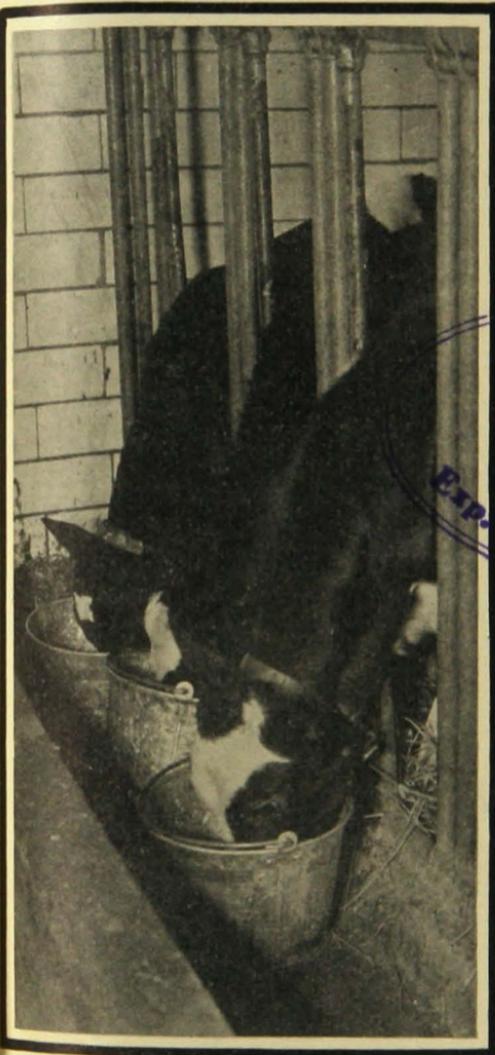


Using Skimmilk on the Farm



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Published in furtherance of Agricultural Extension, Act of May 8, 1914. F. W. Peck, Director, Agricultural Extension Division, Department of Agriculture, University of Minnesota, Co-operating with U. S. Department of Agriculture.

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Until recent years the cream supply for the butter factories, or creameries, came chiefly from small herds. Furthermore, the raising of pigs has always been an important farm enterprise in most of the surplus butter producing areas. When the dairy herd is small and a considerable number of pigs and chickens are raised the economical use of skim milk is a simple matter. Part of it is fed to the calves and the rest to the pigs and chickens.

Even under these conditions, at times it is hard to find a satisfactory use for the skim milk because growing pigs are not on hand all the year, and the heifer calves and poultry on the typical farm can use but a small part of the product of even a small herd of good dairy cows.

For each 100 pounds of butterfat used for butter making, approximately 85 pounds of skim milk and 8 pounds of buttermilk are available for other purposes. If the cows freshen in the fall, about 250 pounds of skim milk should be available daily from each 10 cows during the winter. Assuming 4 heifer calves are raised, 60 to 80 pounds of the milk will be required for them. Fall pigs are raised on some farms, and where enough are on hand the 180 to 200 pounds of skim milk available from each 10 cows, after the calves are supplied, can be used to excellent advantage. The poultry will use some. However, even under typical conditions, it is not unusual to find a surplus of skim milk during the winter.

Furthermore, on a constantly increasing number of farms the number of cows has been increased without making, at the same time, a corresponding increase in the number of swine and poultry. Climatic conditions and a limited acreage for corn and cereals may prevent an expansion of the hog business. As a result, a surplus of skim milk is available on many farms and its economical use becomes a problem.

One result has been a growing interest in finding a market for whole milk rather than cream. Progress has been made in utilizing buttermilk for commercial purposes, and a considerable amount of skim milk, altho a small proportion of the total, is now prepared in the dry or condensed form, or used for the manufacture of casein. In the future the dairy marketing units may be reorganized to the extent that most of the surplus buttermilk and skim milk may be used in a commercial way and the returns to the farm may equal or be greater than those obtained when feeding these products to farm animals.

