(2) The addition of corn oil to a milo-urea ration did not greatly improve performance, but a complex vitamin-trace mineral plus corn oil improved the rate of gain of calves on a milo-urea ration.

Pilot trials with individually-fed identical twin calves fed high milo rations indicated that:

(1) Neither the addition of urea to a cottonseed meal ration nor the replacement of cottonseed meal with soybean meal was of benefit.

(2) Either the replacement of cottonseed meal with fish meal or the addition of copper to a urea ration improved rate and efficiency of gain.

The Relationship Of Animal Age To Lean, Fat And Bone In The Beef Carcass

R. L. Henrickson and R. L. Monroe

Previous beef carcass investigations pertaining to body composition have used animals that include a variation in age, breed, sex, grade, etc. Carcass studies have demonstrated the wide variation in fat composition from animals on a fattening ration. However, age and breed also have caused marked differences in carcass composition.

In general, many beef carcasses today carry more fat, both external and internal, than is desired by the consuming public. Recognition by those in human nutrition and the medical profession that excessive amounts of fat may be harmful to the human body, has caused widespread interest in the fat problem. The role of animal fat in the diet has not been clearly delineated; however, it does appear that less fat is required than was formerly provided in good quality meat. Since removal of excess fat is one of the major problems confronting the beef industry, it is appropriate to determine tissue development during the growth period.

Procedure

Thirty-six Hereford heifers were used to investigate the effect of advancing age on the changes in carcass tissues. The heifers at six months of age were randomly assigned to six age groups. During the period from 6 months until the first group was slaughtered, the calves nursed their dams and had free access to a creep feeder.

The first group was slaughtered when the animals averaged 9 months of age. Carcass measurements and tissue quantities at this age were used as the basis for calculating subsequent changes. The remaining animals were group-fed a fattening ration consisting of shelled corn, cottonseed meal and hulls, alfalfa hay and molasses until the assigned slaughter age was reached (12, 15, 18, 21 and 24 months). Slaughtering and chilling were done in accordance with standard research procedures. The tissues were physically separated with a knife. The lean was analyzed for fat content so as to express the data as "fat free lean."

Results

While it has taken many years to develop beef cattle with the capability of storing large amounts of fat, it will be necessary to bring about more lean development in a short period.

While breed, blood line and level of nutrition are of fundamental importance, sex, exercise and other factors may also influence the quantity of fat or muscle in a carcass. The main factor considered in this investigation was animal age.

It is evident from information in Table 1 that the slaughter weight of the cattle at 9 months of age may be considered average. The calves were from cows that had been on a low level of nutrition. Consequently, the calves received little milk and growth was delayed until they learned to eat the creep fed ration. This would point up the fact that many lightweight calves may be 9 to 12 months of age because of a restricted diet. Since these animals were not on a forced diet during their early growth period, these data should be interpreted to be less than the maximum amount of muscle and fat which would occur.

Carcass weight, as reflected by the weight of one side, is also a poor indication of production or production efficiency (Table 1). The side

Table 1. Influence of Animal Age on the Quantity of Lean Based on a Complete Physical Separation of One Side[1]

Slaughter Age (mo.)	9	12	15	18	21	24
Slaughter wt. (lb.)	451.8	519.7	712.2	844.3	1083.3	1183.6
Side wt. (lb.)	127.9	150.5	220.2	273.0	332.8	389.4
Rib eye area (sq. in.)	5.9	6.5	8.4	9.2	10.7	12.3
Muscle wt. (lb.)[2]	70.6	80.5	103.7	122.1	125.9	143.5
Muscle %	55.7	53.1	47.3	45.9	41.0	42.1
Muscle-Bone ratio	2.9	3.0	2.5	2.7	2.2	2.5
Muscle fiber dia. (u)[3]	44.1	46.7	52.8	54.5	61.5	66.9
Muscle fiber area (sq. u)[4]	1533.1	1723.5	2202.7	2357.2	2940.9	3512.3

[1]The left side of each carcass was used.
[2]Muscle is reported as fat free.
[3]Rib eye muscle.
[4]Cross-sectional area.

weight increased threefold during the 15 month period from 9 to 24 months. However, the actual lean as measured by the rib area or total fat-free lean only doubled during this same growth period. Previous work has shown that age, up to 12 months, has a great effect upon muscle weight distribution. Considerable change in muscle weight associated with age accrued between birth and 9 months of age. It is interesting to note that rib eye area does closely parallel total muscle weight during the period from 9 to 24 months. This is as would be expected since the muscle groups surrounding the vertebra develop at a rate similar to muscle as a whole in the carcass. The remaining weight difference is that of fat and bone.

