

THE EFFECT OF RUMEN INOCULATION ON THE  
GROWTH RATES OF CALVES AND LAMBS

by

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## INTRODUCTION

Knowledge concerning the biochemical activity within the rumen of cattle and sheep is passing through a rapid stage of development. Research workers have discovered that corn cobs, peanut hulls, corn stalks, and other products previously considered waste materials can be utilized as an efficient feed for beef cattle. Lands suitable only for grass and forage production are sources of feed for cattle and sheep. Tons of cobs and corn stalks previously wasted have become part of the farmers' feeding program. These relatively new practices have been developed by applying the limited available knowledge of the biochemical activity that takes place within the rumen of cattle and sheep. However, much remains to be discovered pertaining to the activity of the organisms that are constantly at work within the rumen. Many species of bacteria and protozoa are known to exist in the rumen but the relative number of each species seems to vary with the ration the animal is being fed. Previous investigators have identified some of these species as hay digesting species and others as grain digesting species. Actually, little is known as to whether an organism is capable of attacking hay, grain or both other than the fact that species of organisms found in the rumen vary with the kind of ration.

At birth the rumen of a calf is inactive, containing none of the bacteria found in the mature animal but in the first few months of the calf's life it becomes inoculated with rumen organisms, presumably from contact with his dam or by eating grass or other feeds. Artificial inoculation using the cud of adult cattle to transfer bacteria to the

calf has been a successful practice enabling the calf to utilize roughage at a very early age.

Successful inoculation using the cud from adult animals has led to attempts to develop means of propagating cultures of bacteria from the rumen of adult animals and preserving them for calf inoculation. If rumen organisms can be successfully propagated outside the animal and if these rumen organisms are in part responsible for feed utilization and rate of gain by the animal, high gaining animals might provide valuable material for calf inoculation that would result in more efficient use of feed throughout the productive life of the animal.

With this in mind, cultured materials obtained from fast and slow gaining steers were used to inoculate calves to determine whether such cultures would influence their performance when fed a standard ration.

REVIEW OF LITERATURE

Foley and Nutall (1953) successfully used a dried rumen culture called Bovinoc to inoculate calves at about five days of age. They reported that approximately 125 calves inoculated with this culture developed normally. Growth rates were normal, calf-hood diseases including respiratory infections, diarrhea, etc., were found to be less numerous, and inoculated calves responded to treatment for these common disorders readily. Treated calves started ruminating at a very early age with many observed chewing their cud when ten days of age. Older calves not making satisfactory growth rates were inoculated with dry rumen material to re-establish the normal rumen flora. Noticeable improvement in the appearance, growth rate, and general thriftiness of the calves was observed after inoculation. From these observations, the authors considered dried rumen materials safe, convenient, and effective for early inoculation of young calves and for re-establishing a normal rumen flora in older calves.

McLaughlin (1946) studied the effect of iodinated casein and an enzyme active feed cultured from rumen materials called Diatane. His data indicated growth stimulation from the addition of these treatments to the ration. Average daily gains from Protamone (iodinated casein), Diatane and the control were .52, .57, and .49 pounds respectively.

Pounden, Conrad, and Hibbs (1954) compared cultured rumen material or substitutes for freshly obtained rumen contents for use in inoculating the rumens of young calves fed on a high roughage ration and concluded, "As rumen inoculants, the substitutes studied were inadequate."



Pounden and Hibbs (1949) studied the effect of rumen inoculation of calves on pasture. They concluded that the ability of a calf to use pasture at a young age may be improved by inoculation with essential micro-organisms if grain is fed in limited amounts.

McGilliard, Ronning, Berousek, and Norton (1952) studied the effect of rumen inoculation on rate of gain of calves treated with Aureomycin. Inoculated calves did not go through a characteristic period where gain and feed utilization was decreased following treatment with Aureomycin. However, after sixteen weeks, there was very little difference in the total gain of inoculated calves and calves receiving no rumen inoculation.

Ripley (1951) in a case history of a four year old cow reported that all attempts to treat the cow had failed until fresh rumen material mixed with warm water was administered. The cow regained her appetite and eventually recovered after the fresh rumen material was administered.

Conrad, Hibbs, Pounden, and Sutton (1950) conducted a series of trials studying the ability of cud inoculated calves to digest dry matter, cellulose, and protein when on a high roughage ration. Calves inoculated with rumen material digested a larger per cent of dry matter and cellulose until both inoculated and uninoculated calves were allowed free access to fresh grass clippings. After access to grass clippings, there was no difference in gain between the two groups. The inoculated calves apparently had the ability to utilize dry matter and cellulose and ate more roughage at an earlier age.

