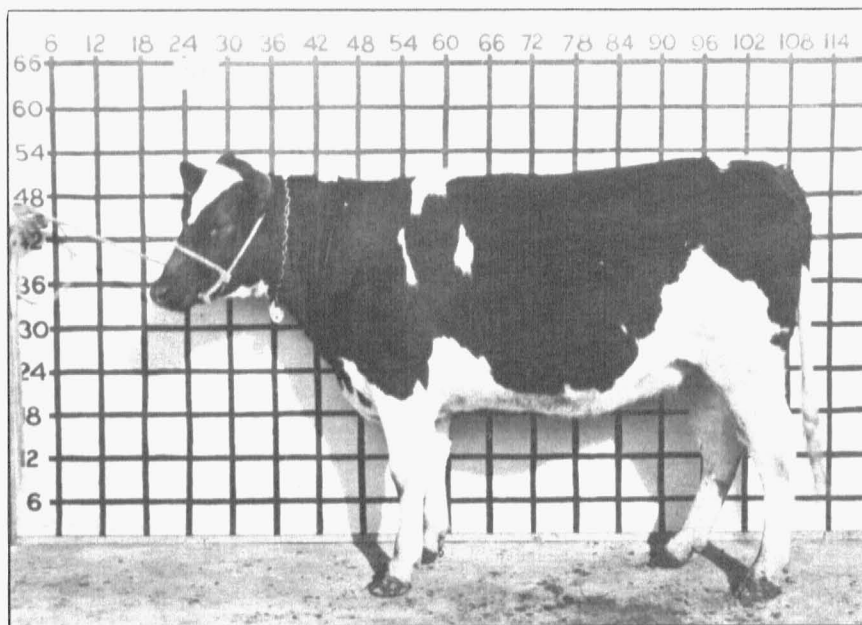


The Growth of Dairy Heifers Raised Chiefly on Roughages

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Summary and Conclusions

1. The feed consumption and growth rates have been recorded of Holstein heifers raised chiefly on hay, silage and pasture with minimum amounts of grain from 6 to 24 months of age.

2. In a series of three trials with 28 Holstein heifers the average consumption of feedstuffs and pasture from 6 to 24 months of age were as follows: (1) 796 lbs. grain, 1728 lbs. lespedeza hay, 115 lbs. alfalfa hay, 2265 lbs. sorgo silage, and 334 days on pasture; (2) 912 lbs. grain, 3934 lbs. lespedeza hay, 3757 lbs. sorgo silage, and 262 days on pasture; (3) 1232 lbs. grain, 1870 lbs. lespedeza hay, 773 lbs. alfalfa hay, 1975 lbs. mixed clover and grass, and 263 days on pasture.

3. The mean body weight of all groups was slightly below normal standards at age 24 months. The height at withers was only slightly below normal for all groups and the circumference of the chest was slightly above normal in the first group and slightly below normal in the other groups. A fourth group of heifers fed on hay, silage, pasture and a mixture of steamed bone meal and salt from 15 to 24 months of age were slightly below normal in weight at age 24 months. None of the deviations from normal were statistically significant.

4. Data is presented showing the average total feed consumption and rate of growth of dairy heifers from 6 months to 2 years of the Holstein-Friesian and Jersey breeds reared at this Station over a two year period. The average monthly consumption in pounds of the several feeding stuffs, grain, hay, silage, and days pasture and the amount of digestible crude protein and total digestible nutrients furnished by each are presented.

5. Normal growth was secured where approximately 55 per cent of the total crude protein and digestible nutrients were secured from pasture.

6. These studies prove that dairy heifers of normal body weight and size may be reared from 6 months to 24 months of age with not more than 900 pounds of grain concentrates provided that good roughage and pasture are provided in abundance.

Growth of Dairy Heifers on Maximum Roughage With Varying Amounts of Grain

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The maintenance of Missouri's milk cow population of one million head requires approximately 250,000 dairy heifers reaching maturity each year. Breeders of dairy cattle are much concerned with any method which will help raise heifers more economically. Under Missouri conditions the maximum utilization of pastures, hay crops and silage supplemented with home grown grains ordinarily reduces feed, labor and other costs. It also conserves soil fertility and grows animals to near normal size and weight at calving age.

Growth investigations with dairy cattle were initiated by C. H. Eckles at the Missouri Agricultural Experiment Station in 1906 and were followed by the more extensive studies of Ragsdale, Brody, Herman and associates. These studies were for the most part on animals raised under dry lot conditions with limited utilization of pasture.

The study reported in this publication was undertaken for the purpose of obtaining growth data and feed consumption values for Holstein and Jersey females raised under a system of management which made heavy utilization of pasture, hay, and silage. Grain was fed only in amounts believed sufficient to promote normal skeletal growth and approximately normal body weight from a few weeks to 2 years of age.

The management of the animals was at all times under practical conditions and compared favorably to those used by dairymen using commonly recommended dairy practices. The calves were nursed by their mothers for the first 3 to 4 days, received mixed whole milk from the herd until 4 weeks of age and were then gradually changed to skim milk, and this was continued until the age of 6-7 months. A limited number of calves were reared on limited whole milk supplemented by a "calf starter ration" fed in dry form. These calves received whole milk to 8 weeks of age and were then weaned. The calf starter and lespedeza hay were placed before the calves as early as

they would eat these feeds, usually at age 2 weeks. The calf starter ration used had the following formula:

Calf Starter Ration*

| Feeding Stuffs | | Protein (Crude) | Digestible Crude Protein | Total Digestible Nutrients |
|----------------------|-------------------------------------|--------------------|--------------------------------|----------------------------------|
| 277.5# | Ground Yellow Corn (No. 2) | 26.1 | 19.7 | 223.7 |
| 275# | Ground Oats | 33.0 | 25.8 | 196.6 |
| 100# | Wheat Bran | 15.8 | 13.1 | 70.2 |
| 100# | Linseed Meal (34%) | 35.3 | 30.7 | 78.4 |
| 100# | Ground Alfalfa (choice leafy green) | 16.5 | 12.4 | 53.7 |
| 50# | Soybean Meal (41%) | 20.4 | 17.4 | 40.2 |
| 50# | Dried Feeding Skimmilk | 17.4 | 16.6 | 42.0 |
| 25# | Soluble Blood Flour | 22.2 | 21.3 | 21.9 |
| 10# | Steamed Bone Meal | ---- | ---- | ---- |
| 10# | Salt | ---- | ---- | ---- |
| 2.5# | Reinforced Cod Liver Oil | ---- | ---- | ---- |
| Total 1000# | | 186.7 | 157.0 | 726.7 |
| Crude Protein 18.67% | | 18.67% | 15.70% | 72.67% |

The calf starter was replaced by a growing heifer grain mixture at the age of 2 months in the case of calves receiving skim milk and at age 4 months in the case of those fed whole milk. The growing heifer grain mix used was as follows:

Growing Heifer Ration*

| Feeding Stuffs | | Protein (Crude) | Digestible Crude Protein | Total Digestible Nutrients |
|----------------|-------------------|--------------------|--------------------------------|----------------------------------|
| 660# | Ground Oats | 79.2 | 62.04 | 471.9 |
| 600# | Corn | 56.4 | 42.6 | 483.6 |
| 400# | Wheat Bran | 63.2 | 52.4 | 280.8 |
| 100# | Bulky Lass | 10.0 | 7.3 | 60.0 |
| 100# | Linseed Meal | 35.2 | 30.6 | 78.2 |
| 100# | Soybean Meal | 44.3 | 37.7 | 82.2 |
| 20# | Steamed Bone Meal | ---- | ---- | ---- |
| 20# | Salt | ---- | ---- | ---- |
| Total 2000# | | 288.3 | 232.64 | 1456.7 |
| Average | | 14.415% | 11.632% | 72.835% |

All heifers were placed on pasture at the age of 8-12 months, depending on the time of the year the calf was born and the condition of the pasture at the time this age range was reached. The pastures used included a permanent pasture consisting of Kentucky bluegrass, timothy, redtop, and white clover and some Korean lespedeza. Other pastures were Korean lespedeza, sweet clover, and temporary pastures such as wheat, winter barley, and Balbo rye.

The heifers were fed roughage from about November 1 of each year until April 1 to May 1. The date of discontinuing roughage feeding depended on the condition of the pasture at the time. The ratio of hay and silage fed depended on the availability of both. For the most part both hay and silage were fed in combination, but during

*The percentage composition and digestible nutrients of all rations are figured from data obtained from Morrison's "Feeds and Feeding" 20th edition.

the winter of 1947-48 only hay was fed due to a shortage of silage as a result of drought conditions.

The heifers were housed in a shed type of barn, open on the south side, but closed on three sides. Hay and silage were fed in large feed bunks. One man cared for some 80 head of heifers and dry cows under this system in addition to much additional farm work.

The amount of grain fed and the period of time that grain was fed were variable depending on the amount and quality of roughage fed and the apparent condition of the heifers. The general plan of the grain feeding was to supplement roughages so as to keep the heifers in good growing condition.

Data are presented on three groups of purebred Holstein heifers that were reared from 6 to 24 months of age principally on roughages and pasture with varying amounts of grain and on one group reared from 15 to 24 months of age on roughages alone.

Table 1 presents the average feed consumption of these four groups of purebred Holstein females.

Table 1.--Feed Consumption of Holstein Heifers

| Group | Animals | Age Mos. | Grain lbs. | Lespedeza hay lbs. | Alfalfa hay lbs. | Silage lbs. | Pasture days | Clover and grass hay lbs. |
|-------|---------|------------|------------|--------------------|------------------|-------------|--------------|---------------------------|
| I | 12 | 6-12 | 346.3 | 217.6 | 115.2 | | 120 | |
| | | 12-24 | 450 | 1510 | | 2265 | 214 | |
| | | Total 6-24 | 796.3 | 1727.6 | | 2265 | 334 | |
| II | 8 | 6-12 | | | | | | |
| | | 15-24 | 0 | 3580 | | 3222 | 97 | |
| III | 7 | 6-12 | 497 | 1446.2 | | 1468 | 43 | |
| | | 12-24 | 415 | 2487.4 | | 2289 | 219 | |
| | | Total 6-24 | 912 | 3933.6 | | 3757 | 262 | |
| IV | 9 | 6-12 | 847.5 | 236.3 | 773.4 | | 33 | |
| | | 12-24 | 384 | 1633.9 | | | 230 | 1974.7 |
| | | Total 6-24 | 1231.5 | 1870.2 | 773.4 | | 263 | 1974.7 |

A comparison of normal and average body weight at monthly intervals for the animals in the four groups is shown in Figure 1.

A study of the skeletal growth shows that the heifers grew approximately normal in body form with respect to weight, height at withers, circumference of chest, and width of hips. The data are presented in Table 2 and are shown in graphic form in Figure 2.