However, at present prices for products prepared from skim milk and buttermilk it is questionable if the farmer can realize as much for his skim milk by selling it for commercial purposes as he can by using it at home. Until 1930 dry skim milk sold at wholesale for about 8 cents a pound. At present the price is much lower. The cost of manufacturing varies from 2 to 4 cents a pound. The average yield is 85

pounds from 100 pounds of skimmilk. On this basis, with the dry product at 8 cents a pound, the farmer could not expect to receive more than 35 to 40 cents a hundred for the skimmilk delivered at the drying plant. Casein recently has had a market value not to exceed 14 cents a pound. The yield is about $2\frac{1}{2}$ pounds per 100 pounds of skimmilk. After allowing for the cost of manufacturing, the possible price for skimmilk to be used for this purpose will usually be less than that paid when dry milk is to be prepared. These figures make it clear that the farmer can not expect a large return from skimmilk sold at the factory. A farmer generally has a market at home that will give returns equal to those he can obtain by selling his skimmilk, or larger.

Conditions are different regarding buttermilk. This product is available in large quantities at the creamery and expense is involved in returning it to the farm. A creamery having a sufficient quantity of buttermilk will find that the best income will be obtained by drying the product. When buttermilk is sold in quantities to the farmer the price is very low, partly because of the expense of handling and because the feeding of either skimmilk or buttermilk to pigs in such quantities that it furnishes the greater part of their ration is not an economical way to use these products. The special value of dairy by-products is as a supplement to be used with corn and cereals. When buttermilk is made the main part of a pig's ration the value is more nearly in proportion to the dry matter contained. A gallon will furnish about a pound of dry matter which would be worth, perhaps, as much as $1\frac{1}{4}$ pounds of corn or barley.

Composition and Value of Skimmilk and Buttermilk

Skimmilk and buttermilk have essentially the same composition. Buttermilk usually has a slightly higher fat content and a portion of the sugar has changed into acid. In skimmilk are found all the solids of the milk except the major part of the butterfat, which has gone into the cream. The special value of skimmilk (or buttermilk) for pigs as a supplement to grains depends upon the proteins, which are of an especially high quality, the mineral matter, and to a certain extent the vitamins. Skimmilk varies in composition because of the breed of cows. Skimmilk from milk with a high average fat percentage also contains more solids-not-fat, especially protein, than that from milk with a lower test. The typical relation is about as follows:

Fat in milk per cent	Solids-not-fat per cent	Protein per cent
5	9.5	3.80
4	8.5	3.32
3.5	8.5	3.15

Comparison of Skimmilk with Other Feeds for Farm Animals

For calf feeding.—No attempt will be made to place a value upon skimmilk when used in the amounts required for raising the necessary heifers to maintain the herd. For this purpose there is no substitute for milk, altho the quantity fed may be less than commonly used. When fed more than from 16 to 18 pounds daily to a calf, or to animals beyond the age of five or six months, the feeding value of skimmilk is best compared with grains. A fair estimate would be 100 pounds of skimmilk replaces 10 to 12 pounds of farm-grown grains, including corn, oats, or barley.

For feeding heifers between the age of six months and the time of freshening.—If plenty of alfalfa is fed, skimmilk could be compared best with grains, and the value would be the same as that given for calves. When the roughage fed is low in protein, for example, timothy or prairie hay, corn fodder, or corn silage, the skimmilk becomes important as a source of protein, which the ration otherwise lacks, and is best compared on a protein basis with feeds commonly depended upon to increase the protein content of the ration. In such a comparison, 100 pounds of skimmilk would approximately equal 11.5 pounds of linseed meal or 10 pounds of cottonseed or gluten meal.

For feeding cows.—When the ration is well supplied with protein, for example, when alfalfa hay is fed and the grain ration contains some bran and other high-protein concentrates, the value of skimmilk is in proportion to the total nutrients supplied and not according to the protein. Under this condition, 100 pounds of skimmilk would be about equivalent to 10 or 12 pounds of home-grown or purchased concentrates. When the ration is otherwise short in protein, the value of skimmilk added to the ration should be compared, on a protein basis, with high-protein concentrates. Under these conditions 100 pounds of skimmilk would approximately equal 11.5 pounds of linseed or 10 pounds of cottonseed or gluten meal.

For feeding pigs.—Skimmilk or buttermilk, its equivalent, is the most valuable protein supplement for balancing a grain ration for hogs. As it is 9/10 water, skimmilk is a very bulky feed, but the dry matter is the most highly digestible of all feeds given to pigs. Swine have very small stomachs in proportion to their needs for food compounds, hence the watery nature of skimmilk makes it necessary to use the feed in moderate amounts.

