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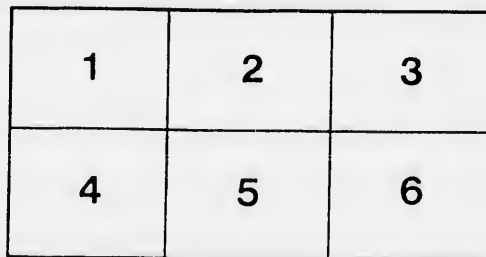
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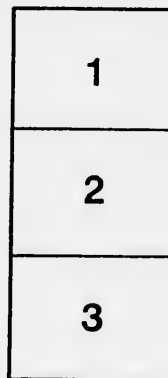
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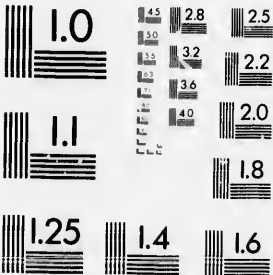
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BULLETIN No 6

# Utilization of By-Products of the Dairy.

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE,  
OF THE PROVINCE OF QUEBEC

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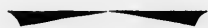
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# Utilization of the By-Products of the Dairy.



## INTRODUCTION.

The object of this bulletin is, not to instruct agriculturalists in the full details of the employment of the by-products of the dairy, but rather to draw their attention to this important subject and to point out to them the best way in which to direct their efforts so as to obtain the greatest advantages from these products.

The Departement of Agriculture at Washington has published a most instructive bulletin on this subject, to which it is well to draw the attention of agriculturalists in the Province of Quebec. The following pages contain some of the most interesting statements contained in it.

In the milk industry there are three principal by-products which the farmer may turn to advantageous account. They are skim-milk, butter-milk, and the whey from cheese.

The manufacture of butter from 1000 lbs of whole milk leaves an average of 800 lbs of skim-milk and 190 lbs of butter-milk ; cheese making leaves about 900 lbs of whey.

In 1000 lbs of skim-milk there are about :

Fat,  $\frac{1}{2}$  to 2 lbs.

Casein and albumine, 30 to 35 lbs.



Lactose, 40 to 50 lbs.

Mineral substances, 7 to 8 lbs.

In 1000 lbs of butter-milk there are about :

Fat, 1 to 2 lbs.

Casein and albumine, 36 lbs.

Lactose, 8 lbs.

Mineral substances, 1 lb.

In 1000 lbs of whey there are about :

Fat,  $3\frac{1}{2}$  to 5 lbs.

Casein and albumine, 12 lbs.

Lactose, 40 to 50 lbs.

Mineral substances, 6 lbs.

These figures are but averages and are subject to great variations ; still, granting the importance of casein as a food substance, as well as that of lactose, they go to show the great value of these products.

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## SKIM-MILK

**Skim-milk considered as a food for man.**— It is well known that good whole milk is one of the most nourishing and wholesome foods that can be used.

The only difference that exists between whole milk and skim-milk, is that the latter contains from 3 to 4 lbs per 100 lbs of fat less than is contained in the former ; but all the casein, lactose, albumine and mineral substances remain in it. Its value therefore as a food product is not so greatly diminished as might be imagined at first sight. Considered from an economic point, the many advantages, which are found in skim-milk, are truly surprising.

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Supposing the daily consumption of whole milk by a family, to be one gallon, for which 22 cts. is paid ; supposing that in the town, where such family resides, skim-milk is sold at 5 cts. per gallon, equal to 50 cts. per 100 lbs. The difference, between the whole milk and the skim-milk, is that the latter contains  $\frac{1}{3}$  lb. less fat per gallon than the former, but this fat may be replaced by butter. If, in addition to the skim-milk used, the family in question consumed only  $\frac{1}{3}$  lb. of butter more than they did before, then from the point of nourishment the result would be the same. But  $\frac{1}{3}$  lb. of butter would only cost from, 6 c. to 8 c. and often less. As a consequence, if, in the first case, this family spent 22 c. for milk, in the second case the expenditure would only amount to 13.

This fact is only mentioned here in order the better to show the value of skim-milk, for it is well understood that, besides the nourishing qualities of foods, other things are taken into consideration in deciding their choice. On the other hand, good skim-milk is a pleasant nutriment : in many cities in Europe it is largely used, its use should be extended in this country, not only in the rural districts but also in the towns ; every one would certainly be the gainer.

Skim-milk is not only used alone, but may also be employed in the kitchen, instead of water in the preparation of many dishes, which are thus rendered more nourishing and wholesome.

