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3-1-1929

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T.M. Olson

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Olson, T.M., "Self Feeders in Dairy Calf Feeding" (1929). *Bulletins*. Paper 236.
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SELF FEEDERS

In Dairy Calf Feeding

Dairy Department
Agricultural Experiment Station
South Dakota State College of
Agricultural and Mechanic Arts
Brookings, South Dakota

Digest

- 1.—Dairy calves on self-feeders showed no greater height at the withers than normal hand-fed calves after three months of age.
- 2.—Self-feeder calves were heavier up to the age of four months than the average hand-fed calves. The average daily gain in weight for all calves, for the ten months period, was 1.46 pounds. The average daily gain in weight of the control lot was 1.71 pounds.
- 3.—Many of the self-feeder calves at about four months of age showed symptoms of abnormal feeding conditions.
- 4.—Those self-feeder calves which showed no physiological disturbances were heavier than hand-fed calves of the same age.
- 5.—A great variation was noted in the amount of feed consumed and the kind of feed selected.
- 6.—The average daily concentrates consumption varied from 6.38 pounds for Lot I to 4.36 pounds for Lot IV, or an average for all lots of 5.39 pounds.
- 7.—The average concentrates consumption for the control lot was 3.05 pounds, or a decrease in concentrates consumption of more than 43 per cent.
- 8.—The average daily consumption per calf of roughage was .644 pounds for the self-feeder calves, and 3.05 for the calves in the control Lot.
- 9.—The feed cost per calf per day, aside from the milk which was hand fed, ranged from \$.0678 to \$.118 or an average of \$.0985 as compared to \$.0627 for the control Lot.
- 10.—The feed cost per pound of gain aside from the milk ranged from \$.0828 for Lot II or an average of \$.0672 as compared to \$.0367 for the control Lot.
- 11.—The cost per unit of growth was considerably greater in case of self-feeder calves. The increase in cost ranges from 25 to 87 per cent when compared to the control Lot.
- 12.—The palatability of the feed seems to be the important factor in its choice, and not its nutritional value.
- 13.—Dairy calves allowed free choice of feeds do not choose a ration best adapted to their physiological well being.
- 14.—Free choice of grain resulted in physiological disturbances and abnormal development of dairy calves.
- 15.—The nutritive ratio for calves on self-feeders was considerably narrower than recommended by the Morrison Feeding Standard.
- 16.—The digestible nutrients consumed by calves on self-feeders did not indicate economical growth.

Self Feeders in Dairy Calf Feeding

T. M. Olson.

Self-feeders have been used with good results in feeding swine, cattle and poultry. The self-feeder has been particularly popular with feeders during the fattening period, since it usually results in the consumption of more feed and thus more rapid and economical gains than in the case of hand-fed animals. The saving of labor is also an item, under some conditions, which justifies the use of self-feeders.

Review of Previous Work

Several experiment stations have done work on self-feeders for dairy calves; however, the conclusions are not in close agreement. McCandlish (1) found that calves self-fed made somewhat greater skeletal growth, and considerably greater increase in live weight, as compared to hand-fed calves. He noted that the extra conditioning delayed breeding, and perhaps impaired the breeding powers of the heifers. His work indicated a lower feed cost per pound of gain with self-fed, as compared to hand-fed calves. The choice of feed at different stages indicated a difference in palatability although the amount of the different feeds consumed varied a great deal.

Nevins (2) reported that self-feeder calves consumed more feed and made more rapid growth than calves fed two feeds per day. No ill effects from the self-feeder plan of feeding calves resulted. He also intimates that self-feeders are labor savers.

Otis (3) noted that calves which were receiving all the grain they would eat made the best gains. A gain of 1.34 pounds daily was recorded as compared to 1.14 pounds daily for calves receiving three-fourths of the full grain ration. The free choice group of calves consumed 122.86 pounds of grain per 100 pounds gain while the hand-fed group consumed 107.12 pounds of grain per 100 pounds gain. The latter group consumed more roughage and milk per 100 pounds gain. Otis concluded that the grain ration can be reduced with profit when grain is high priced.

McCandlish (4) found that young calves prefer whole corn and oats to ground grain, and oil meal to bran. He found that the ration was narrower than is generally recommended, but that calves have the ability to vary their consumption of concentrates to comply with their needs. He noted also that the consumption of hay increased materially as the calves grew older.

Nevins (5) concludes that liberal feeding of either corn or a mixed grain ration supplemented with alfalfa hay produced greater height at the withers in Holstein and Jersey heifers than light feeding, but did not increase the weight of the calves during the first six months. At two years, however, the heavy fed Holsteins were 150 pounds heavier and the heavy Jerseys 50 pounds heavier than the light fed.

Hunt (6) found that dairy cows in milk when given access to self-feeders consumed so much grain that milk production was very uneconomical. He concluded that self-feeders are not practical except as a means of comparing the palatability of feeds. He also noted that the consumption of concentrates increased as the trial progressed.

Nevins (7) concluded that self-feeders for milking cows are not economical from the standpoint of the amount of feed consumed. Self-fed cows consume feeds supplying an excess of net energy and digestible true protein. The free choice of feeds serves a useful purpose in studying palatability of feeds for cows.