The money value of skimmilk varies with changing prices of the feeds with which it is compared. Taking a corn and tankage ration as a standard and substituting skimmilk for all of the tankage, 100 pounds of the milk will replace 14 pounds of corn and 7 pounds of tankage. Assuming feed prices of \$1.00 per hundredweight for corn

and \$3.50 per hundredweight for tankage, the value of 100 pounds of skimmilk would be 38½ cents. This valuation is changed by any shifting in the prices of the feeds with which skimmilk is compared.

Uses of Skimmilk

The uses to which skimmilk may be put on the farm are as follows: (1) Human food, (2) Calf feeding, (3) Pig feeding, (4) Poultry feeding, (5) Part of the ration for dairy cows and growing heifers.

Skimmilk as Human Food

Skimmilk serves a useful purpose as human food altho, on account of the low fat content and the small amount of vitamin A, it should not replace whole milk for young children except under the direction of a physician. The amount used in cooking and in the form of cottage cheese is generally too small to justify much space in this discussion. Information concerning the best means of using this product in the diet may be had from the Agricultural Extension Division, University of Minnesota, or from the United States Department of Agriculture.

Skimmilk for Calf Feeding

Details regarding the raising of calves with skimmilk are found in Special Bulletin 108, Agricultural Extension Division, University of Minnesota. When skimmilk is available, one of the first uses to which a portion of it should be put is in raising the heifers necessary to maintain the dairy herd. From 16 to 20 pounds is a daily allowance for a calf from the age of two months to six months. When a surplus of skimmilk is on hand, more may be fed to larger calves altho equally good results will be obtained if not over 2 gallons, or 16 to 18 pounds, per day is fed and the remainder of the ration made up of grain and hay. The total generally used for raising a calf to 6 months of age ranges from 2,000 to 3,000 pounds.

The question of feeding skimmilk to the calf to be sold later for veal often arises. Experience has shown that it is not practical to undertake to feed a calf skimmilk in this case. The veal calf is usually sold before it reaches an age of six weeks. If it is changed to skimmilk during this period the result is a state of flesh that puts it in a low grade where the price is unsatisfactory. Skimmilk can be used for raising male calves to be fattened at a later age and placed on the market as steers but with calves of the dairy breeds this, as a rule, is a questionable procedure from the economic standpoint. With dual purpose breeds or the larger dairy breeds the chance for profit would clearly be greater than for the smaller breeds.

Feeding Skimmilk to Cows

In order to obtain information concerning the value of skimmilk for dairy cows, the Dairy division conducted an experiment with 7 cows covering a period of three months. The ration given included mixed hay, silage, and a grain mixture consisting of corn 350 pounds, barley 250 pounds, oats 200 pounds, and bran 200 pounds. Fed in the proportions used, additional protein was necessary to provide a balanced ration. One group of cows received this protein in the form of linseed meal, the other in skimmilk. Eight pounds of skimmilk was considered equal to one pound of linseed meal. At the end of each thirty days the groups were reversed—those that had been receiving the linseed meal were given the skimmilk supplement. On the ration with skimmilk, the average production was 26 pounds per day compared with 26.2 on the ration supplemented with linseed meal.

It appeared that the relation between the feeding value of linseed meal and skimmilk, as shown by the composition, was confirmed in the experiments and that 8 pounds of skimmilk may be used interchangeably with one pound of linseed meal. A gallon of skimmilk weighs about 8.6 pounds, slightly more than the amount needed to equal a pound of linseed meal. For practical purposes, however, it is sufficiently accurate, and if more convenient there is no objection to thinking of a gallon of skimmilk as the equal of one pound of linseed meal.

Feeding surplus skimmilk back to the cows has been practiced to a limited extent in recent years as the result of recommendations by the Experiment Station. For example, in one herd improvement association in northern Minnesota the tester reported that 23 out of 26 members were feeding skimmilk back to the cows. Under proper conditions it offers a means of obtaining practically as much income from this product as would be had by selling it for the manufacture of by-products. Typical Minnesota farms grow a liberal amount of feed but the farm-grown ration for the dairy cow usually needs additional protein, requiring the purchase of considerable quantities of high protein feeds, including linseed, cottonseed, or gluten meals. The experiments showed that the dry matter in skimmilk has practically the same composition and feeding value as linseed meal. As milk is largely water, it is found that one gallon (8.6 pounds) of skimmilk is just about equal to one pound of linseed meal. The farmer who needs protein to balance his home-grown grain ration and has a surplus of skimmilk, can use it to good advantage as a means of supplying at least a part of the necessary protein. In feeding it to cows, as is the case in feeding skimmilk for any purpose, to obtain the full value it must serve as a protein supplement rather than merely as a source of nutrients in general. If a cow is already receiving all the protein she needs, a

gallon of skim milk is worth to her about the same as a pound of ground corn or barley; if the skim milk supplies needed protein, each gallon is easily equal to a pound of the more expensive feeds like linseed or cottonseed meal.

