Advances in Feeding Calves

by HENRY T. CONVERSE

SOMETHING like 5 million heifer calves are raised every year in the United States for replacements in dairy herds. Many males are also raised for herd sires. They all need tremendous amounts of milk for which, in times of shortage, they compete with humans.

For 75 years—at least for so long that the practice has gained the force of habit or tradition—authorities have recommended feeding the dairy calf whole milk for a month or longer before changing to skim milk. It has been recommended also that heifer calves that are to be kept for milkers be fed skim milk to 6 or 8 months of age, leastwise when there is plenty of it. Now and then somebody or other experimented and learned that dairy calves could be safely weaned from milk at 2 or 3 months, but few people paid them much heed, the suggestion being that revolutionary.

The accepted way of feeding new calves whole milk and older ones skim milk takes about 200 pounds of whole milk, besides the colostrum, and at least 1,900 pounds of skim milk for each calf. If the feeding of this whole milk could be dispensed with, at least 8 pounds of butter would be saved per calf, or 40 million pounds for the 5 million calves a year. If calves could be weaned from skim milk at 2 months of age, instead of at 6 months, there would be a further saving of 1,600 pounds or more of skim milk per calf, or 8 billion pounds in all.

In 1933, Edward B. Meigs and I started feeding some calves skim milk only (except colostrum) at Beltsville. The first calves were fed skim milk properly supplemented with vitamin A, usually 2 to 4 teaspoonfuls of cod-liver oil starting usually on the fourth day—that is, after three full days on colostrum. The skim milk was continued to at least 6 months of age. Since then, 98 male calves have been reared by this schedule to 6

Female calves fed skim milk after the colostrum period compare favorably with those fed whole milk for 30 days. The calves used for this test were similar ones from the same Holstein and Jersey herds. All had skim milk until 6 months old

Calves	Average weight, in pounds, at different ages (in months)										
	Birth	1	2	3	4	5	6	9	12	18	24
13 Holsteins fed whole and skim milk	83	107	135	177	223	279	337	478	601	776	944
26 Holsteins fed skim milk after the colostrum period	84	101	135	181	233	288	346	483	607	821	986
6 Jerseys fed whole and skim milk	48	65	87	116	151	191	238	347	448	628	764
8 Jerseys fed skim milk after the colostrum period	48	57	78	108	145	186	230	341	454	613	787

months or older, and 33 Jersey and Holstein females have been similarly reared to producing age. The growth rates of Holstein heifers at least have not been adversely affected. The Jersey heifers did not make quite such good gains as those receiving some whole milk, at least during the first few months. However, as we shall see later, we have obtained satisfactory results by feeding Jersey heifers without whole milk, except colostrum, and weaning them at 2 or 3 months, rather than at the usual age of 6 months.

To conserve milk for human use, a war-emergency experiment was begun at Beltsville in 1942 to find out how much earlier than 6 months calves could be weaned from milk. Calves were fed colostrum for about 3 days and then changed to skim milk with 2 to 4 teaspoonfuls of cod-liver oil daily. At first we weaned calves at 90 days and later at earlier ages. The calves were induced to eat generous amounts of a suitable grain mixture and hay as early as possible. The results of weaning calves from skim milk at 90 days were satisfactory.

Subsequently, 6 Jersey heifer calves were weaned from skim milk at 60 days, 10 Jersey steers were weaned at 60 days, and 18 at 45 days. Two Holstein heifer calves were weaned at 60 days, 2 at 45 days, and 3 at 30 days. Eight Holstein steers were weaned at 60 days, and 19 at 30 days. Ten crossbred steers were weaned at 60 days, and 9 at 30 days.

These 87 calves were fed no whole milk except colostrum and were weaned from skim milk at 2 months of age or earlier. In no case did we use dried skim milk, dried blood, tankage, fish meal, or any other high-protein feeds of animal origin that are usually used in dry calf starters.

The feeds other than milk fed to the calves in these milk-saving experiments were the same as those fed to milking cows in the nutrition herd at Beltsville. The grain mixtures comprised corn meal, wheat bran, and linseed oil meal—sometimes with and sometimes without soybean oil meal.

