

COMPARISON of PASTEURIZED and NON-PASTEURIZED MILK.

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The common use of non-pasteurized milk is coming to be less and less practiced, as people come to more fully realize the danger attending the use of it, and the comparative shortness of its keeping quality. It is only within recent years that milk inspection has been considered important; through this inspection it has been discovered that milk is the cause of a great many outbreaks of disease. Milk is the best possible soil for germ growth and disease germs are often carried by it. In the large cities the general milk supply is really a source of danger unless properly cared for by the purchasers.

The care of milk properly begins in the barn-yard and cow-barn. The barn-yard or pasture lot in which the cow is confined should be cared for from a sanitary view point. It should be well drained and well cleaned, and should be kept so. The ordinary barn-yard, full of filth and partly drained, is inexcusable. It is a means, also, of introducing a great many germs into the milk, as germs grow up through the milk channel into the udder itself. The dirt of the barn yard contains a very great number of germs which, if allowed to come in contact with the teat, rapidly multiply and fill the milk. On the common farm, the cow comes, to a dark, dirty cow-barn, covered with filth. She is fed and milked with no care, whatever, as to cleanliness. The milk is carried to the milk house, set aside for a half hour or more until all soluble filth has dissolved, strained through a strainer alive with germs, into improperly cleansed vessels; as a result the milk soon sours, it has an unpleasant flavor, when fresh, and it often causes disease.

The ideal conditions are rapidly being introduced as their value has now come to be recognized. The barns are made with many windows, through which sunlight, a powerful disinfectant in itself, may be admitted; sanitary precautions are taken throughout the entire structure. The cow comes in from clean quarters. She is fed, washed, and the dust laid around her. The milker dons a clean jacket and properly cleanses his hands. The first few streams of milk are rejected, as they are rich in germs. After milking the milk is carried at once to the milk house, where cheese cloth, which can be thoroughly cleansed, is used as a strainer. The utensils used throughout the milking have been thoroughly disinfected, either by live steam or by boiling water. After straining the milk is cooled, at once, to a temperature below 50° F., and is kept at this temperature until further care can be given it.

The matter of rapidly cooling the milk is an important one. Germs multiply in a geometric ratio. Below 50° F., multiplication ceases, but germs are not killed and only await the proper temperature to again begin reproduction. Reproduction is most rapid between 70° and 90° F..

Germs reproduce rapidly at the body temperature. This should be seriously considered. ~~All~~ The greater part of the milk used is not properly ~~reared~~ cared for and very often, as has been stated, contains germs of disease. While the milk is kept cool these do not reproduce, but upon being introduced into the system they reproduce with alarming rapidity and disease ^{may be} ~~is~~ the result. The milk used in large cities, oftenest contains disease germs. The milk there is exposed in all kinds of offensive places. It becomes heated during the process of delivery and is in a very ^{bad} condition when it reaches the purchaser.

This condition necessitates immediate attention, as it is not in a fit condition to be used. Pasteurization is the best means of preparing it for use. Pasteurization accomplishes two points; it kills the disease germs present, hence prevents disease, and it kills the germs which cause the milk to decompose, hence preserves it. It has been a prevalent idea that pasteurization requires expensive apparatus ^{to} carry it on successfully, hence can only be used by those making dairying a profession. This is a mistaken idea. The apparatus needed is so simple that pasteurization may be carried on in the ordinary household, for the preservation of any desired amount of milk.

The simplest method requires only a common milk thermometer, aside from the usual kitchen utensils. The milk is placed in a granite ware vessel, which is placed over direct heat and rapidly stirred until the temperature reaches 185° F.; then it is set aside to cool. This method is not to be recommended unless the milk is to be consumed at once, as there is no way to prevent contamination during the cooling process. The "cooked" flavor, often objected to, is slightly evident in milk treated by this method.

