THE INFLUENCE OF AUREOMYCIN AND RUMEN INOCULATION ON THE GROWTH OF DAIRY CALVES

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INTRODUCTION

Many mold, bacteria, and yeast organisms secrete various metabolic products which inhibit or prevent the growth of other micro-organisms. Certain of these products have come to be known as antibiotics.

A considerable number of these antibiotics have been isolated in the past decade, however, only a few have shown important activity. An even smaller number are of nutritional importance as growth promoting antibiotics. The most important of these are: Penicillin (1941), Streptomycin (1944), Aureomycin (1948), and Terramycin (1949).

These antibiotics are characterized by the inhibition of growth of various kinds of micro-organisms. Penicillin and streptomycin inhibit principally gram-positive and gram-negative bacteria respectively. In contrast to these antibiotics of narrow range activity, aureomycin and terramycin are characterized by their ability to combat a wide variety of organisms and hence have come to be known as "broad spectrum antibiotics."

Recently, it has been demonstrated that when antibiotics have been administered in small quantities to animals they have increased the growth rate and efficiency of feed utilization. These results were thought to be nutritional alone without thought toward the therapeutic effect obtained with antibiotics at considerably higher levels of administration.

An exact knowledge as to the mechanism by which antibiotics produce a more rapid growth has not been determined. There are a large number of theories, the most plausible being that the antibiotics alter the flora in the digestive tract of the animals. Under this theory, antibiotics may eliminate or reduce in number either the organisms that

compete for the food taken in by the animal, or the organisms that slow down growth by the secretion of certain toxins. Should alteration of the flora of the digestive tract prove to be the means by which antibiotics bring about the nutritional effect, the spectrum of the individual antibiotic will probably determine its field of usefulness. Therefore, it is reasonable to assume that the broad spectrum antibiotics will be those most widely accepted in animal nutrition.

Previous work at various stations has indicated that an increase in growth rate and efficiency of feed utilization occurs when calves receive aureomycin in small amounts. Of considerable interest, however, was the observation of a sharp decline in growth rate and feed utilization efficiency when the administration of aureomycin was discontinued. This setback may be due to a lag in the establishment of the normal flora of the rumen following aureomycin administration in accordance with the previously mentioned theory.

The purpose of this investigation was to determine the value of administering aureomycin to dairy calves in reducing scours and increasing the rate of gain and to determine the value of rumen inoculations with rumen material from a mature animal in preventing a decrease in growth rate and feed utilization efficiency following the discontinuation of aureomycin administration.

REVIEW OF LITERATURE

Aureomycin in Calf Nutrition

Aureomycin, derived from the organism Streptomyces aureofaciens, was first described by Duggar (1, 8) in 1948. Since that time this bacteriostatic agent has been subjected to extensive investigations not only as a therapeutic agent in clinical medicine, but also as a growth promoting substance in animal nutrition.

Loosli and Wallace (14) demonstrated that either a crude aureomycin-B_{12} feed supplement or crystalline aureomycin HCl to milk substitutes significantly increased the growth rate and reduced the incidence of scours when fed to calves from the ages of two to eight weeks. The effect observed appeared to be largely antibiotic since crystalline aureomycin HCl resulted in a response equal to that observed with the aureomycin-B_{12} supplement.

These results were not entirely in agreement with the studies by Rusoff and Haq (29) or Williams and Knodt (32) who found that an APF supplement was of no apparent value for calves weaned from milk at an early age. It should be noted that the supplement used by these authors was a vitamin-B_{12} supplement and had no apparent aureomycin activity.

Rusoff (27) also found that injections of pure vitamin-B_{12} were without effect on the growth of dairy calves. However, when an aureomycin-B_{12} supplement was fed to some of the control calves at the age of 14 weeks, an increased growth rate could be noted over the remaining calves used as a control group.

Morrison and Deal (16) observed no differences in scouring, general health, gain or feed consumption of two week old calves when an antibiotic supplement was fed from birth at a 1 percent level of the dry matter content

of the milk fed. The fact that negligible gains are made by calves in the first two weeks and that scours were not a problem in any of the groups was offered as a possible explanation for the results which were obtained.

Bloom and Knodt (5) studied the value of vitamin-B_{12}, DL-methionine, K-penicillin and aureomycin in milk replacement formulae. K-penicillin significantly decreased the rate of gain and the amount of starter consumed. The addition of vitamin-B_{12} and DL-methionine had no apparent effect on the growth rate of the calves, whereas aureomycin supplementation at varied levels increased the rates of gain as much as 20 percent over the other groups. Aureomycin supplementation had its greatest growth promoting effect during the first four weeks, but the difference in gains over the controls did not hold at 12 weeks of age. The incidence of scours were lower in the aureomycin supplemented calves.

Bartley, et al. (2) found that the growth response of dairy calves administered crystalline aureomycin HCl by capsule was approximately twice as great as that of the control group. A considerably lower incidence and severity of scours was noted in the supplemented calves and they were, on the average, thriftier and in better condition than the controls. It might be well to note in this study that the aureomycin appeared to have enhanced growth by controlling scours since these calves were housed under environmental conditions conducive to contracting scours and other calfhood deseases. Of considerable interest in this trial was the sharp drop in growth rate and efficiency of feed utilization which occurred when the supplement was withdrawn at the end of seven weeks of age.

Loosli et al. (15) noted that calves which were removed from aureomycin at the end of eight weeks of age exhibited a very similar drop in growth rate as was previously reported at the Kansas Station (2).

Preliminary studies of the microflora, based on slide examination, failed to reveal any differences in total bacterial count or morphological types, but preliminary cultural studies indicated some physiological variations. The aureomycin supplemented calves consumed more concentrates, required less TDN to make a pound of gain and showed a lower incidence and severity of scours than the controls.

Jacobsen et al. (12) observed that aureomycin supplemented calves gained continuously at a rate 30 percent above the Ragsdale standard whereas the controls approximated the standard. Even though a slight decrease in growth rate occurred when the aureomycin was removed from the diets of the calves at 116 days of age, the drop did not appear to be significant and no adverse effects were noted.

Rusoff and Davis (28) indicated that aureomycin definitely had a growth promoting effect for the first 90 days of administration after which time the rate of growth gradually declined. The growth rates in both the control group and the supplemented groups were approximately the same after 20 weeks of age. No evidence of anorexia or diarrhea was observed in the supplemented calves.

Voelker and Cason (30) found that calves on pasture which were receiving aureomycin-B_{12} supplement gained more rapidly than the controls and did not incur scours when inoculated with fecal material. Further observations indicated no harmful effects from administering 200 mg. of crystalline aureomycin daily in a grain ration. In subsequent studies by these same authors (31) with terramycin no significant growth responses were noted at low intake levels. However, growth responses similar to those previously obtained with aureomycin were shown when levels as high as 100 mg. per 100 pounds of bodyweight were fed.

As calves become older and begin to ingest greater amounts of roughage it appears reasonable that aureomycin may have some effect on the digestive fractions normally associated with rumen function. Bartley et al. (3) observed that even though the total digestible nutrients, digestible protein, and average hay consumption was approximately the same over a 12 week period the aureomycin supplemented calves gained at a greater rate than the controls and exceeded the Ragsdale standard. The supplemented calves consumed 22 percent more grain over a 22 week period. Further studies by these authors on the effect of aureomycin on the digestibility of milk, grain, and hay indicated little difference between the supplemented calves and the control calves in all trials with the exception of the crude fiber fraction which was more readily digested by the control calves. It was also noted that when no grain was fed there was no significant difference between groups with respect to the pounds of gain per pound of TDN consumed. Microscopic examination of the microflora revealed no differences, but preliminary cultural studies indicated some physiological variations.

