ALFALFA VS. PRAIRIE HAY FROM BIRTH OR AFTER EIGHT WEEKS OF AGE FOR YOUNG DAIRY CALVES WITH OR WITHOUT AUREOMYCIN SUPPLEMENT

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INTRODUCTION

The economic importance of raising better dairy herd replacements, male and female, is constantly increasing. This need has called for research as to how these replacements can be raised with maximum efficiency. The major factors involved are as follows: the proper nutrition of the calf so that acceptable growth rates may be achieved; good management practices in order that the incidence of respiratory infection and other undesirable conditions may be kept at a minimum; and as economical as is consistent with good husbandry practices.

The discovery of antibiotics has given research workers a new tool to use in controlling undesirable environmental factors. Antibiotics have proven helpful to the diaryman in raising his replacements by reducing scours, respiratory and other diseases, thereby permitting the calves to increase their growth rate by utilizing the available feed nutrients more completely for general body growth and development. Those antibiotics that have proven useful to the dairyman are penicillin, streptomycin, terramycin, and aureomycin.

In 1948, Duggar (13) announced the preparation of aureomycin from Streptomycin Aureofaciens. Aureomycin has been placed in the category of an ideal therapeutic agent. This organism is in the group actinomyces, found mainly in the soil. Since it has proven to be effective against a wide range of organisms, it is designated as a "broad spectrum antibiotic". It is one of the most important antibiotics yet developed because it is effective against a great number of species of bacteria, has a low toxicity and low incidence of allergy, is effective when administered orally, has little or no tendency for organisms to become resistant to it, and is not inactivated by enzymes.

Previous experimental data indicate that oral administration of aureomycin to young dairy calves will stimulate growth, control scours, and increase efficiency of feed utilization (1, 2, 3, 6, 24, 33, 37, 38, 45, 46, 62, 63, 64). One of the theories given for the growth promoting effect obtained by administering aureomycin orally is that scours will be controlled. As yet, the exact mode of action is not known.

There is a controversy as to the importance of roughage in the diet of young dairy calves. Petersen (53) Mead and Harold (39), and Morrison (41), stated that roughage is important in the ration of young dairy calves because it will supply carotene and vitamin D which are essential to growth. Roughage also aids in the development of the rumen. Ralston Purina (57) indicate that roughage is not necessary up to eight weeks of age.

There is a disagreement by dairymen and research workers as to the kind of roughage that should be fed. Dairymen have indicated that non-legume hays are more desirable than legume hays because of their non-laxative properties. Research workers (61, 43, 23) have found that greater growth can be obtained from feeding legumes which they maintain are not too laxative for calves.

The purposes of this investigation are: 1. to determine the relative value of alfalfa and prairie hay fed from 0 to 16 weeks of age; 2. to determine the value of either prairie hay or alfalfa hay in the diet of young calves when fed from the 0 week or deferred until after 8 weeks of age; 3. to determine the relative value of alfalfa and prairie hay supplemented with 80 mg. of aureomycin from 0 to 10 weeks of age; and 4. to determine the effect of the ration on blood plasma vitamin A and carotene.

REVIEW OF LITERATURE

Effects of Roughage in the Diet of Young Calves

Research workers, (17, 39, 41, 53, 61) have found that young calves should have good quality roughage in their diets. However, other experimental data indicated that hay was not essential in the ration of young calves up to 9 weeks of age (57,74).

Mead and Harold (39) conducted a trial to determine the effect of a ration devoid of roughage, on growth, lactation, and reproduction of ruminants. The results showed that the animals failed to make normal growth when the ration was free from roughage. They observed that the appetite of the animal receiving only concentrates was excellent, but that it was necessary to limit the food consumption in an effort to avoid serious bloat.

Gullickson (17) kept Holstein calves indoors and fed them a normal ration, except for a very limited intake of prairie hay, to about the sixth month of age, after which they were fed only concentrates and a very limited amount of beet pulp. Vitamin D deficiency symptoms developed within a few weeks after the removal of hay from the ration.

Petersen (53) stated that hay was essential in the diet of young calves, and that calves that did not receive hay were likely to suffer from vitamin D deficiency, particularly during the winter or early spring. Morrison (41) concluded that roughage should be fed at 2 weeks of age. He indicated that green-colored, sun cured hay was a very good source of vitamin A and D, and that it had a good content of B-complex vitamins.

Rupel (61) was able to obtain normal growth of dairy calves from birth to 6 months on skim milk or whole milk, provided that good quality legume hay and concentrates were supplied at an early age. The only

concentrate fed was ground corn. He concluded that good legume hays were more desirable than carbonaceous roughages, such as timothy or prairie hay, because they contained more protein and also supplied vitamins essential to growth and health of young calves.

Skaggs (67) demonstrated that calves grew normally when fed dry starter and alfalfa hay alone after one month of whole milk feeding. He suggested if alfalfa cannot be furnished for the roughage, then the dry starter mixture should contain alfalfa leaf meal as a source of carotene.

Willard (73) fed dairy calves whole milk and an unlimited amount of alfalfa hay and concentrates until they were three months of age; thereafter, the grain consumption depended upon the consumption of hay. He observed that when a high level of grain was fed that the amount of hay consumed decreased. He concluded that the calves made normal growth and were able to make satisfactory growth on alfalfa hay alone after they were 9 months of age. In later studies, Willard (72) found that the consumption of hay varied significantly with individual calves.

Morrison et al. (43) demonstrated in a trial with dairy calves that a gain of 1.57 pound daily was made up to six months of age when fed a maximum of 400 pounds of whole milk, calf meal as a gruel, dry calf starter, and alfalfa hay. These gains were compared with an average daily gain of 1.30 pounds made during a previous experiment in which the calves received a limited amount of whole milk from birth and a simple calf starter fed dry without hay. They noted several cases of scours among the calves receiving alfalfa hay, but did not attribute the scouring to the hay. They concluded that alfalfa hay was not too laxative for dairy calves.

Morrison et al. (42) demonstrated that good thrifty calves can be raised on an allowance of skim milk limited to 10 pounds daily, if a good concentrate mixture and good hay were fed in addition. He obtained

excellent growth when 375 pounds of whole milk was fed during the first 7 to 9 weeks of age. After the calves were 9 weeks old, they were fed only a concentrate mixture along with good quality hay. Thereafter, the calves continued to make normal growth.

Jacobson and associates (23) devised an experiment to determine the value of prairie hay or alfalfa hay for growth of 5 month old dairy heifers, when fed with a grain ration of white corn and rice meal supplemented with minerals and linseed oil meal. Both roughages were fed ad libitum. The heifers made normal growth on such a ration, but those animals getting prairie hay had difficulties at calving. He concluded that prairie hay was low in vitamin A, causing a vitamin A deficiency. One group of calves was fed a ration of rice meal and white corn chops with alfalfa hay, but no minerals or protein supplements. The results indicated that growth was below normal. They concluded that the ration did not allow adequate nutrients for normal growth after weaning.

Williams et al. (74) found no apparent difference between prairie or alfalfa hay when fed to Holstein and Jersey calves from birth or beginning at the ninth week of age. It was found that alfalfa hay was not too laxative for normal health in young calves. The analysis of the blood indicated that there were no differences in the plasma vitamin A and carotene between calves that were fed alfalfa or prairie hay.

Norton (50) fed three groups of Holstein calves either alfalfa, mixed grass and legume, or timothy hay for a period of 20 weeks to determine the comparative value of these roughages. A total of 350 pounds of whole milk was fed over a 7 week period. Calf starter was fed free choice up to a maximum consumption of 4 pounds per head. It was observed at 20 weeks that those calves that received alfalfa consumed larger amounts of hay than those fed timothy or mixed grass and legume hays.

He noted that 3 calves receiving alfalfa consumed less starter than the calves receiving mixed grass and legume and timothy. The growth gains were similar for all groups, but those that received alfalfa or mixed grass and legume exceeded the Ragsdale growth standard (56). Those calves receiving timothy hay were below the Ragsdale growth standard. He suggested that if the starter had been limited to less than 4 pounds daily the difference in growth would have been greater. From these data it appeared that calves receiving legume hay will eat less starter than calves receiving non-legume hay.

Norton and Eaton (51) found that the hay consumption fluctuated with the quality of hay fed. They suggested that the quality of hay was as important in the promotion of growth in calves as the kind of starter fed.

Turk et al. (68) conducted an experiment to compare the consumption of alfalfa, mixed grass and legume, and timothy hays that were crushed at the time of cutting. They noted that field crushing increased hay consumption. They concluded that crushing the hay improved the palatability of the roughage.

According to Morrison (41), legume hays excelled non-legume hays for dairy calves because of their higher contents of protein, calcium, and vitamins.

Huffman (22) found similar results to those reported by Morrison. He reported that the protein content of legume hay varied widely and that under certain conditions non-legume hay might surpass legume hays. Factors that affected the composition of legume hay were maturity when cut, method of making hay, the cutting, and many others.

Cave and associates (10) conducted a trial to measure the nutritive value of prairie hay when fed to dairy calves from birth to 6 months of age from cows that had been fed the same kind of hay. All calves

received prairie hay ad libitum and a grain mixture consisting of equal parts of white corn and wheat bran. The grain was not to exceed 3 pounds daily. All calves received mixed herd milk for two weeks and after this were changed to skim milk for the duration of the experiment. At the end of the trial, the calves were tested for night blindness. There was no evidence of any defect in their sight. Blood analyses were made at monthly intervals and showed no significant deviation from normal calves. Carotene determination on the hay indicated that the calves were receiving sufficient vitamin A. The gains made were normal when compared to gains of the herd calves at Kansas State College.

Boyer and associates (9) conducted a trial to determine the blood plasma concentration and the intakes of carotene and vitamin A necessary for the growing calf. Their work showed that 10 micrograms or more of blood plasma vitamin A per 100 ml. of blood was necessary for adequate vitamin A nutrition of the growing calf. Blood plasma vitamin A levels of 7-8 micrograms per 100 ml. of blood were borderline levels while values below this were definitely inadequate. Daily intakes of vitamin A which would maintain deficient, borderline, and adequate concentrations of blood plasma vitamin A were found to be approximately 6, 12, and 18 micrograms per kg. of body weight, respectively. The daily carotene requirements necessary to maintain an adequate plasma vitamin A level and prevent deficiency symptoms were 75 micrograms per kg. for Holstein yearlings. The blood plasma carotene levels necessary to maintain adequate blood vitamin A were 50-70 micrograms of carotene per 100 ml. of plasma.

Ross and co-workers (60) found that the critical blood plasma vitamin A concentration was 6 to 8 micrograms per 100 ml. of blood plasma, when gain in body weight was used as a criterion.

Jacobson et al. (25) studied the blood plasma vitamin A levels and vitamin A stores of calves fed varying amounts of supplemented vitamin A and those reared with present day feeding practices. According to present methods of raising calves with a limited amount of whole milk with hay of above average quality, 2 to 4 weeks were required to deplete the liver of its stores. They considered the stores depleted when the blood plasma vitamin A values reached 4 micrograms per 100 ml. of plasma. The supplementing of vitamin A to calves decreased the number of cases of scours.

Lundquist and Phillips (36) found that blood plasma vitamin A and carotene were extremely low at birth. On the second day after feeding colostrum, the values obtained were 15 to 18 micrograms per 100 ml. of blood and they dropped shortly thereafter. Their data indicated that scouring was more frequent among dairy calves with low blood plasma vitamin A. They demonstrated that administering vitamin A to calves with low vitamin A values was effective in reducing scours.

Moore et al. (40) reported that blood plasma vitamin A values ranged from 7.2 to 14 micrograms per 100 ml. of plasma when dairy calves were fed whole milk, grain, and hay from birth to 4 months of age. They obtained higher blood plasma vitamin A values for calves receiving all legume hay than those receiving mixed legume and grass hay. They concluded that when the roughage was of poor quality that supplementation of vitamin A was needed up to three months of age.

Ellenberger et al. (15) found no appreciable difference in the efficiency of gain among 4 different groups of calves that received good hay, good hay plus a vitamin A supplement, poor hay, and poor hay plus a vitamin A supplement. However, at 24 months of age the group receiving good hay had made an average of 6 per cent more gain than the group

receiving poor hay. They concluded that cod-liver oil concentrates were of no apparent advantage as a supplement to good hay, but that they might have a favorable effect as a supplement to poor hay when growth was used as a criterion.

Gullickson et al. (18) conducted a trial to determine the effect of feeding cod-liver oil on growth of dairy heifers from birth to 6 months of age. Whole milk was fed for 30 days and then was replaced with skim milk. Alfalfa hay was fed ad libitum and a grain mix up to 4 pounds daily. He noted somewhat less digestive troubles in those calves receiving the cod-liver oil than among the non-supplemented group. No significant difference was noted in the rate of gain and height at withers between the supplemented and the non-supplemented group.

Keener et al. (28) observed that respiratory and bowel disturbances were more prevalent during a period of low blood vitamin A than when the blood vitamin A levels were high. Moore and Berry (40) indicated that calves were subject to serious infection if they did not receive adequate vitamin A and carotene value after birth.

Krauss and co-workers (31) reported a decrease in the incidence of pneumonia in calves which received 15,000 units of vitamin A concentrate daily. Phillips et al. (55) found that calf scours and pneumonia could be reduced by administering supplements high in vitamin A.

Nevens and Kendall (49) fed dairy calves vitamin A and D in an oil concentrate from birth to 30 days of age to determine the effect on the incidence of scours and growth. Their results showed that vitamin supplements were not effective in reducing the number of cases of scours or in increasing the rate of gain.

Hibbs and Krauss (20) reported that supplementing 250,000 units of vitamin A on the third and tenth day after birth was not effective in

lowering the incidence or severity of scours. They concluded that calves with severe scours often had plasma vitamin A levels as low as 4.5 micrograms per 100 ml.

Norton et al. (52) conducted a trial with 60 heifer calves of several breeds, supplemented with vitamin A, D, and ascorbic acid to determine the effect of these vitamins on the incidence of scours. They reported that the feeding of these vitamins did not reduce the incidence or severity of scours.

Wise and associates (76) reported results showing that after blood carotenoids reached a peak on about the third day as a result of colostrum feeding, there was a rigid decline for 4 to 5 weeks and then a gradual rise to the post colostrum feeding level or slightly above at 8 to 10 weeks of age. Vitamin A followed a somewhat similar trend.

Moore and Berry (40) studied the effect of colostrum on the vitamin A and carotene content of blood plasma of the newborn calf. The results showed that the blood plasma of the newborn calf was low in vitamin A and carotene. The maximum blood plasma vitamin A would be reached about the 3rd or 4th day of age with a gradual decline thereafter until about 7 to 8 weeks of age. The carotene content of the blood plasma showed a similar trend to that of vitamin A. They concluded that the decline in plasma vitamin A and carotene values after 3 or 4 days was due to the fact that calves were removed from their dams and fed whole milk which was lower in vitamin A than colostrum.

Hibbs and associates (21) studied the influence of the ration and early rumen development on the changes occurring in plasma carotenoids, vitamin A, and ascorbic acid of dairy calves during their early postnatal development. The calves were inoculated with regurgitated material obtained directly from a mature cow. They concluded that rumen inoculation

had no marked effect on the blood carotenoid levels and that neither the inoculation nor the type of ration fed markedly influenced the blood plasma vitamin A. However, results indicated that high quality hay stimulated the development of the rumen function in young calves and appeared to have favorable effects in meeting the vitamin needs.

Ronning and Knodt (59) studied the absorption of vitamin A natural esters by young Holstein calves. The results from administering various levels of vitamin A and carotene indicated that blood plasma vitamin A was increased by administering vitamin A. The blood plasma vitamin A was not consistently increased by the administration of carotene. However, there was a great deal of individual variation observed in the changes in blood plasma levels of both the vitamin A and carotene-fed calves. A possible explanation for not getting an increase in blood plasma vitamin A after the administration of carotene may be due to the inability of the calves to convert carotene to vitamin A efficiently at an early age.

Lundquist and Phillips (36) fed skim milk and 330,000 micrograms of beta carotene daily to a newborn calf for 7 days, and 165,000 micrograms thereafter to determine if calves could use carotene as a precursor of vitamin A. Their results showed that blood plasma vitamin A values dropped on the 4th day regardless of the amount of carotene administered. This indicated that the newborn calf did not possess the ability to convert carotene into vitamin A efficiently.

Eaton and co-workers (14) studied the relative value of field-cured, field-baled hay, artificially dried and ground hay, and artificially dried and pelleted hay as a source of carotene and roughage for dairy calves from 7 to 105 days of age. Those calves receiving artificially dried and pelleted hay were consuming greater amounts of carotene, and had higher blood plasma levels of carotene and vitamin A. The calves

fed artificially dried and pelleted hay also showed a greater increase in live weight than those groups fed field-cured, field-baled hays or the artificially dried and ground hays. The time required to deplete the calves of vitamin A stores after 105 days was twice as long for those fed artificially dried and ground hay as for those fed field-cured, field-baled hay. This indicated that the quality of hay fed would influence the blood plasma carotene and vitamin A levels.

Aureomycin in Calf Nutrition

In 1948, Duggar (13) announced the preparation of aureomycin from Streptomycin aureofaciens. Extensive investigations have been conducted with this bactericide not only as a growth stimulant in animal nutrition, but also as a therapeutic agent in human and veterinary medicine.

Experiments have been conducted with a material designated as animal protein factor (32,66,75). The impure form containing minute amounts of antibiotics and vitamin B_{12} has been fed to dairy calves with the purpose of reducing scours and increasing growth rates. Loosli and Wallace (32) found that either A P F containing aureomycin or crystalline aureomycin HCl added to a liquid milk substitute significantly increased the growth rate and reduced the severity and incidence of diarrhea in calves up to eight weeks of age. Since similar results were obtained from feeding A P F, which contained aureomycin, and crystalline aureomycin, they suggested that the beneficial results obtained were due to the antibiotic in the ration.

Rusoff and Haq (66) demonstrated that the supplementing of vitamin B_{12} or A P F concentrate in an all vegetable protein calf starter was without effect on growth, feed efficiency, and scouring of calves up to 90 days of age. One calf which did not receive either treatment was injected

weekly with 1 mg. of crystalline vitamin B_{12} from 4 to 13 weeks of age. They found that this had no effect on growth, feed efficiency, or incidence of scours. Williams and Knodt (75) found that the addition of A P F, containing vitamin B_{12}, to the basal milk replacement ration did not enhance growth above that obtained from the basal group. They concluded that the A P F used contained only minute amounts of aureomycin.