Pelissier, Slack, Timberger, Turk, and Loosli (1954) studied the effect of cud inoculation on growth rate and roughage utilization of

forty-eight young dairy calves. They stated, "Under the conditions of this experiment, no advantage was shown by the calves that were inoculated with cud material from mature cows on a normal ration."

Available publications on the use of dried rumen culture indicates a wide difference of opinion as to the value of the cultures. Pouden et al (1954) considered cultured substitutes approximately 30% effective when compared with fresh rumen material and suggests using fresh inoculum. Pouden et al (1949) recommends fresh rumen material with a high roughage ration as an excellent management program raising young dairy calves. Other investigators consider dried rumen material effective, convenient, and safe as a growth stimulating agency and as a treatment for mature animals having lost their ability to ruminate.

THE INVESTIGATION

Three commercially prepared dried rumen cultures and fresh rumen liquor were tested to measure their effects on the rate of gain and efficiency of feed utilization by 24 young calves, 24 two-year old steers, and 12 weanling lambs. Two of the rumen cultures were prepared from rumen contents taken at the time of slaughter from fast and slow gaining steers fed in record of performance tests at Blacksburg, Virginia. Samples of rumen material from these steers were collected at Valleydale Packers, Salem, Virginia when the animals were slaughtered. These samples were taken to the laboratories of George A. Jeffreys and Company in Salem and processed to make the dried cultures used in this investigation. The third was a commercially prepared culture, Ruzyme, manufactured by George A. Jeffreys and Company, Salem, Virginia and believed to contain living rumen organisms. Fresh rumen material was extracted, using a stomach tube, from two 24-month old steers on pasture at the Virginia Agriculture Experiment Station, Blacksburg, Virginia.

PROCEDURE

Three separate experiments were conducted: Experiment I, the main source of information for the investigation was supplemented by additional information from Experiment II and Experiment III.

Experiment I

Experiment I was a feeding trial (two phases) using 24 steer calves to compare the three commercially prepared rumen cultures and fresh rumen liquor.

Experiment II

Experiment II was a test to measure the influence of a commercially dried culture taken from the rumen contents of a fast gaining steer and a commercially dried culture taken from the rumen contents of a slow gaining steer on the rate of gain of 24 two-year old steers on pasture.

Experiment III

Experiment III was a feeding trial to test the effect of the culture prepared from the rumen contents of the fast gaining steers on the rate of gain of weanling lambs being fed under dry lot conditions.

## EXPERIMENT I

### Research Animals:

Calves that had not developed an active rumen and which were about the same age, and sex, which had similar genetic and environmental background were considered desirable test animals for this experiment.

A group of 24 Jersey x Hereford crossbred steer calves, three to four months of age, averaging 244 pounds in weight, sired by one bull and produced on one farm from cows of uniform breeding were selected.

### Preliminary Management:

The 24 steer calves that were selected for the experiment were castrated, dehorned, and allowed to remain with their dams for two weeks, or until they had recovered from the shock of castration and dehorning. The calves were removed from their dams to the feeding barn where they were treated with copper sulfate for parasite control. A preliminary feeding period was designed to teach the calves to eat dry feed and to familiarize them with their new surroundings. In this period, they were fed calf starter pellets without antibiotics and good quality mixed hay. After two weeks of preliminary feeding, the calves were assigned to their respective treatments for Phase I.

### Physical Facilities:

For isolation purposes in Phase I, eight stalls, 12 feet long and 12 feet wide, were constructed with solid partitions, approximately five feet high. Each stall was equipped with a feed manger, water trough and salt box. The calves were fed and watered in these stalls and were removed only to be weighed. A set of portable scales placed in a lane

adjacent to the feeding stalls enabled the weights to be taken on each lot with a minimum of exposure to possible outside sources of inoculation. Care was taken to prevent any direct contact among calves on different treatments or any indirect contact through men and equipment.

In Phase II, four additional stalls were made by dividing adjacent pairs of original stalls (see Table 1 - Assignment of Treatment Location in the Barn and Assignment of Calves to Treatments). The location of additional stalls for Phase II made it possible to change treatment on part of the calves without exposing all of them to stalls and equipment used previously by calves on a different treatment.

Treatments:

Treatments for Phase I and Phase II were as follows:

Treatment A - A dried cultured rumen material prepared from the rumen contents of a fast gaining steer.

Treatment B - A dried cultured rumen material prepared from the rumen contents of a slow gaining steer.

Treatment C - Ruzyme, a dried commercial culture manufactured by George A. Jeffreys and Company, Salem, Virginia and sold for rumen inoculation.

Treatment D - Control. No culture administered.