Jacobsen et al. (10) supplemented calves with crystalline aureomycin over a period of 16 weeks and observed an increased growth rate over the controls. No significant differences in feed utilization were noted while the calves were exclusively on a skim milk diet. When hay and grain were added to the diet from 61 to 116 days of age the controls apparently utilized the feed more efficiently. Scouring was lessened with the calves receiving aureomycin.

Murley et al. (17) found that aureomycin supplementation increased the growth rate and reduced the frequency of scours when calves were fed various rations but that all other effects were similar.

Assuming that the nutritional effect of aureomycin is in accord with the existing theory that antibiotics alter the flora in the digestive tract of the animal, it is reasonable, therefore, to assume that a lag in the establishment of the normal flora of the rumen may result following aureomycin administration.

While the optimum levels of intake for both aureomycin-B_{12} supplement and crystalline aureomycin HCl have not been established by the various authors (2, 5, 10, 12, 14, 15, 16, 17, 27, 28, 29, 30, 31, 32) the effects as observed in most instances were similar at all levels of intake. Bartley et al. (3) found that levels ranging from 200 to 2500 mg. of crystalline aureomycin HCl per day, fed to 16 week old calves over a four week period, were without apparent deleterious effects.

Some studies have indicated adverse effects from aureomycin administration. Colby, Rau and Miller (6) noted that fattening lambs lost weight and went off feed when they received 100 mg. of crystalline aureomycin by capsule daily, however, Jordan and Bell (13) observed an increase in growth and feed efficiency when fattening lambs were drenched with five to six mg. of aureomycin per day for a six week period.

Neuman et al. (18) demonstrated that no extreme physiological disturbances occurred when fattening heifers were fed aureomycin. These authors did observe a severe reduction in the appetites of the heifers the first few days after which time they gradually recovered. Bacteriological studies indicated approximately the same total counts but the types of organisms in the lots fed aureomycin were less diverse.

Bell, Whitehair and Gallup (4) found that a marked reduction in the digestibility of crude fiber, dry matter, and nitrogen free extract resulted when steers were fed 200 mg. of crystalline aureomycin HCl per day. Six

hundred milligrams of aureomycin fed daily produced a marked anorexia and fetid diarrhea in steers within 48 to 72 hours. Continued feeding of 200 mg. of aureomycin daily to these steers resulted in somewhat milder digestive disturbances.

Changes in bodyweight, chest circumference and height at the withers are in most instances greater in aureomycin supplemented calves than in non-supplemented calves. Jacobsen et al. (11) noted that gains in bodyweight were significantly greater ($P=0.01$) for calves fed aureomycin than for calves receiving no antibiotic supplement. Increases in height at the withers and in chest circumference also were greater in the supplemented than in the non-supplemented groups, but the differences were not significant at $P=0.05$.

Rumen Inoculation

The value of inoculating young calves with rumen contents from mature animals was recognized by Swedish workers over 100 years ago, but no extensive studies had been carried on in this country until recently.

Studies by Pounden and Hibbs (21) in 1947 indicated that rumen fauna and certain characteristic flora similar to those seen in samples from mature animals were not observed in the majority of calves examined until they were several weeks of age. Upon inoculation of organisms from cows into the rumens of a few calves it was found that some of the organisms became established.

In 1948, investigations by these authors (9, 25, 26) were continued in an attempt to determine if there were any material advantages in stimulating the development in calves of early rumen activity comparable to that in mature animals. The results indicated that inoculations assisted in the establishment of protozoa in the rumen and assisted in the establishment of some, but not all, of the characteristic varieties of rumen microflora. These inoculations were particularly helpful in the establishment of organisms associated with roughage ingestion but were of no value in the establishment of varieties of organisms which were associated with the ingestion of grain. Further observations indicated that rumen inoculations were effective in maintaining higher blood plasma ascorbic acid levels but had no marked effect on blood carotenoid or blood plasma vitamin A levels.

In pasture studies which were carried on in 1949 by Pounden and Hibbs (23, 24) with inoculated and non-inoculated calves, it was observed that rumen protozoa and certain bacteria, used as indicators of the presence of varieties characteristically associated with a high proportion of hay ingestion, were established readily in all inoculated calves. Protozoa did

not develop in the non-inoculated calves. Some characteristic bacteria became established in the non-inoculated calves by six weeks of age, but were limited to only one of the observed varieties and were relatively few in number.

Conrad and associates (7) found that inoculated calves digested a higher percentage of cellulose and dry matter than the non-inoculated controls. Thus, rumen inoculations appear to increase digestion of roughage in calves at an early age. There appeared to be no significant differences in the apparent digestibility of protein by the inoculated and non-inoculated calves. However, the average apparent digestibility of protein differed by approximately two percent in favor of the inoculated group in each series of digestion trials. The inoculations were further seen to stimulate hay consumption at an earlier age than when no inoculations were given.

Further investigations by Pounden and Hibbs (9, 22, 23, 24, 25, 26) indicated that calves raised without typical microbial flora tended to develop an undesirable type of body conformation which was not observed with the inoculated calves. This condition was generally characterized by a "pot bellied" appearance and rough hair coat. No significant difference could be noted between the growth rate of the inoculated versus the non-inoculated calves as measured by gains in bodyweight. In controlled field trials, however, these authors (20) found that rumen inoculation of young calves reduced digestive disturbances and improved growth, roughage consumption, and general health.

EXPERIMENTAL

The experiment was designed to determine any possible effects on the growth and health of young dairy calves due to aureomycin administration and to determine the value of rumen inoculations with rumen material from a mature animal in preventing a drop in growth rate and feed utilization efficiency following the discontinuation of aureomycin administration. Male and female Holstein, Ayrshire, and Guernsey calves from the Oklahoma Agricultural and Mechanical College dairy herd were used for the study.

All experimental calves were removed from their dams within 48 hours after birth and placed in the calf barn for the remainder of the trial. They were isolated in individual pens equipped with a feed bowl. The basal ration consisted of six pounds of mixed Guernsey and Holstein whole herd milk fed by nipple pail twice daily, good quality prairie hay available ad libitum and a commercial pelleted calf starter containing 24 percent protein and a high content of ground alfalfa leaf meal. Starter consumption was limited to a maximum of four pounds per day. Milk was eliminated from the diet of all calves at ten weeks of age.

The experiment was conducted on three groups of calves which were designated as follows:

Group I Untreated controls

Group II Aureomycin and rumen inoculation

Group III Aureomycin but no rumen inoculation

Six Holstein, six Ayrshire and six Guernsey bull and heifer calves were assigned at random to the designated treatments so as to balance the groups as nearly as possible according to sex, breed, and initial bodyweight.

All groups received the same basal ration, with the calves in the control group receiving no additional treatment. The calves in Group II were administered 35 mg. of aureomycin twice daily by capsule for 35 days and were inoculated on the 36th and 41st days with rumen material from mature slaughtered animals. The inoculum consisted of approximately one half pint of rumen material per inoculation and was administered orally. The calves in Group III were administered 35 mg. of aureomycin two times daily by capsule for 35 days but received no inoculum.

To determine the effectiveness of the treatments daily observations were made on the health; physical appearance and severity, incidence, duration and treatment of scours. Observations of growth were made at seven day intervals by measuring changes in bodyweight, chest circumference, and height at the withers.

Termination of the experiment was at 16 weeks of age.

RESULTS

The data relative to the effects of aureomycin administration upon growth, as presented in Appendix Tables II and IV and as summarized in Table I show that the major differences in growth occurred during the first five week period. Average daily gains of 0.69 pounds for Group II and 0.68 pounds for Group III were observed; the control group showed an increase of only 0.35 pounds per day. The bodyweight gains of the calves which received aureomycin were approximately 48 percent greater than that of the controls.