Bloom and Knodt (5) conducted a trial to study the value of vitamin B_{12}, DL-methionine, K-penicillin, and aureomycin in a milk replacement formula for dairy calves. Results of this trial indicated that the use of a milk replacement supplemented with vitamin B_{12} or DL-methionine, improved the rates of growth of the calves. K-penicillin decreased the rate of gain and starter consumed. Bloom and Knodt (6) in another experiment found that the addition of an aureomycin supplement containing vitamin B_{12} to a milk replacement formula significantly increased the rate of gain in weight of calves up to 12 weeks of age. These workers observed the greatest effect during the first 4 weeks of age.

Morrison and Deal (44) observed no difference in weight gain, incidence of scours, general health, or feed consumption in dairy calves when an antibiotic supplement was fed at the rate of 1 per cent of the dry matter content of the milk, from birth to 2 weeks of age. Since scouring was not a problem in the control or supplemented groups, this was offered as an explanation for the results obtained.

Murdock et al. (45) studied the effect of aureomycin on growth, scours, and feed utilization when fed to dairy calves from birth to 12 weeks of age. Their observations indicated that aureomycin fed calves made significantly greater gains than the controls at 6 weeks, but at 12 weeks there was no difference in the weight gains between the groups. However, efficiency of feed utilization was slightly higher for the

supplemented group at the end of the 12 week period.

Mackay and associates (37) studied the influence of an antibiotic feed supplement containing aureomycin on growth, feed utilization, and the incidence of scours in dairy calves. They noted that the aureomycin supplement containing vitamin B_{12} significantly increased the growth rate of calves from birth to 12 weeks of age. The average daily gain for the supplemented group was 1.68 lb. as compared to 1.50 lb. for the control calves. Daily observations indicated that scouring was not a problem and yet the antibiotic was stimulatory to growth. There were no significant differences between the controls and the supplemented group in feed efficiency at 12 weeks.

Loosli and Warner (33) found that calves fed antibiotics gained 22 per cent more rapidly during the first 8 weeks than the controls; also, further observations indicated that the feeding of antibiotics increased the efficiency of feed utilization.

Bartley et al. (1) demonstrated that the feeding of 15 mg. of aureomycin per 100 pounds of body weight daily to dairy calves was effective in increasing growth rate and reducing the incidence of scours from birth to 12 weeks of age. The body weight gains at the end of 7 weeks were 157 per cent and 138 per cent of the birth weight, respectively, for the supplemented and control groups. They found that the supplemented group required less T.D.N. to produce a pound of gain than did the control group. Aureomycin was discontinued after 7 weeks for one group, and at the end of the 12 week period there was no statistical difference in gain between the two groups. It appeared that the discontinuation of aureomycin resulted in some physiological disorder. They concluded that this was responsible for the reduced growth rate during the last 5 weeks of the experiment.

McGilliard and co-workers (38) fed 70 mg. of aureomycin daily to calves from birth to 35 days of age and observed that the average daily gains were twice as great for the supplemented calves as for the control calves. At 35 days of age, aureomycin was discontinued and for the following 11 weeks the control calves made greater gains than the supplemented group. They suggested that aureomycin delayed the rumen microorganisms in becoming established and prevented normal growth later in life.

Jacobson et al. (26) conducted an experiment to determine the effect of feeding 80 mg. of crystalline aureomycin HCl daily to dairy calves from 4 to 116 days of age. At 116 days the calves fed aureomycin averaged 236 pounds and the control group averaged 193 pounds. A second experiment was conducted by Jacobson and associates (27) to determine the effect of continuing the feeding of 80 mg. aureomycin daily to the 116 day old dairy calves for a period of 12 weeks. The effects of removing aureomycin from the ration at 116 days of age were also studied. The observations made at the end of the 12 week experiment indicated that the calves receiving aureomycin made greater gains than did the controls. The removal of aureomycin from the ration at 116 days resulted in an abrupt diminution in rate of growth. The introduction of aureomycin into the diet of calves not previously fed the antibiotic resulted in an early increase in growth rate.

Rusoff et al. (64) found that an aureomycin supplement fed as 2 per cent of an all vegetable protein calf starter, and 75-150 mg. crystalline aureomycin fed by capsule daily stimulated the growth of dairy calves by 20 per cent over that of the controls through 16 weeks. They observed that crystalline aureomycin prevented the onset of scours

early in life while the supplement was not effective until 30 days of age. Crystalline aureomycin was fed at the rate of 75 mg. for the first 10 weeks and 150 mg. for the last 6 weeks, so that equal amounts of the aureomycin supplement and crystalline aureomycin would be consumed. The examination of 122 rumen smears from calves from birth to 8 weeks of age, and one calf from birth to 16 weeks of age, failed to indicate any detrimental effect of aureomycin supplement or pure aureomycin on the microflora of the rumen.

Bartley et al. (3) fed aureomycin to dairy calves at the rate of 3 and 9 gm. per 100 pounds of bodyweight daily from one week to 22 weeks of age. The gains made by both supplemented groups were superior to gains made by the control calves. They found that the supplemented groups required less T.D.N. per pound of gain, indicating a more efficient utilization of feed. Further observations indicated no visible detrimental effects on feed consumption, rumination, or growth from feeding 200-2500 mg. daily of crystalline aureomycin from 12 to 16 weeks of age. The direct microscopic examination of the rumen microflora did not indicate a consistent difference between the controls and the aureomycin fed calves. Preliminary culture studies suggested that there were some differences.

Rusoff et al. (63) found that dairy calves made 10-20 per cent greater weight gains than did the controls when 70 mg. of aureomycin was fed daily in the ration from birth to 16 weeks of age. They noted from bacteriological studies of the fecal content that the common bacterial groups of the intestine, namely, coliforms, enterococci, and clostridium perfringens were not inhibited by aureomycin feeding.

Richardson and associates (58) studied the effects of oral and parenteral administration of crystalline aureomycin HCl to dairy calves from birth to 4 weeks of age. They obtained an increase in growth rate

over the control animals when either 70 mg. was given by oral administration daily or 250 mg. was given in a single oral weekly dose. Results from preliminary data indicated that while growth response was observed, neither 125 nor 500 mg. in single oral weekly doses was as effective as 70 mg. administered daily. There were no growth benefits obtained by weekly intramuscular injections nor weekly subcutaneous implantation of 60 mg. of aureomycin. However, preliminary results indicated that growth rate was augmented by weekly intramuscular injection of 250 mg. of aureomycin. Rusoff et al. (65) obtained greater daily body weight gains from weekly intramuscular injection of 400 mg. of aureomycin than when 50 mg. per day was given orally to dairy calves from 4 to 112 days of age.

While the optimum levels of intake for aureomycin, B_{12} supplement, and crystalline aureomycin HCl have not been established, an experiment has been conducted by Knodt and Ross (30) to determine the effect of various levels of aureomycin in a milk replacement formula for dairy calves. A formula was supplemented with 2, 4, 6, 8, and 10 gm. of crystalline aureomycin HCl per 100 pounds of feed, respectively. Preliminary results through 6 weeks indicated no harmful effects of the higher intake of aureomycin and possibly some beneficial effects in terms of growth. Previously, workers (1,6,27,30,37,38,46,47,48,62,63, 64) have been feeding approximately 80 mg. of aureomycin and obtaining similar results. Bartley et al. (3) fed 2500 mg. of pure aureomycin daily to a 16 week old calf for 4 weeks without any visible detrimental effects. However, preliminary culture of the rumen microflora indicated that the organisms had been altered.

There is a question as to whether the type of ration fed will influence the growth rate of calves receiving aureomycin. Rusoff et al. (63)

conducted a trial to test whether the source of protein in an all vegetable protein calf starter would influence the effect of aureomycin when fed to young calves that were weaned at an early age. They concluded that there was little difference in average daily gain of those calves receiving soybean meal, cottonseed meal, or degossypolized cottonseed meal when fed with 70 mg. aureomycin daily from birth to 16 weeks. Those calves receiving soybean oil meal consumed less starter per pound of gain than did the calves fed cottonseed meal or degossypolized cottonseed meal.

Bloom and Knodt (8) found that feeding 5 to 20 mg. of aureomycin daily in a milk replacement stimulated the growth rate of young calves.

Loosli and associates (34) demonstrated that antibiotic supplement added to milk replacement at the rate of 2 per cent stimulated the growth rate in dairy calves from birth to 8 weeks of age. Those calves fed the antibiotics consumed 40 per cent more concentrates than the controls and required less T.D.N. per pound of gain.

Bloom and Knodt (7) conducted a trial with young dairy calves to determine the effect of feeding from 20 to 154 mg. of aureomycin supplement with a milk replacement and starter. The results indicated that there was no great difference in the rate of gain, consumption of starter and hay, or in the efficiency of feed utilization from feeding these various amounts of aureomycin.

Murley and associates (47) fed dairy calves 80 mg. of aureomycin daily from 4 to 60 days of age to determine the effect of aureomycin when fed with various "practical" and restricted diets. The addition of aureomycin to rations of (1). whole milk, hay and concentrate; (2). reconstituted skim milk, hay and concentrates; and (3). reconstituted skim milk was effective in increasing the weight gains when compared to gains of the control calves. The feed was adjusted so that the T.D.N.

intake was the same for each group. Since an increase in gain in weight was observed for those calves receiving aureomycin, an increase in feed utilization due to aureomycin feeding was indicated. Further observations indicated that there were no differences in the growth rates of those groups receiving aureomycin. They observed that scouring was less frequent among those calves receiving whole milk than those receiving reconstituted skim milk.

Murley et al. (46) in a subsequent trial found that calves fed 80 mg. of aureomycin daily made 41 per cent greater gains than did the controls when fed either whole milk or reconstituted skim milk from birth to 8 weeks of age. The supplemented calves consumed 15 per cent more concentrates and required less T.D.N. per pound of gain. Another trial was conducted to determine the effect of daily administration of 80 mg. of aureomycin on growth and feed utilization when calves were fed a restricted diet. The results indicated that aureomycin gave a slightly greater efficiency of "utilization" of carbohydrates, nitrogen, ash, and ether extract. There was no difference in weight gain between the control group and the supplemented group. When the calves were removed from their restricted diet and given hay and concentrates, the antibiotic supplemented calves exhibited greater weight gains and more efficient feed utilization than the non-supplemented calves.

Jacobson et al. (24) found that 80 mg. of aureomycin fed daily in a restricted diet of skim milk from birth to 60 days did not stimulate growth. Analysis of the urine for reduced sugars and nitrogen, and of the feces for dry matter, reducible sugars, nitrogen, ether extract, and ash revealed no differences attributable to aureomycin supplementation.

Voelker and Jacobson (70) studied the effects of the frequency of feeding milk replacement containing aureomycin to dairy calves from 4 to

88 days of age. Aureomycin was fed at the rate of 40 mg. daily during the first 60 days. For the remainder of the experiment the calves received 80 mg. of aureomycin. Half the calves in each group were fed milk replacement twice daily and the others were fed the same daily allowance in 4 feedings per day. The aureomycin fed calves gained 20 per cent more than the controls. There were no differences in growth rates observed due to the frequency of feeding the milk replacement with aureomycin.

Hibbs and co-workers (19) fed dairy calves 20-80 mg. of aureomycin daily from birth to 12 weeks of age with various ratios of hay to grain, to determine the effect on the performance of calves raised on a high roughage system. The calves fed aureomycin made greater gains than the controls. They found that those calves fed aureomycin consumed more feed, but had a greater efficiency of feed utilization.

Rusoff (62) conducted a 20 week experiment to determine the effect of adding 90-181 mg. of aureomycin daily to 14 week old dairy calves. The results indicated that the aureomycin fed calves made 30 per cent greater gains for the first 6 weeks of the experiment than did the controls. At the end of the experiment the gains for the supplemented groups were similar to those obtained for the control calves. He concluded that the response from feeding this antibiotic to ruminating calves was of a short duration.

Bartley and associates (2) studied the effects of supplementing the grain ration of dairy calves from 7 to 13 months of age with a 1 per cent level of aureomycin. These animals had previously received 45-90 mg. of aureomycin daily per 100 pounds of body weight from birth. The results indicated that aureomycin feeding from 7 to 13 months had no stimulating effect on growth. They stated that it is not known whether aureomycin feeding is necessary from 7 to 13 months of age to maintain the early

growth advantage made during the first 7 months of life.

Fincham and Voelker (16) fed 240 mg. of aureomycin daily to dairy calves from 4 days to 2½ years of age to determine the long-time effects of feeding aureomycin to growing heifers. The maximum growth stimulation from feeding aureomycin was observed from birth to 6 months. At the end of 12 months, the heifers receiving aureomycin had gained only 42 pounds more than the controls. Further observations indicated that there were no differences in efficiency of feed utilization between the controls and the supplemented group at 12 months of age. The number of services per conception was 1.21 and 1.64 for the controls and aureomycin group, respectively.

Wasserman and Duncan (71) found "in vitro" that penicillin, neomycin, and streptomycin at low levels were stimulatory to cellulolytic digestive organisms. Chloromycetin adversely affected the microorganisms of the rumen. It appeared that this was accomplished by a reduction in the number of other types of organisms not connected with cellulose digestion.

Bell et al. (4) fed 0.2 and 0.6 gm. of aureomycin daily in the ration to 620 pound steers to determine the effect on digestibility and general health of the animals for a 5 day period. It was observed that 0.6 gm. produced a marked anorexia and fetid diarrhea within 48 to 72 hours. They found that the addition of 0.2 gm. of aureomycin to the ration produced less digestive disturbance than 0.6 gm. However, the digestibility of crude fiber was reduced 50 per cent by the feeding of 0.2 gm. of aureomycin. They suggested that these levels, when fed to ruminating animals, altered the microflora and reduced the digestibility of crude fiber.

Loosli and Warner (33) found that when mature dairy cows were fed

700 mg. of aureomycin supplement daily in the grain ration there were no deleterious effects on feed consumption. Further observations indicated that 1000 mg. of aureomycin supplement caused a reduction in feed consumption.

Neumann and associates (48) demonstrated that aureomycin fed at the rate of 2 mg. per pound of dry feed in the crystalline form or as a crude concentrate to ruminating heifers for 150 days caused a severe reduction in the appetite of the heifers during the early part of the experiment. However, the continued feeding of aureomycin did not bring about any extremely unfavorable physiological disturbance beyond 150 days. Plate counts and gram stains of the rumen microflora indicated that the normal bacterial flora had been disturbed.

Voelker and Cason (69) found that yearling heifers on pasture which were receiving aureomycin gained more rapidly than the controls. Further observation indicated no harmful effects from feeding 200 mg. of pure aureomycin daily in the grain ration. Their attempt to produce scours by fecal inoculation was unsuccessful.

Chance and associates (11) found that the number of bacteria in the rumen increased when 0.5 gm. of aureomycin was added to the ration of two-year-old steers. Data on the rate of removal of dry matter, crude fiber, crude protein, and nitrogen-free extract were obtained. They concluded that aureomycin stimulated bacterial action in the rumen and may have caused a change in permeability of the rumen wall, which would facilitate faster absorption from the rumen. Chance et al. (12) conducted another experiment to study the influence of 0.5 gm. and 1.0 gm. of aureomycin on the microorganisms, as determined by the concentration of amino acids, riboflavin, nicotinic acid, and pantothenic acid in the rumen. Their results showed that the rate of removal of

the amino acids was accelerated by feeding aureomycin.

EXPERIMENTAL

A 16 week feeding trial was initiated to determine the relative value of alfalfa and prairie hay fed to young dairy calves either from the 0 week or deferring the feeding until after 8 weeks of age, to determine the effects of supplementing either alfalfa or prairie hay with 80 mg. of aureomycin daily from 48 hours after birth to 10 weeks of age, and to determine the effects of the ration on blood plasma vitamin A and carotene levels.

Eighteen Holstein and twelve Jersey male and female calves from the Oklahoma Agricultural and Mechanical College dairy herd were removed from their dams 48 hours after birth and randomized into one of 6 groups of 5 calves each, in such a way that the number of calves in each breed was the same for all groups (Table 1). Each group received the following treatment: Group I received alfalfa hay from birth and starter; Group II received alfalfa hay from birth, starter, and aureomycin; Group III received prairie hay from birth, starter, and aureomycin; Group IV received prairie hay after 8 weeks of age, starter, and aureomycin; Group V received alfalfa hay after 8 weeks, starter, and aureomycin; Group VI received prairie hay from birth and starter.

Those calves receiving aureomycin were given 80 mg. crystalline aureomycin HCl daily in gelatin capsules for the first 10 weeks of life.

All calves received their mother's colostrum for the first 48 hours after birth. On the second day they were placed in individual 3'6" x 5'10" solid-wall pens where they remained for the duration of the experimental period. The individual stalls were equipped with feed buckets for the feeding of the starter. Water was available to the calves in automatic cups at all times. The stalls were bedded with dry wood sawdust to prevent the consumption of the bedding so that accurate feed intake could be determined.

Table 1

Randomization of Calves to Treatment

Replicates or Blocks	Group					
	I	II	III	IV	V	VI
1	82 x	159 xx	112 x	81 xx	99 x	19 xx
2	10 xx	141 xx	142 xx	25 xx	172 xx	47 xx
3	95 x	28 xx	193 xx	119 x	186 x	113 x
4	143 xx	151 x	8 xx	93 x	45 xx	4 x
5	102 xx	23 x	124 x	118 xx	170 xx	169 xx

x denotes Jersey
xx denotes Holstein

The calves were fed a maximum of 375 pounds of Holstein herd milk over a period of 7 to 9 weeks depending upon the breed. Table 2 shows the daily milk allowance for each breed. A dry, 17 per cent total protein calf starter was fed ad libitum, starting at two days of age, up to a maximum of 5 pound daily (Table 3). Table 4 shows the chemical composition of the starter and hay as fed. The digestible nutrients per 100 pounds of feed has been calculated as shown in table 5.

Good quality alfalfa and prairie hay was fed ad libitum in individual racks, from two days of age or eight weeks of age, depending upon their group. All feed offered and refused was weighed daily and recorded.

The growth rates were determined by weight, chest circumference and height at withers at weekly intervals. Blood plasma vitamin A and carotene was determined by Kimble's (29) method at monthly intervals. The calves were bled at the same time of day for the duration of the experiment to minimize the effect of time of feeding on plasma carotene and vitamin A values. Daily observations were made and recorded on the general health and well-being of the individual calves for the duration of the experiment. If a calf had scours that persisted for more than two days, medication was administered. Those calves treated during the first half of the experiment received sulfathalidine. During the last half of the experiment, they were treated with 400 mg. crystalline aureomycin HCl daily until scouring stopped.