Its use is specially recommended in the making of pastry and to bakers for their bread. Bread made with skim-milk instead of water is fresher and remains fresh for a longer time : it is firmer, more palatable and nourishing. By its use, enough flour may be saved to pay for its purchase and bread of equal weight and of considerably greater nutritive value will be produced. In making bread and for pastry, in many cases, the better the milk is skimmed, the better it is.

**Skim-milk as food for animals.**—This is the principal use to which skim-milk is put by the people of this country. Many experiments with animals have been tried and the following general conclusions have been arrived at :

1. Skim-milk gives a better return, when it is fed to young animals and when it forms the principal part of their food.

2. The animals, to which it is best suited, are those which have a rapid growth, such as pigs; but in addition to the milk they require other nourishment and particularly carbonated foods.

3. Except in the case of very young animals better results are obtained by mixing corn with the skim-milk, than by feeding it alone.

**Skim-milk for calves.**—On a dairy farm, there are always a number of calves and much skim-milk, and as skim-milk is most suitable for calves, their raising and fattening is one of the best means of obtaining the greatest advantage from it. Calves are raised, either to replace cows, gone beyond service, or for the slaughter house.

Calves for killing would give but a poor return, were it not for the fact that they give the opportunity of advantageously using the skim-milk, which it is always better to employ in as large quantities as possible in bringing them up. Taking the actual price of veal in this Province, to fatten calves upon other feed, bought outside, or even got off the farm, is seldom an advantageous proceeding to adopt.

Fresh skim-milk is the basis for the feed of calves during the early months, this will give them a good frame and firm muscular tissue. To effect this, quantities of fat in the milk are not necessary. At first soon after birth, the milk should be given warmed to a temperature of about 80°; a little oleaginous mash may be added; but after one month it is better to give with the skim-milk, ground oats, ground Indian-corn or other grain in the proportion of about 1 to 2 lbs of ground grain to 15 or 20 lbs of skim-milk; good hay may also be fed to them with advantage, or they may be put out to pasture in the summer.

It is important here to remark that skim-milk very often causes diarrhoea in calves. This arises from the milk being given to them, when it is too old. The microbes, the cause of the diarrhoea, have probably the time to develop injuriously between the time of skimming and when fed to the calves.

To avoid this, pasteurising at the moment of its leaving the separator is strongly recommended. In Denmark, this is generally done and it is very desirable that serious experiments should be tried in this Province with this object in view. It appears that in certain districts in the south of Ireland 50 or 60 p. c. of the calves die from the use of skim-milk which has been kept too long; this fact merits serious consideration.

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**Skim-milk for hogs.**— It is however by feeding it to hogs, that the greatest profit is derived from skim-milk. Some farmers claim that by so doing it is possible to obtain as much as 50 c. per hundred pounds. This is certainly an exaggeration, still it may be asserted that 15 c. may easily be secured. But to reach this result, it must be given judiciously and according to certain established rules, acquired by experience, which it may be well here to point out.

In the first place there are two purposes which may be had in view, in making use of skim-milk for hogs. 1° to make salt pork for local consumption, 2° to produce meat for the making of bacon, that is for exportation to England. For each of these purposes a different process is required.

Mr. J. C. Chapais has treated this question in a most lucid and interesting manner in a lecture delivered before the scholars of the St-Hyacinthe dairy school. This lecture has been reproduced in the Journal of Agriculture in the Nos of the 15th of April, 15th of May and 15th of June of 1897. It is entitled "*Le porc et l'industrie laitière.*" This lecture should be read by all who are interested in this industry. Useful information may be derived from it in connection with the object of the present short bulletin.

For the production of salt pork, three breeds are particularly recommended. They are the Berkshire, the White Chester and the Poland-China.

For bacon, the Yorkshire and Tamworth breeds should be selected, or a cross between one of these two breeds with the Poland China or even with the large hog common to the country. This latter cross generally gives excellent results.

There are many other breeds, each with merits of its own, but those mentioned above and which are generally found throughout this Province, suffice amply for all needs.

Farmers, especially those in distant districts, should give the preference to the production of bacon, because it can be exported and because in England there is a considerable market for this meat. England imports annually from 65 to 70 millions of dollars worth.

In both cases, either in the production of bacon or of salt pork, skim-milk can only form a portion of the food, as given alone the results will be very unsatisfactory, it should always be given in conjunction with grain and roots, and after three months, the hogs should be put out to pasture during the summer.

As to the proportions of skim-milk and grain, they vary with the ages of the hogs. The following rule is given by the experimental station of Massachusetts.

To animals weighing from 20 to 70 lbs, 2 ounces of moulée (mash or crushed grain) to each quart of milk.

To animals weighing from 70 to 130 lbs, 4 ounces of moulée to the pint of milk.

To animals weighing from 130 to 200 lbs, 6 ounces of moulée to the pint of milk.