The growth of the calves that received no rumen inoculum following the discontinuation of aureomycin administration was similar to that of the control group during the second five week period, whereas the growth of the calves that received rumen inoculations was somewhat greater than either the non-inoculated group or the control group. The average increase in bodyweight of 1.28 pounds per day by the inoculated group of calves during this period was approximately eight percent greater than the average daily gain of 1.16 and 1.19 pounds per day made by the non-inoculated group and the control group, respectively. Although the difference in bodyweight gains during the second period does not appear to be great, the data may be of some significance in that the bodyweight gains of all but one of the calves receiving rumen inoculum were consistently greater than those of the calves which did not get inoculum. Calf No. 81 of the non-inoculated group consistently gained at a greater rate than either the inoculated or the control calves.

Groups I and III, in which depressed growth rates had previously been noted, gained 65.0 and 54.5 pounds respectively during the last six weeks of the trial. These gains were somewhat greater than the increase of 47.83 pounds made by Group II which gained at a relatively constant

Table I

MEAN GROWTH OF CALVES BY PERIODS
AS MEASURED BY GAIN IN BODYWEIGHT, HEIGHT AT WITHERS
AND CHEST CIRCUMFERENCE

Bodyweight (lbs.)

	Group I	Group II	Group III
Initial Bodyweight	77.33	77.00	80.00
Gain in Bodyweight			
Periods: 1	12.00	23.33	23.00
2	41.83	44.83	40.66
3	65.00	47.83	54.50
Total	118.83	116.00	118.16

Height at Withers (in.)

	Group I	Group II	Group III
Initial Height at Withers	28.25	28.15	28.05
Gain in Height at Withers			
Periods: 1	0.98	1.68	1.90
2	2.51	2.45	2.46
3	2.41	2.61	2.70
Total	5.90	6.75	7.06

Chest Circumference (in.)

	Group I	Group II	Group III
Initial Chest Circumference	30.20	30.13	30.83
Gain in Chest Circumference			
Periods: 1	1.58	2.00	2.31
2	3.71	3.56	3.23
3	4.58	4.11	4.25
Total	9.87	9.67	9.80

rate throughout the first and second periods but tended to taper off during the final period of the trial. All of the periods in which a decreased growth rate was observed were apparently followed by periods of acceleration. Conversely, periods of accelerated growth were apparently followed by a decline in growth rate. Thus, no significant difference in total growth was observed at the completion of the 16 week study between Groups I, II, and III which gained 118.8, 116.0, and 118.2 pounds, respectively.

Skeletal growth as measured by height at the withers and chest circumference paralleled the observations made with respect to gains in bodyweight; this was particularly noted during the first period of growth. The groups which received aureomycin showed an average increase of 1.79 inches in height at the withers and 2.15 inches in chest circumference as compared to the control group which gained 0.98 inches in height at the withers and 1.58 inches in chest circumference.

The discontinuation of aureomycin administration apparently had no significant effect on growth as measured by height at the withers but had a slight depressing effect on the non-inoculated group with respect to chest circumference. The inoculated, non-inoculated, and control groups gained 2.45, 2.46, and 2.51 inches in height at the withers and 3.56, 3.23, and 3.71 inches in chest circumference, respectively.

The growth in height at the withers and chest circumference was approximately the same in all groups during the last six weeks of the trial. This was also observed with respect to the total growth in chest circumference of 9.87, 9.67, and 9.80 inches respectively for Groups I, II, and III. The total growth in height at the withers for both of the aureomycin groups was 6.75 and 7.06 inches whereas the growth of the control group, which appeared to be consistently lower throughout the trial, was only 5.90 inches.

Figure I, which is a graphic representation of the data presented in Appendix Table II, indicates that while the control group decreased slightly in weight through the third week, the groups which received aureomycin gained at a relatively constant rate so that the bodyweight gains of these calves were approximately twice as great as that of the controls at the end of the first five weeks.

When aureomycin administration was discontinued the group which received no inoculum showed a slight decrease in growth rate from the sixth through the eighth week, whereas the group receiving inoculum continued to gain at approximately the same rate. The growth rate of the non-inoculated group excluding calf No. 81 is also represented in the graph by a dotted line so as to illustrate the effect that an individual may have on the results.

Both periods in which decreased growth rates were observed in Groups I and III were followed by increased rates of gain so that the total growth in these groups at the end of 16 weeks of age was approximately the same as that of Group II which gained at a more constant rate but began to taper off earlier toward the end of the trial.

The graphic representations of Appendix Tables III and IV which appear in Figures II and III show that the changes in skeletal growth as measured by height at the withers and chest circumference paralleled the changes observed in bodyweight particularly during the first period. The gains in height at the withers subsequent to the first period remained consistently lower throughout the trial in the control group whereas the gains in chest circumference of all groups were relatively the same after the tenth week. In view of these results it appears that the discontinuation of aureomycin or the use of rumen inoculations had little if any effect upon skeletal growth as measured in this study.