The carotene content of the hay was determined monthly by Peterson's (54) method so that carotene consumption could be calculated. The digestion coefficients used in calculating the intake of total digestible nutrients were taken from Morrison's Feeds and Feeding (41).

Table 2

Schedule of Milk Allowance by Weeks

	0	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Pound of Milk per day by breed											
Holstein	8	9	10	8	6	5	4	3			
Jersey	5	6	7	7	6	6	5	5	3	3	

Table 3

Calf Starter Formula

Feed Constituent	Pounds
Alfalfa leaf meal	100
Crimped oats	500
Cracked corn	550
Cottonseed meal (41%)	400
Dried buttermilk	100
Molasses (Blackstraps)	150
Wheat bran	200
Iodized salt	10
Steam bone meal	20
Total	2,030

Table 4

Chemical Composition of Feeds Fed and Digestion Coefficient[1]

Constituent	Dry Matter	Ash	Protein	Ether Extract	Crude Fiber	N.F.E.	Carotene
	%	%	%	%	%	%	P.P.M.
Calf starter (1st analysis)	91.42	6.25	18.78	4.32	8.10	62.55	5.2
Calf starter (2nd analysis)	92.16	5.82	18.50	4.40	5.87	57.57	4.6
Calf starter (3rd analysis)	90.26	5.74	16.64	3.80	6.67	57.41	1.7
Alfalfa hay (1st analysis)	94.87	7.03	12.06	1.80	36.60	42.51	26.7
Prairie hay (1st analysis)	94.79	7.08	4.72	2.45	30.65	55.10	27.3
Alfalfa hay (2nd analysis)	93.40	8.46	16.00	2.19	31.40	35.35	16.8
Prairie hay (2nd analysis)	93.39	7.30	4.84	2.69	28.94	49.62	25.0
Digestion coefficient							
Calf starter			79.19	89.23	44.00	84.93	
Alfalfa hay			71.00	32.00	44.00	70.00	
Prairie hay			37.00	38.00	64.00	58.00	

1. Taken from Morrison "Feeds and Feeding", 21st edition, 1948.

Table 5

Digestible Nutrients Per 100 Pound of Feed Fed

Feed	Protein	Ether Extract	Crude Fiber	N.F.E.	T.D.N.
	%	%	%	%	%
Calf starter (1st analysis)	14.87	8.67	3.56	53.12	80.2
Calf starter (2nd analysis)	14.65	8.83	2.58	48.84	74.9
Calf starter (3rd analysis)	13.18	7.63	2.93	48.71	72.5
Alfalfa hay (1st analysis)	8.56	1.30	16.10	29.76	55.7
Prairie hay (1st analysis)	1.75	2.09	19.62	31.96	55.4
Alfalfa hay (2nd analysis)	11.36	1.57	13.82	24.75	51.50
Prairie hay (2nd analysis)	1.79	2.30	18.52	28.78	51.4

RESULTS AND DISCUSSION

The Relative Value of Alfalfa and Prairie Hay With and Without 80 mg. of Aureomycin from Birth to 10 Weeks of Age

The data relating to the effects of alfalfa and prairie hay upon growth, feed consumption, and monthly blood plasma vitamin A and carotene, are presented in appendix tables I to XXX inclusive, and they are summarized in table 6. These results show little difference between alfalfa and prairie hay. The average total gain in weight at the end of 16 weeks was 138.47 pounds for groups III, IV and VI which received prairie hay. Those calves receiving alfalfa had an average total gain of 139.69 pounds at the end of 16 weeks. These results are shown in table 6. The average initial weight per calf was 80.13 pounds for group III, IV, and VI and 75.80 pounds for groups I, II, and V, are shown in table 6 as summarized from table 7. It is not known whether the difference in initial weight will affect the growth under the condition of this experiment. These gains were compared to the Ragsdale growth standard at 0 and at 16 weeks. The data indicate that the calves weighed less at 0 and at 16 weeks of age. It appeared from this experiment that the calves receiving alfalfa and prairie hay made normal growth when compared to the Ragsdale growth standard, table 8. Williams et al.(74) found no apparent difference in terms of growth between alfalfa and prairie hay fed from birth to 16 weeks of age without aureomycin. However, other workers (41, 43) have found that legume hay excelled non-legume hay.

Growth as measured by the height at withers and chest circumference indicates no difference between those fed either prairie or alfalfa hay for the total 16 weeks, table 6.

The average cases of scours, table 6, as summarized from table 9, were similar for those groups receiving alfalfa and prairie hay for the

Table 6

Prairie Hay vs. Alfalfa Hay With and Without 80 mg. of Aureomycin from 0 to 10 Weeks of Age.

	Groups III, IV & VI (prairie hay)				Groups I, II & V (Alfalfa hay)			
	Birth	4 wks.	10 wks.	16 wks.	Birth	4 wks.	10 wks.	16 wks.
Ave. lb. gain/calf		25.73	86.26	138.47		23.27	83.80	139.69
Ave. daily gain/calf		.92	1.23	1.23		.83	1.20	1.25
Ave. lb. T.D.N./lb. gain		2.05	2.23	2.79		2.27	2.21	2.74
Ave. increase at withers/calf		1.60	4.60	6.72		1.55	4.82	7.18
Ave. increase at heart girth/calf		2.18	6.54	10.08		2.22	6.83	10.10
Ave. milk consumption/calf		246.60	374.26	—		240.33	373.53	—
Ave. starter consumption/calf		15.32	147.87	347.70		14.23	135.42	331.84
Ave. hay consumption/calf		3.56	31.82	115.39		4.05	36.59	136.51
Ave. no. cases of scours/group		6.66	10.00	13.00		5.66	10.00	14.00
Ave. per cent increase in weight above initial weight		32.11	107.65	172.80		30.69	110.55	184.28
Ave. initial body weight	80.13				75.80			
Ave. total weight/calf		105.86	166.40	218.60		99.07	159.60	215.49

	Month							
	1	2	3	4	1	2	3	4
Ave. monthly blood plasma carotene	16.22	49.12	51.08	55.47	25.19	53.20	71.06	70.37
Ave. monthly blood plasma Vitamin A	6.46	6.40	6.46	7.32	7.01	6.25	9.36	7.33

Table 7

Average Per Cent Increase in Weight Above Initial Weight by Groups

Group	Initial Weight	Weeks		
		4	10	16
	(lb.)	(%)	(%)	(%)
I	74.8	29.9	98.4	175.4
II	76.2	36.0	117.8	196.3
III	74.4	45.2	119.6	172.0
IV	77.0	35.1	119.0	192.5
V	76.4	26.2	151.2	181.0
VI	89.0	18.7	87.7	156.4

Table 8

The Average Height at Withers, Heart Girth, and Bodyweight of Experimental Calves as Compared to the Ragsdale Standard

Group	Ragsdale Std. Growth			Experimental Calves Growth		
	Withers	Heart Girth	Weight	Withers	Heart Girth	Weight
at Birth	(in.)	(in.)	(lb.)	(in.)	(in.)	(lb.)
I & VI	28.0	29.8	79.3	27.9	29.6	81.5
II & III	27.9	29.7	77.8	27.5	29.0	76.2
II & III	27.9	29.7	77.8	27.5	29.0	76.2
IV & V	28.0	29.8	79.2	27.3	28.4	77.5
VI, III & IV	28.0	29.8	79.4	27.7	28.8	79.5
I, II & V	28.0	29.7	78.1	27.4	29.2	76.3
I	28.0	29.7	78.2	27.7	29.1	74.8
II	27.9	29.6	77.4	27.5	29.0	77.8
III	28.0	29.7	78.2	27.5	29.0	74.6
IV	28.1	29.8	79.6	27.6	28.5	78.6
V	28.0	29.7	78.8	27.0	28.3	76.4
VI	28.1	29.9	80.4	28.1	30.0	85.2
at 16 Weeks						
I & VI	34.8	41.9	222	35.0	39.0	217
II & III	34.0	41.5	222	35.2	39.0	214
II & III	34.0	41.5	222	35.2	39.0	214
IV & V	34.1	41.3	228	34.8	39.2	220
VI, III & IV	35.7	41.5	230	35.1	39.1	219
I, II & V	33.9	41.6	223	34.9	38.9	215
I	34.3	41.6	225	34.4	38.4	206
II	33.6	41.4	219	35.6	39.6	226
III	34.3	41.6	225	34.8	38.4	202
IV	34.5	40.9	230	34.9	39.6	225
V	33.7	41.7	225	34.6	38.7	215
VI	35.2	42.1	235	35.5	39.3	228

Table 9

Incidence of Scours in Dairy Calves
to 16 Weeks of Age With or Without 80 mg. of Aureomycin Daily
From Birth to 10 Weeks of Age

Group	Calf No.	Week 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I	82						x											
Alfalfa hay	10				x						x				x			
from birth	95	x	x												x			
	143	x		x	x						x							
	102		x		x			x	x	x	x	x		x	x			
II	159					x			x									x
Alfalfa hay	141	x	x															
from birth	28														x			
with	151		x	x									x			x		
aureomycin	23			x				x										
III	142																	
Prairie hay	112																	
from birth	193	x	x										x					
with	8	x		x					x				x	x				
aureomycin	124		x						x									
IV	25																	
Prairie hay	81				x									x				
after 8 wks	119		x	x								x			x	x		x
with	93			x						x								
aureomycin	118		x						x									
V	172		x	x														x
Alfalfa hay	99																x	
after 8 wks	45											x						
with	186											x		x		x		
aureomycin	170			x						x								
VI	19																	
Prairie hay	47				x				x								x	
from birth	113		x		x	x		x					x					
	4		x	x		x			x									
	169	x	x		x			x		x								

x = denotes one case of scours.

duration of the experiment. Scours were recorded if they persisted for more than two days and medication was administered after the second day. If the calves had mild scours they were not recorded. During the last 4 weeks of the experiment it was noted from the daily observations that the feces were thinner for those calves receiving alfalfa hay. However, this did not affect growth or feed consumption of the calves. Various workers (41, 43, 74) have found that legume hay is not too laxative for dairy calves. However, aureomycin may have been an aid in reducing the incidence of scours. Scours were not considered a problem during the 16 week period.

The average feed consumption per calf is given in table 6, as summarized from tables 10 and 11. At the end of 4 weeks those calves in groups I, II, and V, which received alfalfa hay, had consumed an average of 1.9 pounds less starter than those in groups III, IV, and VI, which received prairie hay. During the first 10 weeks those calves receiving alfalfa hay had consumed an average of 12.45 pounds less starter per calf than those receiving prairie hay. The average starter consumption for groups III, IV, VI, was 16.06 pounds more than groups I, II, and V at the end of the 16 week period.

The average hay consumption per calf at the end of 4 weeks was 1.1 pounds more for groups I, II, and V than groups III, IV, and VI. At 10 and 16 weeks those calves receiving alfalfa hay continued to consume more hay than those calves receiving prairie hay.

On a percentage basis, during the 16 week period those calves in groups I, II, and V consumed approximately 15 per cent more hay and 5 per cent less starter than groups III, IV, and VI, which received prairie hay. Norton (50) found that calves fed alfalfa hay consumed greater quantities of hay and less starter than did those groups receiving mixed grass and legume, and timothy hay.

Table 10

Average Total Starter and Hay Consumption per Calf per Group

Group	Starter Weeks			Hay Weeks		
	4	10	16	4	10	16
	(lb)	(lb)	(lb)	(lb)	(lb)	(lb)
I	12.3	116.38	307.16	6.56	42.38	125.64
II	18.84	145.68	348.82	5.60	44.70	148.92
III	15.16	145.80	324.12	5.60	43.14	125.40
IV	17.42	154.48	369.90		14.72	88.16
V	11.56	144.20	339.40		22.68	134.98
VI	13.40	141.34	349.12	5.08	37.60	132.60

Table 11

Total Starter and Hay Consumption by Groups

Group	Starter Weeks			Hay Weeks		
	4	10	16	4	10	16
	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)
I	61.50	591.90	1535.80	32.80	211.90	628.20
II	94.20	728.40	1744.10	28.00	223.50	744.60
III	75.80	729.00	1620.60	28.10	215.70	625.20
IV	87.10	772.40	1849.50		73.60	440.80
V	57.80	721.00	1697.00		113.40	674.90
VI	67.00	706.70	1745.60	25.40	188.00	663.30

No differences were found among the groups in efficiency of feed utilization, table 6.

The blood plasma carotene and vitamin A analyses are given in table 6, as summarized from tables 12 and 13. Those calves receiving alfalfa hay had a slightly higher blood plasma carotene level than those receiving prairie hay. The blood plasma vitamin A was similar for both groups for the entire experimental period. It should be noted (table 14) that the analyses of the hays show a great deal of variation. The average carotene in alfalfa hay for the nine months was 20.45 mcg. per gram and 22.42 mcg. per gram for the prairie hay fed for the same period. The daily observations did not reveal any vitamin A deficiency symptoms. Boyer et al. (9) noted that 10 micrograms or more blood plasma vitamin A per 100 c.c. of blood is necessary for adequate growth in the young dairy calf and blood plasma vitamin A levels below 7-8 micrograms per 100 c.c. of blood were definitely inadequate. The analyses show that those calves fed either prairie or alfalfa hay were inadequate for normal growth on this basis, table 6.

The data relative to the effect of feeding alfalfa and prairie hay as determined by growth and feed consumption, are given in table 15 for individual groups as summarized from Appendix tables I to XXX inclusive. From the 0 week through 16 weeks of age, the average gain made by group I was 131.30 pounds and 139.20 pounds for group VI, table 15. It should be noted that the initial weights were not the same (Table 8). It is not known whether the initial weight will influence the gain made by those calves in group VI under the conditions of this experiment. It appears from the comparison of these two groups that prairie hay may be superior in terms of growth when fed without aureomycin. The slight advantage in growth obtained from feeding prairie hay may be due to less frequent

Table 12

Average Monthly Blood Plasma Carotene by Groups

Group	Month 1	2	3	4
	(μ,%)	(μ.%)	(μ.%)	(μ.%)
I	26.75	54.94	97.88	80.87
II	30.42	71.41	58.00	60.64
III	14.92	59.52	53.70	48.88
IV	18.28	47.82	46.80	39.62
V	18.40	33.26	57.32	69.62
VI	15.46	40.04	52.76	77.92

μ% denotes micrograms of carotene per 100 ml. of blood plasma.

Table 13

Average Monthly Blood Plasma Vitamin A by Groups

Group	Month			
	1	2	3	4
	(μ%)	(μ%)	(μ%)	(μ%)
I	4.93	5.39	10.44	8.93
II	7.44	6.62	7.68	7.70
III	7.10	9.03	7.78	7.29
IV	7.01	5.48	6.35	6.65
V	8.65	6.75	9.96	5.37
VI	5.27	4.71	5.27	8.02

μ% denotes micrograms of vitamin A per 100 ml. of blood plasma.

Table 14

The Carotene Analyses of the Alfalfa and Prairie Hay from October through June

Month	Carotene	
	Alfalfa	Prairie
	P.P.M.	P.P.M.
October	26.7	27.3
November	34.6	18.9
December	32.3	27.9
January	16.8	25.0
February	23.2	13.4
March	12.3	26.3
April	11.2	28.0
May	18.1	20.2
June	8.9	14.8
Average	20.45	22.42

Table 15

Growth Gains and Feed Efficiency at 4, 10, and 16 Weeks of Calves Receiving Alfalfa or Prairie Hay and Supplemented With Aureomycin from Birth to 10 Weeks.

	Group I	Group II	Group III	Group IV	Group V	Group VI
Aureomycin HCl	none	80 mg.	80 mg.	80 mg.	80 mg.	none
	Alfalfa at birth	Alfalfa at birth	Prairie at birth	Prairie at 8 weeks	Alfalfa at 8 weeks	Prairie at birth
No. Holsteins	3	3	3	3	3	3
No. Jerseys	2	2	2	2	2	2
Ave. initial wt.	74.8	76.2	74.4	77.0	76.4	89.00
Ave. lb. gain per calf						
4 weeks	22.40	27.40	33.60	27.00	20.00	16.60
10 "	73.60	89.80	89.00	91.60	88.00	78.20
16 "	131.20	149.60	128.00	148.20	138.28	139.20
Ave. daily gain						
4 weeks	.80	.98	1.20	.96	.71	.59
10 "	1.05	1.28	1.27	1.31	1.26	1.12
16 "	1.17	1.34	1.14	1.32	1.23	1.24
Ave. lb. T.D.N. per lb. gain						
4 weeks	2.32	2.07	1.64	2.00	2.43	2.50
10 "	2.35	2.20	2.21	2.06	2.08	2.42
16 "	2.74	2.70	2.91	2.63	2.79	2.83
Ave. increase at withers						
4 weeks	1.30	1.80	1.90	1.60	1.55	1.30
10 "	4.60	4.95	5.20	4.60	4.90	4.00
16 "	6.60	7.85	7.20	6.80	7.10	6.15
Ave. increase at heart girth						
4 weeks	1.45	2.55	2.65	2.80	2.65	1.10
10 "	5.95	7.40	6.75	7.35	7.15	5.51
16 "	9.20	10.95	9.80	11.40	10.15	9.05

scouring. Those calves receiving alfalfa hay had 20 cases of scours and those fed prairie hay had only 17 cases, table 9.

From 0 through 16 weeks the gains made, as measured at the withers and chest circumference were superior to group VI. At the end of the experimental period, group I had an average increase at withers and chest circumference, respectively, of 6.60 and 9.20 inches as compared to 6.15 and 9.05 inches for group VI.

It is interesting to note that those calves in group I consumed less starter and less hay than those calves in group VI (Table 11) for the 16 weeks. This indicates a slightly greater efficiency of feed utilization for group I.

The blood plasma vitamin A and carotene values at 16 weeks were similar for those receiving alfalfa and prairie hay, tables 12 and 13.