Treatments E and F - Fresh rumen liquor extracted from the rumen of two 24-month old steers on pasture.

TABLE 1

ASSIGNMENT OF TREATMENT LOCATIONS IN THE BARN  
AND OF CALVES TO TREATMENTS

Replicate I - Phase I

Stall	1	2	3	4
Treatments	A	C	D	B
Calves	302 309 311	298 312 317	306 316 319	296 299 315

Replicate I - Phase II

Stall	1	1-2	2	3	3-4	4
Treatments	A	E	C	D	F	B
Calves	302 309	311 312	298 317	306 319	316 296	299 315

Replicate II - Phase I

Stall	5	6	7	8
Treatments	D	A	B	C
Calves	300 310 313	303 307 314	304 308 318	297 301 305

Replicate II - Phase II

Stall	5	5-6	6	7	7-8	8
Treatments	D	E	A	B	F	C
Calves	310 313	300 303	307 314	304 318	308 305	297 301

Assignment to Treatments:

Phase I

The calves were divided into two groups or replicates, the twelve largest calves being assigned to Replicate I and the smallest or lightest calves to Replicate II. Each replicate contained four treatments - A, B, C, and D. Three calves were assigned at random to each of the four treatments and the treatments randomized to positions or stalls in the barn.

Phase II

Two treatments of fresh rumen materials were added to the four treatments used in Phase I, giving a total of six treatments for Phase II. One calf from each treatment group of Phase I was selected at random and assigned to a newly constructed stall adjacent to the one from which it was removed. This arrangement allowed six treatment groups or stalls with two calves per stall for each replicate. The two calves that remained in the original stalls received the same treatments they received in Phase I and the calves in the newly constructed stalls were inoculated with fresh material from the rumen of a mature steer that was grazing on pasture. The new treatments were called E and F.

Feeding and Management:

Phase I

In this phase of the feeding period, each calf received four pounds of a grain mixture containing shelled corn, cottonseed meal and calf starter pellets. The corn and cottonseed meal were mixed in a ratio of 3:1 by weight. When the test started, calf starter pellets were fed at



the rate of one pound per head per day. The starter pellets were reduced each week and completely removed from the ration after four weeks. The forage was a good quality mixed hay and was fed free choice. The grain mixture was held at a constant level in order to estimate the ability of treated calves to utilize forage. After nine weeks, this ration was changed to the fattening ration used in Phase II, so that the ration in the last three weeks was a mixed feed consisting of ground hay and grain.

Dried rumen cultures were administered in one ounce capsules once a week for the first four weeks. The control calves were not treated and were not handled when the other calves were treated. All equipment used to administer the inoculum was thoroughly cleaned after each treatment was administered. Caution was taken to prevent transfer of inoculum from one treatment group to the other. Once a week, the calves were removed from their stalls by treatment groups and weighed individually.

### Phase II

On Phase II, the calves were fed a mixture of 50% ground ear corn, 10% cottonseed meal, and 40% ground mixed hay. The hay and ear corn were ground through a hammer mill then mixed with the cottonseed meal and fed free choice to the calves. Each calf other than those in the control groups received a one ounce capsule of commercially prepared dried rumen culture, or fresh rumen liquor once each week as individual weights were taken.

### Observations:

Individual weights taken once each week, feed consumption, abnormal eating habits and visual appearance of the calves were observed in an effort to estimate the value of the treatments administered.

EXPERIMENT II

Research Animals:

Twenty-four two-year old steers on a pasture experiment at the Virginia Agricultural Experiment Station at Blacksburg, Virginia were selected as test animals. They were divided into three weight groups: heavy (averaging 1078 pounds), intermediate (averaging 1017 pounds), and light (averaging 940 pounds). The steers in each group were paired and were assigned at random to their respective treatments. The heavy steers in Group I were paired to test treatments A and B. The intermediate weight steers in Group II were paired to test treatments A and C. The lightweight steers in Group III were used to test treatments B and C.

Treatments:

The following treatments were administered:

Treatment A - A dried cultured rumen material prepared from the rumen contents of a fast gaining steer.

Treatment B - A dried cultured rumen material prepared from the rumen contents of a slow gaining steer.

Treatment C - Control. No culture was administered.

Feeding and Management:

The 24 steers were assigned to a pasture experiment consisting of four bluegrass and four orchard grass ladino pastures. Both steers in each pair were grazed together in their assigned pasture. Every 14 days all steers were removed in order to obtain weights. The steers receiving

the commercially prepared cultures were caught and given a capsule, the control steers were not handled.

Observations:

Fourteen day weights were recorded to evaluate the treatments.

