Thesis:

Producing, Retaining, and Controlling the Flavor of Butter.

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I. Importance of bacteria:
   1. Size and form.
   3. Where found.
   4. Effect produced.
   5. Temperature at which they grow.
      1. Cleanliness.
      2. Cooling.
      3. Heating.

II. Cream:
   1. Ripening:
      1. Temperature of ripening.
      2. Results.
   2. Non-ripened.
      1. Results.

III. Churning:
   1. Temperature of.
   2. Amount of acidity necessary.
   3. Time.
II. Butter:
1. Flavor.
   1. How secured.
   2. Improver.
     1. Additives, salt, etc.
     2. Food grade cow.
     3. How retained.
2. Aroma.
   2. Changes rapidly in air.
   3. Requires time to develop.
3. Where best kept.
   1. Amount.
   2. When added.
5. Packing.
6. Commercial forms.
   1. Bricks.
   2. Rolls.
   3. Pats.
   4. Pots.
The great importance of bacteria in the dairy industry is at present admitted by all who have given the subject thought. A knowledge of the influence of bacteria in the dairy will be of the highest value to the practical dairyman and to all who handle milk. It will teach them not only to produce good milk that will keep, but also to care for their after they are produced.

Bacteria are the tiniest forms of organic life known. They vary in form and size. Three types are known, namely, colis, bacillus, and spirillum.

A common lactic acid bacterium is about three micro-millimeters long and one wide. One micro-millimeter is one, one thousandth of a millimeter, or one two thousand five hundredths of an inch.

Bacteria multiply by division. The most common method is by fission. This separation takes place very rapidly.
Bacteria comprise a class of organisms found in the air, water, and soil, and in plants and animals. They produce great changes in the medium in which they grow. They grow very easily and readily in milk, but they grow even more readily in cream. They do not, however, grow very well in butter, on account of the removal of the albuminoids.

Some of the bacteria are harmless while others are very harmful. They render the milk opaque. They grow best at a temperature of 30°, but their action is arrested at the freezing point of water. They are killed in most fluids at a temperature of 60°.

The destruction of the harmful bacteria can be accomplished in a very many ways. The best and only way to keep clean of them is by cleanliness. The stable should be kept clean, with the floor well sprinkled, and the air free from dust. The lower part of the cow should be rubbed off with a damp cloth.
just before milking. The milk vessels should be kept bright and shining. All 
scars should be avoided if possible. Vessels should be well soldered, and the vessels 
mashed, scalded, and exposed to the direct 
rays of the sun immediately after use. 
Field last but not least, the milkers 
himself should be clean. 

Cobbling and aerating the milk 
will stop the growth of the bacteria. 
In aerating, the milk is exposed to the 
action of the air, and then reduced 
to a low temperature, as soon as it 
is drawn.

If cooled to a temperature of 40°, 
and held there, little fermentation will 
go on, but in the course of three or 
four days, the milk will have a 
disagreeable flavor, due to the presence 
of those bacteria which will grow, even 
at that low temperature. 

Chemicals can be used in the 
destruction of bacteria. Some of these, 
while killing the bacteria, are also injurious.
to life. Heat is found to be, however, the only agent that will destroy bacteria. The destruction by such an agent is called sterilization. The milk needs to be subjected to a temperature of between 120° and 240° for the hour, for each of three successive days. But in order to overcome the bad effects which arise from over heating, pasteurization needs to be employed. In this, the milk is raised to the desired temperature, held there for two or twenty minutes, and then cooled rapidly to 58° or below.

Cream is that part of the milk into which a large portion of fat has been gathered. This cream contains, like the milk, certain bacteria. These bacteria have to be destroyed in order to get good flavored butter. This destruction is accomplished by means of a certain process known as refrigeration. This is done by treating the natural inoculation, or by the
addition of an artificial starter. The latter is the chief means employed. This starter consists generally of soured skim milk or buttermilk, but the former is generally considered the better of the two. Ripening of the cream makes churning much easier, decomposes or destroys the fibrin, and gives flavor to the butter. The fibrin in the milk rises with the cream, and is skimmed off. Ripening the cream destroys this fibrin, which would otherwise get into the butter, and, on putrefying, ruin the flavor.