At 16 weeks, group II which received alfalfa hay from the 0 week supplemented with 80 mg. of aureomycin made an average gain of 149.60 pounds. Those calves receiving prairie hay supplemented with 80 mg. of aureomycin made an average gain of only 128.00 pounds, table 15. It appears from these data that alfalfa hay supplemented with aureomycin from 0 weeks to 10 weeks is superior to prairie hay. The greater gain made by those calves receiving alfalfa hay is apparently not due to scouring since both groups scoured approximately the same. Supplementing alfalfa hay with aureomycin reduced the frequency of scouring. The group that did not receive aureomycin scoured 20 times while those that received aureomycin scoured only 12 times. Aureomycin also reduced the frequency of scouring among those calves receiving prairie hay.

The calves in group II consumed more starter and hay for the 16 weeks than did group III as given in table 11. Those calves in group II consumed an average of 348.82 pounds of starter and 148.92 pounds of hay for

the 16 week period. Group III consumed an average of 324.12 and 125.40 pounds, respectively, for starter and hay for the same period. The calves in group II also had a greater efficiency of feed utilization when T.D.N. was used as a criterion.

The average blood plasma vitamin A values for group II and III were similar for the 16 weeks, but the carotene values were higher for those calves receiving alfalfa hay, tables 12 and 13.

The average gain at 16 weeks made by group IV which received prairie hay after eight weeks supplemented with aureomycin was 148.20 pounds. Those fed alfalfa hay after eight weeks with aureomycin made an average gain of 138.28 pounds. One calf in group IV died during the 11th week and the missing data were calculated for the 16 week period by the Love (37) method. It is interesting to note that those calves fed prairie hay scoured more frequently than those fed alfalfa hay and yet they made greater gain.

The growth as measured by the height at withers and chest circumference indicates little difference between groups IV and V, table 15.

The average starter and hay consumption (Table 10) indicates that those calves fed prairie hay consumed more starter and less hay than those fed alfalfa hay. The efficiency of feed utilization was also greater for group IV than group V.

The average blood plasma carotene indicates that those calves in group V had higher values than those in group IV. However, the vitamin A values were higher for group IV than group V for the 16 weeks.

The analyses of the hays fed indicate that the average carotene level was higher for prairie hay than for the alfalfa hay over the 9 month period, table 14.

The Value of Alfalfa and Prairie Hay in the Ration of Dairy Calves from Birth to 16 Weeks as Compared to the Feeding of These Hays in the Ration After 8 Weeks of Age When Supplemented with 80 mg. of Aureomycin from Birth to 10 Weeks of Age.

The results from feeding hay from the 0 week or beginning at the ninth week of age are shown in table 16, as a summarization of Appendix tables VI to XXVI, inclusive. Table 16 shows the average growth per calf, feed consumption, average number of cases of scours, and average monthly blood plasma vitamin A and carotene for the 4, 10 and 16 week periods. The average weight gained at the end of 4 weeks was 30.50 pounds for groups II and III, which received alfalfa and prairie hay, respectively, from 0 to 16 weeks of age, with each group receiving 80 mg. of aureomycin daily for the first 10 weeks of life. Groups IV and V gained 23.50 pounds for the same period. At 10 weeks the gains were similar for those receiving hay from the 0 week and those receiving hay after 8 weeks of age. However, at the termination of the experiment, the calves in groups IV and V had gained an average of 143.24 pounds and those in groups II and III had gained 138.80 pounds. It appears that there was little difference in terms of gain from feeding roughage to dairy calves from 0 to 16 weeks or deferring the feeding of hay until after 8 weeks of age. These findings are in agreement with those of Williams (74). These gains were slightly below normal when compared to the Ragsdale standard at the 0 and the 16th week (Table 8).

The skeletal growth measured by the height at withers and chest circumference paralleled those made with respect to body weight gain.

Daily observations indicated no differences in the number of cases of scours in those calves receiving hay from 0 or after 8 weeks of age, table 16, as summarized from table 9. The average starter consumption for the duration of the experiment was 354.65 and 366.47 pounds,

Table 16

Alfalfa and Prairie Hay from 0 Week and Alfalfa and Prairie Hay After 8 Weeks of Age Supplemented with Aureomycin from 0 to 10 Weeks.

	Groups II & III (Hay from 0 Week)				Groups IV & V (Hay after eight weeks)			
	Birth	4 wks.	10 wks.	16 wks.	Birth	4 wks.	10 wks.	16 wks.
Ave. lb. gain/calf		30.50	89.40	138.80		23.50	89.80	143.24
Ave. daily gain/calf		1.09	1.28	1.24		.84	1.29	1.28
Ave. lb. T.D.N./lb. gain		1.86	2.21	2.81		2.22	2.07	2.71
Ave. increase at withers/calf		1.85	5.08	7.53		1.58	4.75	6.95
Ave. increase at heart girth/calf		2.60	7.08	10.38		2.73	7.25	10.78
Ave. milk consumption		242.30	374.30	—		244.30	374.00	—
Ave. starter consumption/calf		17.00	145.74	336.47		14.49	149.34	354.65
Ave. hay consumption/calf		5.60	43.92	137.16		—	18.70	111.57
Ave. no. cases scours by group		5.50	7.50	11.00		4.00	7.00	11.00
Ave. per cent increase in weight above initial weight		40.50	118.72	184.32		30.63	117.07	186.75
Ave. initial body weight	75.30				76.70			
Ave. total weight/calf		105.80	164.70	214.10		100.20	166.50	219.94

	Month							
	1	2	3	4	1	2	3	4
Ave. monthly blood plasma carotene	22.67	65.48	55.85	54.76	18.34	40.54	52.06	54.62
Ave. monthly blood plasma Vitamin A	7.27	7.82	7.73	7.49	7.83	6.11	14.27	6.01

respectively, for groups IV, V and groups II, III. On a percentage basis those calves that received hay from the 0 week consumed 3.23 per cent less starter at 16 weeks than those groups that received hay after 8 weeks of age.

The average hay intake for groups II and III was 137.16 pounds as compared to 111.57 pounds for groups IV and V. Those calves receiving hay from the 0 week consumed 18.66 per cent more hay than those that received hay after 8 weeks of age. It was interesting to note that those calves in groups II and III consumed more feed than groups IV and V, and did not make as great weight gains. The efficiency of feed utilization was slightly higher for groups IV and V than groupsII and III.

The feed cost of those groups receiving hay from the 0 week and those groups receiving hay after 8 weeks of age was calculated to determine the relative cost of each group. The price of the starter fed to the calves was $110.00 a ton, and the alfalfa and prairie hay, respectively, was $25.00 and $15.00 per ton. On this price basis, the calculated feed cost for groups II and III was $199.06 and $206.80 for groups IV and V. Using feed cost as a criterion, calves can be raised only slightly cheaper when hay is fed from the time of birth.

The blood plasma vitamin A and carotene analyses indicate that the carotene was lower for groups IV and V than groups II and III during the first 4 weeks of age. During the last 4 weeks blood plasma carotene values were similar. The blood plasma vitamin A values were approximately the same for the entire experimental period, table 16, except that groups IV and V showed higher values during the third month. However, both groups have low blood plasma vitamin A and carotene values. It is not known why such low blood plasma vitamin A values have been obtained.

The Effect of Feeding 80 mg. of Aureomycin Daily from 0 to 10 Weeks When Alfalfa and Prairie Hay was Fed from 0 to 16 Weeks of Age.

The data relative to the effect of oral administration of aureomycin to dairy calves have been summarized in table 17 for body weight gain, height at withers, chest circumference, pounds of T.D.N. per pound of gain, average number of cases of scours, and average monthly blood plasma vitamin A and carotene. The average weight gained at the end of 4 weeks was 30.50 pounds for the calves in groups II and III which received alfalfa and prairie hay, respectively, from 0 to 16 weeks of age with each group receiving 80 mg. of aureomycin daily for the first 10 weeks. The control calves in groups I and VI showed only an average gain of 19.50 pounds for the same period. The average weight gained at the end of 10 weeks was 89.40 pounds for the calves in groups II and III and 75.90 pounds for those calves in groups I and II. At the end of 16 weeks the calves in groups II and III had gained 138.80 pounds, as compared to 135.20 pounds gained by the control groups. It appears from the data that the removal of aureomycin from the diet at 10 weeks of age decreased the growth rate for the last 6 weeks, table 17. It is evident that the growth advantage obtained in terms of body weight from feeding aureomycin to 10 weeks of age was lost by the end of the 16 week period. Other workers have noted that the removal of aureomycin from the ration would cause a decrease in the growth rate of young calves. The initial weights of those calves in groups I and VI, and II and III are shown in tables 7 and 8. Those calves in groups II and III weighed an average of 6.6 pounds less at the 0 week than those in groups I and VI. The growth of groups II and III during the first 10 weeks may partly be due to the difference in the 0 week weight.

A possible explanation for the growth promoting effects of feeding

Table 17

The Effect of Feeding Aureomycin from Birth to 10 Weeks of Age on Growth, T.D.N. per lb. Gain, Scours, Starter and Hay Consumption When Fed With Alfalfa and Prairie Hay From 0 to 16 Weeks of Age.

	Groups I & VI (Controls)				Groups II & III (Aureomycin)			
	Birth	4 wks.	10 wks.	16 wks.	Birth	4 wks.	10 wks.	16 wks.
Ave. lb. gain/calf		19.50	75.90	135.20		30.50	89.40	138.80
Ave. daily gain/calf		.69	1.09	1.21		1.09	1.28	1.24
Ave. lb. T.D.N./lb. calf		2.41	2.39	2.79		1.86	2.21	2.81
Ave. increase at withers/calf		1.30	4.30	6.38		1.85	5.08	7.53
Ave. increase at heart girth/calf		1.28	5.73	9.13		2.60	7.08	10.38
Ave. milk consumption		243.80	373.40	———		242.30	374.30	———
Ave. starter consumption/calf		12.85	128.86	328.14		17.00	145.74	336.47
Ave. Hay consumption/calf		5.82	39.99	129.12		5.60	43.92	137.16
Ave. no. cases of scours by groups		9.00	15.50	18.50		5.50	7.50	11.00
Ave. per cent increase in weight above initial weight		23.80	92.67	165.07		40.50	118.72	184.32
Ave. initial body weight	81.90				75.30			
Ave. total weight/calf		101.40	157.80	217.10		105.80	164.70	214.10

	Month							
	1	2	3	4	1	2	3	4
Ave. monthly blood plasma carotene	42.21	94.94	150.64	158.79	22.67	65.48	55.85	54.76
Ave. monthly blood plasma Vitamin A	5.10	5.05	7.86	8.48	7.27	7.82	7.73	7.49

aureomycin is that scours may have been controlled. For the first 4 weeks groups I and VI scoured 40 per cent more than groups II and III and at the end of 10 weeks this had increased to 50 per cent. After the removal of aureomycin from the diet, groups II and III scoured approximately 10 per cent more than groups I and VI. It appears that the greatest effect from feeding aureomycin will occur early in life since greater gains and lower incidence of scours were observed during the first 10 weeks of age. These findings are in agreement with those of other workers. For the first 10 weeks, the difference between those calves receiving aureomycin and the controls is probably greater than is indicated in table 17, since medication was administered when scours occurred. The calves in groups II and III did not require medication as frequently. In calf nutrition, research workers have noted that calves receiving aureomycin supplements have a lower incidence of scours than their controls (1, 2, 3, 6, 24, 33, 37, 38, 45, 46, 62, 63, 64). The stimulatory effect on growth for feeding aureomycin appears to be related to the reduction of scours.

The growth at the withers and chest circumference parallels the observations made with respect to body weight gains, table 17. At 4 weeks, groups II and III showed an average increase of 1.85 inches at the withers and 2.60 inches at chest circumference. Group I and VI made an average increase of 1.30 and 1.28 inches measured by height at withers and chest circumference, respectively, for the first 4 weeks. At 10 and 16 weeks, groups II and III which received aureomycin still maintained the increase in growth at withers and chest circumference when compared to groups I and VI. It appeared from these data that aureomycin was effective, at least indirectly, in increasing the skeletal growth as measured by height at withers and chest circumference.

The average intake of hay and grain is given in table 17, as summarized

from table 11. At the end of 4 weeks group II and III consumed approximately 25 per cent more starter than group I and VI. It is interesting to note that, although groups II and III consumed 25 per cent more starter than groups I and VI, the T.D.N. required to produce a pound of gain was less. Bartley (3) found that young calves fed aureomycin required fewer pounds of T.D.N. to produce a pound of gain than did the controls. At 16 weeks of age groups II and III consumed 11.6 and 8.0 per cent more starter and hay, respectively, than did groups I and VI. The hay and starter consumption was approximately the same for all these groups at the end of the experiment. It appears that the calves' appetites were stimulated for the duration of the experiment by the oral administration of aureomycin. It should be noted that there was a greater difference in starter consumption at 10 weeks than at 16 weeks of age. There was not much difference in hay consumption between the two groups at 10 weeks of age.

Loosli et al. (34) found that calves fed aureomycin consumed approximately 40 per cent more grain than did the control groups. Rusoff et al. (64) observed that calves fed aureomycin consumed more starter and indicated, therefore, that the appetite had been stimulated resulting in an increase in growth.

The data indicate that efficiency of feed utilization for 10 weeks was greater for the aureomycin fed calves than the controls, when using the pounds of T.D.N. required to produce a pound of gain as a criterion. At the end of 16 weeks groups I and VI required 2.79 pounds of T.D.N. to produce a pound of gain and groups II and III required 2.81 pounds, table 17.

The blood plasma vitamin A was higher in groups II and III for the first two months of age than in groups I and VI, table 17. However, the

monthly blood plasma carotene was lower for groups II and III than groups I and VI for the duration of the experiment. The reason for such low blood plasma carotene (Table 17) in those calves receiving aureomycin is not known. Boyer et al. (9) found 50-70 micrograms of carotene per 100 ml. of blood was necessary to maintain adequate blood plasma vitamin A in the growing calf.

SUMMARY AND CONCLUSIONS

A 16 week feeding trial was initiated to determine: 1. the relative value of alfalfa and prairie hay fed from 0 to 16 weeks of age; 2. to determine the value of either prairie or alfalfa hay in the diet of young calves when fed from the 0 week or deferred until after 8 weeks of age; 3. to determine the relative value of alfalfa and prairie hay supplemented with 80 mg. of aureomycin from 0 to 10 weeks of age; and 4. to determine the effects of the ration on blood plasma vitamin A and carotene.

1. The results obtained from this experiment show little difference between alfalfa and prairie hay, as measured by height at withers, chest circumference, gain in weight, the efficiency of feed utilization, and the average number cases of scours.
2. Those calves fed alfalfa hay consumed less starter and more hay than those fed prairie hay.
3. Those calves fed alfalfa hay had slightly higher blood plasma carotene values than those fed prairie hay. There were no apparent differences observed in the blood plasma vitamin A values between calves fed alfalfa hay or prairie hay.
4. Those calves fed alfalfa hay supplemented with aureomycin made greater gains than those fed prairie hay with aureomycin.
5. The gains in weight were greater for the groups of calves fed prairie hay after eight weeks of age than those calves fed alfalfa hay after eight weeks of age, when each group received aureomycin from 0 to 10 weeks of age.
6. There were no apparent differences between calves fed hay from the 0 week and those for which the feeding of hay was deferred until

after 8 weeks of age as measured by average gain in weight, growth at withers, and chest circumference. Those calves that received hay from the 0 week consumed more hay and less starter than those fed hay after 8 weeks of age. The calculated feed cost indicated very little difference between calves fed hay from 0 or after 8 weeks of age.

7. There were no apparent differences in blood plasma vitamin A between calves fed hay from 0 or after 8 weeks of age.
8. The oral administration of aureomycin appeared to augment the rate of gain, and reduce the incidence of scours from birth to 10 weeks of age.
9. The feeding of aureomycin stimulated the appetite of the calves, resulting in an increase in the consumption of starter and hay for the duration of the experiment. However, there were no apparent differences between those fed aureomycin and the controls in the efficiency of feed utilization. The growth response from feeding aureomycin was not due to greater efficiency of feed utilization for the 16 week period under the conditions of this trial.
10. The discontinuation of administering aureomycin decreased the growth rate from 10 to 16 weeks, but had no effect on skeletal growth as measured by height at withers and chest circumference during this period.

BIBLIOGRAPHY

1. Bartley, E. E., Fountaine, F. C., and Atkeson, F. W. The Effects of an A P F Concentrate Containing Aureomycin on the Growth and Well-Being of Young Dairy Calves. J. Dairy Sci. 36: 103-111. 1953.

2. Bartley, E. E., Fountaine, F. C., and Atkeson, F. W. Effect on Growth of Feeding Aureomycin to Dairy Calves from Birth to Thirteen Months of Age. J. Dairy Sci. 36: 604. 1953. (Abs.)

3. Bartley, E. E., Wheatcraft, K. L., Claydon, T. L., Fountaine, F. C., and Parrish, D. B. Effects of Feeding Aureomycin to Dairy Calves. Jour. Animal Sci. 10: 1036. 1951. (Abs.)

4. Bell, M. C., Whitehair, C. K., and Gallup, W. D. The Effects of Aureomycin on Digestion in Steers. Proc. Soc. Exptl. Biol. Med. 76: 284-286. 1951.

5. Bloom, S. and Knodt, C. B. The Value of Vitamin B_{12} D. L. - Methionine, Penicillin and Aureomycin in Milk Replacement Formula for Dairy Calves. Jour. Animal Sci. 10: 1039. 1951. (Abs.)

6. Bloom, S. and Knodt, C. B. The Value of Aureomycin and Vitamin B_{12} in Milk Replacement Formulas for Dairy Calves. J. Dairy Sci. 35: 11, 910-914. 1952.

7. Bloom, S. and Knodt, C. B. Aureomycin Supplementation of Ration for Dairy Calves. J. Dairy Sci. 36: 633-636. 1953.

8. Bloom, S., Knodt, C. B., and Ross, E. B. Dairy Calves Grow Faster With Aureomycin in Feed. Science for the Farmer. 7-8. 1953.

9. Boyer, P. D., Phillips, P. H., Lundquist, N. L., Jensen, C. W., and Rupel, I. W. Vitamin A and Carotene Requirements for the Maintenance of Adequate Blood Plasma Vitamin A in the Dairy Calf. J. Dairy Sci. 25: 433-440. 1942.

10. Cave., H. W., Riddell, W. H., and Hughes, J. S. Development of Calves on Prairie Hay when Fed Milk from Dams on Similar Ration. J. Dairy Sci. 20: 415-416. 1937. (Abs.)

11. Chance, C. M., Huffman, C. F., and Duncan, C. W. Antibiotics in Rumen Digestion and Synthesis. I. The Effect of Aureomycin on Rumen Digestion and Passage of Nutrients from the Rumen During Specific Intervals After Feeding. J. Dairy Sci. 36: 253-259. 1953.