Humphrey and Hulce (8) advise a definite grain ration for calves after they are three or four months old. Previous to this age grain can be kept before the calves, allowing them to eat at will.

Turner (9) states that the free choice system of feeding swine which has been found successful, does not appear to be adapted to calf feeding. He intimates that the feed cost is increased when the free choice method is used and the dairy qualities impaired.

Tretsven (10) concludes that self-feeders for growing dairy calves have no special merit over hand-feeding. In two trials in which eight dairy calves were used in each trial, he found the hand-fed calves made a daily gain of 2.07 pounds, and the free choice group of calves made a daily gain of 1.78 pounds. The cost per 100 pounds of gain was \$4.98 for the hand-fed lot, and \$7.29 for the self-fed lot. In the second trial, the hand-fed lot made a daily gain of 2.01 pounds, and the self-fed lot 1.77 pounds. The cost per 100 pounds gain was \$6.08 in the hand-fed lot, and \$6.31 for the self-fed lot.

Objects of Investigation

The work in this experiment was carried on to obtain information on the following points:

- 1.—Influence of self-feeder on growth.
- 2.—Effect of self-feeder on economy of growth.
- 3.—The relative palatability of different feeds to calves.
- 4.—A study of the ability of calves to select the feeds best adapted to their requirements.
- 5.—The effect of free choice of grains on the coefficients of digestion.
- 6.—A study of the physiological disturbances caused by free choice of grain.

Experimental Methods

Calves Used.—Four trials were run with five calves in each trial. The calves were all grade Holsteins except one calf in the second trial which was a grade Shorthorn.

This calf died from strangulation early in the trial and is not considered in this work.

An effort was made to secure calves of the same age and weight for each trial. The initial weights of each group of calves will indicate that the groups were quite similar. Farmers from whom the calves were purchased had no written record of the date of birth of the calves; hence the ages were estimated. The weight and appearance together with the age given by the farmers were used to arrive at the estimated age.

Heifer calves were chosen in order to check carefully on the rate of growth and gain. It was felt that if all of the calves were of the same sex the results would be more uniform.

The calves were placed in pens which were four feet wide and five feet long. At about six months of age the calves were tied in the same pens and the self-feeders placed before them.

Type of Self-Feeders.—The feeder was constructed so that the grain could be placed in a hopper-like arrangement. The grain fed out as it was eaten by the calf in the long trough at the bottom of the hoppers. Each calf had an individual self-feeder. Each feeder had six compartments, each of which contained a different feed.

The hoppers were kept well filled all the time. The grain was weighed in some hoppers every day; in others it was not necessary to weigh in grain oftener than once in two weeks. The grain was weighed out every fifteen days, and a record made of the amount eaten. The clean feed was weighed back into the hoppers. All soiled feed was discarded.

A separate container with two compartments was kept before each calf in which salt and steamed bone meal were used. A record of the amount eaten of these minerals was also kept.

The calves were tied so that they had considerable freedom in moving forward and backward, but could not molest the feed of their neighbor.

Management of Calves.—The calves were allowed to go out of doors for exercise whenever the weather was fit; however their exercise was rather limited. The trials were started along the latter part of November and as the calves were small they could not be let out. As a result, they were kept indoors pretty much all the time until spring. No record was kept of the time the calves were out of doors; however the time did not vary a great deal from hand-fed calves of the same ages kept under normal conditions.

The calves were fed whole milk until four weeks old, and then skimmilk until six months of age. The grain was kept before them all the time in the self-feeder. Alfalfa hay was kept before them at all times. As soon as the calves would drink water they were given all they could drink twice a day.

The calves were bedded with straw and their stalls kept clean and dry. They were curried frequently.

Feeds Used.—Six feeds were kept before the calves all the time. They were white and yellow whole corn, whole oats, ground oats, old process linseed oil meal, and wheat bran. A good quality of alfalfa hay was kept in the manger. The milk and water were hand-fed.

Weights and Measurements.—The calves were weighed and measured every 15 days for the first three trials. During the fourth trial they were weighed and measured at 30 day intervals.

In the first two trials, five measurements were made—height at withers, depth of chest, width at hips, width at thurls and length from the shoulder to the pin bones. In the last two trials, three measurements were taken, viz: height at withers, depth at chest, and width at hips.

In the discussion of results, three measurements will be used throughout for sake of uniformity. It is also felt that the three measurements are a true index of the growth made by the calves, and will be shown by the data presented.

Digestion Trials.—Five day period digestion trials were conducted at the latter part of each trial except in the case of the fourth trial.

The feces were collected and sampled in the regular way. The composite samples were delivered to the station chemist for analysis immediately after each trial.

Influence of Self-Feeders on Growth

Growth is measured by increase in weight and skeletal development. The skeletal development is perhaps the more accurate measure of growth, since an animal may increase in weight and yet not show any appreciable increase in the size of the skeleton.

Table I shows the skeletal growth and weight of the calves by 30 day periods. Similar data are given for a group of eight calves which were hand-fed and cared for under normal conditions. These calves were not on experiment simultaneous with the self-feeder lots, but for comparison in weight and growth may be considered a control lot.