This table shows the weights of different groups of calves weaned at various ages, as compared with normal weights for other similar calves at the same ages. Note that the group of 5 Jersey steers, weaned at 60 days, averaged only 239 pounds at 6 months while another group, weaned at the same age, averaged 303 pounds at 6 months. The reason: The heavier steers were encouraged to eat large amounts of dry feed before and after weaning. The table also shows that although calves may be underweight at 6 months, they usually make greater-than-average gains and reach normal or nearly normal weight at 9 or 12 months

Number of animals	Weaned (days)	Weight of calves, in pounds, at different ages (in months)									
		Birth	1	2	3	4	5	6	9	12	18
		Jersey steers									
7	90	58	65	87	122	160	210	266 [1]	378	....	....
5	60	51	60	78	100	139	184	239 [1]	396	....	....
7	60	61	70	96	131	174	226	303 [1]	384	....	....
9	45	59	71	86	117	160	210	265	398	....	....
Normal for males [4]	.....	60	78	104	141	184	233	282	410	....	....
		Holstein steers									
4	90	97	105	139	195	261	333	417	....	....	....
8	60	93	96	125	164	218	288	363 [2]	504	....	....
11	30	96	109	132	179	239	308	381 [3]	579 [3]	739	....
Normal for males [4]	.....	94	125	164	214	269	336	399	563	741	....
		Jersey females									
3	90	51	57	78	103	146	177	228	353	473	664
2	60	53	66	90	120	152	204	256	382	477	613
Normal for females [4]	.....	53	67	90	121	158	199	243	360	450	601
		Holstein females									
2	60	84	91	117	156	215	295	366	499	615	823
2	45	73	91	124	164	211	265	323	478	614	....
1	30	90	107	139	189	255	314	370	525	708	....
Normal for females [4]	.....	90	112	148	193	243	297	355	509	632	845

[1] 1 animal only. [2] 2 animals only. [3] 7 animals only. [4] Normal according to A. C. Ragsdale

The hay was mostly good alfalfa hay. Timothy hay was fed in a few instances.

All calves weaned at 90 days and at 60 days survived. One of the 20 Jersey calves weaned at 45 days died when it was 49 days old. Two of

the 13 crossbred calves weaned at 30 days died at 52 and 59 days of age, 1 of pneumonia and 1 of scours. Five of the 26 Holstein calves weaned at 30 days died at 35 to 57 days; 4 of the 5 cases had either pneumonia or scours.

We do not believe that early weaning caused the deaths. All these deaths occurred either just before or during the period when dependence for the control of calf scours was placed on the Wisconsin "scour prevention capsules," described later. Since these deaths, 15 Jersey males and 3 Holstein females weaned at 45 days of age have been reared without loss; and 14 Holstein males, 7 crossbred males, and 3 Holstein females weaned at 30 days have been reared without loss. Calves that safely reach 60 days of age usually survive.

It seems that the proper age to wean calves from milk is largely an economic question. If skim milk is plentiful and cheap, it might well be fed to 6 or 7 months of age, but if it is scarce or expensive, as compared to the cost of grain and hay, or if it is plentiful and is needed for hogs or poultry, calves may advantageously be weaned at quite early ages.

If calves are to be safely weaned from milk at 60 days, and particularly if they are to be weaned at 30 or 45 days, they must be trained to eat generous amounts of hay and grain before weaning. Grain and carefully selected hay should be available by the time the calf is 10 or 12 days old. Grain should be rubbed on the nose or placed in the mouth of the calf at convenient times, or a little may be dusted into the bucket just as the milk is nearly finished. The feed boxes should be carefully observed to be sure the calves are eating dry feed before weaning completely from milk.

A few calves in these experiments voluntarily ate as much as a half pound of grain at 20 days of age, and when a handful of grain was mixed into the milk three Holstein calves ate a pound and a half, and two others ate a pound at this early age. At 40 days, several Holsteins—some weaned from milk and some not yet weaned—voluntarily consumed from 1¼ pounds to 3 pounds of grain daily, and in several cases where grain was added to the milk the daily grain consumption was 2 to 3½ pounds—in one case, 4 pounds. Jersey calves seldom eat more than half as much grain as Holstein calves, at least until after 40 days of age. These experiments indicate that, while Holstein calves can almost always be safely weaned by 45 days, and with extreme care at 30 days of age, Jersey calves should be allowed milk for an extra 15 days as a safety measure.

Energy Additions to Skim Milk

Skim milk contains only about half the energy value of whole milk. It is not safe, however, to feed too much skim milk during the first month, because of the danger of causing scours. Therefore, when skim milk is fed immediately after the colostrum period, the energy intake for the first

month or so is apt to be somewhat low and the gain in weight not so large as on whole milk. Calves usually make up this slower early gain.