12. Chance, C. M., Huffman, C. F., Duncan, C. W., and Luecke, R. W. Antibiotics in Rumen Digestion and Synthesis. II. The Effect of Aureomycin on the Concentration of Some Amino Acids and B-Vitamins in the Rumen. J. Dairy Sci. 36: 495-503. 1953.

13. Duggar, B. M. Aureomycin: A Product of the Continuing Search for New Antibiotics. Annals. N.Y. Acad. Sci. 51: 177-181. 1948.

14. Eaton, H. D., Carpenter, C. A., Gaverno, R. J., Jackson, R. E., Elliott, F. I., and Moors, L. A. A Comparison of U.S. No. 2 Field-cured, Field-baled Alfalfa Hay with Artificially Dried and Ground Pelleted Alfalfa Hay as a Source of Carotene and Roughage for Holstein Calves. J. Dairy Sci. 34: 124-135. 1951.

15. Ellenberger, Newlander, Jones, Brodle, and Foote. The Requirements for the Utilization of Feed by Dairy Animals. Vermont Agr. Expt. Sta. Bul. 520, 1944.

16. Fincham, R. C., and Voelker, H.H. The Long-Time Effects of Aureomycin Feeding to Dairy Heifers. J. Dairy Sci. 36: 594. 1953. (Abs.)

17. Gullickson, T. W. Some Experiences in Feeding Cattle on Rations Devoid of Roughage. J. Dairy Sci. 20: 419-420. 1937. (Abs.)

18. Gullickson, T. W., and Fitch, J.B. Effect of Adding Cod Liver Oil to the Ration of Dairy Calves. J. Dairy Sci. 27: 331-335. 1944.

19. Hibbs, J. W. and Conrad, H. R. The Effect of Feeding Aureomycin Supplement on the Performance of Calves Raised on the High Roughage System. J. Dairy Sci. 36: 593-594. 1953. (Abs.)

20. Hibbs, J. W. and Krauss, W. E. The Effect of Supplementary Vitamins on Blood Composition, Liver Storage, and Incidence of Scours in Calves. J. Dairy Sci. 30: 115-120. 1947.

21. Hibbs, J. W. and Pounden, W. D. The Influence of the Ration and Early Rumen Development on Change in Plasma Carotenoids, Vitamin A, and Ascorbic Acid of Young Calves. J. Dairy Sci. 31: 1055-1061. 1948.

22. Huffman, C. F. Feeding Value of Alfalfa Hay is Variable. Michigan Agri. Expt. Sta. (Quarterly Bulletin). 12: 37. 1929.

23. Jacobson, C. O. Value of Legume Hay for Lactation and Growth in Dairy Heifers. Arkansas Bulletin. 318: 1935.

24. Jacobson, N.L., Allen, R.S., and Marley, W.R. The Effect of Aureomycin on Feed Nutrient Utilization of Young Dairy Calves. J. Animal Sci. 10: 1057. 1951. (Abs.)

25. Jacobson, W. C., Converse, H.T., and Moore, L. A. The Effects of Vitamin A and Carotene Intake on Depletion Time of Young Dairy Calves. J. Dairy Sci. 32: 418-428. 1949.

26. Jacobson, N.L., Kaffetzakis, J.G., and Homeyer, P. G. Effects of Aureomycin Supplementation on Changes in Weight and Body Measurements of Dairy Calves. J. Dairy Sci. 35: 1094-1100. 1952.

27. Jacobson, N. L. Kaffetzakis, J. G., and Murley, W. R. Response of Ruminating Dairy Calves to Aureomycin Feeding. Jour. Animal Sci. 10: 1050-1051. 1951. (Abs.)

28. Keener, H. A., Bechdel, S. I., and Thorp, W. T. S. Carotene in Calf Nutrition. J. Dairy Sci. 25: 571-583. 1942.

29. Kimble, M. S. The Photoelectric Determination of Vitamin A and Carotene in Human Plasma. Jour. Lab. and Clin. Med. 24: 1055-1065. 1939.

30. Knodt, C. B. and Ross, E. B. The Value of Various Levels of Aureomycin in Milk Replacements for Dairy Calves. J. Dairy Sci. 35: 493. 1952. (Abs.)

31. Krauss, W. E., Monroe, C. F., and Hayden, C. C. The Value of Milk Fat Substitute Skimmilk Combination for Raising Bull Calves for Veal and Heifer Calves for Replacement. Ohio Agr. Expt. Sta. Spec. Cir. 57. 1939.

32. Loosli, J. K. and Wallace, H. D. Influence of A P F and Aureomycin on Growth of Dairy Calves. Proc. Soc. Exper. Biol. Med. 75: 531-533. 1950.

33. Loosli, J. K. and Warner, R. G. Antibiotics for Dairy Animals. Farm Research Expt. Sta. Quart. Bull. N.Y. State Agr. 18: 3. 1952.

34. Loosli, J. K., Wasserman, R. H., and Gall, L. S. Antibiotics Studies with Dairy Calves. J. Dairy Sci. 34: 500. 1951. (Abs.)

35. Love, H. H. Experimental Methods in Agriculture Research. The Agr. Expt. Sta. of University of Puerto Rico. 1943.

36. Lundquist, N. L. and Phillips, P. H. Certain Dietary Factors Essential for the Growing Calf. J. Dairy Sci. 27: 1023-1030. 1943.

37. Mackay, A. M., Riddell, W. H., and Fitzsimmons, R. Feed Supplement Containing Aureomycin and Vitamin B_{12} for Dairy Cattle. J. Animal Sci. 11: 341-44. 1952.

38. McGilliard, A. D., Ronning, M., Berousek, E. R., and Norton, C. L. The Influence of Aureomycin and Cud Inoculation on the Growth of Dairy Calves. J. Dairy Sci. 35: 493. 1952.

39. Mead, S. W. and Goss, Harold. Some Results of Eight Years of Investigation Concerning the Role of Roughage in the Diet of Ruminants. J. Dairy Sci. 19: 465-466. 1936.

40. Moore, L. A. and Berry, M. H. Vitamin A and Carotene Content of the Blood Plasma of Dairy Calves from Birth up to Four Months. J. Dairy Sci. 28: 821-826. 1945.

41. Morrison, F. B. Feeds and Feeding. 21st Edition. Morrison Publishing Co., Ithaca, New York. 1948.

42. Morrison, F. B., Halce, R. S., and Humphrey, G. C. Raising Dairy Calves Economically. Wisc. Bull. 362. 96-99. 1923.

43. Morrison, F. B. and Rupel, I. W. Rations for Dairy Calves. Wisc. Bull. 396. 37-40. 1927.

44. Morrison, S. H. and Deal, J. F. Effect of A P F Supplementation During the First Two Weeks of Life on the Well-Being and Growth of Dairy Heifers. Jour. Animal Sci. 10: 1057. 1951. (Abs.)

45. Murdock, F. R., Hodgson, A. A., and Blosser, T. H. The Effects of Antibiotics on the Growth and Well-Being of Dairy Calves. Proc. 32nd Ann. Meeting, Western Div. Amer. Dy. Sci. Assoc. Bozemon, Montana. 1951.

46. Murley, W. R., Jacobson, N. L. and Allen, R. S. The Effect of Aureomycin Supplementation on Growth and Feed Utilization of Young Dairy Calves. J. Dairy Sci. 35: 846-56. 1952.

47. Murley, W. R., Jacobson, N. L., Wing, J. M., and Stoddard, G. E. The Response to Aureomycin Supplementation of Young Dairy Calves Fed Various "Practical" and Restricted Diets. J. Dairy Sci. 34: 500. 1951. (Abs.)

48. Neumann, A. L., Snapp, R. R., and Gall, L. S. The Long-Time Effects of Feeding Aureomycin to Fattening Beef Cattle With Bacteriological Data. Jour. Animal Sci. 10:1058-1059. 1951. (Abs.)

49. Nevens, W. B., and Kendall, K. A. The Value of Supplementary Vitamin Feeding in the Rearing of Dairy Calves. J. Dairy Sci. 30: 175-181. 1947.

50. Norton, C. L. Comparative Value of Alfalfa, Grass and Legume, and Timothy Hay for Young Dairy Calves. J. Dairy Sci. 29:546-547. 1946.

51. Norton, C. L., and Eaton, H. D. Dry Calf Starter for Dairy Calves. Cornell Bul. 835. 1946.

52. Norton, C. L., Eaton, H. D., Loosli, J. K., and Spielman, A. A. Controlled Experiment on the Value of Supplementary Vitamins for Dairy Calves. J. Dairy Sci. 29:231-238. 1946.

53. Peterson, W. E. Calf Raising. Dairy Science. 296. 1950.

54. Peterson, W. J. Recent Developments in Methods for Determining Carotene. Ind. Eng. Chem. Anal. Ed. 13:212-216. 1941.

55. Phillips, P. H., Lundquist, N. S., and Boyer, P. D. The Effect of Vitamin A and Certain Members of the B-Complex upon Calf Scours. J. Dairy Sci. 24:977-982. 1941.

56. Ragsdale, A. C. Growth Standards for Dairy Cattle. Mo. Agr. Expt. Sta. Bul. 366. 1934.

57. Ralston Purina Research Report. Hay vs No Hay for Young Calves. Ralston Purina Company, Livestock Research Dept., St. Louis, Mo.

58. Richardson, C. W., Ronning, M., Berousek, E. R., and Norton, C. L. The Effect of Aureomycin Upon the Growth of Dairy Calves When Administered Orally, Subcutaneously, and Intramuscularly. J. Dairy Sci. 36:593. 1953. (Abs.)

59. Ronning, M., and Knodt, C. B. The Rate of Absorption of Vitamin A Natural Esters and Carotene by Male Holstein Calves as Measured by Changes in Blood Plasma Levels. J. Dairy Sci. 35:283-291. 1952.

60. Ross, R. H., Knodt, C. B., and Guerrant, N. B. The Utilization of B-Carotene, Vitamin A-Alcohol, and the Natural Ester of Vitamin A by Holstein Heifers. J. Dairy Sci. 31:111-117. 1948.

61. Rupel, I. W. Rations for Dairy Calves. Wisc. Bul. 404. 1929.

62. Rusoff, L. L. Antibiotic Feed Supplement (Aureomycin) for Dairy Calves. J. Dairy Sci. 34:652-655. 1951.

63. Rusoff, L. L., Alford, J. A., and Hyde, C. E. Effects of Type of Protein on the Response of Young Dairy Calves to Aureomycin with Data on the Intestinal Microflora. J. Dairy Sci. 36:45-51. 1953.

64. Rusoff, L. L., Davis, A. V., and Alford, J. A. Growth Promoting Effects of Aureomycin on Young Calves Weaned From Milk at an Early Age. Jour. Nutritions. 45:289-300. 1951.

65. Rusoff, L. L., Fussell, J. M., Hyde, C. E., and Crow, R. M. Oral Supplementation Versus Intramuscular Injections of Aureomycin to Young Calves. J. Dairy Sci. 36:70. 1953.

66. Rusoff, L. L. and Haq, M. O. Effects of Vitamin B_{12} (A P F) on the Growth of Calves Weaned from Milk at an Early Age. Jour. Animal Sci. 10:331-334. 1951.

67. Skaggs, S. R. Raising Dairy Calves. New Mexico Agr. Expt. Sta. Bul. 351. 1949.

68. Turk, K. L., Morrison, S. H., Norton, C. L., and Blaser, R. E. Effects of Curing Methods Upon Feeding Value of Hay. Cornell Agri. Expt. Sta. Bul. 874. 1951.

69. Voelker, H. H., and Cason, J. L. Antibiotic Studies with Dairy Calves. Jour. Animal Sci. 10:1065. 1951. (Abs.)

70. Voelker, H., and Jacobson, N. L. Effects of Various Antibiotics and a Detergent Acid of Frequency of Milk Replacement Feeding of Young Dairy Calves. J. Dairy Sci. 36:592. 1953. (Abs.)

71. Wasserman, R. H., Duncan, C. W., Churchill, E. S., and Huffman, C. F. The Effects of Antibiotics on *in vitro* Cellulose Digestion by Rumen Microorganisms. J. Dairy Sci. 35:571-79. 1952.

72. Willard, H. S. Standardizing Hay Palatability Trials with Calves. J. Dairy Sci. 29:546. 1946. (Abs.)

73. Willard, H. S. Hay Consumption of Holstein Calves. J. Dairy Sci. 21:153-160. 1938.

74. Williams, J. B. Alfalfa Versus Prairie Hay for Dairy Calves. Thesis. Oklahoma A. & M. College. 1953.

75. Williams, J. B. and Knodt, C. B. A P F Supplement in Milk Replacements for Dairy Calves. Jour. Animal Sci. 10:144-148. 1951.

76. Wise, G. H., Caldwell, M. J., Parrish, D. B., Atkeson, F. W., and Hughes, J. S. Relation of Typical Postnatal Changes in the Diet of the Dairy Calf to the Concentration of Carotenoids and Vitamin A in Blood Serum. Jour. Animal Sci. 7:70-77. 1948.

APPENDIX

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Table I

Weekly Feed Consumption, Body Growth Measurements,
and Plasma Carotene and Vitamin A Values for Calf No. 82 Group No. 1

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/# Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	45	25.50	26.50	10	0	0	1.63	.517	4.4	1.39		
1	48	25.50	26.75	35	0.8	0.2	6.46	1.92	20.41	6.07		
2	54	25.50	27.00	42	2.0	1.2	9.12	2.41	42.00	11.11		
3	58	26.75	27.50	49	2.2	3.3	11.59	3.01	78.50	19.33		
4	62	26.75	28.00	42	2.7	2.5	10.40	2.40	64.05	14.75	75.3	10.2
5	60	27.00	27.50	42	4.0	2.8	11.61	2.76	68.90	16.40		
6	66	27.25	28.00	35	4.7	2.2	10.70	2.35	58.68	12.70		
7	74	28.50	29.50	35	4.6	2.4	10.73	2.07	61.37	11.84		
8	85	28.50	30.25	21	5.4	1.2	8.42	1.42	39.51	6.64	108.5	10.8
9	85	29.50	30.50	24	10.7	4.4	14.94	2.51	69.23	11.63		
10	100	30.00	32.00	36	11.1	4.9	17.50	2.50	55.79	7.97		
11	104	29.75	32.50	-	12.4	5.6	13.06	1.79	71.81	9.86		
12	115	30.75	33.00	-	20.9	4.9	19.49	2.42	86.45	10.73		
13	127	31.50	33.25	-	24.1	5.9	22.61	2.54	101.59	11.42	190.2	14.0
14	130	31.00	34.50	-	26.5	9.2	26.38	2.89	159.06	17.47		
15	136	32.50	34.75	-	32.1	8.0	30.20	3.17	159.60	16.76		
16	150	32.00	35.00	-	32.5	14.9	34.36	3.27	233.12	22.20		
Growth gain, feed consumption at												
4 wk	17	1.25	1.5	178	7.7	7.2	39.20					
10 "	55	4.5	5.5	371	48.2	25.1	113.10					
16 "	105	6.5	8.5	371	196.8	73.6	259.20					

Table II

Weekly Feed Consumption, Body Growth Measurements,
and Plasma Carotene and Vitamin A Values for Calf No. 10, Group No. I.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/# Wt./Day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	94	29.50	31.50	16	0.1	0	2.69	.41	7.28	1.10		
1	95	29.50	31.00	63	0.7	0.6	11.16	1.67	38.78	5.83	2.34	2.8
2	97	29.50	31.50	70	1.6	1.3	13.42	1.97	53.61	7.89		
3	102	30.00	31.50	56	1.8	1.9	11.63	1.62	56.71	7.94		
4	112	30.50	32.00	42	4.4	1.4	11.15	1.42	49.33	6.29		
5	124	30.75	33.75	35	4.1	3.0	10.66	1.22	68.99	7.94	62.4	6.20
6	125	31.00	33.50	28	15.8	5.5	20.30	2.23	91.36	10.44		
7	141	31.50	34.50	35	22.5	8.3	28.37	2.87	131.52	13.32		
8	146	32.25	35.00	28	21.5	8.1	26.32	2.57	124.57	12.18		
9	164	33.00	36.00	-	24.3	7.4	23.61	2.06	113.49	19.88		
10	180	34.75	37.50	-	33.5	13.8	34.55	2.74	183.88	14.59	114.9	10.2
11	190	33.50	38.50	-	35.0	15.7	36.81	2.77	247.41	18.60		
12	205	34.75	38.75	-	35.0	12.9	35.26	2.46	217.96	15.18		
13	215	35.50	39.00	-	35.0	13.8	35.76	2.38	227.43	15.11		
14	231	35.50	40.50	-	35.0	19.2	38.76	2.40	284.23	17.57	89.1	7.52
15	250	36.00	41.00	-	35.0	21.0	37.03	2.12	189.77	10.84		
16	245	36.25	41.50	-	35.0	26.6	39.91	2.33	220.96	12.88		
Growth gain, feed consumption at												
4 wk	18	1.0	.5	247	8.6	5.2	50.05					
10 "	86	5.25	6.0	373	130.3	51.3	193.86					
16 "	151	6.75	10.0	373	340.3	160.5	417.39					

Table III

Weekly Feed Consumption, Body Growth Measurements,
and Plasma Carotene and Vitamin A Values for Calf No. 95, Group No. I.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/# Wt./Day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	49	25.75	26.50	32.5	3.0	3.1	9.43	2.74	53.96	15.73	19.8	7.4
1	60	26.00	27.00	42	3.5	3.5	11.60	2.76	63.53	15.10		
2	66	27.00	28.00	49	5.7	1.5	13.39	2.89	50.73	10.99		
3	78	27.25	29.00	49	3.5	1.0	11.35	2.08	40.31	7.38	25.5	6.11
4	87	27.50	29.50	49	4.8	1.5	12.35	2.03	39.90	6.55		
5	90	28.50	30.50	42	7.1	2.1	13.25	2.10	44.95	7.13		
6	95	28.50	31.50	35	10.7	4.5	16.04	2.41	62.72	9.43		
7	108	29.25	31.00	35	9.0	8.0	16.57	2.19	78.68	10.40	26.1	1.71
8	117	29.25	31.75	21	16.3	8.7	16.69	2.04	78.10	9.53		
9	131	30.50	32.75	21	22.9	10.0	22.30	2.43	98.43	10.73		
10	135	30.50	33.50	-	24.3	12.7	24.74	2.62	115.06	12.17		
11	140	31.00	34.00	-	26.2	15.7	27.71	2.82	134.25	13.69		
12	140	31.25	34.00	-	29.3	17.5	30.96	3.15	149.84	15.28	70.2	9.65
13	155	32.00	35.25	-	32.3	16.0	31.65	2.91	156.23	14.39		
14	169	32.00	35.50	-	35.0	18.2	34.48	2.91	176.37	14.90		
15	183	32.75	36.00	-	35.0	18.4	34.85	2.72	354.39	27.66		
16	185	33.25	36.50	-	35.0	17.8	34.54	2.66	173.09	13.36	86.1	11.0
Growth gain, feed consumption at												
4 wk	38	1.75	3.00	221.5	20.5	10.6	58.12					
10 "	86	4.75	7.00	375.5	110.8	56.6	167.71					
16 "	136	7.50	10.00	375.5	303.6	160.2	361.90					