Method of Feeding Skim Milk to Cows

In the experimental work it was found some of the cows drank the skim milk readily; others rejected it entirely. After trying various ways of getting the animals to take the skim milk, it was found that the best plan was to mix the grain with the milk. If a cow was to be fed a gallon of skim milk at feeding time, this amount was poured into a pail and her grain allowance was added to the milk. The two were mixed by stirring, and the mixture was fed on the silage. By this means all the cows took the milk readily. At the same time only a little extra work was involved.

Rations with Skim Milk for Cows

If the comparison between skim milk and linseed meal is kept in mind, the experienced feeder will make few mistakes in feeding skim milk to cows. He knows that when good alfalfa hay is the chief roughage fed, along with some silage, and the grain mixture is based upon oats and corn or barley, high protein concentrates in addition to the mixture are needed only for the heaviest milking cows. The cow producing 20 to 30 pounds of milk containing 3.5 per cent fat or 15 to 20 pounds of 5 per cent milk is well supplied with the home-grown mixture alone. Added to a ration of this kind, for a medium producing cow, a gallon of skim milk ordinarily would be worth a little more than a pound of barley or corn, about 10 cents per 100 pounds. Clearly this is not the combination from which to get the most value from skim milk as a feed for cows.

The highest value from skim milk is realized when it is used as a source of protein in a ration otherwise lacking in this constituent. When timothy or prairie hay is fed either with or without silage and the grain ration on hand is a mixture of home-grown grains, there will be a shortage of protein even for moderate milk production. This necessary protein can be supplied in the form of high protein concentrates including linseed oilmeal, gluten meal, or cottonseed meal. If skim milk is on hand it may be used to advantage under these conditions.

A good general rule to follow under such conditions is to feed the cows all the silage and hay they will eat up clean, and use a mixture of the grains available. Equal parts of corn, oats, and barley, all ground, is desirable, altho any one of the three may be left out of the mixture if it is not available. This grain mixture should be fed at the

rate of about one pound to each 3 pounds of milk produced. In addition, one gallon of skimmilk should be fed with each 4 pounds of grain.

A Holstein cow producing 25 pounds of milk daily would receive under these conditions a daily ration as follows:

Timothy or prairie hay	all she will eat
Silage, when available	30 to 35 pounds
Grain (mixed home-grown)	8 pounds
Skimmilk	2 gallons

Danger of Spreading Disease

It is recognized that some objection can be raised to feeding skimmilk to cows on the ground that diseases, especially tuberculosis and abortion, might be spread by this means. If milk from cows badly affected with these diseases is fed to others there is some danger. However, in such cases the animals have many other opportunities to become infected and for this reason the possible danger from the milk hardly appears serious enough to prevent its use for feed if otherwise desirable. Bringing buttermilk or skimmilk onto the farm for feeding can not be recommended unless the herd from which it comes is known to be healthy or else the milk is carefully pasteurized.

Skimmilk for Growing Heifers

Experiments were conducted, also, to compare linseed meal with skimmilk as a source of protein in rations for animals between the age of six months and the time of first freshening. Timothy hay was used, so a fairly large amount of protein in the form of linseed meal or skimmilk was required to balance the ration. The calves were given daily as much timothy as they would consume and 2 pounds of corn. This ration was too low in protein, and in order to supply the deficiency 8 pounds of skimmilk was fed daily to each heifer in one group and a pound of linseed meal to each of those in the other. Both groups made satisfactory growth and no difference could be noted in the results over a period of three months.

When alfalfa hay is the roughage used, unquestionably the heifer will receive sufficient protein. In this case, skimmilk can not be fed to as good advantage as when prairie or timothy hay is the roughage used. On some farms both alfalfa and timothy are on hand and in this case the recommended procedure is to feed the alfalfa hay to the cows and the timothy to the heifers, supplementing the timothy with a small grain ration and at least a gallon of skimmilk daily. For yearling heifers, when it is desired to use skimmilk and timothy hay, a suitable ration would be as follows:

Timothy or prairie hayall they will eat
 Silage, if available10 to 20 pounds
 Grain (corn or barley and oats, equal parts) 2 pounds
 Skimmilk1 gallon

With this ration yearling heifers will make good growth. It furnishes a means of using some of the hay less desirable for the cows and at the same time disposing of the surplus skimmilk satisfactorily.