The height at withers (Figure 1) shows a fairly close correlation with the normal growth curve for purebred Holsteins as well as with the control lot. It should be borne in mind that the calves used in the self-feeder trials were grade Holsteins. Some may have had scrub or grade dams, and even though the color markings were true to grade Holsteins, some may not have been very far removed from beef ancestors; hence the correlation is about as close as could be expected.

The weights and measurements given are for all the calves of the same ages. There was considerable individual difference in growth, some making more rapid growth than others. In a few cases the calves did not develop normally; hence these calves affected the average of the group. It was also more difficult to get accurate measurements of calves which would or could not stand up well, or whose legs were bowed or otherwise deformed.

Table I.—SKELETAL DEVELOPMENT AND WEIGHT FROM BIRTH TO TEN MONTHS COMPARED WITH NORMAL AND CONTROL LOT.

Age (Months)	Weight			Height at Withers			Width at Hips			Depth of Chest		
	Self-fed Calves	Control Lot	Normal Weight	Self-fed Calves	Control Lot	Normal Height	Self-fed Calves	Control Lot	Normal Width	Self-fed Calves	Control Lot	Normal Depth of Chest
0	95	85.3	90	29.1	29.6	28.3	6.9	7.11	-----	12.4	-----	-----
1	132	115	121	30.7	31.4	30.2	8.3	7.8	-----	13.1	-----	-----
2	169	160	157	32.7	32.8	32.3	9.5	8.6	-----	14.2	-----	-----
3	211	216	200	34.7	35.9	34.2	9.9	9.5	-----	15.3	-----	-----
4	254	278	249	36.1	37.0	36.2	10.7	10.7	-----	16.6	-----	-----
5	295	333	302	37.4	39.3	38.0	11.3	11.7	-----	17.3	-----	-----
6	334	385	349	38.7	40.7	39.7	11.8	12.3	-----	18.1	-----	-----
7	388	447	389	39.7	42.2	40.9	12.6	13.2	-----	18.6	-----	-----
8	431	490	425	40.8	43.6	42.2	13.2	13.4	-----	19.4	-----	-----
9	486	539	466	42.6	44.3	42.9	14.4	14.4	-----	20.4	-----	-----
10	537	606	501	43.8	45.2	43.8	14.4	15.3	-----	21.5	-----	-----

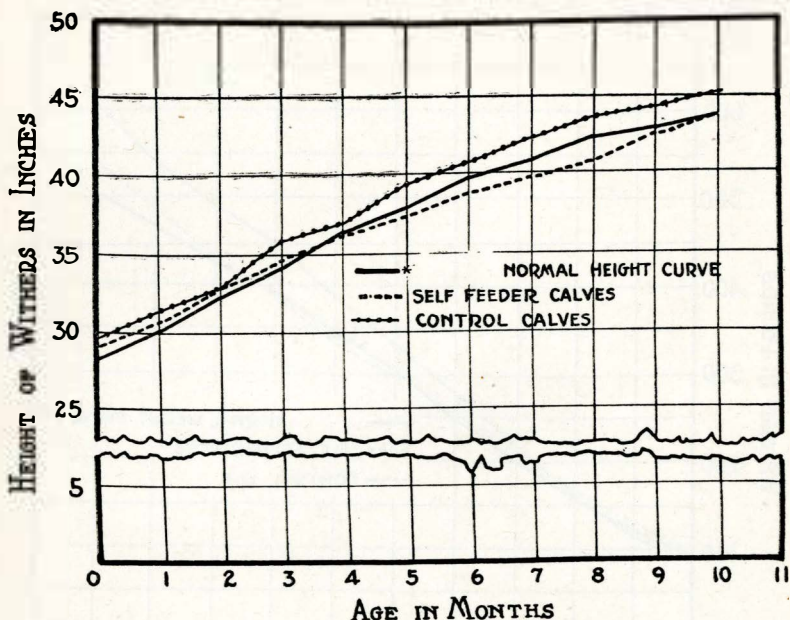


Fig. 1.—Average height at withers of self feeder calves and control lot calves, compared with the normal.

*Eckles' normal growth in weight and height of dairy heifers as reported in Mo. Res. Bul. 36 provides a convenient standard to use in comparing individuals of these breeds.

The calves, as shown by data in Figure 2, seem to be slightly above normal in growth and weight up to the age of three months. From then on they were below normal in both skeletal development and weight. Hulce and Humphrey (8) found that at this age calves developed abnormalities which made it advisable to take them off self-feeders.

The average decrease in weight and skeletal development of the calves after four months of age can be attributed to the abnormal development of many of the calves at about this age. They became bow-legged and stiff in their hind legs and back. Some calves showed marked symptoms of rickets. Others developed digestional trouble which led to bloating, and in a few cases fits.

No experimental data is available explaining these abnormal conditions. Reed and Hoffman attributed the bowed legs and similar conditions of calves on self-feeders to over eating on grain.

If the calves which showed physiological disturbances and abnormal skeletal development in these trials had been omitted from the total number of calves, the average weight and height at withers would have been above normal.

The data charted in Figures 1 and 2 seem to indicate that the calves compare closely in height at withers and weight with the normal growth curve and the control lot.