Table IV

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 143, Group No. I.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/# Wt./day	Carotene Consumed	Carotene Consumed 100/lb. Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	85	29.25	30.50	36	.7	.9	6.93	1.16	29.65	4.52	5.1	5.25
1	90	29.00	30.00	63	5.9	1.2	15.67	2.48	54.21	8.60		
2	104	30.00	30.75	70	1.4	0.4	12.76	1.75	38.30	5.26		
3	100	30.00	31.00	54.5	1.7	0.9	10.75	1.53	37.44	5.34	14.1	1.09
4	108	30.25	31.75	42.0	2.4	1.8	9.57	1.26	33.50	4.43		
5	110	30.50	32.00	42.0	7.2	0.9	12.70	1.64	38.47	4.99		
6	124	31.00	33.00	35.0	11.9	2.1	15.70	1.80	51.85	5.97		
7	140	31.00	33.50	28.0	17.6	5.0	20.32	2.07	76.78	7.83	36.6	6.06
8	150	32.75	34.50	-	25.5	4.5	21.42	2.04	75.90	7.22		
9	162	33.00	35.50	-	33.1	7.1	28.45	2.50	104.92	9.25		
10	161	33.25	36.25	-	26.4	11.6	25.75	2.28	113.84	10.10		
11	160	33.75	36.00	-	21.1	8.8	20.34	1.81	88.59	7.90		
12	170	33.75	36.50	-	26.8	6.4	23.37	1.96	88.25	7.41	49.7	8.36
13	185	34.50	37.00	-	33.8	9.2	29.24	2.25	101.56	7.84		
14	185	34.00	38.00	-	30.8	15.4	30.26	2.33	150.15	11.59		
15	200	35.00	38.00	-	35.0	14.5	32.84	2.34	146.00	10.42		
16	220	35.00	38.50	-	35.0	18.2	34.75	2.25	176.37	11.45	50.9	7.85
Growth gain, feed consumption at												
4 wk	23	1.00	1.25	265.5	12.1	5.2	55.68					
10 "	76	4.00	5.75	370.5	133.8	36.4	180.02					
16 "	135	5.75	8.00	370.5	316.3	108.9	350.82					

Table V

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 102, Group No. I.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/# Wt./day	Carotene Consumed	Carotene Consumed 100/lb. Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	101	29.00	31.00	28	1.2	0.3	5.69	.804	18.30	2.58		
1	102	29.75	29.50	63	1.0	0.5	11.35	1.58	35.33	4.94		
2	98	29.50	30.50	70	1.4	0.9	13.03	1.89	43.56	6.34	16.5	4.43
3	115	30.50	31.00	56	2.2	1.6	11.60	1.44	38.13	4.73		
4	117	30.50	32.00	56	6.8	1.3	14.89	1.81	46.03	5.62		
5	125	31.50	33.00	42	8.0	3.0	14.38	1.64	51.83	5.92		
6	135	31.25	33.25	35	18.5	4.6	21.93	2.32	79.50	8.41	41.1	2.16
7	155	31.50	34.25	35	29.1	5.0	30.08	2.77	101.33	9.34		
8	160	31.75	34.50	-	34.1	6.3	28.79	2.57	102.93	9.19		
9	170	32.75	35.25	-	33.6	9.8	30.21	2.53	119.67	10.05		
10	166	33.50	36.50	-	32.9	9.2	29.38	2.52	115.17	9.91		
11	194	34.00	36.75	-	35.0	9.6	31.16	2.29	121.57	8.95	64.4	9.99
12	207	34.50	37.50	-	35.0	13.2	32.17	2.22	135.32	9.33		
13	200	35.00	37.75	-	35.0	14.6	32.89	2.43	146.82	10.48		
14	210	35.00	38.00	-	35.0	13.0	32.07	2.18	133.68	9.09		
15	235	34.75	38.75	-	35.0	14.8	33.00	2.00	148.46	9.02	97.4	9.35
16	230	35.50	40.50	-	35.0	17.3	34.28	2.12	96.60	6.00		
Growth gain, feed consumption at												
4 wk	16	1.50	1.00	273	12.6	4.6	56.56					
10 "	65	4.50	5.50	385	168.8	42.5	211.33					
16 "	129	6.50	9.50	385	378.8	125.0	406.90					

Table VI

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 159, Group No. II.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb. Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	87	29.50	31.00	22	0.3	0.2	3.94	.64	13.52	2.22		
1	92	28.75	31.00	63	1.8	2.0	12.83	1.99	63.33	9.83		
2	102	29.50	31.50	70	2.2	1.2	13.84	1.93	188.50	26.40	42.9	8.8
3	107	30.00	32.00	56	4.7	2.6	14.35	1.91	73.78	9.85		
4	116	30.50	32.00	42	8.7	1.8	14.83	1.82	65.30	8.04		
5	123	31.50	32.50	35	8.8	1.9	13.82	1.60	63.92	7.42		
6	140	31.50	35.50	28	7.2	2.3	11.62	1.18	62.94	6.42		
7	146	31.50	35.00	21	18.8	5.8	21.73	2.12	138.39	13.54	110.3	11.4
8	153	32.50	35.50	35	28.0	7.1	32.12	2.99	135.30	12.63		
9	163	33.00	36.50	-	26.3	7.4	25.21	2.20	118.19	10.35		
10	177	33.00	37.00	-	30.8	12.0	31.39	2.53	163.82	6.85		
11	189	34.00	37.75	-	33.6	13.1	34.24	2.58	178.78	13.51	78.6	9.42
12	200	34.50	38.50	-	34.3	7.9	31.91	2.27	163.71	11.69		
13	200	35.75	39.00	-	31.3	9.1	30.17	2.15	169.29	12.09		
14	214	35.50	39.00	-	34.8	11.2	34.15	2.27	199.60	13.32		
15	229	35.75	40.00	-	35.0	17.2	37.65	2.34	263.19	16.41	95.9	10.7
16	272	36.50	41.00	-	35.0	21.5	37.29	1.91	192.56	10.10		
Growth gain, feed consumption at												
4 wk	29	1.00	1.00	25.3	17.7	7.8	59.79					
10 "	90	3.50	6.00	372	137.6	44.3	195.68					
16 "	185	7.00	10.00	372	341.6	124.3	401.09					

Table VII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 141, Group II.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt/day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	99	28.75	30.50	36	.0	.0	5.87	8.49	15.84	2.28		
1	100	29.25	31.50	61	2.1	.6	11.96	1.72	40.57	5.79		
2	83	30.00	31.50	70	1.7	.6	13.11	2.25	43.59	7.50	45.6	8.34
3	110	30.00	32.50	56	4.0	1.6	13.23	1.71	46.23	6.00		
4	117	31.00	33.25	42	4.2	1.6	11.11	1.35	40.54	4.94		
5	129	31.50	34.00	42	9.5	1.9	15.52	1.71	55.28	6.12		
6	142	32.00	35.00	42	10.4	5.3	18.14	1.82	83.31	8.38	104.1	7.14
7	155	33.00	36.00	26	17.6	4.9	21.08	1.94	104.35	9.61		
8	171	33.00	36.50	-	29.5	6.6	27.34	2.28	138.76	11.59		
9	175	34.00	37.25	-	30.8	7.5	28.88	2.35	151.28	12.34		
10	185	34.25	38.50	-	32.3	11.6	32.37	2.50	197.94	15.28	86.9	12.0
11	200	34.50	38.00	-	32.1	11.5	29.29	2.09	130.82	9.34		
12	202	34.50	38.75	-	35.0	13.8	33.32	2.35	149.67	10.58		
13	207	35.50	39.50	-	35.0	19.5	36.25	2.50	181.42	12.52		
14	230	36.50	40.00	-	35.0	25.7	39.45	2.45	215.94	13.41	106.1	5.18
15	235	36.50	41.00	-	35.0	25.6	39.39	2.39	202.85	12.33		
16	255	37.50	41.00	-	35.0	28.3	40.79	2.28	216.56	12.13		
Growth gains, feed consumption at												
4 wk	18	2.25	2.75	265	12.0	4.4	55.28					
10 "	86	5.50	8.00	375	142.1	42.2	198.61					
16 "	156	8.75	10.50	375	349.2	166.6	417.10					

Table VIII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 28, Group II.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb. Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(μg%)	(μg%)
0	105	29.50	31.00	4	.0	.0	.65	.884	1.76	.239		
1	109	30.50	31.50	63	1.2	0.7	11.62	1.52	35.87	4.70		
2	114	31.00	32.50	70	3.7	0.8	14.82	1.85	45.59	5.71		
3	127	30.00	33.00	70	8.3	0.8	18.51	2.08	56.40	6.34	18.0	9.30
4	135	32.50	34.25	56	11.5	2.9	19.97	2.11	82.17	8.69		
5	154	33.50	35.00	42	18.1	1.4	22.14	2.05	75.74	7.02		
6	163	33.50	35.50	42	17.1	2.0	21.67	1.89	79.71	6.98		
7	170	33.50	36.50	28	25.5	2.6	26.46	2.22	99.60	8.36	53.3	3.95
8	185	34.00	37.00	-	29.5	7.0	25.70	1.98	100.35	7.74		
9	195	34.50	38.25	-	35.0	11.7	32.24	2.36	137.97	10.10		
10	204	34.50	38.50	-	35.0	14.4	33.63	2.35	153.00	10.71		
11	215	35.25	39.50	-	35.0	22.5	37.80	2.51	198.13	13.16	47.9	6.12
12	230	35.00	40.00	-	34.4	23.2	37.71	2.34	189.41	11.76		
13	235	36.50	39.75	-	35.0	22.4	37.75	2.29	186.59	11.34		
14	250	37.25	41.50	-	35.0	25.6	39.40	2.25	202.85	11.59		
15	253	37.00	42.50	-	34.4	24.1	38.18	2.15	193.98	10.95		
16	270	38.00	42.50	-	35.0	23.7	38.42	2.03	193.20	10.21	48.5	10.9
Growth gain, feed consumption at												
4 wk	30	2.00	3.25	263	24.7	5.2	65.57					
10 "	99	5.00	7.50	375	184.9	44.3	227.41					
16"	165	8.50	11.50	375	393.7	185.8	456.67					

Table IX

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 151, Group No. II.

Weekly	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb. Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	45	25.75	25.50	17.5	0.1	.0	2.93	.93	7.94	2.52		
1	48	26.25	26.00	42	0.7	0.9	7.91	2.35	26.98	8.02		
2	56	26.75	26.50	49	10.5	0.4	16.63	4.24	49.28	12.58	33.0	5.34
3	60	27.50	27.50	49	9.2	1.8	16.37	3.89	62.12	14.79		
4	73	27.50	27.75	49	7.0	1.8	14.60	2.85	56.95	11.14		
5	75	28.25	29.00	42	8.6	1.7	14.69	2.79	56.57	10.77		
6	88	28.50	29.50	42	9.8	1.9	15.76	2.55	61.50	9.98	58.7	8.58
7	100	29.25	30.50	35	11.0	2.4	15.18	2.16	51.65	7.37		
8	105	29.50	31.50	28	19.7	3.3	21.01	2.85	71.68	9.75		
9	110	30.25	32.00	21	22.4	6.6	23.60	3.06	92.59	12.02		
10	125	30.50	32.25	-	30.3	14.8	30.32	3.46	145.46	16.62		
11	135	31.00	33.25	-	32.2	16.2	32.46	3.43	157.21	16.63	33.3	2.60
12	140	31.25	33.25	-	30.4	13.8	29.88	3.04	133.34	13.60		
13	145	32.25	34.25	-	35.0	16.3	34.60	3.40	155.60	15.33		
14	148	32.50	34.50	-	33.0	16.2	33.06	3.19	150.94	14.56		
15	150	32.50	35.00	-	26.6	13.9	27.08	2.57	125.94	11.99	22.5	7.76
16	164	33.00	35.25	-	34.2	17.7	33.91	2.95	171.65	14.95		
Growth gains, feed consumption at												
4 wk	28	1.75	2.25	206.5	27.5	4.9	58.44					
10 "	80	4.75	6.75	374.5	129.3	35.6	179.00					
16 "	119	7.25	9.75	374.5	320.7	129.7	369.99					

Table X

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 23, Group II.

Weeks.	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt/day	Plasma Carotene	Plasma Vitamin A.
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(μg%)	(μg%)
0	45	25.50	25.00	17.5	.0	0.7	3.24	1.02	15.24	4.83	12.6	5.49
1	55	26.00	25.25	42	1.2	0.4	7.95	2.06	23.20	6.02		
2	55	25.75	26.25	49	1.7	1.2	9.88	2.56	31.78	8.25		
3	64	25.50	27.00	49	3.3	0.4	10.66	2.37	30.65	6.84		
4	77	27.50	28.50	49	6.1	3.0	14.10	2.61	50.96	9.45	30.8	2.10
5	80	29.00	29.00	49	7.8	5.2	16.51	2.94	64.20	11.46		
6	100	28.50	29.50	42	12.9	6.5	19.86	2.83	78.33	11.19		
7	105	29.50	30.50	28	22.5	9.2	26.15	3.55	105.86	14.40		
8	120	30.00	32.50	28	22.3	8.1	25.44	3.02	99.85	11.88		
9	127	31.00	33.00	21	24.6	11.1	24.14	2.71	107.06	12.04	43.4	8.27
10	139	31.50	33.75	-	32.1	11.3	29.09	2.98	117.49	12.07		
11	142	32.25	34.00	-	32.9	13.0	30.54	3.07	132.06	13.20		
12	160	32.50	34.50	-	34.2	13.2	31.59	2.82	134.71	12.02		
13	165	32.25	35.00	-	32.3	13.5	30.37	2.62	135.71	12.74	30.2	3.93
14	155	33.00	36.00	-	35.0	12.6	31.86	2.93	77.72	7.16		
15	170	32.75	36.00	-	35.0	15.0	33.10	2.74	87.40	7.34		
16	168	33.25	38.00	-	35.0	13.8	32.48	2.73	82.56	7.02		
Growth gain, feed consumption at												
4 wk	32	2.00	3.50	206.5	12.3	5.7	45.83					
10 "	94	6.00	8.75	374.5	134.5	57.1	187.02					
16 "	123	7.75	13.00	374.5	338.9	138.2	376.96					

Table XI

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 112, Group III

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(μ%)	(μ%)
0	53	26.00	26.50	2.5	.0	.0	.41	.11	1.1	.29		
1	60	26.50	27.50	42	0.2	0.2	7.12	1.69	20.66	4.91		
2	63	27.00	27.00	49	1.6	0.9	9.77	2.21	33.03	7.48	16.8	7.6
3	67	27.50	28.50	49	2.8	1.4	11.01	2.34	45.85	9.77		
4	75	28.00	29.00	41.5	5.4	1.4	11.87	2.26	48.66	9.26		
5	80	28.00	29.00	42	5.5	1.3	11.98	2.13	47.85	8.54		
6	100	29.25	30.75	35	6.9	2.6	12.68	1.81	64.51	9.21		
7	100	29.50	30.50	35	14.0	4.3	19.32	2.76	102.69	14.67	70.2	15.5
8	109	29.50	31.00	35	16.5	3.9	21.10	2.76	98.40	12.89		
9	120	31.25	33.00	35	15.5	5.7	21.29	2.53	116.46	13.86		
10	115	31.00	32.25	9	14.3	3.7	14.99	1.86	79.52	9.87		
11	101	30.00	32.00	-	8.4	4.5	9.23	1.30	70.77	10.00	36.0	3.0
12	115	31.50	32.50	-	21.1	7.3	20.97	2.60	93.90	11.66		
13	120	31.25	32.50	-	11.3	6.6	12.72	1.51	66.62	7.93		
14	117	31.00	33.00	-	8.8	7.5	11.21	1.36	66.21	8.08		
15	123	31.50	32.50	-	18.9	5.7	18.32	2.12	79.01	9.17	19.1	1.46
16	130	31.50	32.25	-	16.1	6.6	15.45	1.69	112.16	12.32		
Growth gains, feed consumption at												
4 wk	22	2.00	2.50	184.0	10.0	3.9	40.18					
10 "	62	5.00	5.75	375	82.7	25.4	141.54					
16 "	77	5.50	5.75	375	167.3	63.6	229.44					

Table XII

Weekly Feed Consumption, Body Growth Measurements and Plasma Carotene and Vitamin A Values for Calf No. 142, Group III.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb. Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	100	29.00	31.00	44	0.3	0.5	7.69	1.09	24.35	3.47	14.1	5.1
1	99	29.00	31.00	63	1.4	1.7	12.33	1.77	52.52	7.57		
2	111	29.50	32.50	70	3.6	1.4	15.07	1.93	56.97	7.33		
3	117	30.00	32.50	56	4.8	1.8	13.97	1.70	58.69	7.16		
4	140	30.00	34.00	42	6.6	3.0	13.80	1.40	71.94	7.34	82.5	9.44
5	140	31.50	34.00	35	15.8	5.9	21.65	2.20	119.44	12.18		
6	156	32.00	35.00	35	20.6	4.4	24.66	2.25	113.71	10.41		
7	160	32.00	35.50	28	18.1	4.9	21.79	1.94	110.42	9.85		
8	167	32.50	36.25	-	18.4	4.1	17.03	1.45	89.73	7.67		
9	178	33.00	37.00	-	32.7	13.7	33.82	2.71	232.20	18.63	95.7	14.1
10	196	32.75	36.50	-	35.0	18.3	38.21	2.78	193.33	14.09		
11	205	34.25	37.50	-	35.0	16.5	37.21	2.59	182.41	12.71		
12	217	34.75	38.25	-	35.0	15.5	36.65	2.41	176.33	11.60		
13	216	34.50	39.00	-	34.0	13.7	34.86	2.30	163.06	10.78	55.1	3.41
14	230	34.75	39.50	-	35.0	9.3	31.00	1.92	183.66	11.40		
15	235	35.75	39.75	-	35.0	16.4	34.64	2.10	268.29	16.30		
16	242	35.50	41.75	-	35.0	18.9	35.93	2.12	298.09	17.59		
Growth gain, feed consumption at												
4 wk	40	1.00	3.00	275	16.7	8.4	62.86					
10 "	96	3.75	5.50	373	157.3	59.7	220.02					
16 "	142	6.50	10.75	373	366.3	150.0	430.31					