The most common and most successful method, by which to carry on domestic pasteurization, requires a tin pail and cover, a perforated pie tin, and bottles or tin cans which hold from one half pint to a pint. Mason jars may be used instead of bottles. The utensils, used to contain the milk, should be thoroughly sterilized by boiling before the milk is placed in them. Fill them with milk and set on the perforated pie tin, which is up side down in the bottom of the pail. Fill the pail with water, to a level with the milk. Heat the water to the desired temperature, remembering that the water is hotter than the milk inside the can. When the desired temperature is reached re-

move the direct source of heat and cover the pail closely with a cloth. Let this remain so, the desired length of time; remove the cans and cool as rapidly as possible. It is easily seen that tin is more efficient than glass, in this process, because it can be heated and cooled more rapidly thus giving the least possible chance of reproduction of organisms.

Authorities differ as to the length of time and as to the temperature which brings about the most successful pasteurization. The following experiments show to quite an extent the results which may be obtained by various methods, temperatures and times.

QUANTITATIVE ANALYSIS.

Experiment Number one. I. ---

Conditions.

The sample of milk, used in this experiment, was taken on a rainy, cool day. No special sanitary precautions were taken; milk was drawn into a non-sterilized flask. Sample was taken at the last of the milking.

Method.

A common double boiler was used in pasteurizing. The temperature was taken in the milk, not in water surrounding. The desired temperature was maintained by removing and returning the source of direct heat. The sample was allowed to cool outside of water.

Results.

Plate.	Temperature.	Length of Pasteurization.	Length of Growth.	Colonies in 1c.c.
No. 1	--- Non-pasteurized.	---	48 hrs.	835.
No. 2.	- 180° - Cooled at once.	---	48 hrs.	105.
No. 3.	- 165° - 20 min.	---	48 hrs.	5.

EXPERIMENT NUMBER TWO. II.

Conditions.

Sample taken on a hot, damp day. A sterile flask was used, the cow was washed, and the dust laid, before the flask was opened. Sample was taken at the first of the milking.

Method.

The method used was the same as used in experiment number one.

Results.

Plate.	Temperature.	Length of Pasteurization.	Length of Growth.	No. of colonies 1 c.c.
No. 1	- - - - -	Non-pasteurization.	48 hrs. - - -	105
No. 2	- - -165°F.	- - - 20 min. - - -	48 hrs. - - -	-5
No. 3	- - -180° F.	- - - cooled down at once	48 hrs. - - -	0.

EXPERIMENT NUMBER THREE. III.

Sample taken on a windy damp day. A sterile flask was used to receive the milk. The sample was taken at the first of the milking.

Method.

The milk was placed in sterile bottles. These were set in in a large utensil, with a perforated pan in the bottom, and were surrounded with water to a level with the milk in the bottles. The water was then heated to the desired temperature, the direct source of heat removed and the vessel closely covered for the desired length of time. The milk was then rapidly cooled and the inoculations made.

Results.

Plate.	Temperature.	Length of Pasteurization.	Length of Growth.	No. of Colonies 1 c.c.
No. 1	- - - - -	Non-pasteurization	- - - 48 hrs. - - -	2420
No. 2	- - -155° F.	- - -30 min. - - -	48 hrs. - - -	35
No. 3	- - -140° F.	- - -30 min. - - -	48 hrs. - - -	55

EXPERIMENT NUMBER FOUR. IV.

Conditions.

Sample taken on a quiet, dry day. Drawn into a sterile flask. Sample taken about the middle of the milking.

Method.

The milk was placed in sterile bottles and these placed in water already raised to the desired temperature. The vessel was then very closely covered and set aside the desired length of time. *Experiment No. 3, the bottles were placed in cold water and the temperature slowly raised to desired point.

Results.

Plate.	Temperature.	Length of Pasteurization.	Length of growth.	No. of Colonies 1 c.c.
No. 1 - - -	Non-pasteurization.	- - -	48 hrs. - - -	1240.
No. 2 - - -	133°F.	- - - 30 min.	- - 48 hrs. - - -	120.
*No. 3 - - -	145°F.	- - - 30 min.	- - 48 hrs. - - -	80.
No. 4 - - -	145°F.	- - - 30 min.	- - 48 hrs. - - -	745.

EXPERIMENT NUMBER FIVE. V.

Conditions.

Sample taken on a damp, windy day. Drawn into a sterile flask. Taken about the middle of milking.

Method.

A tin pail and bottles were used as in the last experiment.

Results.