In recent experiments at Beltsville, added energy has been fed in the skim milk for about 2 months, or fed in warm water if the calf has been weaned from milk. Corn meal, ground soybeans, oatmeal gruel, flaxseed jelly, or the same grain mixture as fed dry was fed mixed into the skim milk to different groups of calves. Starting usually with a quarter of a pound daily at from 5 to 12 days of age, the extra feed was mixed into the skim milk. The amount of feed was usually increased to a half pound in a few days and continued usually to 60 days and sometimes to 90 days.

The soybeans proved particularly unpalatable. The oatmeal gruel formed a pasty feces that stuck all over the calf. The corn meal was not very well cleaned out of the bucket, particularly when fed in warm water after weaning from milk, and there seemed to be more tendency to scour. Mixing into the skim milk the same grain mixture that was fed dry proved quite successful. In a few cases, as much as a half pound of the grain mixture was added to the milk before the calf was 10 days old, but we usually did not add as much as a half pound of grain daily until the calf was 15 to 20 days old. Usually, too, a half pound daily was as much grain as was added at any time to the milk or to the water after weaning from milk. However, the last three Holstein calves fed grain in milk were fed more than a half pound daily. With these three calves, the half pound fed in the milk by 15 days of age was increased to about a pound daily before 30 days of age. At 40 days, when these three calves had been weaned from milk for 10 days, they were eating a pound of grain daily mixed in the warm water and 2, 2½, and 3 pounds respectively, as dry grain.

Twenty-three calves have been fed grain in milk as an energy supplement. Flaxseed cooked to a jelly in a little water, although more expensive, appeared to be the best energy supplement for skim milk.

Thirty-nine calves in the Beltsville experiments received about a half pound daily of dry flaxseed cooked to a jelly in water. With Holstein calves, a half pound of the dry flaxseed made into a jelly was usually safely added to the skim milk before the calves were 10 days old. Smaller calves seemed to do better if the increase to a half pound was not made until 12 to 15 days of age. The groups of calves fed either flaxseed jelly or a grain mixed with the skim milk made somewhat better average gains in body weight during the first month than did those calves that had in addition to skim milk only such amounts of grain and hay as they would voluntarily eat from the manger. The gains of the calves fed the flaxseed jelly averaged a little better than the gains of the calves with the grain added to the milk. We found that the average gains of the group fed corn meal in the skim milk for added energy were almost as large as the gains of the group fed a grain mixture in the skim milk. Nevertheless, the corn meal is considered less satisfactory for the purpose than a grain mixture.

During their first month, calves will gain weight faster if an energy supplement is added to their skim-milk diet. Flaxseed jelly ranks high for this purpose

Energy supplement	Holstein		Jersey	
	Number of animals	First-month gains (pounds)	Number of animals	First-month gains (pounds)
No energy supplement	13	7.6	15	6.1
Corn meal	4	12.5	5	9.6
Grain in milk	15	12.8	8	10.9
Flaxseed jelly	22	15.6	17	11.6

Is Added Calcium Needed for Early-weaned Calves?

Fourteen pounds of skim milk contains about 7½ grams of calcium, a generous contribution to the needs of the calf for this element. In the Beltsville experiments, the first calves weaned from skim milk at 60 days of age or earlier were fed a grain mixture containing 3 percent of bone meal when alfalfa as well as when timothy hay was fed. The excellent results, even when timothy hay (which is low in calcium) was fed, indicates that the calcium from bone meal satisfactorily replaces the calcium of the milk which is usually fed.

Calves weaned at 30 to 40 days of age and fed timothy or grass hay and a grain mixture without a calcium supplement showed rachitic or calcium-deficiency symptoms (not vitamin D deficiency, for the calves had cod-liver oil) within 2 months. More recently, 40 calves have been weaned from skim milk at 45 days or earlier. They received alfalfa hay with a grain mixture without a calcium supplement. Two or three of these calves ate very little hay during the first month after weaning and might possibly have been benefited at this period by the addition of calcium, but this is not at all certain. Blood-calcium analyses were made on several of the calves weaned at 30 to 45 days and fed alfalfa hay without a calcium supplement. In only one case was there any decided lowering of the blood calcium after weaning. Calves weaned much before 6 months and fed grass hay definitely should be fed some added calcium until 6 months, when the calcium can be discontinued.