Table XIII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 193, Group No. III.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	82	27.75	29.50	51	.0	.0	8.31	1.44	22.4	3.90		
1	85	28.75	30.50	63	1.9	0.5	12.07	2.02	37.86	6.36	8.7	7.62
2	104	28.75	31.75	70	4.9	2.6	16.78	2.30	58.10	7.98		
3	115	30.00	32.75	56	6.7	1.6	15.39	1.91	50.10	6.22		
4	125	30.25	33.00	42	11.5	1.0	16.62	1.89	51.58	5.89		
5	135	31.00	34.25	35	18.3	1.8	21.38	2.26	69.33	7.33	41.1	6.03
6	146	31.75	34.75	28	19.6	1.8	20.17	1.97	74.54	7.29		
7	152	31.50	35.50	28	23.8	2.6	23.73	2.23	92.82	8.72		
8	165	32.50	36.50	-	33.2	7.3	28.62	2.47	156.07	13.51		
9	180	33.00	37.25	-	35.0	14.0	33.41	2.65	239.68	19.02	56.3	4.70
10	190	33.25	37.50	-	35.0	16.7	34.80	2.61	284.89	22.42		
11	203	34.00	38.50	-	35.0	16.9	34.90	2.45	287.43	20.22		
12	195	34.50	39.25	-	33.6	16.5	33.65	2.46	279.44	20.47		
13	207	34.50	39.50	-	35.0	15.6	34.23	2.36	270.92	18.69		
14	215	35.25	39.25	-	35.0	14.2	33.51	2.22	253.14	16.81	51.5	8.76
15	235	36.00	40.25	-	35.0	17.8	34.52	2.09	190.00	11.55		
16	240	36.00	41.00	-	35.0	16.2	33.70	2.00	175.34	10.44		
Growth gains, feed consumption at												
4 wk	43	2.50	3.50	282	25.0	5.7	69.17					
10 "	108	5.50	8.00	373	189.9	49.9	231.28					
16 "	158	8.25	11.50	373	398.5	147.1	435.79					

Table XIV

Weekly Feed Consumption, Body Growth Measurements and Plasma Carotene and Vitamin A Values for Calf No. 8, Group III.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(μg%)	(μg%)
0	80	28.25	29.50	26.5	1.7	.8	6.13	1.09	20.51	3.66		
1	89	28.75	29.50	63	1.2	1.1	11.84	1.90	37.22	5.97		
2	100	29.25	29.50	70	0.7	0.2	12.08	1.72	33.65	4.78		
3	105	30.25	31.00	56	2.7	1.3	12.01	1.63	38.87	5.19	20.4	6.03
4	120	30.50	31.75	56	7.9	1.8	15.97	1.90	62.53	7.44		
5	125	30.75	32.50	42	9.4	1.6	14.71	1.68	57.10	6.52		
6	140	31.75	33.50	35	19.5	3.2	21.96	2.24	94.10	9.60		
7	155	31.75	34.00	28	25.7	5.6	26.77	2.46	132.53	12.21	26.1	5.71
8	167	33.00	35.50	-	29.9	3.5	24.19	2.06	106.64	9.12		
9	180	33.00	36.00	-	35.0	11.1	31.92	2.53	213.77	16.96		
10	185	34.50	36.50	-	35.0	13.6	33.21	2.56	245.52	18.95		
11	190	34.75	37.50	-	35.0	11.5	32.14	2.41	218.85	16.45		
12	200	34.75	37.50	-	35.0	11.6	32.18	2.29	220.12	15.72	30.2	8.28
13	215	35.25	38.25	-	35.0	16.5	33.86	2.24	178.09	11.83		
14	228	34.00	39.00	-	35.0	17.5	34.37	2.15	187.25	11.73		
15	225	35.50	39.50	-	35.0	17.0	34.11	2.16	182.67	11.59		
16	245	36.50	40.00	-	35.0	15.0	33.09	1.92	164.35	9.58	63.0	8.33
Growth gain, feed consumption												
4 wk	40	2.25	2.25	271.5	14.2	5.2	58.03					
10 "	105	6.25	7.00	376.5	168.7	43.8	210.79					
16 "	165	8.25	10.50	376.5	378.7	132.9	410.54					

Table XV

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 124, Group III.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	57	27.00	26.50	27.5	0.3	0.3	4.89	1.22	14.63	3.66		
1	59	27.00	26.25	42	0.9	0.3	7.73	1.87	22.42	5.42		
2	66	28.25	27.00	49	1.3	1.4	9.81	2.12	33.11	7.16	14.6	9.14
3	71	28.50	27.50	49	4.4	1.3	11.95	1.97	46.21	9.29		
4	80	28.75	28.50	49	3.0	1.6	11.06	1.97	46.87	8.36		
5	86	28.75	29.25	49	4.6	2.7	12.82	2.12	63.31	10.51		
6	100	30.00	30.00	35	10.2	5.1	15.97	2.28	97.41	13.91	77.7	8.49
7	110	29.75	30.50	35	17.2	5.0	21.16	2.74	114.68	14.90		
8	118	30.50	32.00	21	24.3	4.6	23.99	2.90	118.20	14.30		
9	120	31.50	32.50	18	31.2	6.7	29.75	3.54	157.91	18.79		
10	131	32.50	34.00	-	33.0	7.9	28.78	3.12	168.97	18.42		
11	138	32.50	34.00	-	26.7	6.8	23.49	2.43	141.90	14.68	50.3	8.81
12	137	32.25	33.50	-	26.4	16.0	27.36	2.85	166.89	17.40		
13	140	32.75	34.00	-	28.0	25.7	33.51	3.41	256.97	26.22		
14	143	32.50	34.00	-	28.3	15.9	28.69	2.86	167.44	16.72		
15	165	34.00	35.50	-	35.0	14.6	32.88	2.84	160.69	13.91	55.7	14.5
16	155	34.50	37.00	-	35.0	15.7	33.44	3.08	132.23	12.18		
Growth gain, feed consumption at												
4 wk	23	1.75	2.0	216.5	9.9	4.9	45.44					
10 "	74	5.50	7.50	374.5	130.4	36.9	177.91					
16 "	98	7.50	10.50	374.5	309.8	131.6	357.28					

Table XVI

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 81, Group IV.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A.
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mb.)	(γ%)	(γ%)
0	101	30.00	32.00	32	0.1	-	5.30	.74	14.32	2.02		
1	107	29.75	32.00	63	1.2	-	11.23	1.50	30.54	4.07	5.10	1.3
2	116	30.50	33.00	70	5.8	-	16.06	1.97	44.43	5.47		
3	120	31.00	33.00	56	9.0	-	16.35	1.94	45.79	5.45		
4	132	31.00	33.50	42	14.2	-	18.23	1.97	51.85	5.61		
5	128	31.50	34.25	35	11.8	-	15.17	1.69	43.13	4.81	55.7	5.67
6	153	32.00	35.00	28	19.7	-	20.36	1.90	58.62	5.47		
7	160	33.00	36.00	28	25.9	-	25.34	2.26	73.19	6.53		
8	175	33.25	36.50	21	21.7	-	20.83	1.70	60.24	4.91		
9	183	34.00	37.50	-	26.7	4.4	23.85	1.86	112.64	8.79		
10	199	33.50	38.00	-	34.0	5.9	30.54	2.19	146.81	10.53	48.9	3.12
11	204	34.50	38.50	-	35.0	7.7	32.34	2.26	128.99	9.00		
12	224	35.50	38.75	-	33.3	5.8	29.92	1.90	113.46	7.23		
13	213	35.00	38.75	-	35.0	7.2	32.06	2.15	125.95	8.44		
14	232	35.50	40.00	-	35.0	9.2	33.17	2.04	138.09	8.50	36.6	2.00
15	245	36.00	40.50	-	35.0	9.3	31.00	1.80	183.66	10.70		
16	254	36.25	41.00	-	35.0	11.1	31.92	1.79	205.11	11.53		
Growth gains, feed consumption												
4 wk	31	1.00	1.50	263	30.3	-	67.17					
10 "	98	3.50	6.00	375	170.1	10.3	203.26					
16 "	153	6.25	9.00	375	378.4	60.6	393.67					

Table XVII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 25, Group IV.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	116	31.00	32.00	44	0.5	-	7.57	.93	20.54	2.52		
1	120	31.00	32.50	63	1.4	-	11.39	1.35	31.01	3.69		
2	125	30.75	35.50	70	1.4	-	12.53	1.43	34.09	3.89		
3	140	31.50	34.00	56	10.4	-	17.47	1.78	49.08	5.00	49.1	7.20
4	150	32.75	35.50	56	13.8	-	20.20	1.92	57.07	5.43		
5	160	33.00	36.00	56	15.1	-	21.24	1.89	60.13	5.36		
6	180	34.00	37.25	28	22.1	-	22.29	1.76	64.26	5.10		
7	189	34.00	37.75	-	27.2	-	21.81	1.64	63.92	4.83	79.8	4.92
8	203	33.75	39.00	-	32.5	-	26.06	1.83	76.38	5.37		
9	214	35.50	39.00	-	33.0	9.4	31.67	2.11	134.61	8.98		
10	223	36.00	39.50	-	35.0	9.1	33.11	2.12	137.49	8.80		
11	234	36.00	40.50	-	35.0	9.8	33.45	2.04	141.74	8.65	73.5	4.65
12	250	36.50	41.25	-	35.0	7.3	29.97	1.71	159.82	9.13		
13	250	36.50	42.00	-	35.0	11.0	31.87	1.82	203.92	11.65		
14	255	36.75	41.50	-	35.0	20.2	36.59	2.04	195.41	10.94		
15	270	37.00	42.25	-	35.0	24.0	38.55	2.03	218.48	11.54		
16	294	36.50	43.00	-	35.0	23.2	38.14	1.85	367.44	17.84	25.2	0.8
Growth gains, feed consumption at												
4 wk	34	1.75	3.50	289	27.5	-	69.16					
10 "	107	5.00	7.50	373	192.4	18.5	225.34					
16 "	178	5.50	11.00	373	402.4	114.0	433.91					

Table XVIII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 119, Group IV

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	31	23.00	23.00	25	.0	-	4.07	1.87	1.10	.50		
1	34	23.00	23.00	40	0.6	-	7.00	2.94	19.01	7.85		
2	37	23.25	23.50	49	1.2	-	8.95	3.45	24.38	9.41	5.1	9.6
3	50	24.25	24.25	49	3.2	-	10.55	3.01	29.08	8.30		
4	53	25.00	24.75	49	2.1	-	9.67	2.60	26.50	7.14		
5	59	25.00	25.25	49	2.9	-	10.31	2.49	28.38	6.87		
6	65	26.25	26.50	42	8.2	-	13.42	2.94	37.75	8.29	29.1	10.7
7	75	26.50	28.50	42	8.3	-	13.06	2.48	35.74	6.80		
8	80	27.50	29.75	28	12.8	-	14.15	2.52	38.94	6.95		
9	96	28.00	30.00	24.0	23.8	4.2	23.89	3.55	110.13	16.38		
10	110	29.00	30.25	-	30.5	11.8	28.91	3.75	204.10	26.50	21.0	5.76
11	130	29.25	31.50	-	32.9	11.4	30.50	3.35	213.21	23.42		
12	130	29.50	32.00	-	34.2	12.6	32.09	3.52	231.16	25.40		
13	135	30.50	32.50	-	34.2	13.4	32.50	3.43	241.32	25.53		
14	145	31.00	33.00	-	35.0	11.3	32.02	3.15	216.31	21.31		
15	155	31.00	33.00	-	35.0	11.6	32.18	2.96	220.12	20.28	30.2	14.2
16	165	31.50	34.00	-	35.0	15.6	33.39	2.89	169.85	14.70		
Growth gains, feed consumption at												
4 wk	22	2.00	1.75	189.5	7.1	-	40.24					
10 "	79	6.00	7.25	374.5	93.6	16.0	143.98					
16 "	134	8.50	11.00	374.5	299.9	91.0	336.66					

Table XIX

Weekly Feed Consumption, Body Growth Measurements and Plasma Carotene and Vitamin A Values for Calf No. 118, Group IV.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	83	29.50	29.00	52	1.0	-	9.28	1.59	25.23	4.34		
1	85	29.00	30.00	61	0.5	-	10.34	1.73	28.02	4.70	16.5	6.93
2	102	30.50	30.25	70	2.2	-	12.54	1.75	35.38	4.95		
3	100	30.50	31.00	56	3.4	-	11.67	1.66	31.71	4.53		
4	115	31.00	32.50	42	3.3	-	9.32	1.15	25.34	3.14		
5	125	32.25	32.50	35	10.5	-	13.57	1.58	37.24	4.25	42.2	2.77
6	130	32.75	33.50	28	18.3	-	18.27	2.00	50.38	5.53		
7	148	33.00	35.00	21	23.4	-	20.95	2.02	57.91	5.58		
8	160	33.75	35.50	9	28.7	-	21.50	1.91	59.70	5.33		
9	175	34.75	36.25	-	35.0	-	26.22	2.14	72.80	5.94		
10	189	34.50	37.00	-	35.0	7.4	30.02	2.26	166.78	12.60	47.9	8.01
11	200	35.00	37.00	-	33.2	8.4	29.18	2.08	175.74	12.55		
12												
13	(Calf died at the end of 11th week)											
14												
15	*Calculated values for 16th week											
16	270	36.75	42.50	374	425.3	95.6	432.40	1.82			41.1	7.30
Growth gain, feed consumption at												
4 wk	32	1.50	3.50	281	10.4	-	53.15					
10 "	106	5.00	8.00	374	161.3	7.4	183.68					
16 "	187	7.25	13.50	374	425.3	95.6	432.4	1.82			41.1	7.30

*Missing data from the 11th to the 16th week was calculated by the Love (37) method.

Table XX

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 93, Group IV

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(%)	(%)
0	54	27.00	25.00	7.5	2.0	-	2.83	.74	8.00	2.11		
1	55	25.75	26.00	42.0	0.3	-	7.09	1.84	19.19	4.98		
2	60	26.50	27.00	47.5	0.6	-	8.22	1.95	22.31	5.31	15.6	10.0
3	70	26.50	27.50	49	2.0	-	9.49	1.93	25.72	5.24		
4	70	28.75	28.75	49	6.9	-	13.16	2.68	35.91	7.32		
5	80	28.25	29.50	49	9.3	-	14.95	2.66	40.90	7.30		
6	88	28.25	29.75	42	8.6	-	13.29	2.15	36.37	5.90	32.3	3.34
7	93	28.50	30.00	35	29.6	-	27.88	4.28	76.97	11.82		
8	135	30.50	32.50	35	32.8	-	30.27	3.20	83.62	8.84		
9	110	30.25	32.00	18.0	32.7	13.1	34.16	4.43	242.30	31.40		
10	122	30.50	33.00	-	30.2	8.3	26.89	3.14	168.23	19.69		
11	137	31.50	34.00	-	32.1	7.5	27.90	2.90	162.02	16.89	42.8	10.2
12	140	32.00	34.25	-	33.7	8.6	28.85	2.94	104.73	10.68		
13	130	32.50	34.00	-	23.4	6.9	20.51	2.25	79.39	8.72		
14	143	32.50	34.50	-	35.0	10.3	30.66	3.06	121.20	12.10		
15	150	33.25	35.50	-	34.1	12.3	31.04	2.95	138.93	13.23	65.0	8.96
16	143	33.50	37.50	-	30.2	11.7	27.91	2.78	101.76	10.16		
Growth gains, feed consumption at												
4 wk	16	1.75	3.75	195	11.8	-	40.79					
10 "	68	3.50	8.00	374	155.0	21.4	188.23					
16 "	89	6.50	12.50	374	343.5	78.7	355.10					

Table XXI

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 99, Group V.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	56	25.00	26.00	15	0.1	-	2.53	.64	6.84	1.74	20.0	15.0
1	50	26.00	27.00	42	1.1	-	7.73	2.20	21.07	6.02		
2	55	26.25	26.50	49	1.9	-	8.06	2.09	26.03	6.76		
3	55	26.75	27.50	49	2.4	-	9.91	2.57	27.20	7.06		
4	65	27.50	28.50	49	4.8	-	11.84	2.60	32.84	7.21		
5	81	27.50	29.50	49	5.1	-	12.08	2.13	33.55	5.91	42.9	7.92
6	100	29.00	31.00	42	9.4	-	14.38	2.05	40.57	5.79		
7	108	29.50	30.75	35	14.0	-	16.93	2.23	48.30	6.38		
8	112	30.50	32.00	21	19.6	-	19.14	2.44	55.30	7.05		
9	127	30.00	33.00	21	24.1	7.4	26.87	3.02	143.72	16.16	77.7	15.1
10	146	30.50	34.50	-	32.2	6.5	27.46	2.68	103.18	10.09		
11	150	30.75	35.25	-	35.0	12.0	32.40	3.08	139.64	13.29		
12	151	31.00	35.00	-	30.7	16.7	31.59	2.98	156.88	14.84		
13	177	32.00	36.00	-	34.4	22.4	37.30	3.01	196.32	15.84	79.8	2.91
14	170	32.50	36.50	-	33.7	24.2	37.70	3.16	193.03	16.22		
15	189	33.00	37.00	-	34.2	24.4	38.18	2.88	195.09	14.74		
16	190	33.25	37.50	-	34.2	24.1	38.03	2.85	193.56	14.55		
Growth gains, feed consumption at												
4 wk	9	2.50	2.50	204	10.3	-	40.07					
10 "	90	5.50	8.50	372	114.7	13.9	156.93					
16 "	134	8.25	11.50	372	316.9	137.7	372.13					