It is noted that in all groups the average live weight was slightly below normal, but in no case was the difference statistically significant. The height at withers was slightly below normal for all groups at age 24 months. The circumference of chest was slightly above normal in the first group and slightly below normal in the case of the other groups at age 24 months. The width at hips was slightly below normal in all groups. These data show that, in the case of group 4, the average live weight, height at withers, and circumference of chest were somewhat higher from 6 to 17 months of age. This may be

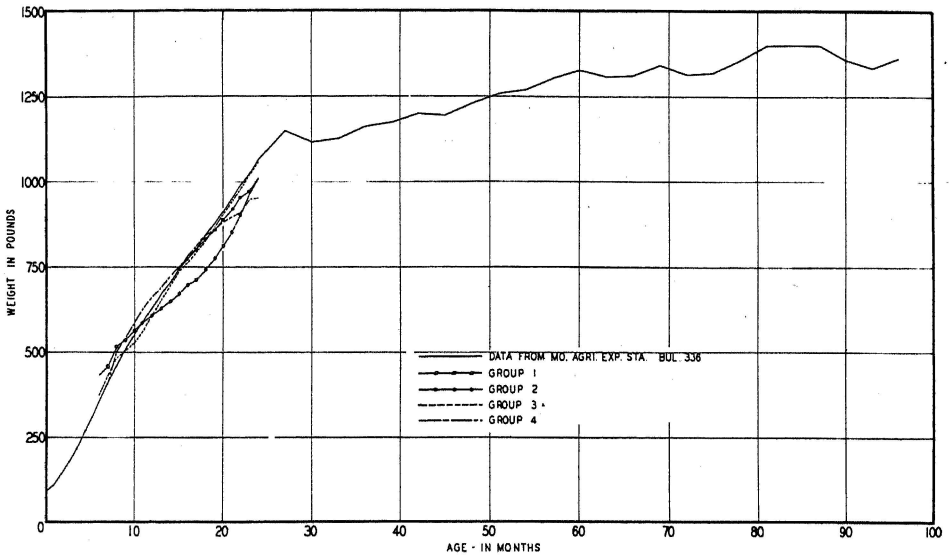


Fig. 1.—A comparison of normal and average body weights of Holstein heifers raised chiefly on roughages.

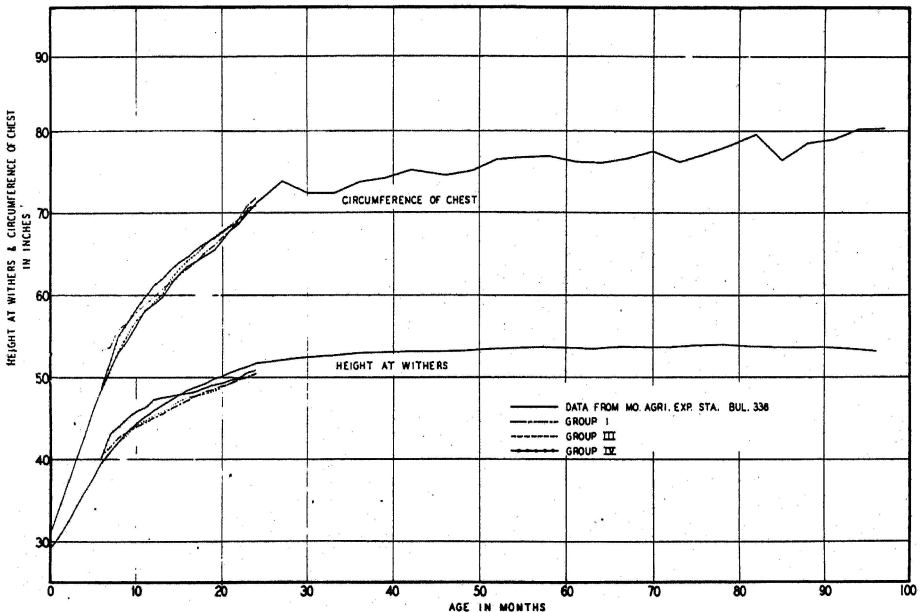


Fig. 2.—A comparison of chest circumference and wither height of experiment animals and normal.