The hogs should receive as much of these mixtures as they are able to eat at each feed, without anything being left in the trough.

Other foods, such as roots may be used instead of moulée in the following proportions.

One pound of moulée is recognized as equivalent to 5 lbs of skim-milk, to  $4\frac{1}{2}$  lbs of potatoes, to  $5\frac{1}{2}$  lbs of cow beets and to 7 lbs of turnips.

A certain quantity of roots may also be substituted to a portion only of the moulée. Still it must not be forgotten that an excess of roots produces a soft and melting pork, while on the other hand, the greater the quantity of moulée given, the higher will be the cost of the pork produced.

Roots are more suitable for the production of salt pork. The same may be said of indian corn, especially when given during the latter period of fattening, as it produces a softer meat, which is quoted at a lower figure at the abattoirs. Peas on the contrary render the meat more firm; given in small quantities they are useful during the latter periods of fattening. For this purpose they should not be given in large quantities. Skim-milk fed alone gives a fourth class quality of meat.

For making bacon, thin meat is required; hogs should therefore receive a variety of feed. Hogs should be sold when they attain a weight of 200 lbs.

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for if the fattening is forced beyond this, the cost of the meat obtained thereafter is too high. For example if an allowance of  $4\frac{1}{2}$  lbs of nutriment, for each pound of increase in weight, is required to raise the weight of a hog from 85 to 116 lbs,  $8\frac{1}{3}$  lbs of extra nutriment for each pound in weight gained will be required to raise the weight of the same hog from 148 lbs to 173 lbs.

The following conclusions have been arrived at by Mr Grisdale after a series of experiments carried on for several years at the experimental farm at Ottawa :

Skim-milk may constitute the principal feed of young pigs with advantage and economy.

For the fattening of hogs of 100 lbs weight, no more than five pounds of skim-milk per head per day, besides other feed, can be given with advantage.

In any case, hogs fed partly on skim-milk are stronger and of better appearance than those fed upon grain alone.

Skim-milk gives a greater return per 100 lbs when mixed in small quantities with each feed, than when a larger proportion is used.

Skim-milk is generally equal to  $\frac{1}{3}$  or  $\frac{1}{4}$  of its own weight of mixed grain.

It increases the effectiveness of grain in the feed and facilitates the formation of a firm meat.

The feeding of mixed grain is preferable to that of only one kind.

Grain is better after having been steeped for 24 hours than when fed dry.

**Skim-milk for other animals.**— Skim-milk is further advantageously employed in the feeding of poultry, and some breeders of poultry and turkeys have discovered that, used in this way, a return of 50 cts. per 100 lbs may be obtained. Its employment has been attempted, and in many cases with success, in the feeding of lambs, fowls, horses and cows ; finally certain kinds of thin cheese have been made from it, which have found remunerative sale.

**Skim-milk employed as a fertilizer.**— Its composition is such that if compared with manure and other commercial fertilizers, its value would

be from \$2.00 to \$2.80 per ton or from 10 cts. to 14 cts. per 100 lbs: this when used in compost. It has not yet been determined if, applied directly to the crops, it would not possess a far greater value.

**Desicated casein of skim-milk.**— There are manufactories of desicated casein. This casein when prepared is a hard elastic substance, having the appearance of horn. For its preparation the skim-milk is run into large vats where it is heated up to a temperature of 150° F. A certain quantity of acid specially prepared for the purpose is then added, when the whole is stirred for some moments; the casein curdles and is at once precipitated. The whey is drawn off and the cake of curd is broken so as to allow it to drain. It has then a fibrous appearance and is rather sticky. Carried to a table to complete its draining, it is washed so as to deprive it of all its acid.

After this it is press dried and passed on to a mill where it is cut fine and spread in thin layers upon sieves covered with cloth, which are placed in a dry house heated by steam and fanned by a vertical draught of air, where it is completely dried at a temperature of 120°. To effect this generally takes 24 hours; it should be stirred every now and then; commercial desicated casein is then obtained, it looks somewhat like gum-arabic. Care must be taken to prevent discoloration during the manufacture. For transport it is placed in 70 lbs bags. 3½ lbs of desicated casein may be made from 100 lbs of skim-milk. It is saleable to paper makers at from 4c to 7c per lb. It is employed chiefly to stick the paper and for other industrial purposes.

**Casein of skim-milk used as a substitute for celluloid.**— It is prepared in a similar manner to that indicated in the last paragraph, but with more care, to prevent discoloration, and it is submitted to a heavy pressure. It is then called lactite, is excessively hard and may be substituted to ivory, bones and celluloid in the manufacture of billiard balls, buttons, combs, brushes, &c., &c. It is then, almost pure white, but it can be colored by metallic salts. When colored black it greatly resembles vulcanized rubber.