Plate.	Temperature.	Length of pasteurization.	Length of growth.	No. of colonies, 1 c.c.
No. 1 - - - -	Non-pasteurized.		72 hrs.	55
No. 2	145°F.	15 min.	72 hrs.	10
No. 3	160°F.	15 min.	72 hrs.	10

EXPERIMENT NUMBER SIX. VI.

Conditions.

Sample taken on a damp, windy day. Milk drawn into sterile flask. Sample taken at middle of milking.

Method.

Tin cans were used instead of bottles. These were well sterilized before the milk was added, and were cooled, at the end of the experiment, in ice water.

Results.

Plate.	Temperature.	Length of Pasteurization.	Length of Growth.	No. of Colonies 1 c.c.
No. 1	- - Non-pasteurized	- - - - -	48 hrs.	- - - 2255.
No. 2	- - 145°F.	- - - - 15 min.	- - - 48 hrs.	- - - - 340.
No. 3	- - 160°F.	- - - - 15 min.	- - - 48 hrs.	- - - - 175.

The following experiment shows, in a very slight degree, the effect of pasteurization from a quantitative standpoint.

QUALITATIVE ANALYSIS.

Non-pasteurized milk.

Plate I Colony I.

M. xanthogenicus.

Morphology. Cocci 0.5 - 0.8 microns; occur singly,

in twos, and in groups. Stain by Gram's method.

Agar Plate. A round white growth, with clear outline.

Gelatin Stab. A crateriform liquefaction becoming stratiform, with milk white sediment.

Agar Stab. In depth growth white - opaque; on the surface soft, milk white.

Potato. Growth milk-white, limited.

Pathogenesis. Guinea pigs, negative. According to Freire the organism is pathogenic in the summer and for small birds.

Habitat. Isolated from cases of yellow fever and supposed by Freire to be the cause of the disease.

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PLATE I.

COLONY 2.

B. inunctus.

Morphology. Bacilli medium sized; occur singly, in pairs, and in chains.

Agar Plate. A thin, irregular growth on the surface.

Gelatin Plate. Round entire.

Gelatin Stab. Radiating outgrowths from the line of stab,

Agar surface growth thick, glistening.

Agar Slant. Growth whitish.

Potato. Growth ~~slimy~~ ^{slimy}.

Habitat. Water.

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PLATE I.

Colony 3.

Str. Lactis.

Morphology. Cocci medium sized frequently in pairs. In agar, colonies, short chains.

Agar Colonies. A very thin white growth.

Gelatin Colonies. Small, round, becoming liquefied and spreading; also thin granular.

Agar Slant. A glistening white growth.

Potato. Glistening white discrete masses.

Bouillon. Good growth; a thin film on surface ; the medium becomes viscous.

Pl.I, Col.3, Con.

Milk. Rendered bitter. Coagulated at the end of 24 hours;
acid, peptonized.

Habitat. Isolated from cream with bitter taste.

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PLATE I.

Organism not named.

Colony 4.

Streptococcus Class IV. A under I.

Morphology. Cocci, in chains and pairs, small.

Agar Colonies. Small, round, yellow growth.

Bouillon. Slight pellicle, cloudy with sediment.

Gelatin Stab. Liquefied stratiform.

Agar Slant. Yellowish, translucent with heavy spots.

Potato. Heavy, dirty white, dry, raised, rough.

L. Milk. Acid reaction.

Milk. Coagulated.

Habitat. Isolated from milk.

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PLATE I.

Str. proteus.

COLONY 5.

Morphology. Cocci 0.3 microns, forming chains which have
a tendency to arrange themselves in rings.

Agar Colonies. A thin, round, white growth.

Gelatin Colonies. Smooth, raised, very white, becoming 1.0
m/m, not spreading.

Gelatin Stab. In depth a good growth on the surface,
growth snow-white, raised.

Agar Slant. Growth smooth, thick, white, glistening.

Milk. Coagulated, acid.

Bouillon. Turbid; a slight sediment.

Habitat. Milk.

PLATE II.

Str. - acidi - lactici.

COLONY 1.

Morphology. Cocci very small; oval in pairs or chains.

Agar Colonies. Heavy center with fine long prongs or branches.