### EXPERIMENT III

#### Research Animals:

Twelve lambs, all by Hampshire rams and out of western ewes were selected and fed for a period of 91 days. They were late lambs averaging about 70 pounds when they were weaned and put on feed. Six ewe and six wether lambs were selected for this work.

#### Treatments:

The lambs were randomized by sex into two groups with three ewes and three wethers in each group.

Group I was treated with a dried cultured rumen material prepared from rumen contents of a fast gaining steer. The dried cultured rumen material was mixed in the feed at the rate of one ounce per lamb per day.

Group II, the control animals, received no culture.

#### Feeding and Management:

The lambs in each group were fed two pounds of grain per head per day and choice alfalfa hay ad-libitum. No record was kept of the amount of hay consumed. The lambs were fed and watered in their stalls and were removed and weighed once each week.

#### Observations:

Weights, live grades, and slaughter grades were recorded in order to evaluate the materials used.

RESULTS

Experiment I

Phase I

Feed Consumption:

In the first phase of Experiment I, the grain mixture was held constant for all lots and hay was fed free choice in order to measure the influence of the treatments on roughage consumption. The heavier calves (calves in Replicate I) consumed an average of .37 pounds more hay per head per day than the lighter calves or the calves in Replicate II. Calves in treatment D consumed the greatest amount of hay and the calves in treatment B consumed the smallest amount of hay. There was a difference of .29 pounds between the two lots. However, analysis of variance of the average hay consumption indicated that these differences may have been due to chance alone. Certainly, the experimental treatments had no marked effect on hay consumption in the first phase of this test.

The amount of hay consumed by each calf in the different treatments is shown in Table 2.

TABLE 2

HAY CONSUMPTION PER HEAD PER DAY

Experiment I - Phase I

Replicate	I	II	Average
Treatments:	Pounds	Pounds	Pounds
A	7.37	6.99	7.18
B	7.45	6.36	6.90
C	6.66	7.30	6.98
D	7.52	6.86	7.19
Average	7.25	6.88	

TABLE 3

ANALYSIS OF VARIANCE FOR HAY CONSUMPTION

Experiment I - Phase I

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Square
Treatments	3	.1233	.0411
Replicates	1	.2775	.2775
Error	3	.8114	.2705
Total	7	1.2112	

Average Gain:

In the first phase of Experiment I, weights and gains were recorded in 14-day periods. The average gains and the total gains per calf per period for each treatment are shown in Tables 4, 5, 6, 8, and 9. The difference in gain due to experimental treatments was small and non-significant and could be expected to appear due to chance alone.

TABLE 4  
AVERAGE GAINS PER CALF PER PERIOD  
Phase I - Replicate I

Treatments	14-Day Periods						Average
	1	2	3	4	5	6	
A	31.00	28.33	11.66	28.00	29.33	13.00	23.61
B	20.33	26.66	20.00	24.66	11.33	29.33	22.06
C	20.00	27.33	23.00	16.00	20.33	8.33	19.17
D	18.33	39.33	11.66	22.00	24.00	15.33	21.78
Average	22.42	30.42	16.42	22.66	22.17	16.50	

TABLE 5  
AVERAGE GAINS PER CALF PER PERIOD  
Phase I - Replicate II

Treatments	14-Day Periods						Average
	1	2	3	4	5	6	
A	22.66	29.33	18.33	23.33	10.00	27.66	21.89
B	15.33	28.33	19.33	20.00	23.33	16.00	20.39
C	17.33	26.00	24.66	21.00	6.66	34.33	21.67
D	26.66	35.33	14.33	25.66	23.33	17.66	23.27
Average	19.66	29.92	19.16	22.50	15.83	23.92	

TABLE 6

AVERAGE GAINS PER CALF PER PERIOD

Phase I - Replicates I and II

Treatments	14-Day Periods						Average
	1	2	3	4	5	6	
A	26.83	28.83	15.00	25.67	19.83	20.33	22.75
B	17.83	27.50	19.67	22.33	17.33	22.67	21.22
C	18.67	26.67	23.83	18.50	13.50	21.33	20.42
D	20.83	37.33	13.00	23.83	23.67	16.50	22.53
Average	21.04	30.08	17.86	22.58	18.58	20.21	

TABLE 7

ANALYSIS OF VARIANCE OF GAINS IN EXPERIMENT I - PHASE I

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Squares
Replicates	1	.86	.86
Treatments	3	0131.74	43.91
Periods	5	2353.40	470.68*
Reps. x Treatment	3	127.34	42.45
Reps. x Periods	5	598.93	197.86
Treatment x Periods	15	1647.80	109.85
Reps. x Treatment x Periods	15	2387.70	159.18
e-within lots	96	4366.67	45.49
Total	143	11614.44	