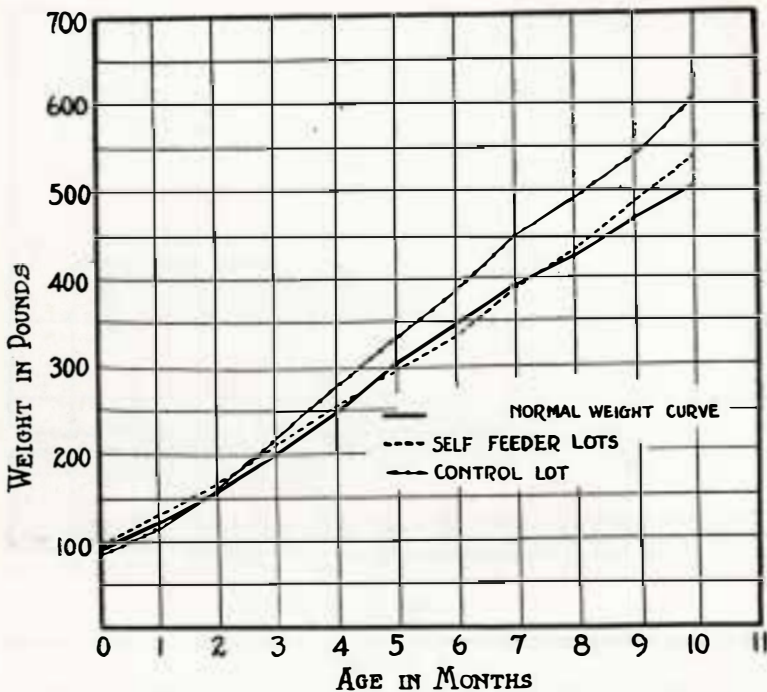


Fig. 2.—Average weight of self-fed and control-lot calves compared with normal weight curve.

Figure 3 shows a very close correlation of the growth of different parts of the calves' anatomy. The height at the withers increases in the same ratio as the width at the hips, and the depth of chest. The data seem to indicate that growth even under rather abnormal feeding conditions takes place uniformly and therefore one measurement is sufficient in ascertaining the skeletal development of dairy calves.

Calves on self-feeders do not grow more rapidly after three months of age than hand-fed calves. If self-feeders are used for calves up to this age it would seem advisable to use a balanced mixture of feeds rather than allow calves free choice of individual feeds.

The Effect of Self-Feeder on Economy of Growth

Maximum growth is always desired; however the feed cost per unit of growth is very important from the practical point of view. If one has to choose between rapidity of growth at great cost, and slower growth with a lower feed cost per unit of growth, the latter method will be followed by the greatest number of dairymen. With the average dairyman, time is not as important a factor as cost.

Table II shows the total pounds of feed consumed by each lot of calves, the total feed consumption of all lots, and the feed consumed by the hand-fed control lot. Calf 5 in Lot I died of strangulation shortly after the trial had started and is not considered in the lot.

A great variation is noted in the choice of grain, and also in the amount of concentrates of each kind eaten. It is significant that this wide variation should obtain when calves have free access to the same kinds of feeds. The average daily consumption of concentrates is also significant particularly from the standpoint of economy of growth.

The average daily concentrates consumption per calf of the self-fed lots was 5.39 pounds. The hand-fed calves in the control lot consumed 3.05 pounds. This represents a saving of 2.34 pounds of concentrates a calf per day, or a saving of about 40 percent in concentrates. In view of the fact that the control lot calves made greater gain in weight and skeletal growth on 40 percent less concentrates is significant and indicates the greater feed economy in hand-feeding of dairy calves.

In arriving at the monetary cost of the increase in weight and skeletal growth it is necessary to put an arbitrary value on each feed. It is apparent that the prices used are a great factor in the final results because of the wide variation in consumption of the different kinds of feeds. However for the practical dairyman, the cost factor is very important and if the same prices are maintained throughout the monetary cost of gains will have its value as a means of comparison.

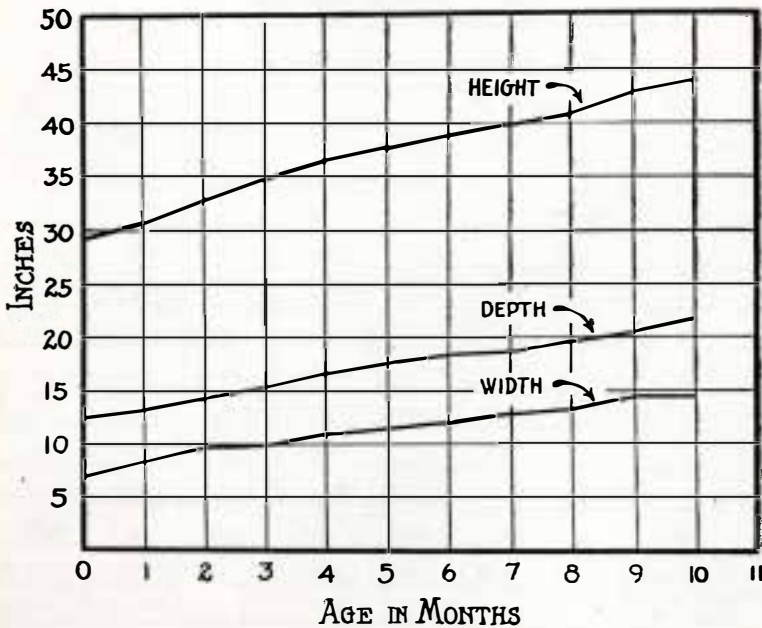


Fig. 3.—Comparison of height at withers, depth of chest and width at hips of 19 calves.