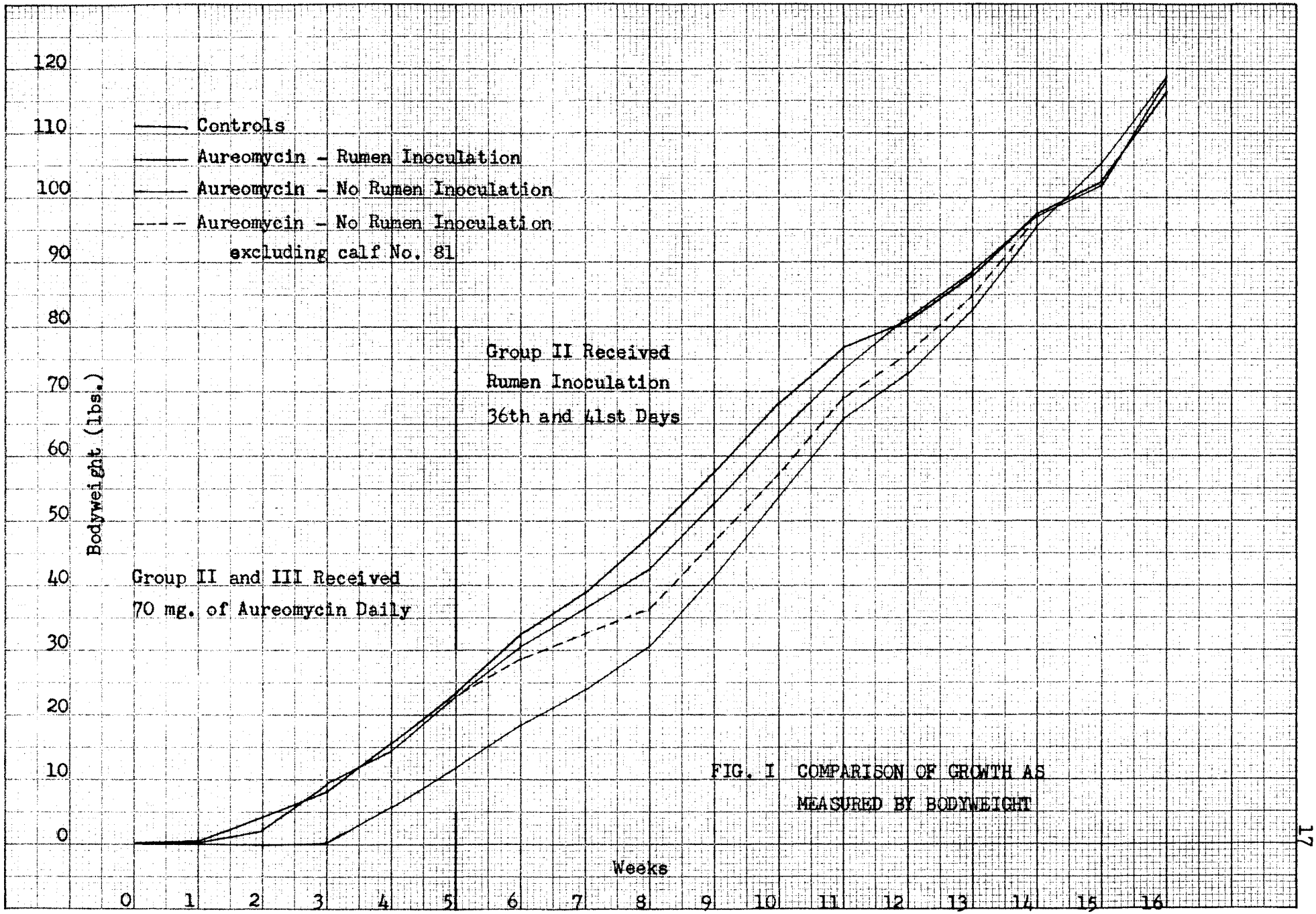

FIG. I COMPARISON OF GROWTH AS MEASURED BY BODYWEIGHT

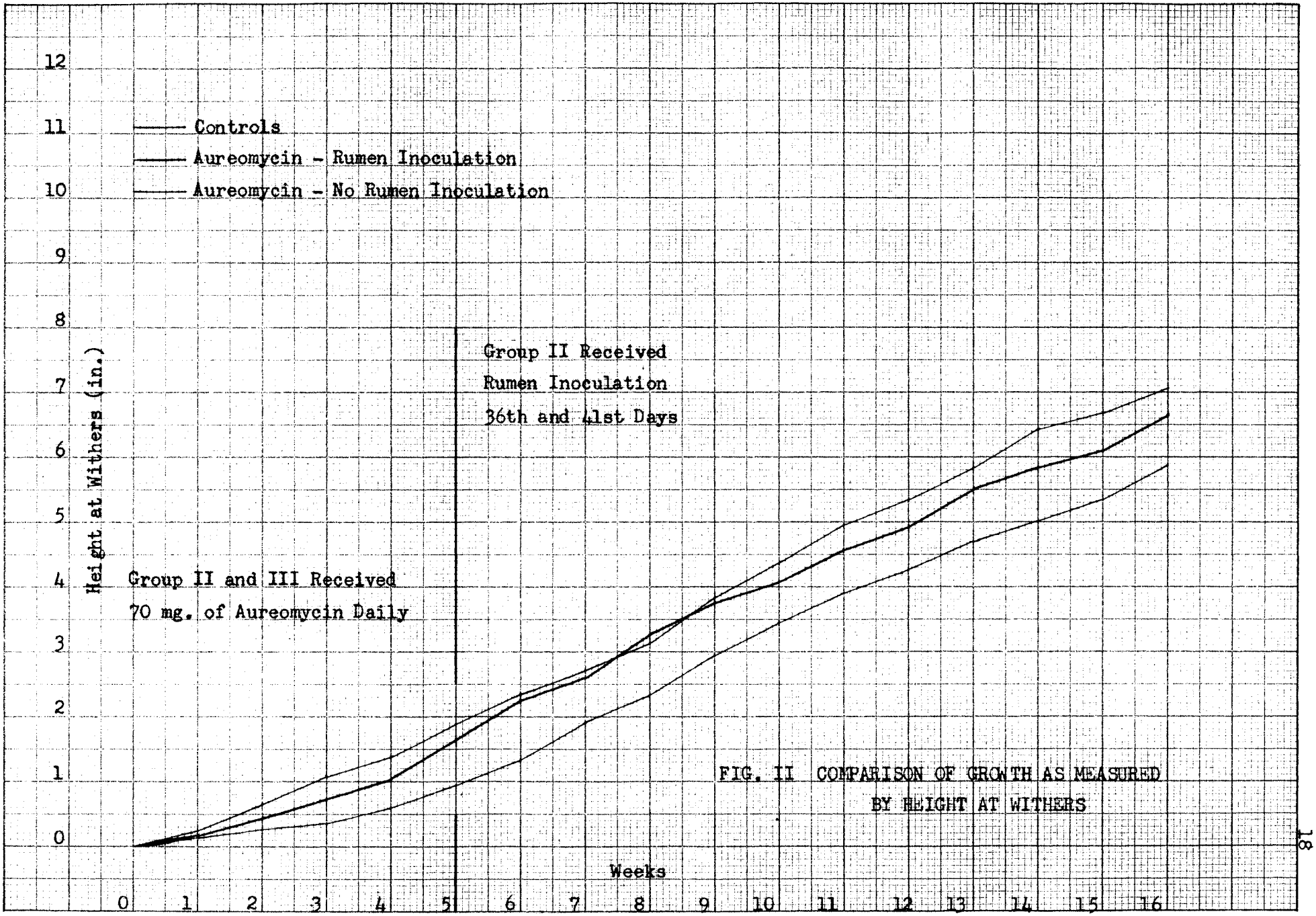

FIG. II COMPARISON OF GROWTH AS MEASURED BY HEIGHT AT WITHERS

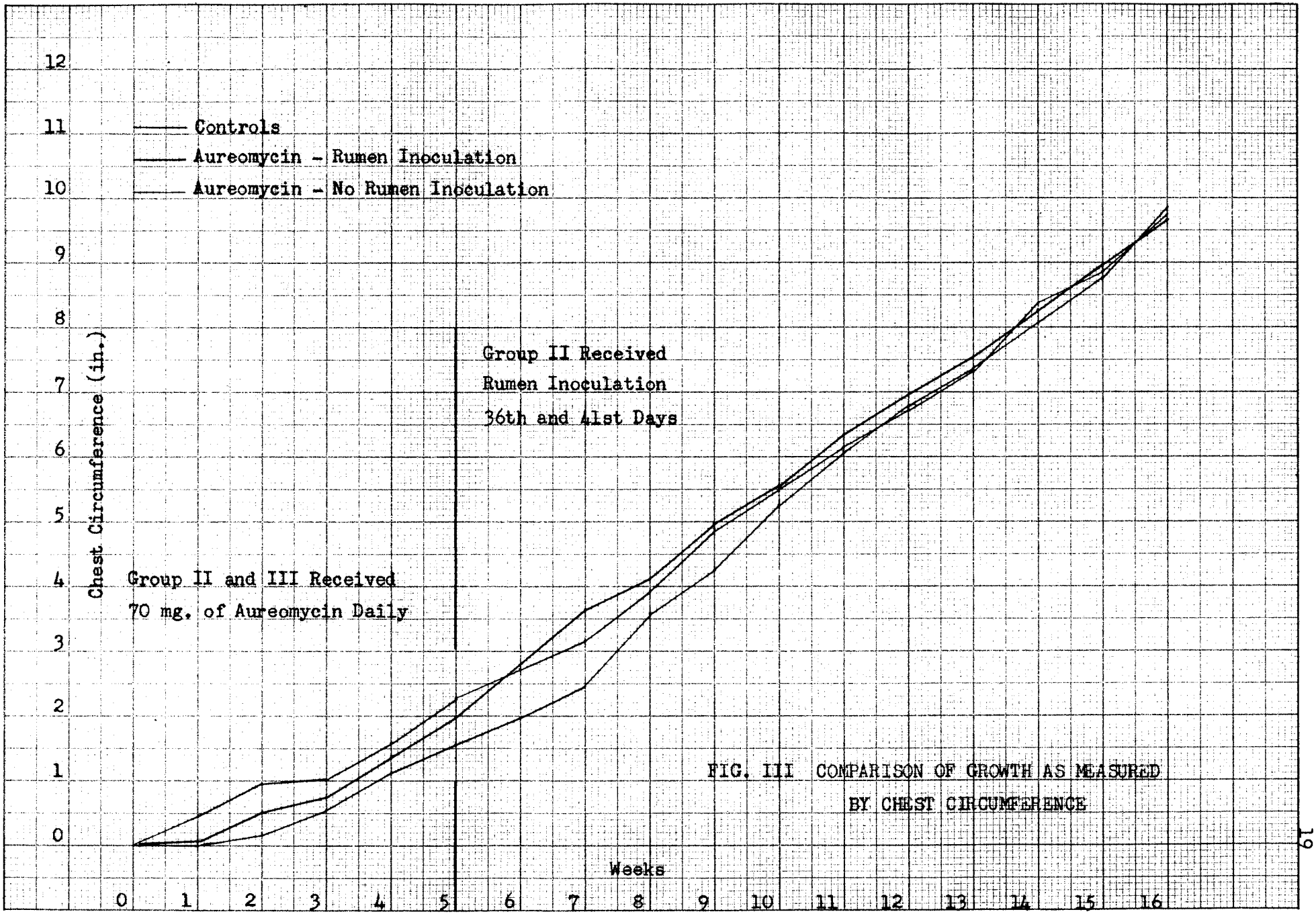

FIG. III COMPARISON OF GROWTH AS MEASURED BY CHEST CIRCUMFERENCE

Both groups of calves which received aureomycin consumed more starter throughout the entire trial than the control group. The consumption of starter, presented in Figure IV and Appendix Table V and summarized in Table II, closely paralleled the gains in growth of the corresponding groups. The aureomycin groups consumed more starter in each period during the study but apparently did not utilize the starter as well as the control group after the first five weeks. Unfortunately this fact cannot be termed conclusive since the facilities did not permit the measurement of hay consumption.

Scours, as summarized in Appendix Table VI, were not a serious problem in any of the groups and were not observed after the third week of age. The cases observed in the control group tended to be of greater severity, longer duration and required more treatment before a response could be noted, thus in many instances a marked reduction in vigor and feed consumption resulted. The control group contracted four cases of scours, two of a severe nature, which averaged ten days duration and required up to 12 days of treatments. Only one case of medium severity occurred in Group II and this case cleared up with one treatment. An average duration of four days was observed with the three cases of scours incurred by Group III; the most severe case responded to treatment in four days.