Protein

The grain mixtures fed to most of the calves weaned at an early age were grain mixture No. 75 (2 parts corn meal, 2 parts wheat bran, and 1 part linseed oil meal) and grain mixture No. 65 (3 parts corn meal,

2 parts wheat bran, 2½ parts linseed oil meal and 2½ parts of soybean oil meal.) Grain mixture No. 75 contained about 17 percent protein and about 0.14 percent calcium. Mixture No. 65 contained about 25 percent protein and about 0.20 percent calcium.

The calf's needs for protein are quite high and, of course, are amply supplied by the milk in the usual milk-feeding program. When milk is discontinued at an early age, a high protein grain mixture is necessary. In the few cases tried, the 17-percent mixture with alfalfa hay seemed adequate. Most of the calves fed alfalfa hay, as well as those fed grass hay, however, were fed the higher protein grain mixture because the calves seemed to eat larger amounts of this mixture during the first and second months, possibly because it was a little less bulky. While these experiments do not cover the point, probably even with early weaning from milk, farm-grown grains could replace the higher protein grain mixture when the calves are 4 or 5 months old, at least when alfalfa or other legume hay is fed.

Vitamin D

Some conservative investigators suggest that some vitamin D supplement might well be fed during the milk-feeding period or during the winter months. Several experiments, however, indicate that supplementary vitamin D is seldom needed. I. W. Rupel, G. Bohstedt, and E. B. Hart, working at the Wisconsin Agricultural Experiment Station, reported that calves on rations devoid of vitamin D, but exposed to all available sunlight both summer and winter, gained nearly as much weight as calves fed a vitamin D supplement. S. I. Bechdel, K. G. Landsburg, and O. J. Hill at the Pennsylvania station reported that 2½ pounds of sun-cured alfalfa hay supplied an adequate amount of vitamin D.

At Beltsville 50 calves received carotene and skim milk after 3 or 4 days of colostrum feeding, and therefore had to depend from birth on sun-cured hay in the ration and exposure to sunlight for their supply of vitamin D. Most of these calves had very little exposure to sunlight during the first 6 months of life and several of the calves had very little exposure to sunlight during the first full year. Some four or five of the calves kept for a full year out of all direct sunlight showed only mild rachitic symptoms—slightly roached backs—during a period when they were eating little hay, but the symptoms disappeared when they ate more hay.

Cod-liver oil, which supplies both vitamins A and D, was fed experimentally to calves in the Holstein and Jersey breeding herds at Beltsville. These calves are always fed whole milk until about 30 days old and skim milk for at least 6 months. A suitable grain mixture is fed, with a limit of 3 pounds daily. Alfalfa hay, usually of U. S. No. 2 grade, was fed free

choice in hayracks. Alternate calves in each breed, 70 in all, were fed 20 cubic centimeters (4 teaspoons) of cod-liver oil daily. The addition of the cod-liver oil showed no advantage in gains in body weight at 3 months or at 6 months of age. Monthly observations showed no difference between the two groups as to thickness, mellowness, and flexibility of the hide, or as to the animal's health, vigor, or condition.

If dehydrated or barn-dried hay or grass silage constitutes the only roughage, while the calves are kept out of the sunlight, growing animals will probably require a vitamin D supplement. If heavy grain feeding materially lessens the amount of hay consumed, they might get rickets. In other words, it appears that additional vitamin D is needed by the growing calf only under unusual conditions of feeding or management.

Vitamins B and C and Nutritional Scours

Several experiments have indicated that the cow manufactures vitamins B and C in adequate amounts, and that the calf receives enough of them in the milk until its capacity to synthesize them is sufficiently developed to take care of its own needs. Paul H. Phillips, at the Wisconsin station, reported that the calf at birth was deficient in vitamin A, ascorbic acid (vitamin C), and niacin (nicotinic acid). He reported also that 90 percent of calf scours was due to nutritional deficiencies and could be prevented by feeding these substances during its first 2 weeks of life. As a result of this report, many drug houses now are advertising, for the preventions of scours, capsules containing the Wisconsin recommendation—vitamin A, 5,000 International units; vitamin D, 500 International units; vitamin C (ascorbic acid), 250 milligrams; and niacin (nicotinic acid), 50 milligrams.