Table XXII

Weekly Feed Consumption, Body Growth Measurements and Plasma Carotene and Vitamin A Values for Calf No. 172, Group V.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	101	28.50	30.00	36	0.1	-	5.94	.84	16.08	2.27		
1	104	29.25	31.00	63	2.3	-	12.11	1.66	33.13	4.55		
2	87	29.00	31.00	70	3.6	-	14.30	2.34	39.26	6.44	24.0	6.99
3	110	29.50	32.00	56	3.9	-	12.26	1.59	33.81	4.39		
4	117	30.50	33.00	42	6.3	-	11.90	1.49	33.29	4.06		
5	135	30.75	33.50	42	13.5	-	17.67	1.86	50.21	5.31		
6	143	32.00	34.50	42	23.3	-	25.53	2.55	73.24	7.31	52.2	5.61
7	157	32.00	35.50	21	34.2	-	30.85	2.80	89.61	8.15		
8	165	33.00	36.75	-	35.0	-	28.07	2.43	82.25	7.12		
9	185	33.75	37.00	-	34.8	9.0	32.92	2.54	176.46	13.62		
10	198	34.25	38.00	-	35.0	12.5	35.03	2.52	213.75	15.42	82.5	12.8
11	220	34.50	38.50	-	35.0	12.9	32.86	2.13	144.65	9.39		
12	212	34.50	39.00	-	35.0	14.1	33.73	2.27	151.34	10.19		
13	220	34.50	39.50	-	35.0	21.6	37.34	2.42	193.11	12.53		
14	239	35.50	40.00	-	35.0	29.1	41.20	2.46	234.89	14.04	137.3	6.60
15	254	36.00	40.00	-	35.0	27.8	40.53	2.27	214.02	12.03		
16	265	37.00	41.00	-	35.0	29.1	41.20	2.22	220.63	11.89		
Growth gains, feed consumption at												
4 wk	16	2.00	3.00	267	16.2	-	56.51					
10 "	97	5.75	8.00	372	192.0	21.5	226.58					
16 "	164	8.50	11.00	372	402.0	156.1	453.44					

Table XXIII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 186, Group V.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	51	27.00	26.75	32.5	0.7	-	5.86	1.64	15.95	4.46	28.2	6.90
1	55	26.50	26.50	42	3.2	-	9.41	2.44	26.00	6.75		
2	63	26.50	27.50	49	1.8	-	9.43	2.13	25.90	5.87		
3	70	28.50	28.50	49	1.9	-	9.51	1.94	26.03	5.31		
4	75	27.50	29.50	49	4.0	-	11.20	2.13	30.96	5.89	25.1	11.2
5	86	28.25	29.75	42	5.3	-	11.68	1.94	29.50	4.90		
6	93	29.00	31.00	35	11.1	-	11.42	1.75	38.49	5.91		
7	96	29.00	31.50	35	22.0	-	22.18	3.30	61.16	9.10		
8	116	29.50	32.00	21	29.4	-	25.44	3.13	70.39	8.66	68.3	12.3
9	125	29.50	32.75	21	28.9	13.7	32.02	3.65	138.95	15.88		
10	138	31.00	33.75	-	28.5	16.6	29.90	3.09	143.61	14.86		
11	145	31.50	34.75	-	32.3	17.3	33.10	3.26	155.07	15.27		
12	150	32.00	34.25	-	28.2	16.2	29.46	2.80	140.95	13.42		
13	160	32.00	34.75	-	32.5	16.8	32.99	2.94	152.94	13.65	56.9	7.49
14	168	32.75	36.00	-	35.0	19.3	35.31	3.00	185.40	15.76		
15	175	33.00	36.50	-	33.7	20.4	34.94	2.85	193.43	15.79		
16	185	33.25	37.00	-	34.3	21.1	35.73	2.75	199.64	15.41		
Growth gain, feed consumption at												
4 wk	19	.50	2.75	221.5	11.6	-	45.41					
10 "	87	4.00	7.00	375.5	136.8	30.3	178.05					
16 "	134	6.25	10.25	375.5	332.8	141.4	379.58					

Table XXIV

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 45, Group V.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	89	28.00	30.00	11	.0	-	1.79	.28	4.84	.77	16.8	7.59
1	97	28.75	30.50	63	1.4	-	11.39	1.67	31.01	4.56		
2	103	29.50	31.00	70	0.9	-	12.13	1.68	32.92	4.56		
3	111	30.00	31.50	70	1.9	-	12.93	1.66	35.27	4.53		
4	110	29.25	32.00	56	1.0	-	9.93	1.28	26.99	3.50	12.2	4.02
5	114	30.00	32.00	42	2.3	-	8.57	1.07	23.26	2.91		
6	117	30.00	32.50	35	6.1	-	10.27	1.25	28.09	3.42		
7	130	31.00	34.00	28	10.3	-	12.28	1.34	33.74	3.70		
8	135	31.00	34.25	-	18.0	-	13.48	1.42	37.44	3.96	6.6	0.1
9	137	31.25	34.25	-	20.2	6.2	18.32	1.91	73.51	7.66		
10	150	32.00	34.50	-	23.4	7.7	21.49	2.04	87.79	8.36		
11	155	32.50	35.50	-	32.8	8.8	29.10	2.68	112.93	10.40		
12	150	32.50	35.50	-	29.7	11.8	28.32	2.69	121.72	11.59		
13	135	32.75	35.50	-	14.0	7.3	14.25	1.50	66.20	7.00	14.1	0.4
14	158	32.50	36.00	-	20.4	8.4	19.12	1.72	84.67	7.65		
15	165	33.00	36.50	-	35.0	16.4	33.82	2.92	161.59	13.99		
16	176	33.50	37.00	-	31.2	10.1	27.82	2.25	106.95	8.68		
Growth gains, feed consumption at												
4 wk	21	1.25	2.00	270	5.2	-	48.17					
10 "	61	4.00	4.50	375	85.5	13.9	132.58					
16 "	87	5.50	7.00	375	248.6	76.7	285.01					

Table XXV

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 170, Group V.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(%)	(%)
0	85	29.00	30.00	4	.0	-	.65	.01	1.76	.29		
1	85	28.25	30.00	63	1.3	-	11.31	1.90	30.78	5.17	3.0	6.77
2	92	29.50	31.00	70	2.2	-	12.54	1.94	35.38	5.49		
3	100	30.00	32.50	70	5.4	-	15.45	2.20	42.03	6.00		
4	115	30.50	33.00	56	5.6	-	13.32	1.65	36.29	4.50		
5	127	31.25	33.50	42	18.2	-	20.48	2.30	56.34	6.33	33.9	5.02
6	146	31.25	34.75	42	25.7	-	26.10	2.55	71.94	7.03		
7	158	32.50	35.50	28	30.9	-	27.71	2.50	76.59	6.92		
8	168	33.25	36.50	-	32.7	-	24.49	2.08	68.02	5.78		
9	173	33.50	35.50	-	35.0	15.9	34.40	2.84	153.57	12.68		
10	190	34.25	37.75	-	35.0	17.9	35.43	2.66	163.73	12.31	51.5	9.48
11	188	34.00	38.00	-	31.9	20.7	33.79	2.56	194.51	14.78		
12	200	34.50	38.50	-	32.8	21.4	34.80	2.48	200.95	14.35		
13	214	34.50	38.00	-	35.0	21.2	36.29	2.42	201.00	13.41		
14	230	35.50	39.75	-	35.0	21.8	36.60	2.27	205.93	12.79	60.0	9.47
15	225	35.50	40.50	-	35.0	23.2	37.32	2.36	120.44	7.64		
16	230	36.00	41.00	-	35.0	21.0	36.19	2.22	111.58	6.93		
Growth gains, feed consumption at												
4 wk	30	1.50	3.00	263	14.5	-	53.27					
10 "	105	5.25	7.75	375	192.0	33.8	221.88					
16 "	145	7.00	11.00	375	396.7	163.0	436.87					

Table XXVI

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 19, Group VI

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	98	29.50	31.75	52	1.2	1.1	10.05	1.46	35.13	5.12		
1	98	29.50	32.50	63	2.8	1.8	13.51	1.96	49.73	7.24		
2	102	29.50	32.00	70	2.3	2.1	14.42	2.01	54.20	7.59	12.3	4.4
3	111	30.00	32.50	56	2.1	1.7	11.75	1.51	51.08	6.57		
4	115	30.50	33.00	42	8.1	2.2	14.56	1.80	65.35	8.11		
5	126	30.50	32.50	36	11.9	1.3	16.13	1.82	60.25	6.83		
6	146	31.50	34.25	28	11.3	3.0	15.29	1.49	76.83	7.51		
7	146	31.50	34.50	21	18.9	8.6	23.35	2.28	162.45	15.89	72.3	7.82
8	157	32.50	35.50	6	25.3	6.2	24.70	2.24	132.40	12.04		
9	166	32.50	36.50	-	23.1	7.7	22.79	1.96	141.60	12.18		
10	180	33.00	37.00	-	26.1	8.3	25.53	2.02	155.46	12.33		
11	195	33.00	37.50	-	29.5	5.7	26.82	1.96	133.96	9.81	72.0	3.12
12	210	34.25	38.50	-	35.0	10.7	34.00	2.31	147.20	10.01		
13	216	35.00	39.00	-	35.0	15.9	36.88	2.43	178.76	11.82		
14	232	35.00	40.00	-	34.6	19.8	38.72	2.38	201.50	12.40		
15	252	35.50	41.00	-	35.0	19.2	38.71	2.19	198.80	11.26	137.3	8.90
16	293	36.00	41.00	-	35.0	20.1	36.54	1.17	312.39	15.17		
Growth gain, feed consumption at												
4 wk	17	1.00	1.25	283	16.5	8.9	64.29					
10 "	82	3.50	5.25	374	133.1	44.0	192.08					
16 "	195	6.50	9.25	374	337.2	135.4	403.75					

Table XXVII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 47, Group VI.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	110	29.00	33.00	34.5	0.6	0.7	6.49	.84	25.45	3.30		
1	94	28.50	31.00	63	0.8	0.4	11.13	1.60	34.66	5.26	18.0	6.41
2	110	29.00	31.50	70	1.4	1.0	13.09	1.70	45.43	5.90		
3	110	29.00	32.00	56	2.0	1.2	11.40	1.48	42.95	5.57		
4	118	29.75	32.50	56	6.4	0.9	14.76	1.78	49.89	6.03		
5	124	30.25	33.50	42	8.2	2.0	14.53	1.67	60.43	6.96	38.1	5.46
6	127	31.25	34.00	35	11.4	2.9	16.45	1.85	59.79	6.72		
7	153	31.00	34.75	19	22.5	2.3	22.42	2.09	75.20	7.02		
8	160	31.50	35.00	-	27.5	1.1	22.66	2.02	71.30	6.36		
9	165	32.00	36.00	-	33.0	2.0	27.57	2.38	89.69	7.76	52.1	2.16
10	189	32.50	37.00	-	35.0	1.3	26.88	2.03	88.30	6.67		
11	190	32.50	38.00	-	35.0	5.5	29.04	2.18	138.36	10.40		
12	202	32.50	38.50	-	35.0	12.0	32.40	2.29	215.84	15.26		
13	203	33.50	39.00	-	35.0	25.5	39.35	2.76	376.76	26.51	52.7	1.08
14	210	34.00	39.00	-	35.0	24.0	38.58	2.62	377.60	25.68		
15	224	34.00	40.00	-	35.0	25.3	39.24	2.50	394.11	25.13	-	
16	235	35.25	40.50	-	35.0	26.7	39.97	2.42	411.89	25.03		
Growth gains, feed consumption at												
4 wk	8	.75	- .5	279.5	11.2	4.2	56.87					
10 "	79	3.50	4.00	375.5	148.8	15.8	187.38					
16 "	125	6.25	7.50	375.5	358.8	134.8	405.96					

Table XXVIII

Weekly Feed Consumption, Body Growth Measurements
and Plasma Carotene and Vitamin A Values for Calf No. 113, Group VI.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(%)	(%)
0	55	25.75	26.00	22.5	.2	.0	3.83	.87	10.37	2.68		
1	53	25.25	27.00	42	1.4	0.3	8.14	2.19	25.17	6.78	20.7	9.15
2	70	26.75	26.75	49	5.4	1.4	13.09	2.67	42.75	8.72		
3	70	27.25	27.50	49	3.2	1.5	11.38	2.32	38.19	7.79		
4	80	27.50	28.50	49	6.1	1.2	13.54	2.41	43.18	7.71		
5	90	28.50	29.50	42	10.2	1.5	15.86	2.51	51.56	8.18	60.6	5.39
6	107	28.50	30.25	42	7.5	2.8	13.90	1.85	67.46	9.00		
7	110	29.50	31.50	35	14.5	2.2	17.70	2.29	71.78	9.32		
8	120	30.50	31.50	21	24.8	4.7	24.41	2.90	116.85	13.91		
9	133	30.50	32.75	21	31.5	14.6	34.52	3.70	248.79	26.73	70.2	8.18
10	152	31.25	34.00	-	35.0	15.3	34.08	3.20	267.11	25.10		
11	165	31.75	34.00	-	34.5	14.6	33.34	2.88	257.18	22.26		
12	170	31.75	35.25	-	33.8	14.7	32.87	2.76	256.99	21.59		
13	173	31.75	35.50	-	35.0	15.9	34.39	2.83	274.73	22.68		
14	180	33.00	36.75	-	35.0	16.1	34.49	2.73	277.27	22.00	86.9	16.5
15	189	33.00	36.50	-	35.0	19.1	35.19	2.65	201.91	15.26		
16	205	33.00	37.00	-	35.0	17.5	34.37	2.39	187.25	13.04		
Growth gains, feed consumption at												
4 wk	25	1.75	2.50	211.5	16.3	4.4	49.98					
10 "	97	5.50	8.00	372.5	139.8	45.5	190.45					
16 "	150	7.25	11.00	372.5	348.1	143.4	395.10					

Table XXIX

Weekly Feed Consumption, Body Growth Measurements and Plasma Carotene and Vitamin A Values for Calf No. 4, Group VI.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	66	27.50	28.50	25	.0	.0	.40	.08	1.10	.23		
1	67	27.75	28.00	42	0.7	0.2	7.52	1.60	21.34	4.55		
2	67	27.50	28.00	47.5	1.6	0.9	9.52	2.02	30.12	6.42	12.6	4.22
3	80	28.25	28.50	49	2.8	0.9	10.54	1.88	38.11	6.80		
4	85	29.00	29.50	49	7.1	1.7	14.18	2.38	56.59	9.51		
5	100	29.50	30.50	49	7.9	3.0	15.44	2.20	73.75	10.53		
6	105	29.75	31.00	42	14.6	5.7	20.71	2.81	116.79	15.80	14.6	4.78
7	120	30.00	31.50	28	16.9	4.7	19.64	2.33	107.16	12.75		
8	107	29.75	31.00	35	25.1	6.7	27.95	3.73	152.70	20.38		
9	132	30.50	34.00	32.5	30.4	8.1	32.23	3.48	180.40	19.52		
10	135	31.25	32.50	-	31.8	10.7	29.32	3.10	202.03	21.37		
11	147	32.00	34.00	-	32.1	10.5	29.44	2.86	200.12	19.44	39.3	9.68
12	170	32.50	34.00	-	35.0	12.8	31.95	2.68	144.20	12.11		
13	170	32.50	35.25	-	34.4	14.5	32.39	2.72	159.31	13.38		
14	175	32.75	36.00	-	35.0	18.8	35.05	2.86	199.16	16.25		
15	190	33.50	35.50	-	35.0	17.1	34.16	2.56	183.59	13.80	53.3	6.74
16	183	33.00	38.00	-	35.0	18.5	34.88	2.72	151.09	11.79		
Growth gains, feed consumption at												
4 wk	19	1.50	1.00	190	12.2	3.7	42.16					
10 "	69	3.75	4.00	376.5	138.9	42.6	187.45					
16 "	117	5.50	9.50	376.5	345.4	134.8	385.32					

Table XXX

Weekly Feed Consumption, Body Growth Measurements and Plasma Carotene and Vitamin A Values for Calf No. 169, Group VI.

Weeks	Body Wt.	Height at Withers	Heart Girth	Milk	Starter	Hay	Est. T.D.N. Consumed	T.D.N. per 100/lb Wt./day	Carotene Consumed	Carotene Consumed 100/lb Wt./day	Plasma Carotene	Plasma Vitamin A
	(lb.)	(in.)	(in.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(mg.)	(mg.)	(γ%)	(γ%)
0	116	29.75	32.00	44	0.1	0.3	7.42	.913	21.42	2.63		
1	115	30.00	31.75	63	0.2	0.2	10.54	1.30	29.40	3.65		
2	125	30.50	32.50	70	1.2	0.9	12.87	1.47	39.08	4.46	13.7	2.18
3	135	30.50	33.00	56	3.0	1.3	12.04	1.27	46.38	4.90		
4	130	31.25	33.25	56	6.3	1.5	14.62	1.60	55.62	6.11		
5	140	31.50	34.00	35	6.3	2.1	11.50	1.17	53.36	5.44		
6	151	32.00	34.00	28	11.5	4.1	15.28	1.44	85.11	8.05	14.6	7.01
7	160	31.75	34.50	21	15.6	4.4	17.37	1.54	97.57	8.71		
8	175	32.50	35.00	-	34.2	7.0	29.21	2.38	160.04	13.06		
9	170	33.50	35.50	-	33.0	8.8	29.24	2.45	180.40	15.15		
10	180	33.50	36.50	-	34.7	9.5	30.87	2.45	192.83	15.30		
11	190	33.50	36.50	-	35.0	9.6	31.15	2.34	194.72	14.64	30.2	3.23
12	205	34.00	37.00	-	35.0	10.5	30.77	2.14	123.13	8.58		
13	205	34.25	38.00	-	35.0	13.9	32.52	2.26	154.27	10.76		
14	210	34.50	38.00	-	35.0	12.6	31.85	2.16	142.37	9.68		
15	233	34.75	38.75	-	35.0	10.9	30.98	1.89	126.79	7.77	59.4	6.86
16	225	35.00	40.00	-	35.0	17.3	34.27	2.17	143.03	9.08		
Growth gains, feed consumption at												
4 wk	14	1.50	1.25	289	10.8	4.2	57.49					
10 "	64	3.75	4.50	373	146.1	40.1	190.96					
16 "	109	5.25	8.00	373	356.1	114.9	382.50					

VITA

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candidate for the degree of
Master of Science

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