Dry Skimmilk and Dry Buttermilk

The low market price of dry skimmilk and dry buttermilk is responsible for a widespread interest in the possibility of using them for animal feeding. The composition of the two products is approximately as follows:

	Water per cent	Protein per cent	Fat per cent	Sugar per cent	Ash per cent
Dry skimmilk	4	35	2	50	9
Dry buttermilk	2	38	6	40	14

The farmer who has an abundance of skimmilk on the farm has no reason to consider the use of the dry product. When the price of the dry product is reduced to a point at which it approaches that of grains and grain by-products, the use of these dairy by-products should be considered for such purposes as feeding cows and pigs. These products are already widely used in connection with calf raising by those selling whole milk.

An important fact to be kept in mind is that one pound of either dry buttermilk or dry skimmilk dissolved in 10 pounds of water is practically equal to the fresh skimmilk or buttermilk in feeding value. By taking this relation into account, the facts given in this publication regarding the use of fresh skimmilk may be applied to the use of the dry product.

Another plan of procedure is to estimate one pound of the dry product as equal to 11 pounds of the fresh. Dry skimmilk or buttermilk may be fed to dairy cows as a substitute for high-protein feeds. There appears to be no question regarding the use of this dry product for this purpose except that of price. For cows, one pound of the dry product has, practically at least, the same feeding value as an equal amount of linseed meal, probably more with some roughages.

As a substitute for tankage for hogs, dry milk products may be used at the rate of about 1½ pounds of the dry milk for each pound of tankage. On the basis of a chemical analysis, tankage is about twice as rich in protein as the dried milk products, but the latter appear to contain a better quality of protein, which partly offsets the difference in amount.

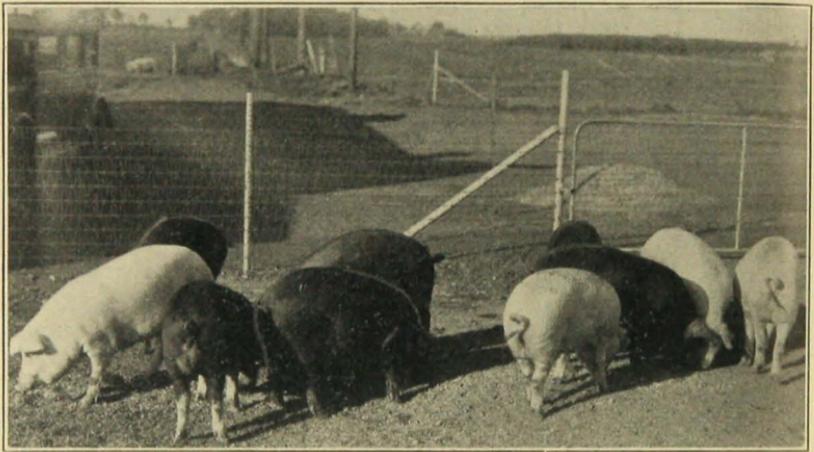
Dry buttermilk or skimmilk may be substituted for an equal amount of beef scrap for poultry feeding. However it is not recommended

that it entirely replace meat scrap. A mixture of the two is best, using up to half of the dried milk product.

FEEDING SKIMMILK TO PIGS

E. F. FERRIN

The high-protein value of skimmilk chiefly accounts for the satisfactory results when the feed is used for pigs. Besides this, the mineral compounds are of such high quality that skimmilk is the outstanding supplement to grains fed to growing pigs. From 2 to 3 pounds of milk for every pound of grain in the ration will furnish



Market Pigs Fed a Ration of Shelled Corn, Wheat Middlings, and Creamery Buttermilk

all the protein and minerals necessary. If skimmilk or buttermilk is very cheap, it will be economical to feed as much as 5 pounds to one pound of grain, but above this allowance the milk usually is a detriment rather than a help. Small pigs fed chiefly on skimmilk get such large quantities of water in the milk and are so short of the total nutrients they need that they become "pot-bellied" and rough haired and fail to thrive.