\* Significant at .05 level



TABLE 8

TOTAL GAINS PER CALF PER PERIOD

Phase I - Replicate I

Treatment A		Periods						
Calf No.	Beg. Wt.	1	2	3	4	5	6	Total
302	268	32	22	10	33	31	6	134
309	305	30	35	8	31	33	16	153
311	249	31	28	17	20	25	17	138
<b>Total</b>	<b>822</b>	<b>93</b>	<b>85</b>	<b>35</b>	<b>84</b>	<b>89</b>	<b>39</b>	<b>425</b>
<b>Treatment B</b>								
296	271	17	24	19	24	7	32	123
299	269	19	25	17	30	25	24	140
315	279	25	31	24	20	2	32	134
<b>Total</b>	<b>819</b>	<b>61</b>	<b>80</b>	<b>60</b>	<b>74</b>	<b>34</b>	<b>88</b>	<b>397</b>
<b>Treatment C</b>								
298	269	28	31	29	8	28	17	141
312	279	20	33	33	15	14	9	106
317	229	12	18	7	25	19	17	98
<b>Total</b>	<b>777</b>	<b>60</b>	<b>82</b>	<b>69</b>	<b>48</b>	<b>61</b>	<b>25</b>	<b>345</b>
<b>Treatment D</b>								
306	250	15	38	8	26	20	14	121
316	263	22	38	14	20	23	16	133
319	273	18	42	13	20	29	16	138
<b>Total</b>	<b>786</b>	<b>55</b>	<b>118</b>	<b>35</b>	<b>66</b>	<b>72</b>	<b>46</b>	<b>392</b>

TABLE 9

TOTAL GAINS PER CALF PER PERIOD

Phase I - Replicate II

Treatment A		Periods						
Calf No.	Beg. Wt.	1	2	3	4	5	6	Total
303	213	21	27	11	25	3	28	115
307	236	21	20	21	21	3	32	118
314	231	26	41	23	24	24	23	161
<b>Total</b>	<b>680</b>	<b>68</b>	<b>88</b>	<b>55</b>	<b>70</b>	<b>30</b>	<b>83</b>	<b>394</b>
Treatment B								
304	241	21	39	23	24	21	17	145
308	179	15	16	20	14	26	14	105
318	203	10	30	15	22	23	17	117
<b>Total</b>	<b>623</b>	<b>46</b>	<b>85</b>	<b>58</b>	<b>60</b>	<b>70</b>	<b>48</b>	<b>367</b>
Treatment C								
297	228	19	24	26	34	9	28	140
301	216	19	23	26	16	4	44	132
305	241	14	31	22	13	7	31	118
<b>Total</b>	<b>685</b>	<b>52</b>	<b>78</b>	<b>74</b>	<b>63</b>	<b>20</b>	<b>103</b>	<b>390</b>
Treatment D								
300	237	30	38	23	26	23	12	152
310	213	23	32	11	30	27	22	156
313	212	17	25	9	21	20	19	111
<b>Total</b>	<b>662</b>	<b>70</b>	<b>106</b>	<b>42</b>	<b>77</b>	<b>70</b>	<b>53</b>	<b>419</b>

In the second phase of Experiment I, 24 steer calves were fed a fattening ration of 60% concentrates and 40% hay. Two treatments of fresh rumen liquor were added to the three commercially prepared cultures used in Phase I and administered to the calves in one ounce capsules. Weights were recorded, and gains were tabulated to estimate the affect these treatments had on rate of gain. The analysis of variance indicate that treatment differences were non-significant and differences this large could be expected to happen by chance. Tables 10, 11, 12, 14, and 15 contain the average gain and the total gain of the animals in this phase:

TABLE 10

AVERAGE GAINS PER CALF PER PERIOD

Phase II - Replicate I

Treatments	14-Day Periods						Average
	1	2	3	4	5	6	
A	21.50	30.00	11.00	46.00	36.50	26.00	28.50
B	11.00	18.00	31.50	35.50	28.00	20.50	24.08
C	15.00	23.50	30.50	31.50	26.00	23.00	24.92
D	6.50	42.00	23.00	27.00	28.00	34.50	26.83
E	25.00	13.00	40.00	25.00	31.00	25.00	26.50
F	14.00	18.00	37.50	11.50	34.00	20.50	22.58
Average	15.50	24.08	28.92	29.42	30.58	24.92	