Table 2.--Skeletal growth - Holstein heifers

| Age | Weight lbs. | | | | Height at Withers | | | Circumference of Chest | | | Width at Hips | | |
|-----|-------------|----------|-----------|----------|-------------------|-----------|----------|------------------------|-----------|----------|---------------|-----------|----------|
| | Group I | Group II | Group III | Group IV | Group I | Group III | Group IV | Group I | Group III | Group IV | Group I | Group III | Group IV |
| | 6 | 430.2 | | 371.3 | 347.5 | 40.5 | 39.6 | 40.3 | 53.3 | 48.6 | 48.8 | 12.1 | 12.0 |
| 7 | 458.3 | | 427.9 | 412.5 | 41.6 | 40.9 | 43.2 | 53.7 | 50.9 | 51.9 | 12.6 | 12.8 | 12.3 |
| 8 | 516.2 | | 483.6 | 500.3 | 42.8 | 42.2 | 44.1 | 55.8 | 53.5 | 55.1 | 13.5 | 13.5 | 13.7 |
| 9 | 537.8 | | 505.2 | 542.0 | 43.4 | 43.2 | 45.2 | 56.7 | 55.2 | 56.7 | 13.9 | 13.8 | 14.3 |
| 10 | 567.4 | | 526.7 | 592.4 | 44.0 | 44.2 | 45.9 | 58.0 | 56.9 | 58.3 | 14.3 | 14.1 | 14.7 |
| 11 | 589.9 | | 564.5 | 630.4 | 44.6 | 44.8 | 46.4 | 58.9 | 58.1 | 59.8 | 14.7 | 14.5 | 15.4 |
| 12 | 610.3 | | 612.6 | 665.8 | 45.1 | 45.3 | 47.3 | 59.8 | 59.2 | 61.2 | 15.1 | 15.0 | 15.6 |
| 13 | 630.0 | | 654.0 | 692.7 | 45.6 | 45.8 | 47.5 | 60.7 | 60.2 | 62.0 | 15.4 | 15.5 | 15.7 |
| 14 | 650.4 | | 696.7 | 722.4 | 46.2 | 46.5 | 47.7 | 61.6 | 61.9 | 63.2 | 15.7 | 15.9 | 16.0 |
| 15 | 670.9 | 745.8 | 738.0 | 750.7 | 46.7 | 47.1 | 47.9 | 62.5 | 63.2 | 64.0 | 16.0 | 16.5 | 16.3 |
| 16 | 699.7 | 776.0 | 769.3 | 780.5 | 47.3 | 47.5 | 48.1 | 63.4 | 64.3 | 64.7 | 16.4 | 16.8 | 16.7 |
| 17 | 712.6 | 805.7 | 797.2 | 812.4 | 47.8 | 47.8 | 48.4 | 64.2 | 65.1 | 65.6 | 16.7 | 17.0 | 17.0 |
| 18 | 742.7 | 835.4 | 831.0 | 837.4 | 48.3 | 48.1 | 48.8 | 65.3 | 66.2 | 66.3 | 17.0 | 17.2 | 17.3 |
| 19 | 775.1 | 863.9 | 866.5 | 861.7 | 48.6 | 48.3 | 49.1 | 66.1 | 67.1 | 67.0 | 17.3 | 17.5 | 17.7 |
| 20 | 814.0 | 891.5 | 905.9 | 882.1 | 49.0 | 48.8 | 49.4 | 67.0 | 67.8 | 67.7 | 17.5 | 17.8 | 18.0 |
| 21 | 853.7 | 922.1 | 942.6 | 899.8 | 49.3 | 49.3 | 49.7 | 68.0 | 68.6 | 68.5 | 17.8 | 18.1 | 18.2 |
| 22 | 904.8 | 956.1 | 980.9 | 909.8 | 49.7 | 49.8 | 49.9 | 69.4 | 69.4 | 69.0 | 18.2 | 18.6 | 18.3 |
| 23 | 965.1 | 971.9 | 1019.9 | 947.6 | 50.1 | 50.2 | 50.6 | 70.9 | 70.2 | 70.6 | 18.6 | 18.8 | 18.7 |
| 24 | 1011.1 | 1010.0 | 1062.5 | 950.4 | 50.5 | 50.5 | 50.9 | 71.9 | 71.0 | 71.0 | 18.9 | 19.1 | 18.9 |

explained by the fact that they were placed on pasture at age 12 months whereas the other groups were placed on pasture at an average age of 8 months. Thus the growth rate may be hastened but with increased cost for grain and harvested roughages. The poor gains in weight in the case of group 4 from 20 to 24 months may be explained by the fact that they were wintered (5 months) on 2.8 pounds of grain mix per day plus ad libitum consumption of a poor grade of clover and grass hay.

Table 3 shows the average total feed consumption of dairy heifers from birth to two years of 40 heifers of the Holstein-Friesian and Jersey breeds reared at this station over a two year period. The

Table 3.--Average Total Feed Consumption of Dairy Heifers from Birth to Two Years

| Age Months | Whole milk (lbs.) | Skim milk (lbs.) | Calf starter (lbs.) | Grain mix (lbs.) | Alfalfa hay (lbs.) | Lespedeza hay (lbs.) | Atlas Sorgo (lbs.) | Pasture days |
|--------------------|-------------------|------------------|---------------------|------------------|--------------------|----------------------|--------------------|--------------|
| Holsteins | | | | | | | | |
| Birth-6 mo. | 293.2 | 1906.9 | 26.9 | 466.9 | | 264.8 | | |
| 6-12 mo. | | | | 586.9 | 330.9 | 580.2 | 386.3 | 66 |
| 12-18 mo. | | | | 180.0 | | 1200.4 | 890.0 | 120 |
| 18-24 mo. | | | | 155.4 | | 1342.6 | 160.0 | 131 |
| Total Birth-24 mo. | 293.2 | 1906.9 | 26.9 | 1389.2 | 330.9 | 3388.0 | 1436.3 | 317 |
| Jerseys | | | | | | | | |
| Birth-6 mo. | | | | | | | | |
| 6-12 mo. | | | | 470.2 | 643.5 | 298.2 | 426.0 | 66 |
| 12-18 mo. | | | | 207.3 | | 976.8 | 1394.0 | 103 |
| 18-24 mo. | | | | 192.5 | | 1466.7 | | 115 |
| Total 6-24 mo. | | | | 879.0 | 643.5 | 2741.7 | 1820.0 | 284 |

average live weights, circumference of chest, heart girth, and width at hips for these animals are presented in Tables 4 and 5. These values are also presented graphically in Figures 3 and 4.