Of greater significance with respect to this problem was the total drugs required to control scours in the different groups. The drugs required to control scours in Group I were 1080 gr. of sulfathalidine, 8 oz. of kaopectinate, 18 g. of sulfamethazine, 60,000 units of bacitracin, 1 g. of streptomycin, and 1,500,000 units of aqueous penicillin whereas the only medications required to control scours in Groups II and III were 120 and 300 gr. of sulfathalidine, respectively.

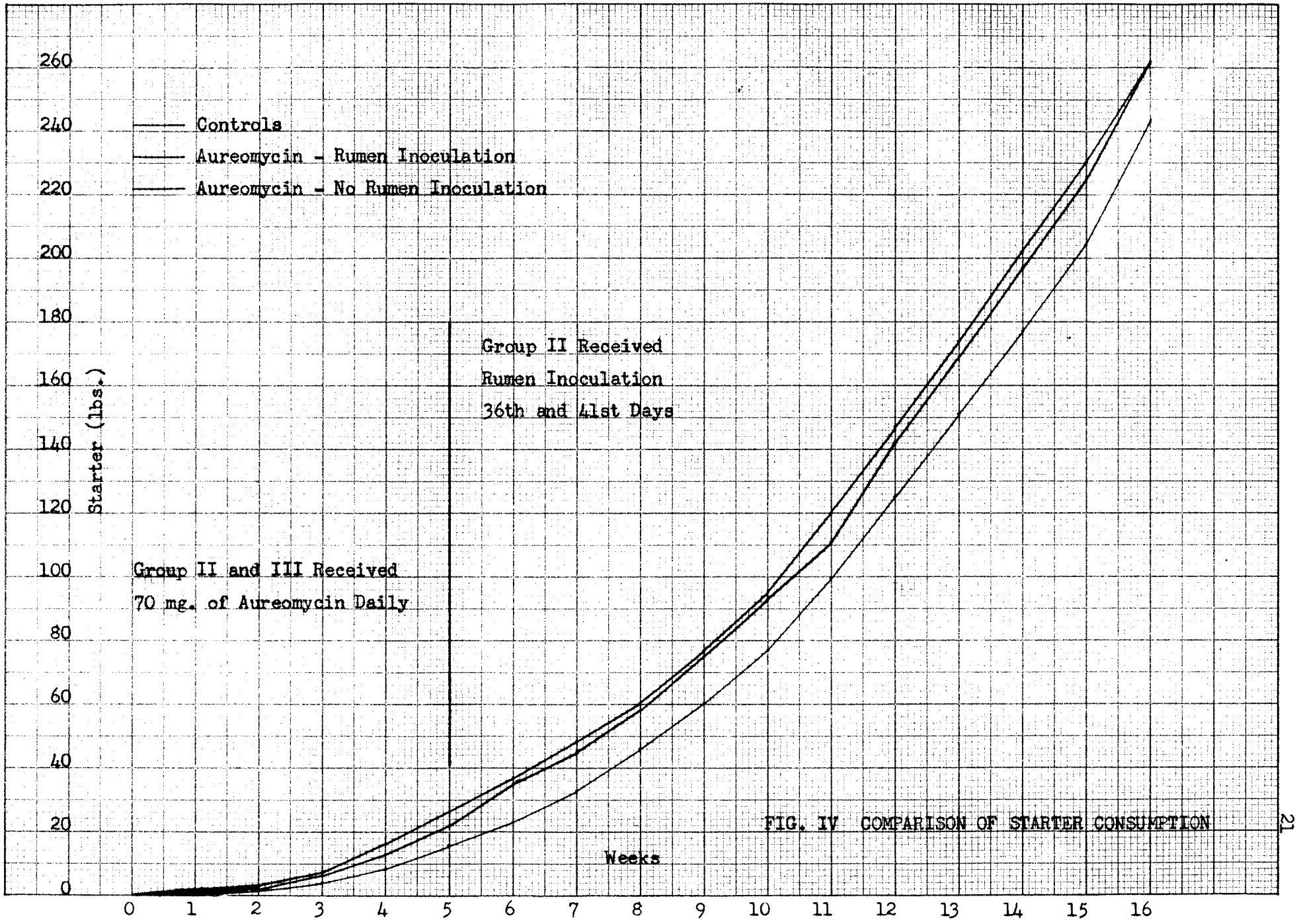

FIG. IV COMPARISON OF STARTER CONSUMPTION

Table II

MEAN STARTER CONSUMPTION
OF CALVES BY PERIODS

Periods	Starter Consumption (lbs.) Group I	Group II	Group III
1	16.19	23.21	26.78
2	61.45	71.11	69.13
3	165.98	168.83	166.83
Total Consumption	243.62	263.15	262.74

Since a comparison of growth and scours for the first three weeks of age indicates a possible correlation, aureomycin may have had a favorable effect on the rate of growth due to the control of scours.

DISCUSSION

The results clearly indicate that a 70 mg. oral dose of aureomycin administered daily had a beneficial effect upon the growth of dairy calves during the first several weeks of life. The observations made in this trial appear to substantiate the popular theory that the major nutritional effect of aureomycin lies in its ability to control scours.

Although the incidence and the control of scours was not a serious problem in any of the groups, it was obviously more prevalent in the control group. This was true particularly during the first three weeks of the calves' lives. It was also observed that the major differences in the growth rate between control calves and those receiving aureomycin occurred during the first three weeks of the trial. While the aureomycin calves held a 48 percent growth advantage for the entire five week administration period, it should be noted that the average gain of the aureomycin calves during the first three weeks was 99 percent greater than that of the control calves.