Butter made from ripened cream will keep longer than that made from sweet cream. Bacteria are the cause of rancidity in butter; they cannot, however, live on pure fat, but require a certain amount of albuminous matter. The butter made from ripened cream will, of course contain more bacteria than that made from sweet cream, but the bacteria cannot as well grow and multiply.
Ripening gives a flavor to butter which sweet cream does not. Overripening produces, on the other hand, very bad effects. The flavor, quality, and texture of the butter are ruined. Underripening has almost the same effect upon butter as overripening.

If a portion of the cream is ripened and the other is not, or if there are different degrees of ripeness in the cream, the cream is very hard to churn. Part of the cream will be churned into butter sooner than the other, there will be small white specks through out the butter, and a very large portion of it will be wasted unless that which it first formed is taken out, and the rest of the cream churned longer.

The least variations of temperature during the ripening process produces the best flavored butter. Cream ripens at a temperature between 80° and 90°, but the cream is best ripened at a temperature of between 55° and 60°. Cream exposed in a dairy at 60° will be ripe.
enough for churning in twelve hours, but in cold weather the addition of a starter is necessary. The amount of acid necessary as the proper point for churning is about six tenths per cent. Dried tests are employed in determining whether or not the cream is in the right condition as to ripeness. For refined cream butter, 20 cubic centimeters of alkali should neutralize the acid in twenty five cubic centimeters of the cream. In making the test clean water should be used in washing the dishes, as strong alkaline water will destroy the accuracy of it. The alkali can only be prepared by one who has a delicate balance at hand. It is made by dissolving five and six tenths grains of potassium hydroxide in four grains of sodium hydroxide in one liter of distilled water.

The development of lactic acid in
Ripened cream is what gives the butter its fine flavor. The bacteria which produced this lactic acid, have probably developed other products which aid in the improvement of the flavor.

Sweet cream produces butter of a most delicate, but an insufficiently full flavor. The flavor of cream raised at 60° for twelve hours in shallow vessels is perfect, but the butter it produces when churned sweet does not satisfy the requirements of those who prefer butter with a pronounced flavor. It contains less casein and water than butter made from ripened cream.

Ripened cream also yields the largest quantity of butter. It may be churned at a temperature of 54° in summer, and at 64° in winter.

The flavor of the butter is derived from the serums, not from the fat of the milk and cream. It is very much...
improved by the addition of a small quantity of fine dry salt. This addition of salt is preferable after the butter has been partially worked. A great many wine men use wine as a means of salting, but this is not nearly so good as dry salting. The amount of salt to be incorporated varies with the demand. Some like a great deal of salt in the butter, while others like very little or none. The general amount is about \( \frac{1}{2} \) of an ounce to every pound of butter.

The flavor of the butter is also affected by the food given to the cow. Good grass or hay is excellent feed where the milk is properly managed, but fermented foods of all kinds are to be avoided. Bran, cottonseed, raps, pea meal, linseed meal, soybean meal, etc., are excellent additions to hay and grass. The animal should never be fed just before milking; but full time should be given the food to digest. If this rule be followed, turnips,
parsley, etc. can be eaten by the animal, and the milk will not be tainted.

The aroma of butter is a guide to its keeping qualities. It changes very rapidly like newly made butter which is exposed to the light and air. It requires time to develop; therefore, butter should not be judged direct from the churn.

Butter very readily takes in disagreeable odors from paint, fish, kerosene, cooked vegetables, tar, decaying substances, etc. These odors all produce very disagreeable flavors in the butter. So the cream and butter should not be kept in the cellar, where all the vegetables are stored, but should have a separate, cool, and well-aired and drained building.

If the cream has been too much ripened, the addition of a small teaspoonful of powdered salt, pith to every three gallon jar of milk, will usually prevent the bitter taste which
always arises from over cultured cream.

Churning has a great deal to do with the flavor of the butter. The cream is, of course, first cultured. The temperature of churning in cold weather should be about 60°, and in warm weather about 56°. The process of churning will raise the temperature a little, and so, to begin with, the cream should be a little too cold rather than too warm. The number of revolutions of the churn should be about from forty-five to fifty a minute, but at first, they should be slower, increasing slowly in the first five minutes, and decreasing toward the end. The warmer the weather, the fewer should be the revolutions.