The average monthly comparison of feeding stuffs and of digest-

Table 4.--Body Weight and Skeletal Measurements - Holstein Heifers

| Age Months | No. of Animals | Weight | | Height at Withers | | Circumference of Chest | | Width at Hips | |
|------------|----------------|--------|----------------|-------------------|----------------|------------------------|----------------|---------------|----------------|
| | | Lbs. | Normal* (lbs.) | Inches | Normal* (ins.) | Inches | Normal* (ins.) | Inches | Normal* (ins.) |
| Birth | 16 | 89.5 | 90 | | | | | | |
| 1 | 16 | 111.8 | 112 | 30.6 | 30.6 | 33.2 | 33.9 | 7.2 | 7.3 |
| 2 | 16 | 148.1 | 148 | 32.4 | 32.3 | 36.5 | 37.0 | 8.1 | 8.4 |
| 3 | 15 | 189.7 | 193 | 34.3 | 34.3 | 39.4 | 39.9 | 9.1 | 9.2 |
| 4 | 16 | 237.1 | 243 | 36.0 | 36.2 | 42.6 | 42.9 | 9.8 | 10.1 |
| 5 | 14 | 283.2 | 297 | 37.7 | 37.7 | 45.2 | 46.0 | 10.8 | 11.1 |
| 6 | 15 | 335.9 | 355 | 39.4 | 39.7 | 47.6 | 48.7 | 11.5 | 11.9 |
| 7 | 16 | 394.2 | 410 | 41.2 | 41.1 | 50.3 | 51.1 | 12.3 | 12.7 |
| 8 | 20 | 466.4 | 492 | 42.7 | 42.3 | 53.4 | 53.2 | 13.3 | 13.4 |
| 9 | 19 | 508.5 | 509 | 43.7 | 43.5 | 55.5 | 54.6 | 13.8 | 14.0 |
| 10 | 20 | 552.9 | 552 | 44.7 | 44.4 | 57.4 | 56.3 | 14.3 | 14.5 |
| 11 | 19 | 599.5 | 593 | 45.5 | 45.3 | 59.1 | 58.2 | 15.0 | 15.1 |
| 12 | 18 | 638.0 | 632 | 46.3 | 46.0 | 60.4 | 58.9 | 15.3 | 15.5 |
| 13 | 17 | 672.5 | 671 | 46.7 | 46.7 | 61.1 | 59.8 | 15.6 | 15.8 |
| 14 | 18 | 705.1 | 705 | 47.1 | 47.3 | 62.4 | 61.4 | 16.0 | 16.2 |
| 15 | 19 | 738.8 | 746 | 47.4 | 47.9 | 63.4 | 62.6 | 16.4 | 16.5 |
| 16 | 19 | 765.8 | 782 | 47.8 | 48.5 | 64.3 | 63.6 | 16.7 | 16.9 |
| 17 | 18 | 796.6 | 809 | 48.1 | 48.9 | 65.2 | 64.2 | 17.0 | 17.2 |
| 18 | 17 | 843.6 | 845 | 48.5 | 49.3 | 66.3 | 64.9 | 17.3 | 17.5 |
| 19 | 17 | 860.7 | 878 | 48.8 | 49.8 | 67.1 | 65.5 | 17.6 | 17.8 |
| 20 | 16 | 886.5 | 912 | 49.2 | 50.2 | 67.7 | 66.7 | 17.9 | 18.1 |
| 21 | 12 | 927.3 | 952 | 49.7 | 50.6 | 68.9 | 67.9 | 18.2 | 18.3 |
| 22 | 10 | 963.0 | 986 | 49.9 | 51.0 | 69.5 | 68.8 | 18.4 | 18.7 |
| 23 | 9 | 998.9 | 1024 | 50.4 | 51.3 | 70.3 | 70.1 | 18.7 | 19.2 |
| 24 | 7 | 1058.3 | 1069 | 50.5 | 51.7 | 71.0 | 71.3 | 19.0 | 19.4 |

* From Missouri Agricultural Experiment Station Bulletin 336.

Table 5.--Body Weight and Skeletal Measurements - Jersey Heifer

| Age Months | No. of Animals | Weight | | Height at Withers | | Circumference of Chest | | Width at Hips | |
|------------|----------------|--------|----------------|-------------------|----------------|------------------------|----------------|---------------|----------------|
| | | Lbs. | Normal* (lbs.) | Inches | Normal* (ins.) | Inches | Normal* (ins.) | Inches | Normal* (ins.) |
| 6 | 3 | 285.7 | 243 | 36.3 | 36.2 | 46.1 | 43.7 | 10.3 | 10.3 |
| 7 | 6 | 324.9 | 286 | 37.6 | 37.7 | 48.6 | 46.3 | 11.1 | 11.0 |
| 8 | 7 | 347.2 | 324 | 38.3 | 39.0 | 49.5 | 48.4 | 11.6 | 11.7 |
| 9 | 8 | 375.4 | 360 | 39.3 | 40.1 | 51.3 | 50.1 | 12.2 | 12.4 |
| 10 | 10 | 403.8 | 393 | 40.0 | 40.9 | 52.2 | 51.5 | 12.6 | 13.4 |
| 11 | 10 | 420.8 | 420 | 40.3 | 41.7 | 53.4 | 52.8 | 12.9 | 13.3 |
| 12 | 10 | 439.3 | 450 | 41.0 | 42.2 | 54.3 | 54.0 | 13.2 | 13.7 |
| 13 | 11 | 452.6 | 479 | 41.2 | 42.8 | 55.2 | 55.3 | 13.4 | 14.1 |
| 14 | 14 | 479.1 | 507 | 41.8 | 43.3 | 56.2 | 56.3 | 13.8 | 14.5 |
| 15 | 14 | 495.1 | 530 | 42.2 | 43.9 | 57.1 | 57.5 | 14.2 | 14.9 |
| 16 | 12 | 502.0 | 558 | 42.6 | 44.4 | 57.8 | 57.6 | 14.5 | 15.2 |
| 17 | 12 | 519.2 | 580 | 43.0 | 44.7 | 58.6 | 59.5 | 14.8 | 15.6 |
| 18 | 12 | 540.2 | 601 | 43.3 | 45.2 | 59.4 | 60.0 | 15.1 | 15.8 |
| 19 | 11 | 576.9 | 622 | 44.0 | 45.5 | 60.8 | 61.1 | 15.5 | 16.0 |
| 20 | 11 | 605.5 | 642 | 44.3 | 45.9 | 61.6 | 61.9 | 15.8 | 16.4 |
| 21 | 10 | 634.5 | 665 | 44.6 | 46.2 | 62.3 | 62.8 | 16.1 | 16.5 |
| 22 | 10 | 666.4 | 684 | 45.0 | 46.4 | 63.1 | 63.8 | 16.4 | 16.8 |
| 23 | 9 | 709.7 | 708 | 45.6 | 46.7 | 64.4 | 64.5 | 16.8 | 17.1 |
| 24 | 7 | 732.3 | 733 | 46.0 | 46.9 | 65.5 | 65.3 | 17.1 | 17.5 |

* From Missouri Agricultural Experiment Station Bulletin 336.

ible nutrients and the average daily gains are presented in Tables 6 and 7.