Two calves in the control group did not contract scours. It is of added significance that they gained an average of 20 pounds during the first period as compared to an average gain of 12 pounds for all the animals in Group I.

With one exception, all of the animals in the non-inoculated group exhibited a reduced growth rate following the discontinuation of aureomycin administration. The average gain for all of these calves during the second period was 40.6 pounds, but when the data of calf No. 81 are excluded from the group average it becomes 34.8 pounds. It was noted that this calf not only made consistent gains throughout the first period but also gained an average of two pounds per day during the five weeks

following aureomycin administration. The gain of 70 pounds which was made by calf No. 81 during this period was 15 pounds more than the largest gain made by any other calf in the three groups.

None of the differences in the growth rate between groups appear to be of any practical significance, especially since recovery from periods of retarded growth was made before the calves were 16 weeks of age. The differences in growth response to the various treatments at this point of the study furnish sufficient evidence to indicate that aureomycin had some adverse effect upon the normal establishment of the rumen flora.

The need for further fundamental investigation with respect to the effect of aureomycin upon the normal rumen flora is clearly indicated. It would be desirable to conduct a study whereby the period of aureomycin administration is extenuated so that scours might effectively be controlled during the "critical period" as observed in this experiment without substantially effecting the development of normal rumen function. The desirability of a study whereby aureomycin could act on the intestinal flora without coming in contact with the rumen organisms is also evident. In this manner scour control would be equally effective without any disturbance to normal rumen physiology.

Skeletal growth as measured by height at the withers and chest circumference paralleled the observations made with respect to gains in bodyweight during the first period of growth, but the parallelism to differences in bodyweight in subsequent periods did not appear to be of any significance even though the total gain in skeletal growth was approximately the same in all groups at the end of the trial. These results were not at all surprising in view of the fact that skeletal growth generally will remain constant in spite of a decline in rate of bodyweight gain.

Although a decline in growth rate was observed in all groups at various periods during the trial, there appeared to be no significant difference between groups in total growth at the completion of the study. The data indicate that the differences resulting from the various treatments were not great enough to be of practical significance with respect to total growth.

Both groups of calves which received aureomycin consumed more starter throughout the trial than the control group, but apparently did not utilize the starter as well as the controls after the first period. Unfortunately this fact cannot be termed conclusive since there was no measurement of hay consumption. Yet, in theorizing, it appears that aureomycin may have had an adverse effect upon the normal establishment of the rumen flora, thus causing a decrease in digestibility of those fractions normally associated with bacterial breakdown.

SUMMARY

Observations were made to determine the value of aureomycin administration in reducing scours and improving the rate of growth and to determine the value of rumen inoculations with rumen material from a mature animal in preventing a drop in growth rate and feed utilization efficiency following the discontinuation of aureomycin administration in young calves.

The administration of aureomycin appeared to substantially increase the rate of gain and reduce the incidence, severity, and duration of scours in young calves under the conditions of this trial.

The use of rumen inoculations tended to prevent a decrease in growth rate following the discontinuation of aureomycin administration but the differences which resulted between the inoculated and non-inoculated calves were not great enough to be of practical significance.

The groups of calves which received aureomycin consumed more starter throughout the trial but apparently did not utilize the starter as well as the control calves after aureomycin administration was discontinued. Unfortunately this fact cannot be termed conclusive since facilities did not permit measurements on hay consumption.

All periods of decreased growth were apparently followed by periods of acceleration. Conversely, all periods of accelerated growth apparently were followed by a decline in growth rate so that the growth of all groups was approximately the same at the termination of the 16 week experiment.

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APPENDIX

APPENDIX

TABLES

Table I

WEIGHTS, MEASUREMENTS AND CONDITION
OF CALVES ON DAY OF INITIAL OBSERVATION

Calf No.	Breed	Sex	Weight lbs.	Height at Withers in.	Circum-ference of chest in.	Condition
			Group I (Control)			
97	Hol.	Male	97.0	29.8	32.5	Good
171	Ayr.	Fem.	62.0	27.0	30.0	Good
37	Guern.	Fem.	58.0	28.0	29.5	Good
201	Guern.	Male	66.0	27.8	28.0	Good
140	Ayr.	Male	60.0	25.7	27.2	Good
159	Hol.	Male	121.0	31.2	34.0	Good
$\bar{X}$	----	----	77.33	28.25	30.20	----
			Group II (Aureomycin - Rumen Inoculation)			
190	Guern.	Male	75.0	29.0	31.0	Good
9	Hol.	Fem.	80.0	28.5	32.5	Good
61	Guern.	Fem.	62.0	26.3	28.5	Good
58	Ayr.	Fem.	67.0	28.2	28.5	Good
184	Ayr.	Male	85.0	27.7	29.8	Good
199	Hol.	Male	93.0	29.2	30.5	Good
$\bar{X}$	----	----	77.00	28.15	30.13	----
			Group III (Aureomycin - No Rumen Inoculation)			
2	Ayr.	Fem.	62.0	26.0	29.5	Good
59	Hol.	Fem.	100.0	30.2	33.5	Good
0	Guern.	Male	64.0	27.5	30.0	Good
84	Guern.	Fem.	70.0	28.5	29.5	Good
81	Ayr.	Male	75.0	26.3	29.5	Good
112	Hol.	Male	110.0	29.8	33.0	Good
$\bar{X}$	----	----	80.00	28.05	30.83	----

Table II

WEEKLY GROWTH OF CALVES AS MEASURED
BY BODYWEIGHT (LBS.)

Calf	First Period					: Second Period					: Third Period					
No.	1st	2nd	3rd	4th	5th	: 6th	7th	8th	9th	10th	: 11th	12th	13th	14th	15th	16th
						Group I (Control)										
97	0.0	4.0	1.0	-2.0	10.0	10.0	4.0	3.0	13.0	23.0	19.0	0.0	18.0	20.0	20.0	12.0
171	7.0	-4.0	2.0	13.0	8.0	2.0	8.0	4.0	17.0	8.0	14.0	9.0	11.0	9.0	3.0	17.0
37	5.0	1.0	1.0	0.0	2.0	4.0	4.0	10.0	5.0	14.0	12.0	14.0	8.0	6.0	11.0	25.0
201	-4.0	-3.0	11.0	5.0	6.0	10.0	9.0	6.0	14.0	10.0	10.0	11.0	11.0	23.0	5.0	10.0
140	-4.0	8.0	-3.0	12.0	2.0	5.0	5.0	10.0	8.0	7.0	12.0	13.0	1.0	8.0	4.0	9.0
159	-3.0	-8.0	-10.0	7.0	8.0	7.0	4.0	7.0	7.0	13.0	4.0	-4.0	12.0	10.0	15.0	8.0
$\bar{X}$	0.16	-0.33	0.33	5.83	6.00	6.33	5.66	6.66	10.66	12.50	11.83	7.16	10.16	12.66	9.66	13.50
						Group II (Aureomycin - Rumen Inoculation)										
190	1.0	5.0	4.0	6.0	10.0	12.0	2.0	3.0	10.0	16.0	18.0	5.0	8.0	15.0	10.0	5.0
9	5.0	0.0	7.0	9.0	11.0	3.0	6.0	10.0	11.0	18.0	2.0	18.0	4.0	18.0	1.0	22.0
61	3.0	0.0	2.0	10.0	5.0	12.0	6.0	12.0	8.0	4.0	8.0	1.0	10.0	12.0	-3.0	24.0
58	1.0	6.0	2.0	4.0	5.0	13.0	11.0	11.0	13.0	7.0	10.0	0.0	14.0	1.0	8.0	16.0
184	-5.0	4.0	7.0	10.0	11.0	8.0	6.0	4.0	5.0	10.0	7.0	0.0	8.0	4.0	1.0	8.0
199	-3.0	8.0	2.0	7.0	3.0	6.0	9.0	12.0	11.0	10.0	6.0	2.0	0.0	4.0	14.0	6.0
$\bar{X}$	0.33	3.83	4.00	7.66	7.50	9.00	6.66	8.66	9.66	10.85	8.50	4.33	7.33	9.00	5.16	13.50
						Group III (Aureomycin - No Rumen Inoculation)										
2	0.0	8.0	-3.0	5.0	8.0	10.0	4.0	4.0	2.0	14.0	11.0	14.0	6.0	15.0	5.0	15.0
59	4.0	-4.0	11.0	7.0	7.0	2.0	1.0	8.0	12.0	15.0	17.0	5.0	6.0	16.0	0.0	23.0
0	6.0	1.0	7.0	4.0	7.0	5.0	6.0	0.0	20.0	8.0	10.0	7.0	15.0	7.0	8.0	25.0
84	-5.0	-2.0	2.0	8.0	14.0	5.0	9.0	1.0	9.0	14.0	7.0	13.0	7.0	8.0	15.0	15.0
81	-4.0	1.0	10.0	3.0	10.0	18.0	13.0	19.0	8.0	12.0	1.0	8.0	1.0	6.0	4.0	5.0
112	0.0	8.0	16.0	4.0	5.0	7.0	0.0	5.0	10.0	3.0	12.0	0.0	9.0	0.0	-3.0	14.0
$\bar{X}$	0.16	2.00	7.16	5.16	8.50	7.83	5.50	6.16	10.16	11.00	9.66	7.83	7.33	8.66	4.83	16.16