The rather startling claims concerning the efficacy of these supplements for the control of calf scours led several investigators in Ohio, Michigan, and Cornell University to initiate rather extensive check experiments with more than 1,200 calves. The trials were made in experiment station and university herds, in other State institution herds, and in New York in some private herds. Alternate calves in each herd were fed the supplements, and the other calves served as controls. Capsules of two colors were usually used. Capsules of one color contained the supplement and capsules of the other color contained an inert oil. The herdsmen were not told which capsules contained the supplements. The reports, by W. E. Krauss, for Ohio and Michigan, and A. A. Spielman, for New York, did not indicate any favorable effect on the control of scours from feeding the "scour-prevention capsules."

Calf-feeding experiments in the nutrition herd at Beltsville were being continually disrupted by deaths from scours, pneumonia, and other ailments, when the hopeful reports on the control of calf scours were being

made by the Wisconsin station. No division of animals into experimental and control groups was made, but nearly all the calves on feeding experiments from December 1943, to March 1945, received the supplements recommended to control "nutritional scours." During this period of about 15 months, 64 calves received capsules containing ascorbic acid (500 milligrams), and niacin (100 milligrams). Each day the calves also received 20,000 to 40,000 International units of vitamin A from cod-liver oil. Eighteen of these calves, or 28 percent, died before 65 days of age. Eleven of the 18 died before 30 days of age. We did not keep a careful record of the condition of the feces during the first part of the period but of the 18 that died, autopsy reports of the station veterinarian showed scours as the cause of death in 13 cases, scours and pneumonia in 2 cases, and pneumonia in 3. Thirteen of the calves that died had received two capsules daily for the first 5 days and one capsule daily for the next 10 days if they lived that long. Thus, the calves that died had more than twice the amount of each of the supplements included in the capsules reported by the Wisconsin station as capable of controlling 90 percent of "nutritional scours" in calves.

Very few of the calves fed "scour-prevention capsules" at Beltsville were treated with sulfa drugs or any other therapeutic agents; however, one such calf might be cited as a specific case. A Jersey steer received colostrum for 3 days and then skim milk. Starting the day after birth 20 cubic centimeters of cod-liver oil or about 36,000 International units of vitamin A were fed daily. For 4 days starting the day after birth, the calf received two of the capsules daily or a daily dose of 1 gram of ascorbic acid and 200 milligrams of niacin. For the next 11 days the calf was fed one capsule. Although this dosage was much more generous than the Wisconsin recommendations, the calf started scouring on the fifth day after birth. The calf scoured from the fifth to the thirty-fourth day except for the eleventh, twelfth, and thirteen days, when the feces were soft. From the thirty-first day combined sulfaguanidine and sulfathiazole treatment was administered for 8 days. Scours were not observed after the fourth day of this treatment.

Sulfa Drugs for Calf Scours

The use of sulfa drugs began in March 1945, when we realized that the "scour prevention capsules" were not preventing deaths from scours of dairy calves. While there was some variation in dosages, all calves received at least 2 grams daily of either sulfaguanidine or sulfathiazole. These protective doses of sulfa drugs were usually started within 2 or 3 days after birth (sometimes on the day of birth) and were continued for 30 days or longer. If scours developed the dosage was increased for a few days until the scours subsided or the calf died. The severity of scours and

the number of deaths was much less during the sulfa drug period than when "scour-prevention capsules" were fed.

From March 23, 1945, to January 19, 1946, 46 calves were placed on feeding experiments. Nearly all were taken from the maternity barn before 3 days of age. Of the 46 calves, 5 died. This gives a mortality rate of 10.6 percent, as compared with the loss of 28 percent among 64 calves fed "scour capsules." Of the 5 calves that received sulfa drugs that died, 1 seemed unable to swallow and consumed less than 1 pound of milk daily for the 6 days that it survived; 1 died at 1 month of age while running to the scales to be weighed, apparently in perfect health. Of the 5 calves that died only 3 had any history of scours.

Those responsible for the feeding of calves should be cautioned not to rely on the use either of sulfa drugs or large doses of vitamin A to prevent scours, pneumonia, or other infections among calves kept in unsanitary quarters. Calf pens should be kept clean and dry and they should be thoroughly disinfected frequently. The intensity of infections among calves is apt to be greater where large numbers of calves are continuously housed together than when only a few calves are kept.

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FOR FURTHER READING

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A Cow a Calf Will Be, by W. W. Swett, page 195.