56	15.74	15.12	15.86	16.18	15.66	76.55	1.15	.24
Aug. 4	77	15.50	14.99	15.72	16.10	15.47	77.78	.77	.15—
								3.44	.68—

TABLE NO. 14.
CREAMERY BUTTER SHRINKAGE EXPERIMENT "E"

Date weighed	Days old	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Wt. of print	Total weight	Total shr'ge	Av. shr'ge
		No. 1	No. 2	No. 3	No. 4	No. 5			
April 18		16.28	16.34	15.93	15.79	16.16	80.50		
" 19	1	16.25	16.30	15.84	15.75	16.10	80.24	.26	.05—
" 20	2	16.16	16.25	15.78	15.69	16.08	79.96	.28	.06—
" 21	3	16.14	16.20	15.75	15.64	16.04	79.77	.19	.04—
" 22	4	16.10	16.20	15.78	15.65	16.01	79.74	.03	.01
" 24	6	16.05	16.19	15.73	15.62	15.97	79.56	.18	.04—
" 25	7	15.92	16.15	15.71	15.62	15.92	79.32	.24	.05—
" 26	8	15.84	16.11	15.70	15.57	15.76	78.98	.34	.07—
" 27	9	15.81	16.09	15.68	15.55	15.74	78.87	.11	.02—
May 1	13	15.73	16.05	15.66	15.52	15.62	78.58	.29	.06—
" 4	16	15.67	16.03	15.63	15.52	15.62	78.47	.11	.02—
" 8	20	15.58	16.00	15.58	15.37	15.55	78.18	.19	.04—

A glance over the foregoing tables shows that the main part of the shrinkage of the prints occurred during the first week of the experiments. The following summary will show the average amount of shrinkage on the different kinds of prints in one week:

SHRINKAGE OF VARIOUS KINDS OF PRINTS IN ONE WEEK.

Kind of prints.	No. of prints.	Total shrinkage.	Average shrinkage.
Creamery, 1 lb.	25	5.76 oz.	.23 oz.
Ranch, 1 lb.	11	2.81 oz.	.25 oz.
Ranch, 2 lb.	7	1.91	.27 oz.
Av. of all 1 lb. prints	36	8.57	2.38

The above summary indicates that ranch butter has a greater shrinkage than creamery butter under similar conditions. It shows also that the proportionate shrinkage is less in the 2-lb. prints than in the 1 lb. prints.

VARIATION OF RESULTS IN FIRST WEEK OF VARIOUS EXPERIMENTS

Kind of prints	Date of experiment	Experiment	No. of prints	Total shrinkage	Average shrinkage
Creamery, 1 lb.	Sept. 3-10	A Creamery	5	1.05	.21
Creamery, 1 lb.	Dec. 6 13	B Creamery	5	1.60	.32
Creamery, 1 lb.	May 12-19	C Creamery	5	1.25	.25
Creamery, 1 lb.	May 19 26	D Creamery	5	.75	.15
Creamery, 1 lb.	April 18 25	E Creamery	5	1.18	.23
Ranch, 1 lb.	Nov. 29-Dec. 6	A Ranch	3	.56	.19
Ranch, 2 lb.	" "	A Ranch	1	.09	.09
Ranch, 1 lb.	Dec. 6 13	B Ranch	4	1.48	.37
Ranch, 1 lb.	Dec. 8-15	C Ranch	4	.78	.19
Ranch, 2 lb.	Dec. 8-15	C Ranch	1	.32	.32
Ranch, 2 lb.	Dec. 8 15	D Ranch	5	1.50	.30

CONCLUSIONS.

The conclusions drawn from the study of Idaho butter as reported in this bulletin are as follows:

1. Idaho butter, and especially ranch butter, has many defects which can be prevented:
 - a. By care in preparing the cream for churning.
 - b. By correct methods of manufacture.
 - c. By cooling the butter to a low temperature immediately after making and keeping it in a firm condition until it reaches the consumer.
 - d. By shortening the time from when the butter is made until it reaches the consumer.
 - e. By storing butter or cream only in such a place as not to expose it to foul odors or filth.
2. Idaho ranch butter grades about 4.5 points lower than Idaho creamery butter.
3. Acidity of Idaho butter bears a general relationship to quality, high acidity being usually associated with low quality.
4. Under store conditions, 1 lb. prints of butter shrink about $\frac{1}{4}$ ounce in the first seven days. Ranch butter shrinks more than creamery butter and 2 lb. prints shrink less in proportion to their weight than 1 lb. prints.