TABLE 11

AVERAGE GAINS PER CALF PER PERIOD

Phase II - Replicate II

Treatments	14-Day Periods						Average
	1	2	3	4	5	6	
A	15.50	21.00	22.50	32.00	11.00	44.00	24.33
B	18.50	21.00	32.00	18.50	19.50	33.00	23.75
C	34.50	30.50	39.50	6.00	39.00	29.00	29.75
D	26.00	23.00	33.50	27.00	29.50	29.00	28.00
E	17.50	31.00	12.50	30.00	25.50	30.50	24.50
F	15.50	24.00	17.50	32.00	19.50	34.00	23.75
Average	21.25	25.08	26.25	24.25	24.00	33.25	

TABLE 12

AVERAGE GAINS PER CALF PER PERIOD

Phase II - Replicate I and II

Treatments	14-Day Periods						Average
	1	2	3	4	5	6	
A	18.50	25.50	16.75	39.00	23.75	35.00	26.42
B	14.75	16.50	31.75	27.00	23.75	26.75	23.42
C	24.75	27.00	35.00	18.57	32.50	26.00	27.33
D	16.25	32.50	28.25	27.00	28.75	31.75	27.42
E	21.25	22.00	26.25	27.50	28.25	27.75	25.50
F	15.25	21.00	27.50	21.75	26.75	27.25	23.25
Average	18.46	24.01	27.58	26.83	27.29	29.08	

TABLE 13

ANALYSIS OF VARIANCE OF GAINS IN EXPERIMENT I - PHASE II

Source of Variation	Degrees of Freedom	Sums of Squares	Mean Squares
Replicates	1	.44	.44
Treatments	5	377.58	75.52
Periods	5	1768.33	353.66*
Reps. x Treatment	5	284.89	56.98
Reps. x Periods	5	1083.47	216.69
Treatment x Periods	25	2597.83	103.91
Reps. x Treatment x Periods	25	5356.19	214.24
e-within lots	72	3841.00	53.34
Total	143	15309.75	

\* Significant at .05 level

TABLE 14

TOTAL GAINS PER CALF PER PERIOD

Phase II - Replicate I

Treatment A		Periods						
Calf No.	Beg. Wt.	1	2	3	4	5	6	Total
302	402	19	26	13	33	57	22	170
309	458	24	34	9	59	16	30	172
Total	860	43	60	22	92	73	52	342
Treatment B								
299	409	17	24	29	35	21	32	158
315	413	5	12	34	36	35	9	131
Total	822	22	36	63	71	56	41	289
Treatment C								
298	410	12	22	31	35	30	19	149
317	327	18	25	30	28	22	27	150
Total	737	30	47	61	63	52	46	299
Treatment D								
306	371	8	46	20	30	30	33	167
319	411	5	38	26	24	26	36	155
Total	782	13	84	46	54	56	69	322
Treatment E								
312	395	23	13	34	23	32	28	153
311	387	27	13	46	27	30	22	165
Total	782	50	26	80	50	62	50	318
Treatment F								
296	394	15	20	39	12	35	19	140
316	396	13	16	36	11	33	22	131
Total	790	28	36	75	23	68	41	271

TABLE 15

TOTAL GAINS PER CALF PER PERIOD

Phase II - Replicate II

Treatment A		Periods						
Calf No.	Beg. Wt.	1	2	3	4	5	6	Total
307	354	23	18	24	33	23	40	161
314	392	8	24	21	31	-1	48	131
Total	746	31	42	45	64	22	88	292
Treatment B								
304	386	17	22	34	17	19	32	141
318	320	20	20	30	20	20	34	144
Total	706	37	42	64	37	39	66	285
Treatment C								
297	368	32	35	39	12	44	16	178
301	348	37	26	40	0	34	42	179
Total	716	69	61	79	12	78	58	357
Treatment D								
310	369	24	19	32	33	33	34	175
313	323	28	27	35	21	26	24	161
Total	692	52	46	67	54	59	58	336
Treatment E								
303	328	16	30	3	32	21	36	138
300	389	19	32	22	28	30	25	156
Total	717	35	62	25	60	51	61	294
Treatment F								
305	359	15	28	14	34	10	32	133
308	284	16	20	21	30	29	36	152
Total	643	31	48	45	64	49	68	285

Experiment II

Twenty-four yearling steers in a pasture experiment at Blacksburg, Virginia were divided into three groups of eight steers each. The animals in each group were paired, and treatments were assigned at random. Treatments in this experiment were the same as in Experiment I except that treatment C was a control. The culture in treatment A was from a fast gaining steer, and treatment B was culture from a slow gaining steer. Group I was used to compare treatment A with treatment B. Group II was used to compare treatment A with treatment C and Group III was used to compare treatment B with treatment C. Weights and gains of the steers were recorded and compared.