Three pounds of skimmilk to one pound of grain usually is the most desirable proportion. As small an allowance as equal parts of skimmilk and grain will give a high value for the dairy by-product, if protein from another good source is included in the ration. Large amounts of skimmilk fed to pigs give very poor returns. Records from the Askov farm accounting route, in Pine County, show that on some farms from 10 to 30 pounds of skimmilk were fed for each pound of grain. The cost of producing 100 pounds of pork ranged from \$13 to \$16. In each of these cases there was a loss of several dollars for every hundredweight of hogs grown.

The best way to be certain of the proper adjustment in the quantities of milk and grain is to self-feed the grain and give the pigs all the skimmilk or buttermilk they will consume. This plan works well for either growing pigs or fattening hogs. For brood sows the self-feeding of grain is not desirable, as they usually get too fat—the quantity of grain should be limited. The milk can be fed in as large quantities as the sows will take or can be reduced in amount if the supply is small.

In only a few cases will the addition of skimmilk or buttermilk not improve an otherwise good hog ration. When such high-class forage crops as alfalfa or rape are at their best and the grain feed is ideally suited to the pigs, adding milk to the ration may not be beneficial. However, this situation does not often exist. It is the general rule that milk at a reasonable price will contribute to both the rate and the economy of gains.

Buttermilk or skimmilk fed alternately sweet and sour will cause pigs to scour. Skimmilk separated on the farm always can be fed sweet, but sometimes in hot weather buttermilk sours. If this happens very often, the best plan is to hold sweet buttermilk until it sours so that the milk is always fed to the pigs at about the same degree of acidity. Sows suckling pigs less than 3 or 4 weeks of age should not be fed a large amount of skimmilk or buttermilk; the risk of scours is too great. Pigs from one month to 3 months of age are likely to scour in rainy weather, especially if fed milk. Therefore, care must be taken if the best results are to be obtained. The value of skimmilk and buttermilk produced in Minnesota each year if used for pig feeding is conservatively worth from 750 thousand to one million dollars.

USING SKIMMILK IN POULTRY FEEDS

A. C. SMITH

Milk, either liquid or dried, may often be used in poultry feeds advantageously. Altho it must be admitted that at no stage of life is milk a natural food for poultry, yet it has been proved at several agricultural experimental stations that liquid milk is a suitable source of animal food for adult flocks, and figures given here substantiate the claim that liquid milk is a suitable and satisfactory source of animal food for young and growing chicks. Dried milks have been in common use so long that proof of their adaptability is unnecessary.

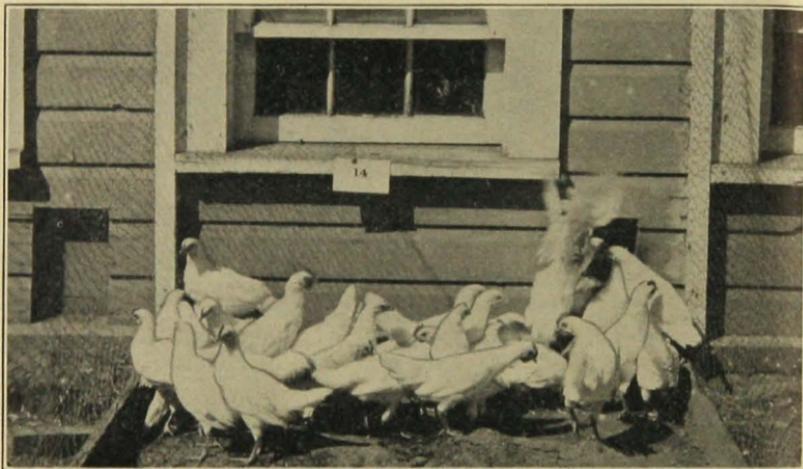
The use of locally grown products saves time, cost of transportation, and possibly other expenses. Many farms are producing both grain and milk a proper combination of which makes a complete ration for poultry, with some mineral matter and greens. It is often pos-

sible for the farmers to get a supply of buttermilk at little or no cost above transportation, and even then it is a return haul.