Table III

WEEKLY GROWTH OF CALVES AS MEASURED
BY HEIGHT AT WITHERS (IN.)

Calf	First Period					Second Period					Third Period					
No.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
								Group I (Control)								
97	0.2	0.0	0.2	0.0	0.4	0.4	0.9	0.1	0.5	1.1	0.2	0.4	0.2	0.6	0.5	0.7
171	0.0	0.5	0.0	0.0	0.8	0.2	0.5	0.8	0.6	0.6	0.7	0.3	0.6	0.3	0.6	0.1
37	0.2	0.0	0.0	0.0	0.2	0.1	0.5	0.5	0.8	0.7	0.6	0.7	1.1	0.1	0.4	0.7
201	0.2	0.0	0.3	1.0	0.2	0.5	0.7	0.3	0.9	0.6	0.0	0.6	0.5	0.6	0.3	0.1
140	0.4	0.2	0.0	0.2	0.2	0.6	0.5	0.6	0.3	0.0	0.8	0.0	0.0	0.2	0.2	0.6
159	0.0	0.0	0.0	0.4	0.3	0.5	0.4	0.2	0.7	0.0	0.4	0.1	0.3	0.0	0.0	1.0
$\bar{X}$	0.16	0.10	0.08	0.26	0.35	0.38	0.58	0.41	0.63	0.50	0.45	0.35	0.45	0.30	0.33	0.53
								Group II (Aureomycin - Rumen Inoculation)								
190	0.0	0.5	0.3	0.0	0.8	0.6	0.3	0.8	0.2	0.5	0.5	0.2	0.8	0.5	0.6	0.6
9	0.2	0.1	0.4	0.0	1.3	0.5	0.3	1.2	0.5	0.5	0.3	0.4	0.5	0.6	0.0	0.7
61	0.7	0.0	0.5	0.3	0.5	0.7	0.3	0.7	1.0	0.4	0.4	0.0	1.1	0.3	0.8	0.5
58	-0.2	0.2	0.4	0.2	0.1	0.9	0.3	0.6	0.4	0.2	0.7	0.9	0.0	0.1	0.0	0.7
184	0.3	0.0	0.2	0.8	0.5	0.9	0.1	0.3	0.4	0.3	0.7	0.0	1.0	0.0	0.1	0.5
199	0.0	0.8	0.0	0.7	0.5	0.1	0.7	0.4	0.6	0.0	0.5	0.5	0.2	0.5	0.0	0.5
$\bar{X}$	0.16	0.26	0.30	0.33	0.61	0.61	0.33	0.66	0.51	0.31	0.51	0.33	0.60	0.33	0.25	0.58
								Group III (Aureomycin - No Rumen Inoculation)								
2	0.0	0.4	1.2	0.2	0.0	0.7	0.5	0.4	0.6	0.8	0.8	0.4	0.5	1.0	0.2	0.0
59	0.3	0.5	0.0	0.0	0.5	0.1	0.4	0.5	1.0	0.2	0.6	0.7	0.3	0.3	0.7	0.0
0	0.2	0.8	0.5	0.0	1.0	0.2	0.3	1.0	0.5	0.3	0.4	0.3	0.7	1.3	0.0	1.0
84	0.2	0.2	0.2	0.4	0.3	0.9	0.3	0.2	0.8	0.5	0.5	0.5	1.0	0.2	0.3	0.7
81	0.3	0.2	0.4	0.5	0.4	0.9	0.4	0.3	0.5	1.3	0.9	0.2	0.6	0.4	0.3	0.1
112	0.4	0.5	0.3	0.7	0.8	0.0	0.3	0.2	0.7	0.3	0.3	0.1	0.0	0.4	0.0	0.5
$\bar{X}$	0.23	0.43	0.43	0.30	0.50	0.46	0.36	0.43	0.68	0.56	0.58	0.36	0.51	0.60	0.25	0.38

Table IV

WEEKLY GROWTH OF CALVES AS MEASURED
BY CHEST CIRCUMFERENCE (IN.)

Calf	First Period					Second Period					Third Period					
No.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
							Group I (Control)									
97	0.0	0.5	1.0	0.5	0.0	0.1	0.2	0.4	0.8	1.6	0.8	0.6	1.0	1.0	1.0	0.0
171	0.0	0.0	1.0	0.5	0.3	0.2	0.4	1.1	1.0	0.5	0.5	0.5	1.0	0.5	1.0	1.3
37	0.0	0.0	0.7	0.8	0.2	0.1	1.1	0.6	0.2	0.8	1.1	0.9	1.0	0.5	1.0	1.7
201	0.0	0.5	0.0	0.5	1.0	0.7	0.3	1.8	1.2	1.2	1.6	1.0	0.0	0.7	0.5	0.8
140	0.0	0.8	0.0	0.2	1.0	0.6	0.7	1.5	0.8	0.4	1.0	1.0	0.8	0.4	0.0	1.3
159	0.0	-0.8	-0.4	1.0	0.2	0.8	0.2	1.4	0.0	1.6	0.0	0.0	0.0	1.2	0.6	1.2
$\bar{X}$	0.0	0.16	0.38	0.58	0.45	0.41	0.48	1.13	0.66	1.01	0.83	0.66	0.63	0.71	0.68	1.05
							Group II (Aureomycin - Rumen Inoculation)									
190	0.0	1.0	0.0	0.5	0.0	1.0	0.3	0.4	0.8	1.1	1.1	0.2	0.6	1.0	0.7	0.8
9	0.0	0.0	0.1	0.0	0.9	0.3	0.5	0.7	1.0	0.5	0.5	1.5	0.5	1.2	0.8	0.8
61	0.0	1.5	0.2	0.1	0.5	1.2	0.4	0.6	0.8	0.4	0.8	1.0	0.8	0.7	0.5	1.0
58	0.0	0.2	0.8	0.5	1.0	0.8	1.2	1.0	0.7	0.8	1.0	0.0	0.6	0.4	1.0	0.5
184	0.2	0.2	0.0	1.3	0.5	0.2	1.8	0.2	0.6	0.4	1.0	0.6	0.2	0.2	0.6	0.5
199	0.0	0.0	0.1	1.5	0.7	1.4	0.8	0.0	1.4	0.1	0.3	0.5	0.7	1.0	0.5	0.7
$\bar{X}$	0.03	0.48	0.23	0.65	0.60	0.81	0.83	0.48	0.88	0.58	0.76	0.63	0.56	0.75	0.68	0.71
							Group III (Aureomycin - No Rumen Inoculation)									
2	0.0	1.5	0.0	0.2	0.3	0.5	0.4	0.2	0.6	1.0	0.8	0.4	0.6	2.2	0.3	0.5
59	0.5	0.0	0.2	0.3	0.5	1.0	0.1	0.4	0.6	0.2	0.7	1.1	0.5	0.7	0.0	1.7
0	1.0	1.0	0.0	0.0	1.0	0.2	0.5	0.8	1.5	0.0	0.5	0.5	1.0	1.0	0.5	1.3
84	0.0	0.1	0.0	0.0	0.9	0.5	1.0	0.8	1.2	1.0	1.0	0.3	0.7	1.5	1.2	1.1
81	0.5	0.0	0.2	2.6	0.6	0.1	0.5	1.3	1.1	1.6	0.0	0.0	1.0	0.8	0.7	0.3
112	0.8	0.4	0.0	0.3	1.0	0.3	0.2	1.0	0.8	0.0	0.8	1.2	0.0	0.0	0.2	0.4
$\bar{X}$	0.46	0.50	0.06	0.56	0.71	0.43	0.45	0.75	0.96	0.63	0.63	0.58	0.63	1.03	0.48	0.88