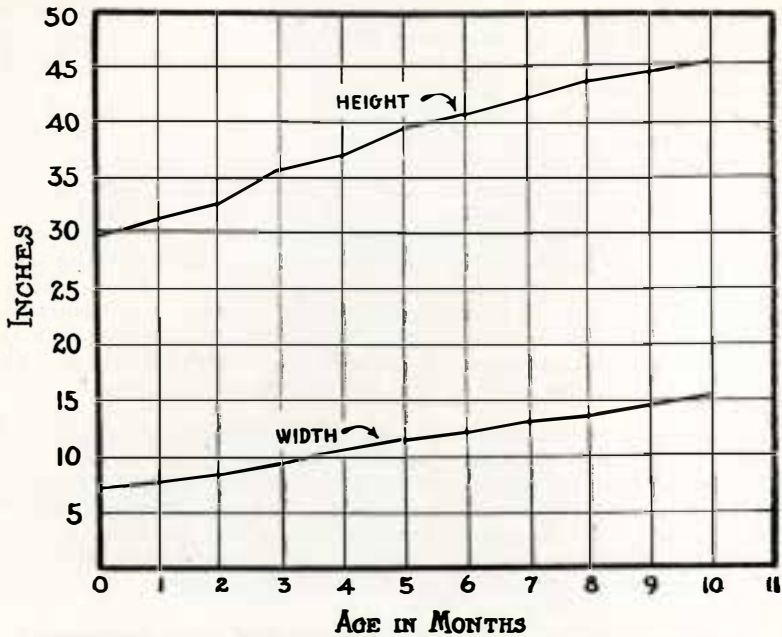


Fig. 4.—Comparison of height at withers and width at hips of control lot.

Table II.—FEED CONSUMPTION BY LOTS.

	Lot I.	Lot II.	Lot III.	Lot IV.	Total	Control Lot
Number of Calves.....	4	5	5	5	-----	8
Number Feeding Days..	203	213	232	194	842	232
Calf Days	812	1035	1050	970	3867	1856
Yellow Corn	Lbs. 118.8	Lbs. 2217.6	Lbs. 44.4	Lbs. 1667.1	Lbs. 4047.9	Lbs. 1977
White Corn	986.7	772.3	42.6	98.2	1899.8	Barley 1760
Wheat Bran	912.4	53.5	458.2	545.8	1969.9	377
O. P. Oil Meal.....	1572.7	1625.7	2205.2	2439.	5648.2	115
Ground Oats	126.1	377.0	766.6	563.3	1833.0	1433
Whole Oats	1468.5	911.6	1978	1101.8	5459.9	-----
Alfalfa Hay	446.0	560.2	685.2	599.9	2291.3	5663.
Av. Daily Concentrates Consumption	6.38	5.76	5.23	4.36	5.39	3.05
Av. Daily Roughage Consumption	-----	-----	-----	-----	.644	3.05

Table III.—TOTAL FEED CONSUMPTION OF 19 CALVES

Calf	Lot I.				Lot II.					Lot III.					Lot IV.					Total
	1	2	3	4	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Yel. Corn	56.2	13.9	22.1	26.6	161.7	722.7	696.3	567.5	19.4	10.2	2.8	12.4	9.0	10.0	282.6	240.2	254.3	456.2	433.8	4047.9
Wh. Corn	142.8	231.1	207.3	405.5	199.0	231.8	246.6	87.0	7.9	11.7	3.7	9.0	9.2	9.0	6.7	7.1	30.9	44.8	8.7	1899.8
Wheat Bran	293.9	221.3	173.9	223.3	5.6	7.6	1.5	28.7	10.1	74.1	10.4	109.2	149.3	115.2	13.2	72.7	83.4	309.3	67.3	1969.9
O. P.																				
Oil Meal	113.2	434.3	416.8	608.4	107.0	520.0	316.5	511.2	171.0	404.3	44.2	726.6	651.6	379.2	10.8	60.0	40.1	82.6	50.4	5648.2
Gr. Oats	27.8	45.7	16.4	36.2	9.4	113.0	113.2	126.7	15.7	41.2	7.0	152.0	368.5	197.3	77.6	185.5	175.9	90.5	33.8	1833.0
Whole Oats	534.2	329.0	231.3	374.0	21.9	72.7	135.1	358.4	323.5	422.6	57.3	681.8	462.7	353.6	342.5	248.5	218.0	116.4	176.4	5459.9
Alf. Hay	101.9	79.6	96.8	167.7	92.3	157.7	117.3	164.4	28.5	150.8	1.0	183.8	181.3	168.3	98.0	110.2	85.4	192.2	114.1	2291.3
Skimmilk	3780	3780	3780	3780	2982	2982	2982	2982	2982	3290	2016	3290	2436	3290	2716	2716	2716	2716	2716	57932.0

SELF FEEDERS IN DAIRY CALF FEEDING

The data in Table IV show that so far as feed is concerned, calves can be raised more economically by hand-feeding. The feed cost per day of the hand-fed lots was \$.0627 compared to \$0.117 for the free choice group in Lot I or a decrease of 88 per cent in feed cost.