Feeding trials made by the Poultry division with skimmilk, sweet and sour, buttermilk, and liquid whole milk showed gains in weight as follows:

In the second year's feeding trials:

Lot	Grain (lbs.)	Chicks (lbs.)	Feed	Chicks (lbs.)
1.	57	126	sour skimmilk	26
2.	57	153	sweet " "	27
3.	57	161	buttermilk	28
4.	44	127	sweet whole milk	25



Eigh-Weeks-Old Chickens Fed Skimmilk

To produce a pound of chicken 1.9 pounds of grain and 3.8 pounds of liquid skimmilk were used. To estimate the value of skimmilk per hundredweight used in this way, subtract the value of the grain used for a pound of chicken (1.9 pounds) from the market value of a pound of chicken. Then divide by the number of pounds of milk used to the pound of grain (3.8) and multiply by 100.

Comparing all these results it appears that:

(1) Both skimmilk and buttermilk are superior to sweet whole milk as a feed for growing chicks. Sweet whole milk was included because it was thought that butterfat might promote a more normal intestinal action than skimmilk or buttermilk. Measured by the number of survivals, this theory did not work out.

(2) Comparing Lots 1 and 4, it appears that the butterfat in the whole milk had considerable influence upon gains, as the chicks in this lot weighed practically as much as those in the lot fed sour skimmilk with a consumption of 9 pounds less grain with only one less survivor.

(3) Sweet skimmilk is more palatable than sour skimmilk and for that reason, if no other, is a better feed for growing chicks.

(4) Buttermilk appears to be slightly more productive than skimmilk but not significantly so. A comparison of Lots 2 and 3 in the table shows that 8 pounds of buttermilk produced 1 pound of chick even though 0.3 pound less grain was consumed. In the first year's trial, sweet skimmilk gave slightly, but not materially, larger gains. It appears that it does not matter whether skimmilk or buttermilk is fed from the standpoint of feeding values.

(5) The method of feeding milk (as a beverage) recommends itself because of extreme simplicity.

(6) The variation in feed cost between sweet and sour skimmilk and buttermilk is less than one-fifth of a cent per pound of gain, therefore selection should depend upon supply and convenience. All other conditions being equal, sweet skimmilk or buttermilk should be the choice of the farm poultry keeper because of a slightly lower death rate and greater palatability.

Death Rates

In this 8-week trial period, not a chick was lost in either the lots fed sweet skimmilk or buttermilk, only one in the lot fed sour skimmilk, and two in the lot fed whole milk. Whatever advantage there is in these figures favors the buttermilk and sweet milk. In the first year's trial, as in that of the second, death rates were highest in the lots fed sour skimmilk and whole sweet milk.

Greens and Minerals

Two questions naturally arise when the intake of milk is twice as much as of grain or more: (1) do chicks so fed require greens? (2) is an additional supply of minerals beneficial? Experiments with parallel lots show that gains are more rapid and therefore acquired at less cost when greens are fed. This fact indicates the advantage of a green run or range over bare yards, for the chick without a supply of greens ate more grain and weighed less than those supplied with greens.

The results indicated that the mineral intake from a grain-milk ration was adequate until eight weeks of age, when the feeding trials were discontinued, and that a grain-milk ration with a supply of greens and natural grit is ample and practically complete.

The impetus that milk imparts to the growth of chicks is indicated by comparing those that have milk for a beverage with those that have water and are otherwise on the same ration.

The question of the adaptability of milk to each of the three common methods of feeding chicks is one in which the practical feeder is interested. A ration of small cracked grains with liquid skimmilk or buttermilk as a beverage, has proved satisfactory. This combination gives economical gains.

From comparing results of two lots of chicks fed an all-mash ration of identical composition, one lot supplied with skim milk as a beverage and the other with water, the lot that received the skim milk averaged over 50 per cent more weight than the chicks that drank water.

An average difference in weight of approximately 50 per cent was found in favor of the lot supplied with liquid skim milk of two lots fed grain and mash, the other with water only as a beverage.

In the mash-fed group, the lot fed liquid skim milk produced a pound of chicken for 2.41 cents less than the lot that had water only. In the group fed a combination of scratch grain and mash, the lot supplied with liquid skim milk produced a pound of chicken for 2.78 cents less than the lot in which the chicks had water only. The scratch grain-liquid skim milk lot gave the lowest cost of gains by 20 per cent, tho slightly greater weights were attained by both mash-fed lots.

To put it in other words, the amounts previously stated were saved with every pound of chicken produced by making skim milk the beverage instead of water.

The death rates should be considered, and these were on the average about 4 per cent greater in the lots supplied with liquid skim milk, which difference may be very quickly dismissed as immaterial because of the lower cost of production.