The relative proportions of digestible crude protein and total digestible nutrients furnished by grain, hay and silage, and by pasture are shown graphically in Figure 5.

These data indicate that dairy heifers may be reared from 6 months to 24 months of age with not more than 900 pounds of grain provided that good roughage and pasture are provided in abundance.

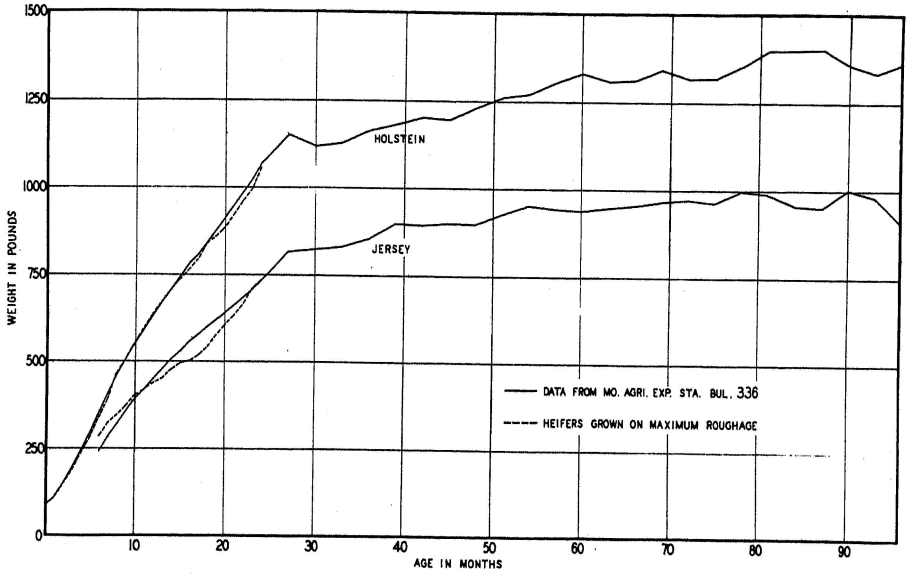


Fig. 3.—A comparison of normal and average body weights of Holstein and Jersey heifers raised chiefly on roughages.

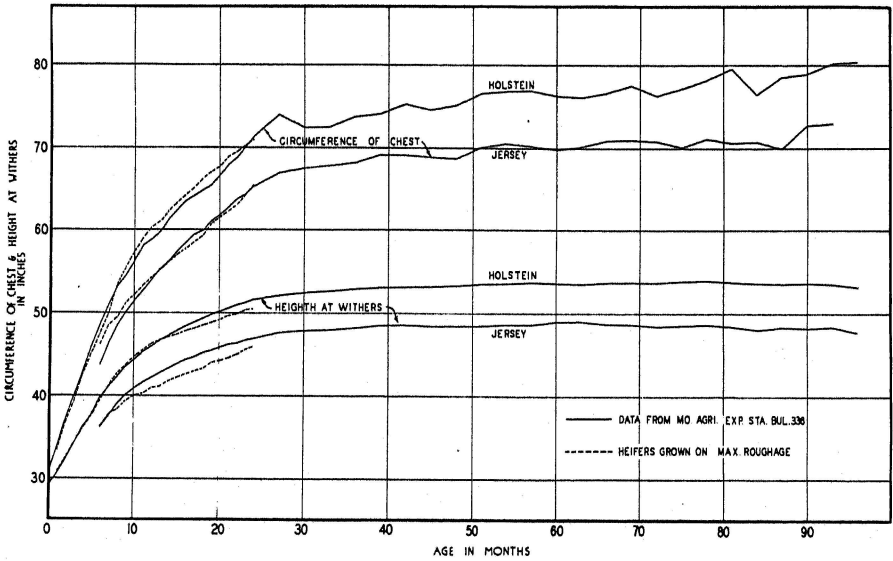


Fig. 4.—A comparison of normal and average body measurements of Holstein and Jersey heifers raised chiefly on roughages.

Table 6.--The Average Monthly Feed Consumption, Digestible Nutrients, and Average Daily Gains - Holstein Females