The feed cost per pound of gain is also in favor of the hand-fed lot. Table IV shows a cost of \$.0367 per pound of gain for the hand-fed control lot of calves, and an average of \$.0673 per pound of gain for the self-fed calves. This represents a saving of \$.0306 per pound gain, or a saving of more than 83 percent.

In ascertaining the feed cost per pound of gain the value of the whole and skimmilk is omitted as the milk was hand-fed in both instances. If the value of the milk were included in the cost it would not change the relative cost materially as about the same amount of milk was fed in all trials.

In view of the fact that after four months of age the self-fed calves did not make as rapid gain in growth as the hand-fed calves represented by the normal growth curve and that the cost per unit of gain was considerably greater, it is apparent that self-feeders of the type used in these trials are not economical for dairy calves.

Relative Palatability of Different Feeds to Calves

The total consumption of each calf (Table III) may be of interest in order to study the individual variation in feed consumption and note the kind as well as total feed consumed. The total consumption of the various feeds should be a fair index as to its palatability.

The first three lots ate heavily of oil meal. For some unexplainable reason the fourth lot ate sparingly of the oil meal. So far as physical examination of the meal would determine its palatability, it should have been equal to any of the lots of meal used. On the other hand Lot II ate sparingly of the wheat bran as compared to the other lots.

It is significant that the calves within each lot, were more uniform in their choice of feeds than were the lots of calves. This would seem

Table IV.—THE AVERAGE FEED COST PER CALF

	Self-Feeder Lots				Control Lot
	I.	II.	III.	IV.	
Feed Days -----	203	213	232	194	232
Number Calves -----	4	5	5	5	8
Calf Days -----	812	1035	1050	970	1856
Yellow Corn -----	\$ 1.78	\$33.26	\$.67	\$25.01	\$29.71
White Corn -----	\$14.80	\$11.58	\$.64	\$ 1.47	\$18.74
Wheat Bran -----	\$13.69	\$.80	\$ 6.87	\$ 8.19	\$ 5.65
O. P. Oil Meal -----	\$43.25	\$44.71	\$60.66	\$ 6.71	\$10.37
Ground Oats -----	\$ 1.58	\$ 4.71	\$ 9.58	\$ 7.04	\$17.93
Whole Oats -----	\$18.36	\$11.40	\$24.72	\$13.77	
Alfalfa Hay -----	\$ 2.68	\$ 3.36	\$ 4.11	\$ 3.60	\$33.98
Feed Cost per Calf Day -----	\$.118	\$.106	\$.102	\$.0678	\$.0627
Cost of Feed per Lb. Gain -----	\$.0686	\$.0828	\$.0718	\$.0458	\$.0367

Table V.—AVERAGE DAILY GAIN IN WEIGHT OF CONTROL LOT AND SELF FEEDER CALVES.

Control Lot Calves										
Calf No. -----	1	2	3	4	5	6	7	8	Average	
Initial Wt. Lbs.-----	109	80	73	90	87	97	87	83	88	
Final Wt. Lbs.-----	596	454	445	404	473	538	451	521	485	
Gain in Wt. Lbs.-----	487	374	372	314	386	441	364	438	397	
No. of Days-----	232	232	232	232	232	232	232	232	232	
Average Daily Gain Lbs.-----	2.09	1.61	1.60	1.35	1.66	1.90	1.57	1.89	1.71	

Self-Feeder Calves																				
	Lot I.				Lot II.					Lot III.					Lot IV.					Average
	1	2	3	4	*1 1	2	3	4	*2 5	1	*3 2	3	4	5	1	2	3	4	5	
Initial Wt. -----	200	198	141	204	145	164	182	222	104	103	93	138	103	100	97	132	121	158	74	141
Final Wt. -----	618	497	411	665	218	584	545	558	249	367	168	538	564	471	325	366	361	528	396	444
Gain in Wt.-----	418	299	270	461	73	420	363	336	145	264	75	400	461	371	228	234	240	370	322	303
No. of Days-----	210	210	210	210	188	210	210	210	210	232	122	232	232	232	189	189	189	189	189	203½
Av. Daily Gain--	1.99	1.42	1.29	2.19	0.39	2.00	1.73	1.60	0.69	1.14	0.61	1.77	1.99	1.60	1.21	1.24	1.27	1.96	1.70	1.46

*1. Symptoms of stiffness—Feb. 9, 1924—died June 7, 1924.

*2. Symptoms of stiffness—Feb. 9, 1924.

*3. Symptoms of stiffness—Jan. 17, 1925—died March 9, 1925.

to indicate that palatability of the feeds was the important factor in its choice.

It is apparent from Table III that oil meal ranks first in palatability for dairy calves with whole oats and whole yellow corn in the order given. Wheat bran, ground oats, and white corn apparently rank about the same in palatability.

Table III indicates that the grain ration for calves might well contain whole corn and whole oats. If a high protein feed is needed, oil meal should receive first consideration.

Can Calves Select Their Feed?