Table V

WEEKLY STARTER CONSUMPTION
BY CALVES (LBS.)

Calf No.	First Period 1st	2nd	3rd	4th	5th	Second Period 6th	7th	8th	9th	10th	Third Period 11th	12th	13th	14th	15th	16th
						Group I (Control)										
97	1.0	2.0	5.4	7.6	9.5	9.8	9.7	11.7	14.1	28.0	28.0	26.0	28.0	28.0	28.0	28.0
171	1.0	1.6	3.5	5.7	8.9	7.8	12.8	12.3	18.0	18.0	28.0	28.0	28.0	28.0	28.0	28.0
37	0.4	0.1	2.3	2.0	5.1	1.8	6.8	13.0	12.0	13.0	17.0	21.0	20.0	24.0	24.0	44.0
201	1.0	0.9	1.0	6.0	10.0	8.0	10.0	13.0	15.0	17.0	22.0	28.0	28.0	28.0	28.0	52.0
140	1.0	1.0	0.7	3.0	5.0	7.0	7.0	8.0	8.0	11.0	17.0	25.0	24.0	23.0	24.0	43.0
159	0.5	1.0	2.0	2.0	5.0	8.0	13.0	20.0	18.0	17.0	21.0	25.0	28.0	28.0	28.0	40.0
$\bar{X}$	0.81	1.10	2.65	4.38	7.25	7.06	9.88	13.00	14.18	17.33	22.16	25.50	26.00	26.50	26.66	39.16
						Group II (Aureomycin - Rumen Inoculation)										
190	0.7	2.1	4.6	8.2	10.0	11.5	7.3	12.0	13.0	21.0	27.0	28.0	28.0	28.0	28.0	36.0
9	1.0	3.2	7.1	7.4	10.7	11.2	11.2	15.5	24.0	27.0	26.0	28.0	28.0	28.0	28.0	24.0
61	1.2	5.5	4.9	8.7	8.5	16.0	11.0	13.0	19.0	18.0	21.0	25.0	26.0	28.0	28.0	44.0
58	1.0	1.0	4.0	3.5	5.0	12.0	11.0	14.0	21.0	17.0	23.0	26.0	25.0	28.0	28.0	40.0
184	1.0	1.5	0.5	8.0	11.0	10.0	10.0	12.0	13.0	14.0	19.0	26.0	27.0	28.0	28.0	32.0
199	0.3	3.0	2.0	2.0	9.0	13.0	11.0	12.0	12.0	14.0	17.0	25.0	28.0	28.0	28.0	48.0
$\bar{X}$	0.86	2.71	3.85	6.30	9.03	12.28	10.25	13.08	17.00	18.50	22.16	26.33	27.00	28.00	28.00	37.33
						Group III (Aureomycin - No Rumen Inoculation)										
2	0.5	1.1	4.2	7.7	8.1	8.5	7.5	10.6	12.7	14.0	22.0	26.0	28.0	28.0	27.0	36.0
59	0.9	1.6	6.3	11.1	11.0	9.8	9.5	12.5	21.0	24.0	26.0	28.0	28.0	28.0	28.0	28.0
0	0.6	0.5	3.7	7.3	8.5	8.6	10.3	9.8	17.0	18.0	21.0	26.0	28.0	28.0	28.0	40.0
84	1.0	0.7	3.0	7.0	12.0	12.0	11.0	11.0	14.0	17.0	25.0	28.0	27.0	28.0	28.0	36.0
81	1.0	1.0	3.9	6.0	12.0	13.0	14.0	19.0	19.0	24.0	25.0	24.0	28.0	28.0	26.0	34.0
112	3.0	5.0	7.0	15.0	10.0	12.0	13.0	13.0	13.0	16.0	28.0	28.0	28.0	28.0	28.0	20.0
$\bar{X}$	1.16	1.65	4.68	9.01	10.26	10.65	10.88	12.65	16.11	18.83	24.50	26.66	27.83	28.00	27.50	32.33

Table VI

EFFECT OF AUREOMYCIN ON THE
HEALTH OF EXPERIMENTAL CALVES

Calf No.	1st day of initial observation	duration of abnormality	diagnosis of abnormality	days treatment given after initial observation	Treatments	Severity
				Group I (Control)		
97	15th	3 days	scours	---	---	Mild
171	----	------	------	---	---	----
37	8th	6 days	scours	3rd	120 gr. sulfathalidine	Medium
201	2nd	12 days	scours	6th	120 gr. sulfathalidine	Severe
				7th	60 gr. sulfathalidine	----
				9th	180 gr. sulfathalidine	----
140	----	------	------	---	---	----
159	2nd	18 days	scours and septicemia from gastro enteriitis	1st	180 gr. sulfathalidine	Severe
				2nd	2 oz. kaopectinate with sulfonamides	----
				5th	9 g. sulfamethazine 6 oz. kaopectinate	----
				6th	20,000 units bacitracin 180 gr. sulfathalidine	----
				10th	240 gr. sulfathalidine 20,000 units bacitracin	----
				11th	9 g. sulfamethazine 1 g. streptomycin 20,000 units bacitracin	----
				12th	1,500,000 units aqueous penicillin	Temp. 105°

Table VI (Continued)

EFFECT OF AUREOMYCIN ON THE
HEALTH OF EXPERIMENTAL CALVES

Calf No.	1st day of initial observation	duration of abnormality	diagnosis of abnormality	days treatment given after initial observation	Treatments	Severity
			Group II (Aureomycin - Rumen Inoculation)			
190	--	--	--	--	--	--
9	--	--	--	--	--	--
61	14th	6 days	scours	4th	120 gr. sulfathalidine	Medium
58	--	--	--	--	--	--
184	--	--	--	--	--	--
199	--	--	--	--	--	--
			Group III (Aureomycin - No Rumen Inoculation)			
59	--	--	--	--	--	--
2	10th	4 days	white scours	1st 3rd	120 gr. sulfathalidine 120 gr. sulfathalidine	Severe --
0	--	--	--	--	--	--
84	2nd 12th	3 days 4 days	scours scours	-- 1st	-- 60 gr. sulfathalidine	Mild Medium
81	--	--	--	--	--	--
112	--	--	--	--	--	--

VITA

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