All churns should have a value through which the evolving gas can be repeatedly let off, until no more escapes, and also a circular plane of glass through which the state of the
Cream may be observed, and when the phase is no longer clouded but comparatively clear, the butter is beginning to come. At this stage, the churn should be turned slowly, and brought to a standstill as soon as the granules of butter have attained the size of a grain of wheat. The butter milk should then be let out of the churn through a small valve, and clear, cold water added, and the churn turned slowly for about half a minute. Then nearly the whole of the liquid should be let out, and again fresh water be put in, and this repeated several times until the liquid comes out nearly as clear as when it went in. When the butter has been sufficiently washed it will present a beautiful golden appearance in the churn, and it is then ready to be worked.

Now the dry salt is incorporated.
in the butter by means of a worker. The
rise of the worker is to incorporate the
salt; to consolidate the butter into a
compact mass, and to press out the
superfluous water. All this is
accomplished without touching the
butter with the hands. New persons
have hands which are cold enough
to touch the butter with impunity,
and as carbonic acid is continually
exuded through the skin, the flavor
of the butter is easily ruined. The
roller, or butter-worked, is run by hand.
The rollers, in passing over the butter,
flatten out the mass, and roll it up again into a lump; and
while the salt is being incorporated
in the butter, the water is being
pressed out, and the butter becomes
a compact and solid mass. A little salt always improves and
developes the flavor of the butter. The
quantity to be added varies from an ounce down, to every pound of butter.
Once puree to the pound is heavy
salting, and therefore, so much is
not used, save in butter which is
to be kept a considerable time.

Butter made from good cream
will keep fresh for weeks without
salt, in a room whose atmosphere
is free from odors, and whose
temperature is under 60°.

If colouring is used, it should
be added immediately before the
cream enters the churn. It
should not exceed the natural
amount that of butter creams is
preferable to other colouring, especially
if prepared in spirit, which prevents
it from fermentation or change.
Preparations in oil, are good, but
there is a great danger of
rancidity, and in all cases
the body and texture of the butter
are interfered with, according to
the quantity used.

The butter is now ready to be
made into rolls, pâté, etc. It is commonly made up into one half pound, one pound, or two pound lumps of various shapes, and often with more or less decorations.

It should not be packed in anything that will give it a woody flavor. Lining the box or package with parchment paper will not prevent this, but lining it with paraffine wax will, to a greater or less extent. A package solidly will retain the flavor of the butter for a month. The butter must also be packed solidly in boxes. The packing and wrapping has a great deal to do with the butter retaining its flavor. It should be so well protected that other odors such as that of kerosene, fish, vegetables, etc., will not be contaminated. This has to be looked to, especially if the butter has to be shipped any great distance.
Commercial forms of butter. Bricks are made with the Scotch hands. Some are plain, and others are fluted.

Rolls are made by rolling the lumps of butter between two boards or by compressing them into a mould. Both forms are easy to handle, and pack, but are awkward for table use unless they are divided.

Pate can be made according to from by a cup mould and by a box print.

Heavily salted butter for keeping is put into pots, and is known as bottled butter. The pots should be absolutely clean and not previously used for any purpose which is liable to spoil it for use. The butter is pressed into them with a scoop, so as to leave no crevices at the top lidded, and covered with a slightly wet muslin cloth, and this with half an inch of salt.
pressed down upon it; covered finally with stiff paper and put into a cool, dry place.

In contact with the air, good butter keeps better in pots than it does in prints. Sunlight, apart from air and temperature, effects butter prejudicially, tending to convert the fixed fats into tallow, and to decompose the volatile fats. Storage in a tight will secure the butter against any such risks.

The composition of butter is: water, nine and five-tenths percent; fat, eighty-eight and thirty-five hundredths percent; casein, seventy-five hundredths percent; sugar, fifteen-hundredths percent; and ash, in the form of salt, one and five-tenths percent.

The flavor of butter is thus retained by keeping bad odors away from it; packing, salting, etc., and by keeping it away from the direct rays of the sun.