Daily observations indicated that the calves were very erratic in their eating when allowed free choice of feeds. At the beginning of the trials most of the calves ate freely of oil meal. Oil meal was the sole feed for several days to a week. In some cases it resulted in scours. Perhaps corn would be the only feed eaten for the following week, with perhaps a small consumption of the other feeds.

This procedure of eating was followed more or less irregularly throughout the trial, with perhaps a tendency to choose from more feeds as the trial progressed. Table I and Figures 1 and 2 seem to show no greater growth in the self-fed calves than hand-fed calves. Table V shows an average daily gain of 1.46 pounds for the self-fed calves, and an average daily gain of 1.71 pounds for the hand-fed calves. These data seem to indicate that so far as gain in weight is concerned dairy calves do not choose feeds best adapted to their requirement.

Figures 5, 6, and 7 indicate very clearly that the calves were not normal. The abnormal skeletal development, rachitic condition, and other malformations indicated some disturbing factor. It cannot be definitely stated whether these conditions were due to too liberal eating of concentrates, or the unbalanced condition of the ration eaten or other factors. Whatever the cause might be it at least indicates that dairy calves do not choose feeds best suited to their needs.

Free Choice of Grain Affects Digestibility

Table VI shows the results of the digestion trials for the first three trials. Because of the short time for the trials (5 days), too much significance cannot be given to the coefficients of digestion. The manner in which the calves ate the various feeds also tends to vitiate the results.

Table VI.—COEFFICIENTS OF DIGESTION

Lot	Lot I.				Lot II.					Lot III.				Av.
	1	2	3	4	1	2	3	4	5	1	3	4	5	
Calf No. -----														
Protein -----	74	80	87	78	84	77	88	80	85	82	83	85	84	82
E. Extract -----	87	89	90	85	72	79	81	82	80	90	87	94	92	85
Cr. Fiber -----	41	58	62	60	54	47	51	55	46	53	40	67	44	52
N. F. E. -----	92	91	92	89	92	93	92	92	89	89	90	92	85	90
Ash. -----	78	67	67	68	61	61	65	69	64	48	46	72	65	64
Dry Matter -----	84	84	87	83	84	84	85	87	82	80	80	86	80	84

Table VII.—DIGESTIBLE NUTRIENTS REQUIRED FOR ONE POUND GAIN

	Lot I.				Lot II.					Lot III.					Lot IV.				
	1	2	3	4	1	2	3	4	5	1	*2	3	4	5	1	2	3	4	5
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Gain in Wt.....	418	299	270	461	78	420	368	336	145	254	75	400	461	371	228	234	240	370	322
Dig. Dry Matter	969.8	1039.0	1221.8	1608.7	580.9	1544.7	1371.8	1584.9	559.2	1085.0	-----	1652.3	1669.0	1172.5	861.5	928.3	899.8	1204.5	895.6
Dig. Cr. Prot.....	157.48	234.8	341.3	330.5	176.2	345.9	327.5	363.6	193.1	284.3	-----	419.8	384.5	298.2	168.0	188.9	180.8	234.1	179.4
Total Dig. Nut.	954.5	1061.5	1233.3	1624.	582.5	1566.4	1420.6	1550.4	556.0	1125.0	-----	1702.7	1703.9	1178.5	880.2	936.8	914.0	1218.6	915.7
Nutritive Ratio	1:4.9	1:3.5	1:2.6	1:3.9	1:2.3	1:3.5	1:3.3	1:3.2	1:1.8	1:2.9	-----	1:3.1	1:3.4	1:2.9	1:4.2	1:3.9	1:4.0	1:4.2	1:4.1
Dry Matter Re- quired per 1 lb. gain -----	2.32	3.48	4.52	3.49	7.96	3.68	3.78	4.72	3.86	4.11	-----	4.13	3.62	3.16	3.77	3.96	3.75	3.25	2.78
Dig. Crude Pro. Required per Lb. Gain -----	.376	.785	1.264	.717	2.414	.824	.902	1.082	1.332	1.077	-----	1.049	.834	.804	.737	.807	.754	.633	.557
T. D. N. Re- quired per Lb. Gain -----	2.283	3.550	4.568	3.523	7.980	3.729	3.913	4.614	3.834	4.261	-----	4.257	3.696	3.177	3.861	4.003	3.808	3.253	2.844

*Calf 2, Lot III. died before digestion trial.

Inasmuch as there are no comparative data on calves hand-fed, it cannot be definitely stated what effect self-feeders have upon the coefficients of digestion. The relatively high coefficients for fiber can be explained on the basis of the rather low consumption of hays and high fiber feeds. In other words, the calves ate more freely of grains low in fiber.

Table VII shows the nutritive ratios, and the digestible crude protein and total digestible nutrients required per pound gain. The nutritive ratios on the whole are narrower than recommended by the feeding standards for calves of similar ages. The average for the thirteen calves on which trials were run was 1:3.4. The nutritive ratio recommended by the Morrison standard for calves of the same age and weight is 1:4.5 to 6.5. Hence it is observed that the calves on self-feeders consumed more protein than required. The records of feed consumption indicates that such was the case.