Galatin Colonies. Porcelain-white, the size of a pin's head.

Gelatin Stab. In depth but slight growth; Surface growth elevated, white, with dentate margins, becoming in 6 weeks light yellow.

Milk. Becomes coagulated, acid.

Habitat. Cow's Milk.

PLATE II.

M. candicans.

COLONY 2.

Morphology. Cocci 1.0 - 1.2 microns; occurs singly and in clumps.

Gelatin colonies. Deep: round - lenticular, opaque, dark, entire. Surface: round, glistening porcelain-white, slightly raised, thinner on margin.

Gelatin Stab. In depth growth white, filiform - beaded; on surface growth white, glistening raised.

Agar Slant. Growth white, limited, slightly raised, greasy.

Bouillon. Turbid with a pellicle, becoming clear.

Milk. Not coagulated.

Potato. Growth thick, white, greasy, with many edges.

Glucose bouillon. No gas.

Habitat. Air, water, milk, etc.

PLATE III.

COLONY .

Str. vermiformis.

Morphology Streptococci which show slow vermiform movements. Chains resemble filaments.

Agar Colonies. An irregular yellow growth.

Gelatin Colonies. Yellowish white becoming liquefied; concentric structure. Microscopically the colonies show radiate margins.

Gelatin Stab. Liquefaction rapid; a dirty yellow sediment.

Potato. A dirty yellow growth.

Habitat. Water.

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PASTEURIZED MILK.

PLATE I

COLONY 1.

Organism not named.

Traces to *Str. Class II*, Bundle IV.

Morphology. Medium sized cocci, single and in long chains.

Agar Colonies. Large, white, with blunt prongs radiating from a common center.

Gelatin Stab. Growth in bottom of tube. Liquefied stratiform. No growth on top.

Bouillon. Sediment in suspension.

Potato. White, wrinkled growth.

Agar Slant. White growth.

Milk. Not changed.

Habitat. Isolated from milk.

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PLATE II.

COLONY 1.

Organism not Named.

Streptococcus Class IV A under I.Morphology. Cocci in long, slender chains, also occur singlyAgar Colonies. Irregular, yellow.Bouillon.- Pellicle and sediment.Gelatin Stab. Liquefied napiform.Agar Slant. Growth cream to yellow, buttery.Potato. Moist wrinkled growth.Milk. Digested.Habitat. Isolated from milk.

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PLATE III.

COLONY 1.

Etr. Albus.

Morphology. Streptococci, which show independent movements only during period of division. (?)Gelatin Colonies. Flat, round, with white margins; liquefaction crateriform.Gelatin Stab. Develop chiefly on the surface; liquefaction rapid; a white sediment.Potato. A slimy white growth.Habitat. Water.

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These experiments give, in a very general way, a comparison of pasteurized and non-pasteurized milk. These show only the comparative numbers and kinds of bacteria present; other experiments showing the comparative keeping quality, digestibility and healthfulness would prove much in favor of pasteurized milk. Pasteurized milk is

most economical in every sense. It produces greater profits commercially; it is wholesome longer, and it is free from disease producing bacteria.

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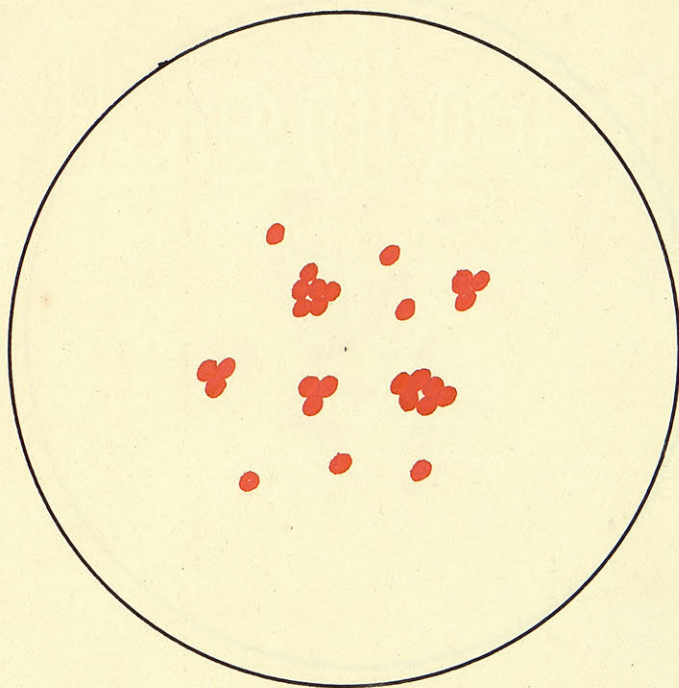
PLATE I. *M. xanthogenicus*.PLATE II. *B. inunctus*.