**Skim-milk employed in painting.**— Skim-milk has been long used for painting purposes: it is mixed with hydraulic cement or lime water, so as to form a light paint with which the walls of houses are colored. The

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usual quantities are one pound of cement to one gallon of skim-milk. As this mixture hardens very rapidly, more than one gallon at a time should never be prepared and it should only be prepared at the moment when required for use. It must be continually stirred while using. It forms a good, durable and economical paint, when applied to wood or stone. Without other ingredients but cement, this mixture is of a light yellowish color, but other coloring matter may be added. For other painting purposes, it may be again made sour and mixed with linseed oil, lime and water.

A mixture of olive oil and skim-milk is also employed for wool in spinning mills.

### BUTTER-MILK

The composition of butter-milk is almost similar to that of skim-milk, but it is slightly more acid.

In some countries it is highly valued as a food product and is sold at as high a price as whole milk.

In certain European towns, whole milk is churned to permit of its being sold as butter-milk.—In this Province it is not yet extensively used for human food; its employment is principally confined to the feeding of animals. It is most suitable for the feeding of hogs and calves; but when given to calves it should not be too sour. It should not be given to very young calves and when it is substituted to sweet milk, it should only be done by degrees.

For the feeding of hogs, it is used in the same way as skim-milk. Its admitted value is  $\frac{1}{3}$  of skim-milk.

### WHEY

The whey from cheese is chiefly used in the feeding of hogs and in the preparation of lactose as explained further on.

There are about 90 lbs of whey to each 100 lbs of milk made into cheese; whey contains about 93 p. ct. of water and 7 p. ct. of solids.



In it are found 0.35 to 1 p. ct. of fat, 1 p. ct. of casein and albumine, 5 p. ct. of sugar and from 0.65 to 1 p. ct. of ashes. It is generally very slightly acid when it leaves the cheese vat. Its acidity then varies from 0.3 to 0.4 p. ct.

Numerous experiments have shown that it is of great value as a feed for hogs when mixed with other things.

At the experimental farm of Wisconsin it was found that 760 lbs of whey are equivalent to 100 lbs of grain. Therefore when grain is worth \$12.00 per ton, whey according to this, is worth, 18 cts. per 100 lbs.

It is poor economy to feed hogs upon nothing but milk.

The food value of whey for feeding hogs is generally considered as equal to half that of skim-milk.

Whey should not be too sour when given to animals.

Whey is also used as a feed for calves, but this cannot be strongly recommended.

### SUGAR OF MILK

Lactose or sugar of milk is a very important constituent of milk, of which milk contains from 4 lbs to 6 lbs per 100 lbs.

Factories for the production of lactose have been in existence for many years. This industry first appeared in Switzerland. In 1880 the United States imported it to the amount of \$60,000 annually. Since that date establishments for the manufacture of this sugar have been put up in Germany and in the United States.

This sugar is principally employed in pharmacy and formerly was sold at from 30 cts. to 35 cts. per lb. Its general appearance is that of small white crystals.

Lactose is obtained from cheese whey. This whey is generally bought by the factories at from 4 c to 6 c and sometimes 7 c per 100 lbs for the purpose of extracting the sugar.

Formerly the whey was evaporated in vessels similar to those used in the manufacture of maple sugar; but the lactose thus obtained was not pure and was strongly discolored.

At the present similar to that of sugar is obtained of these factories about  $\frac{1}{2}$  p. c. t. 1800 lbs of refined

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At the present time the whey is evaporated in a vacuum with apparatus similar to that used in factories for the production of condensed milk. A pure sugar is obtained, freed from grease, casein and all mineral substances. Some of these factories use from 10,000 lbs to 60,000 lbs of whey per day. From about  $\frac{1}{2}$  p. c. to 3 p. c. of this weight is extracted, that is from 250 lbs to 1800 lbs of refined sugar.

There are different qualities of lactose. The purest lactose is in the form of large translucent crystals and is generally sold at 17 c per lb. Next in quality is the granulated lactose which is sold in boxes or barrels at from 15 c to 16 c per lb. Lastly there is the pulverized lactose which resembles very white flour and which is sold in barrels containing 225 lbs at from 10 c to 12  $\frac{1}{2}$  c per lb. There is still an inferior quality which is sold at from 9 c to 10 c.

The United States, formerly an importer of lactose, has become an exporter and now sends large quantities of this product both to Germany and to Great Britain. In the state of Illinois there is a lactose factory with a daily production of from 16 to 18 barrels. This industry might perhaps be profitably established in some parts of this Province.

GABRIEL HENRY, C. E.

Quebec, 18th June 1900.