Physiological Disturbances Caused By Free Choice of Grain

It is well known among calf raisers that, for the best results, calves must be kept healthy and in a thrifty, growing condition. Feeds or feeding conditions which do not permit or make possible these favorable conditions should be avoided in so far as possible.

The calves on self-feeders did not maintain this thrifty condition. Some ate too freely of the oil meal which led to scours, and a refusal of feed for several days. Others ate too freely of corn, eating corn only



Fig. 5.—Note the condition of the coat, and unthrifty appearance. The joints are slightly enlarged. This calf bloated continually after eating or drinking milk. It became gradually worse until it was killed.

for several days. In individual cases as high as nine pounds of corn per day were eaten by calves from three to four months old. Very little roughage was consumed even though alfalfa hay of excellent quality was kept before them at all times.

Visible symptoms of physiological disturbances began showing up after the calves had been on the self-feeder from four to five months. The first symptoms noted were stiffness and a rather stilted gait. Then swelling of the joints, bowed legs or hunch backs occurred as shown by the photographs.

Calf 1, Lot III, perhaps suffered the greatest from physiological disturbances. Its coat became very rough and it lost greatly in weight. About the time photograph shown in Figure 5 was taken the calf began bloating as soon as it ate any kind of feed or even when it drank milk. It grew gradually worse and would bloat four or five times a day. It was tapped with a rubber hose, but finally bloated so frequently that it was necessary for an attendant to be present all the time. It seemed to be in constant pain and was killed to relieve it from its misery.

Calf 5, Lot II, shown in Figures 6 and 7, developed a hunch back, bowed legs, and swollen joints. It lived through the entire experimental trial and was finally put in the pasture with the college herd. It grew very slowly but apparently was well. It, however, never got over its deformities. Only a few of the 19 calves are shown in the photographs. These were the ones which showed marked symptoms of nutritional

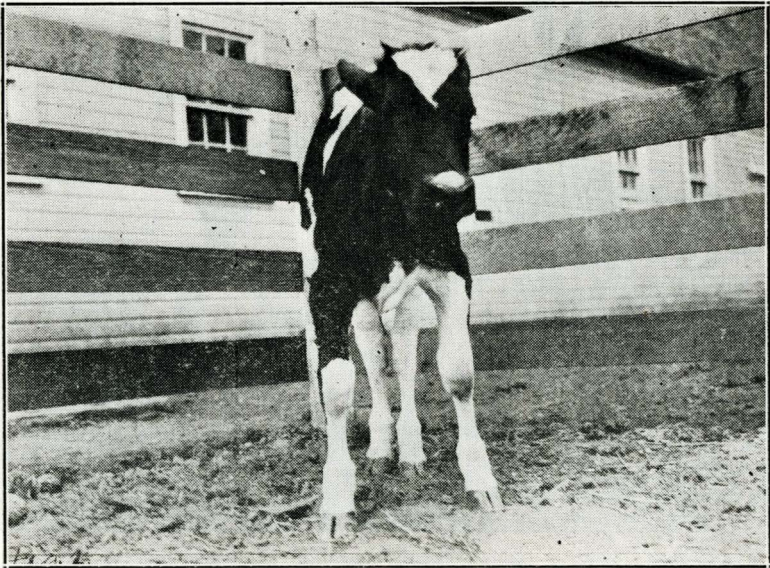


Fig. 6.—Note the marked enlargements of the joints, and unthrifty condition.

disturbances. Many others indicated abnormalities less pronounced, and were not like calves kept under normal conditions in their general appearance. They lacked the development of middle found in normal hand-fed calves and were not as uniform in deposition of fat or muscular development as hand-fed calves. The lack of middle was due to the small amount of roughage consumed.

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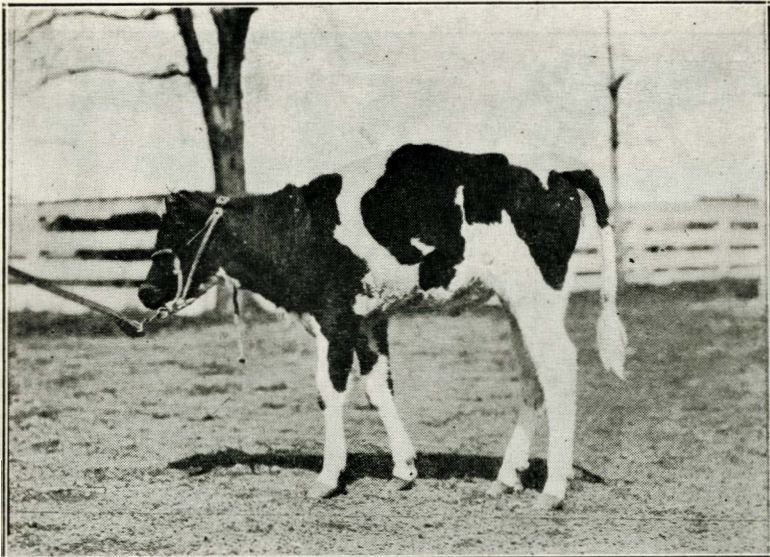


Fig. 7.—Side view of same calf as in Fig. 6. The hump back and physical condition are shown better in this photograph. This calf lived through the trial and was placed in the pasture with the college herd. It gained in flesh and physical condition very slowly but did not get over its deformities.

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