PLATE III. *Str.lactis*.

PLATE IV. Organism not Named.



PLATE V. *Str. proteus*.PLATE VI. *Str. acidilactici*.

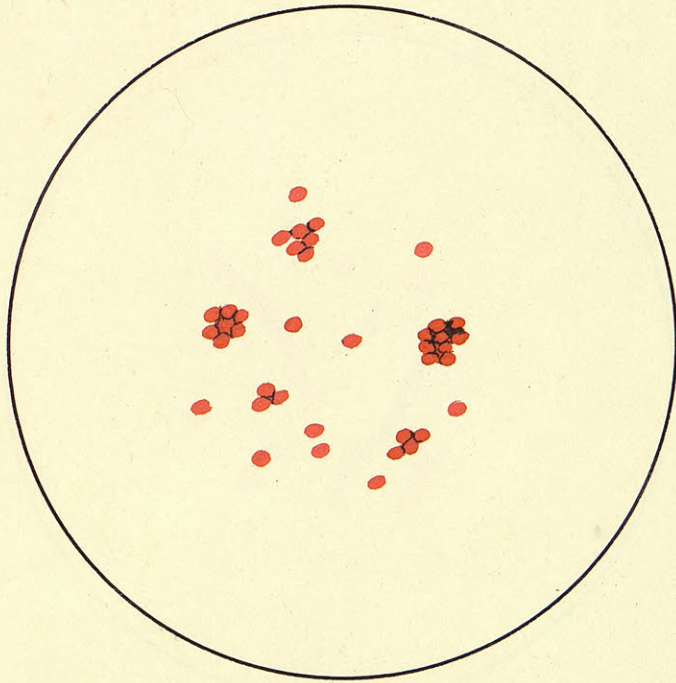
PLATE VII. *M.candicans*.PLATE VIII. *Str.vermiformis*.

PLATE IX. Organism not Named.

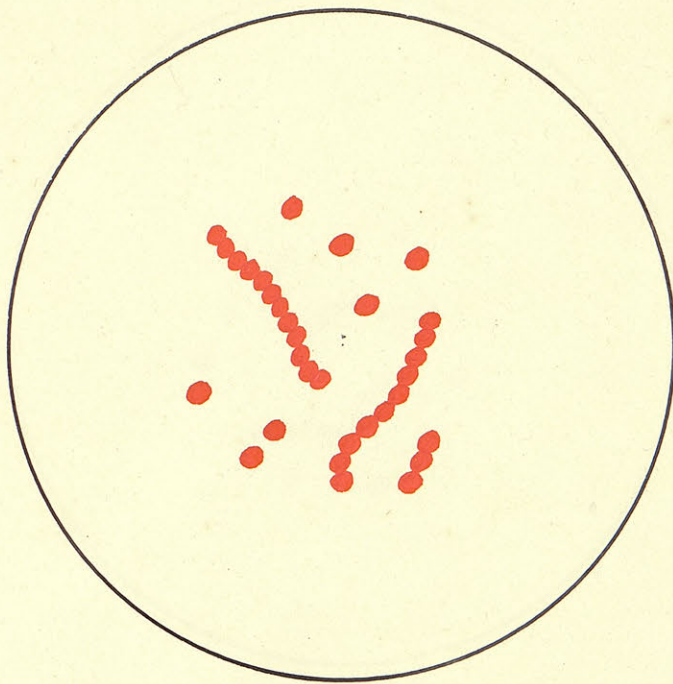


PLATE X. Organism not Named.



PLATE XI. Str. Albus.