TABLE 16

WEIGHTS AND TOTAL GAINS STEERS ON PASTURE

Treatment A versus Treatment B							
Pairs	Treatment A (High Culture)			Treatment B (Low Culture)			Difference A - B
	Steer Number	Initial Weight	Gain	Steer Number	Initial Weight	Gain	
1	152	1055	90	184	1105	85	5
2	172	1120	130	157	1030	80	50
3	111	1125	140	104	1005	150	-10
4	135	1155	125	116	1030	105	20
		Total	485		Total	420	65
		Average	121		Average	105	16

Treatment A versus Treatment C							
Pairs	Treatment A (High Culture)			Treatment C (Control)			Difference A - C
	Steer Number	Initial Weight	Gain	Steer Number	Initial Weight	Gain	
5	39	1075	55	10	1020	70	-15
6	46	945	85	153	975	105	-20
7	177	1035	120	26	990	215	-95
8	112	1055	120	156	1040	270	-50
		Total	380		Total	560	-180
		Average	95		Average	140	- 45

Treatment B versus Treatment C							
Pairs	Treatment B (Low Culture)			Treatment C (Control)			Difference B - C
	Steer Number	Initial Weight	Gain	Steer Number	Initial Weight	Gain	
9	42	890	30	58	960	50	-20
10	29	915	75	22	900	100	-25
11	32	860	100	119	990	180	-80
12	52	985	45	165	1040	170	-125
		Total	250		Total	500	-250
		Average	62		Average	125	- 63



TABLE 17

TEST OF SIGNIFICANCE OF TREATMENT DIFFERENCES IN GAINS

<u>Treatment</u>	<u>Difference</u>	<u>S. E.</u>	<u>t</u>	
A - B	16	12.7	1.26	NS
A - C	-45	18.37	2.48	NS
B - C	-63	24.86	2.53	NS

(t for P = .05 with 3 DF = 3.18)

Experiment III

Twelve lambs, six ewes and six wethers were fed in dry lot for a period of 91 days. Individual weights were recorded once each week and the total gain of each lamb was calculated from the unadjusted beginning and end weights.

Each lamb was graded by a committee of three graders at the beginning and end of the feeding period. Gain in grade was calculated from the average beginning and end grades.

A negative difference was found in total gain in weight and grade, but this difference proved to be a non-significant one. The small negative gains in weights might be accounted for by some trouble with sore feet (foot rot) in the lot of treated lambs the first two weeks of the feeding period. Weights and grades are recorded in Tables 18, 19, and 20.

TABLE 18

TOTAL GAIN - WEIGHTS - GRADES

	Lamb No.	Sex	Weights			Grades		
			Starting	End	Gain	Starting	End	Gain
Group 1 (Treated)	60	Ewe	72	91	19	13	14	1
	78	Wether	68	97	29	13	15	2
	87	Wether	68	91	23	10	11	1
	125	Ewe	71	95	24	13	14	1
	128	Ewe	73	97	24	10	13	3
	150	Wether	67	100	33	13	12	-1
		Total		419	571	152	72	79
	Average		69.83		25.3	12		1.16
Group 2 (Control)	82	Ewe	78	100	22	13	13	0
	112	Wether	69	89	20	10	13	3
	125	Wether	75	111	36	13	14	1
	134	Wether	63	98	35	13	16	3
	138	Ewe	71	94	23	13	14	1
	164	Ewe	68	88	20	10	12	2
		Total		424	580	156	72	82
	Average		70.68		26	12		1.66

TABLE 19

SUMMARY OF GROUP TOTALS: WEIGHTS - GRADES

Group	Weights			Grades		
	Starting	End	Gain	Starting	End	Gain
I (Treated)	419	571	152	72	79	7
II (Control)	424	580	156	72	82	10
Difference	- 5	- 9	- 4	0	-3	-3

There was a small but not significant negative difference. No benefits were realized from the addition of the cultures used in this experiment.

TABLE 20

ANALYSIS OF VARIANCE OF GAIN AND GRADE

Sources of Variation	Degrees of Freedom	Gains		Grades	
		Sums of Squares	Mean Squares	Sums of Squares	Mean Squares
Treatments	1	1.4	1.4	.83	.83
Within Treatments	10	399.3	39.93	20.17	2.01
Total	11	400.7		21	

## DISCUSSION

### Experiment I

Three commercially prepared rumen cultures and two treatments of fresh rumen liquor were tested to determine their effect on rate of gain and efficiency of feed utilization of young beef calves. The treated calves were caught once each week and given a capsule filled with prepared culture or fresh rumen liquor. The control calves were not caught or disturbed in any way. However, this difference in management of the calves is not believed to have been responsible for the small non-significant difference in rate of gain. Cultured materials and fresh rumen liquor in other investigations have been responsible for early rumination and in turn resulted in more efficient feed utilization by young calves. The calves used in this investigation were about four months of age and all calves were observed chewing their cud before the feeding trial was completed. This indicates that the calves had developed an active rumen and that inoculation had probably taken place from natural sources. None of the rumen inoculants, either of the commercially prepared culture or the fresh rumen liquor, used in this investigation had any effect on the growth rate of the calves. It would appear that the rumen flora resulting from natural inoculation was adequate for normal growth under the conditions of this experiment.