Meat Scraps vs. Liquid Skim Milk

The relative value of meat scraps and liquid skim milk is something the practical feeder should know. It was found that 36 pounds of scratch grain, 42 pounds of mash, and 159 pounds of liquid skim milk produced 29.09 pounds of chicken; and 32 pounds of scratch grain, 43.9 pounds of mash and 18.51 pounds of meat scraps produced 29.64 pounds of chicken. The number of pounds of mash consumed by each lot was practically the same, the grain consumption was practically equal; the pounds of chicken produced differed only slightly. So for all practical purposes 159 pounds of liquid skim milk may be said to equal 18 pounds of meat scraps (approximately 50 per cent protein). Reduced to simplest terms, 2 gallons of skim milk is equal to one pound meat scraps in food value.

Results with Growing Pullets

Pullets between the ages of 8 and 19 weeks so fed that they depend upon liquid skim milk for the sole supply of animal food attained almost as much weight as those supplied meat scraps and at lower cost. The combination of cracked and small grains with liquid skim milk produced to lowest feed costs. This is particularly good news for the farmer, as it means that all the feed necessary to grow good pullets is, or may

be, raised on the farm except the mineral, of which the amount required is small.

Pullets fed as described acquired a normal weight for the strain of Single Comb White Leghorns, of which they were representatives. Tho hatched late, 40 per cent matured during the sixth month, 33½ per cent during the seventh month, and 15 per cent the eighth month. These pullets would undoubtedly have matured at an earlier age if they had been hatched earlier.

Methods and Results with Laying Flock

This simple method of feeding scratch grain three times a day, oyster shells, cracked limestone, cracked raw bone, and granulated charcoal in hoppers with sweet skimmilk as the only beverage was continued with the laying pullets for a year. The egg yield was fairly good, the feeding costs were low, and a satisfactory profit over feed cost was realized. The eggs were of good size, or weight, tho they varied between 22 and 28 ounces to the dozen, a large percentage weighing 24 ounces or over.

Dried Buttermilk

Dried buttermilk is a most common ingredient of starting and growing mashes and to a somewhat less extent of laying mashes. Experimental results at the Minnesota Agricultural Experimental Station have shown that it can be substituted pound for pound for meat scraps in starting and growing rations. The maximum growth was obtained on a consumption of 12 per cent, the same percentage as proved most effectual with meat scraps.

A variety of animal foods is beneficial within certain limits, as it is with foods in general. Mashes that contained both dried buttermilk and meat scraps produced more weight than mashes that contained either alone, as was proved by the feeding trials. Somewhat better gains were made when the mash contained 5 per cent of dried buttermilk with 25 per cent of meat scraps, or 15 per cent of dried buttermilk with 15 per cent meat scraps than when a mash with 30 per cent of either alone was fed. It seemed immaterial whether the amount of dried buttermilk was 5 per cent of 15 per cent when the balance up to 30 per cent was made up with meat scraps.

The meat scraps usually contained at least one-fifth or more bone ash, an undoubted factor in the growth rate, while dried buttermilk contains comparatively little of the necessary mineral elements. For this reason 3 to 5 per cent of bonemeal should be added when dried buttermilk is the only source of animal food, or when meat scraps is less than 15 per cent of the mash after chicks become 6 to 8 weeks old.

Simplest of All Methods of Feeding Poultry

1. Provide a four-compartment hopper or four small single hoppers.
2. Fill each of the compartments or hoppers with
 - a. A high-grade calcium carbon grit
 - b. Crushed oyster shells
 - c. Cracked raw bone (meat packers product and more palatable than steamed bone)
 - d. Granulated charcoal.
3. Provide a suitable receptacle for skim milk or buttermilk. This receptacle should hold enough milk to last the flock 24 hours. A **galvanized iron dish should not be used**. Enamel or porcelain lined iron or steel dishes are as good as any kind. Cast iron dishes may be used. A constant supply of milk is positively imperative. No water should be given, otherwise not enough milk will be consumed.
4. Feed scratch grains three times a day. More often would be beneficial, if convenient. In general, there is an advantage in feeding "little and often" especially in cold weather. Do not allow grain to remain in the litter for any length of time. Keep hens a little hungry until the evening meal, which should be a liberal one.
5. Provide greens and succulents. In winter, alfalfa or clover leaves or leaf meal or with some raw roots, as raw mangles, rutabagas, turnips or potatoes. Cabbage is also excellent.