Percent lean in the side decreased by 13.6 percent during the growth period. It is readily obvious that percent lean in the side or carcass does not reflect a true measure of growth. This reduction in percent lean is the result of rapid fat deposition.

Muscle-bone relationships are of some use in interpreting the value of production. Previous work has shown that the muscle-to-bone ratio increases with age up to 12 months. The findings in this investigation further show a decrease in muscle-bone ratio as fat becomes a confounding factor.

Major changes in muscle fiber size occur with advances in age. At 9 months of age the cross-sectional fiber area was 1533.1 square microns, whereas at 24 months the area had increased to 3512.3 square microns (Table 1). Thus, more than a doubling of fiber area accrued during this 15 month period. Muscle weight also doubled during this period. The increase in cross-sectional fiber area may account for the change in total muscle weight.

Changes in fat and bone deposition during the fattening period are presented in Table 2. At 9 months of age, only a trace of marbling was observed. At 24 months the amount increased to "moderately abundant." There would appear to be some direct correlation between the quantity of marbling and outside fat cover. However, other work has shown that marbling may be present without excessive outside fat cover. These data reflect a five-fold increase in fat weight as the animal matures from 9 to 24 months. The percentage of fat increased from 25.0 to 43.1 Bone weight increased with animal age while the percentage of bone decreased. This was primarily influenced by the great quantities of fat which are deposited during the fattening period.

Specific gravity has been considered a measure which would reflect the level of fatness. It is evident from the data in Table 2 that the fatter carcass will have a lower specific gravity. Similar values were obtained when the specific gravity data from one side is compared with those from both sides. Thus it becomes obvious that only one side of the carcass would need to be subjected to the specific gravity treatment to gain a measure of carcass fat.

Table 2. Changes in Fat, Lean and Specific Gravity as Influenced by Animal Age

Slaughter Age (mo.)	9	12	15	18	21	24
Marbling	Traces	Traces	Sm.Amt.	Sm.Amt.	Modest	M.Abundant
Fat thickness (in.)	0.2	0.4	0.6	0.9	1.0	1.4
Fat wt. (lb.)	32.5	43.8	74.9	102.3	137.7	168.6
Fat (%)	25.0	28.9	33.8	37.3	41.4	43.1
Bone wt. (lb.)	24.5	26.9	41.3	45.8	58.7	58.1
Bone (%)	19.3	18.1	18.7	17.0	17.7	14.8
Specific gravity (side	1.0702	1.0667	1.0563	1.0462	1.0292	1.0258
Specific gravity (carcass)[1]	1.0686	1.0658	1.0567	1.0455	1.0296	1.0249

[1]Both sides of the carcass were used.

Summary

Hereford heifers were used to reflect the changes in major tissue development from 9 to 24 months of age. Muscle weight from one side increased from 70.6 to 143.5 pounds, similar growth change was reflected by rib eye area measurements which increased from 5.9 to 12.3 square inches. The percent muscle in the side did not appear to be a good measure of carcass value since percent lean is inversely related to the quantity of fat. The muscle-bone ratio appeared to increase up to 12 months but further advancements in age resulted in a reduction. This was considered to be caused by the rapid increase of fat. Cross-sectional muscle fiber area increased with animal age and tended to reflect a direct relationship to total fat-free lean.

This investigation indicates the need for additional work on the development of muscle as affected by age, breeding and/or nutrition. The production factors must be studied from the standpoint of their effect upon muscle systems as a distinct entity, rather than wholesale, or retail cuts.

Fat in a choice carcass is generally abundant. Fat thickness at the 12th rib area provided a rapid means for determining differences in carcass fat. Specific gravity of one side was nearly as good as when both sides were used to measure fat difference.