### Experiment II

Two commercially prepared products were tested to determine their effect on two-year old steers grazing on pasture. In this experiment the steers in the treated groups were caught in a squeeze and given a

capsule containing one ounce of the inoculation every two weeks. The steers in the control groups were not disturbed in this manner. It is possible that this additional handling of the treated steers might have been responsible for the small, but non-significant negative differences in rate of gain made by treated animals. At any rate there is no evidence that the additional rumen inoculation affected the growth rate of the treated animals.

### Experiment III

Twelve lambs averaging 70 pounds were weaned and put on dry feed. Six were treated with a commercially prepared culture and six were fed without the addition of the culture. The lambs in the treated group developed foot rot shortly after the beginning of the experiment. This trouble was corrected by sanitation and direct medical treatment almost immediately and is not believed to be responsible for the small, but non-significant negative difference in rate of gain of the treated group. It is believed that the treatment had no effect on the rate of gain and grade of the lambs.

### CONCLUSIONS

Three experiments were conducted using 24 young beef calves, 24 two-year old steers, and 12 weanling lambs as test animals to compare the effects of commercially prepared dried rumen materials and fresh rumen liquor on the rate of gain and feed utilization of young beef calves, mature steers, and weanling lambs.

Analysis of the data collected indicates that the materials studied did not increase the quality, the rate of gain or efficiency of feed utilization of beef calves three to four months of age and weanling lambs under dry lot feeding conditions, or mature steers on pasture.

It is, therefore, concluded that with animals of these ages, no beneficial effects are likely to result from rumen inoculation either with dried cultures or fresh rumen liquor.

SUMMARY

1. Three commercially prepared rumen cultures and fresh rumen liquor were compared to determine their effect on the rate of gain and efficiency of feed utilization of a) twenty-four steer calves, b) twenty-four two-year old steers on pasture, and c) twelve weanling lambs. Two of the cultures were prepared from the rumen contents of fast and slow gaining steers from experimental feeding tests, the other was a commercial product marketed under the trade name of Ruzyme.

2. Experiment I - Phase I

Twenty-four Jersey x Hereford steer calves three to four months of age were assigned at random to treatments in two replicates. Each calf in the treated lots was given a capsule containing one ounce of the culture weekly and all calves were fed four pounds of grain and mixed hay ad-libitum. No differences were observed in rate of gain or hay consumption of the calves receiving the rumen inoculation.

3. Experiment I - Phase II

Two additional treatments consisting of fresh rumen liquor obtained from two two-year old steers on pasture were added to the prepared cultures tested in Phase I. One calf was removed from each lot to form two new treatment groups consisting of two calves each. All treatments were replicated in this phase. One ounce of the fresh rumen liquor or the prepared culture was given to each calf in the treated groups weekly. The ration was changed to a fattening ration consisting of 50% corn and cob meal, 10% cotton seed meal and 40% ground mixed hay.

No differences could be detected in rate of gain due to the rumen liquor or the commercially prepared cultures in Phase II.

4. Twenty-four two-year old steers on pasture were paired by weight and pasture assignment and divided into three groups to test the effect of the cultures prepared from rumen contents of the fast and slow gaining steers on the rate of gains of steers on pasture. One ounce of the culture was given to each steer in the treated groups every two weeks. The steers in the control lots were not disturbed when the treated animals were inoculated. The treated animals made smaller gains than those in the control groups but the differences, though sizeable, were non-significant and may have been partially due to the extra handling of the animals when the cultures were administered.

5. The culture prepared from the rumen contents of the fast gaining steer was further tested for its effect on rate of gain and slaughter grade using twelve weanling lambs averaging seventy pounds in weight assigned at random to two groups of six lambs each. The lambs were fed two pounds of grain per head daily with alfalfa hay ad-libitum for a 91-day feeding period. The lambs in the treated group received a grain mixture containing one ounce of the culture per lamb per day. The differences in rate of gain and slaughter grades between the two groups were small and probably due to chance alone.



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