| Age Mos. | No. of Animals | Average Daily Gain | | Whole milk Lbs. | Skim milk Lbs. | Grain Lbs. | Alfalfa hay Lbs. | Lespedeza hay Lbs. | Atlas Sorgo Silage Lbs. | D.C.P. | T.D.N. | Pasture Days |
|----------|----------------|--------------------|---------------|-----------------|----------------|------------|------------------|--------------------|-------------------------|--------|--------|--------------|
| | | Lbs. | Normal Lbs. † | | | | | | | | | |
| Birth- 1 | 6 | .86 | .91 | 265.0 | 9.5 | * 3.0 | | .7 | | 9.61 | 46.32 | |
| 1- 2 | 6 | 1.21 | 1.26 | 28.5 | 322.0 | *23.8 | | 1.8 | | 16.12 | 50.81 | |
| 2- 3 | 6 | 1.39 | 1.48 | | 391.5 | 75.7 | | 18.3 | | 24.25 | 97.40 | |
| 3- 4 | 6 | 1.58 | 1.70 | | 401.5 | 111.0 | | 48.3 | | 31.51 | 139.18 | |
| 4- 5 | 6 | 1.54 | 1.83 | | 406.2 | 138.4 | | 82.7 | | 38.05 | 177.16 | |
| 5- 6 | 6 | 1.76 | 1.93 | | 343.7 | 160.4 | | 114.6 | | 41.37 | 204.18 | |
| 6- 7 | 19 | 1.94 | 1.77 | | 64.9 | 179.4 | 56.2 | 111.6 | | 39.52 | 220.50 | |
| 7- 8 | 19 | 2.40 | 1.55 | | | 166.9 | 59.0 | 106.0 | | 35.57 | 204.46 | 4.2 |
| 8- 9 | 19 | 1.40 | 1.34 | | | 103.5 | 61.1 | 49.5 | | 23.16 | 130.65 | 14.4 |
| 9-10 | 19 | 1.48 | 1.17 | | | 71.8 | 76.5 | 69.9 | 63.2 | 23.46 | 135.90 | 13.4 |
| 10-11 | 19 | 1.55 | 1.17 | | | 46.1 | 64.2 | 120.5 | 160.0 | 23.97 | 152.35 | 13.0 |
| 11-12 | 19 | 1.28 | 1.01 | | | 25.5 | 42.2 | 114.2 | 163.2 | 19.28 | 123.85 | 16.6 |
| 12-13 | 19 | 1.15 | 1.07 | | | 18.6 | 21.4 | 150.3 | 214.7 | 19.72 | 134.95 | 15.6 |
| 13-14 | 19 | 1.09 | 1.06 | | | 30.9 | 3.5 | 188.1 | 218.9 | 23.05 | 155.12 | 18.0 |
| 14-15 | 19 | 1.12 | 1.10 | | | 45.8 | | 201.0 | 180.3 | 25.30 | 164.92 | 16.6 |
| 15-16 | 19 | .90 | 1.07 | | | 41.7 | | 222.8 | 128.4 | 26.41 | 165.53 | 18.7 |
| 16-17 | 19 | 1.03 | .73 | | | 28.5 | | 181.3 | 54.7 | 20.82 | 123.30 | 22.6 |
| 17-18 | 19 | 1.57 | .93 | | | 26.2 | | 219.5 | 22.1 | 23.44 | 136.67 | 21.7 |
| 18-19 | 17 | .57 | .39 | | | 34.5 | | 321.8 | 32.9 | 33.91 | 197.64 | 18.1 |
| 19-20 | 17 | .86 | 1.09 | | | 41.1 | | 339.5 | 36.5 | 36.34 | 212.15 | 17.4 |
| 20-21 | 17 | 1.36 | 1.65 | | | 48.1 | | 430.0 | 24.7 | 45.39 | 262.61 | 13.8 |
| 21-22 | 16 | 1.19 | .92 | | | 43.0 | | 423.2 | | 43.97 | 251.69 | 15.3 |
| 22-23 | 11 | 1.20 | 1.73 | | | 36.8 | | 387.2 | | 39.94 | 228.46 | 16.4 |
| 23-24 | 11 | 1.98 | 1.67 | | | 60.5 | | 588.2 | | 61.21 | 350.34 | 9.2 |

* Calf starter.

† Missouri Agricultural Experiment Station Bulletin 338.

Table 7.--The Average Monthly Consumption, Digestible Nutrients, and the Average Daily Gains--Jersey Females

| Age Months | No. of Animals | Average Daily Gain | | Grain (lbs.) | Alfalfa hay (lbs.) | Lespedeza hay (lbs.) | Atlas Sorgo (lbs.) | T.D.N. | D.C.P. | Pasture Days |
|------------|----------------|--------------------|----------------|--------------|--------------------|----------------------|--------------------|--------|--------|--------------|
| | | Lbs. | Normal* (lbs.) | | | | | | | |
| 6- 7 | 4 | 1.31 | 1.37 | 75 | 90 | | | 98.95 | 18.33 | 14.8 |
| 7- 8 | 4 | .74 | 1.15 | 76.3 | 91.5 | | | 100.63 | 18.64 | 15.3 |
| 8- 9 | 4 | .94 | 1.04 | 82.7 | 94.5 | | | 106.72 | 19.71 | 15.3 |
| 9-10 | 4 | .95 | .97 | 69.9 | 102.8 | 105 | 150 | 179.20 | 29.75 | 7.5 |
| 10-11 | 4 | .57 | .88 | 60.9 | 77.9 | 108.5 | 155 | 162.82 | 26.72 | 10.1 |
| 11-12 | 4 | .62 | 1.00 | 32.8 | 61.2 | 213.5 | 305 | 211.76 | 32.41 | 7.8 |
| 12-13 | 5 | .44 | .82 | 25.3 | 26.4 | 252.0 | 360 | 217.29 | 31.83 | 8.4 |
| 13-14 | 5 | .88 | .78 | 44.0 | | 249.4 | 360 | 216.04 | 30.98 | 12.4 |
| 14-15 | 5 | .53 | .91 | 65.0 | | 221.4 | 320 | 210.41 | 30.55 | 12.2 |
| 15-16 | 5 | .23 | .91 | 52.0 | | 143.0 | 208 | 143.27 | 20.91 | 18.4 |
| 16-17 | 5 | .57 | .81 | 21.0 | | 58.8 | 80.4 | 57.86 | 8.51 | 24.6 |
| 17-18 | 5 | .70 | .73 | | | | | | | 30.6 |
| 18-19 | 4 | 1.22 | .97 | 21.7 | | 206.2 | | 123.17 | 21.51 | 22.8 |
| 19-20 | 4 | .95 | .73 | 21.7 | | 206.1 | | 123.17 | 21.51 | 22.8 |
| 20-21 | 4 | .97 | .83 | 42.0 | | 417.1 | | 247.79 | 43.30 | 15.3 |
| 21-22 | 4 | 1.06 | .86 | 43.4 | | 417.1 | | 248.79 | 43.46 | 15.2 |
| 22-23 | 4 | 1.44 | 1.28 | 20.3 | | 210.9 | | 124.62 | 21.78 | 22.8 |
| 23-24 | 4 | .75 | .91 | 43.4 | | 417.1 | | 248.79 | 43.46 | 15.2 |

* From Missouri Agricultural Experiment Station Bulletin 338

In these experiments approximately 55% of the digestible crude protein and the total digestible nutrients were secured from pasture. The practical applications of these facts can mean the savings of many dollars to Missouri dairymen in raising heifers of normal size at

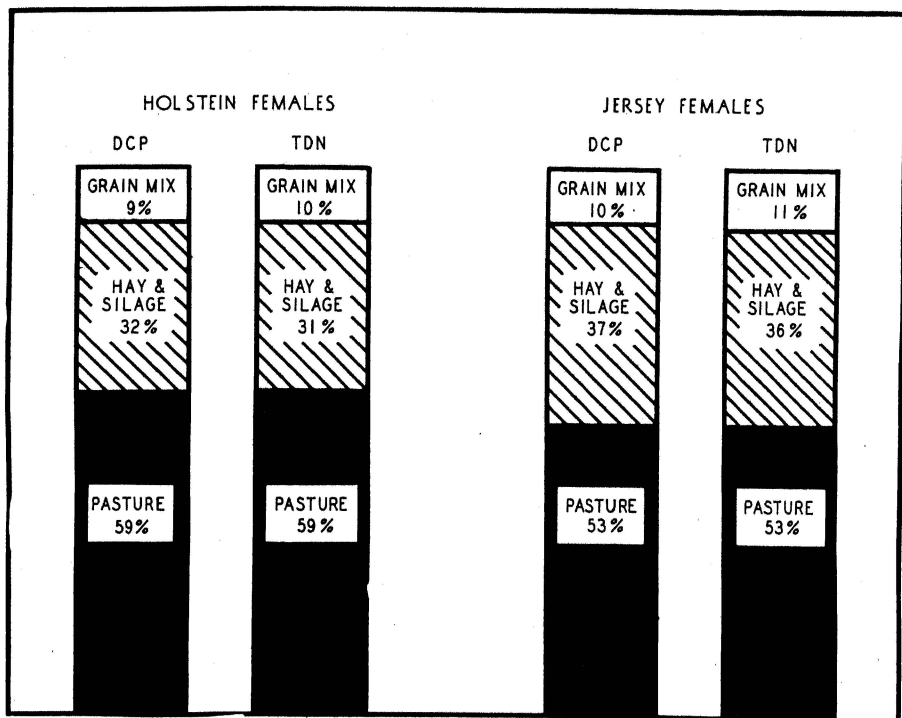


Fig. 5.—Relative proportion of digestible crude protein and total digestible nutrients furnished by grain, hay, silage and pasture for growing Holstein and Jersey heifers.

freshening time. Much emphasis must be placed on the proper feeding and growth of the heifer to 6 months of age, however, if proper growth and development on a heavy roughage feeding program is to result. The heifer below 6 to 9 months of age is not sufficiently well developed with respect to the rumen and barrel capacity to ingest enough total roughage to supply the nutrients for maximum growth. The feeding of optimum amounts of milk and concentrates the first few months cannot be emphasized too strongly. Heifers from 8 to 24 months of age can handle roughages very satisfactorily. The time required to grow a heifer is a factor not to be overlooked, because it is a non-productive period. In these studies any system of management which failed to produce approximately normal growth at freshening time was considered inadvisable and poor economy.

Feeding and Management for Growing Heifers on Maximum Roughage Ration

The new born calf should receive the first milk or colostrum, then fed the first 6 to 8 weeks on whole milk and a dry calf starter ration as herein described, or if skim milk is available the calf should be changed from whole milk to skim milk at 3 to 4 weeks of age. Grain feed and leafy hay should be provided at the end of the first week. Practical plans for growing the dairy calf to 6 months of age are given in detail in Missouri Agriculture Experiment Station Bulletin 377, "Raising The Dairy Calf" and the reader is urged to consult that publication for further details, including care of the dry cow, the new born calf, and sanitation measures.

Feeding Heifers from 6-12 Months of Age.—Feed concentrates until the heifers are 10-12 months of age if in winter, or until the animals are 8-10 months of age if they are on pasture. The amount of concentrates received will depend on the quality and amount of pasture, hay, silage or other roughage the heifer consumes. With roughage of high quality 2 to 3 lbs. of concentrates per head daily should be enough, while with roughage of only fair quality 4 to 5 lbs. daily may be required to keep them growing properly. Heifers 6-12 months of age will normally consume 8 to 15 lbs. of hay per day or 5 to 10 pounds of hay and 8 to 15 pounds of silage. Heifers on good pasture need little or no grain after 10 months of age. Water and a mineral mixture of steamed bone meal and salt (equal parts) should be kept before them at all times.

Feeding Heifers Over One Year of Age.—After heifers reach the age of one year their capacity to utilize roughage is well developed and little concentrates are necessary provided the roughage is of high quality. When on good pasture no concentrates are necessary but when grazing is scant additional feed in the form of hay, silage or concentrates or a combination of these is necessary. Heifers of this age may be wintered satisfactorily, up to 3 or 4 months before calving, if fed all the good legume hay and corn or sorgo silage they will consume, or on all the well cured legume hay they will eat. Heifers wintered in this way will not carry as much weight as some breeders desire but the skeletal growth will approximate normal.

With roughage of poor quality it is necessary to feed small amounts of concentrates to obtain the normal rate of growth. If the roughage is fair in quality not over 2-4 pounds of grain daily should be needed up to 3 or 4 months before calving. During the period 3 to 4 months prior to calving the heifer should be fed all the good roughage she will consume plus 4 to 5 pounds of concentrates in order to meet the need for nutrients in the developing fetus and also so the heifer will freshen in good condition for high production during her first lactation.