"Valsyn Mix" In Comparative Studies of the Prevention of Coliform Diarrhea in Calves[1]

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INTRODUCTION

Escherichia coli, a pathogenic member of the family *Enterobacteriaceae*, is a normal inhabitant of the lower bowel of all warm-blooded animals. Few or no *E. coli* are found in the stomach and anterior portions of the intestines, and normally, carnivora and omnivora harbor this organism more abundantly than herbivora, very few being found in the feces of cows and horses. A strict parasite, *E. coli* is not naturally abundant except in intestinal tracts, in feces, or in material subjected to fecal contamination.

Hagan and Bruner[3] mentioned that it is apparent that certain serotypes of *E. coli* are more important than others in their relationship with the socalled 'white scours' or 'calf scours', with specific reference to the work of Orskov who demonstrated that type O 26: B 6 occurs in both calf scours and infant diarrhea. In serotype designation, "O" indicates heat-stable somatic antigens, while "B" indicates the K-type, heat-labile somatic antigens. Besides these, there are "H"-type flagellar, heat-labile antigens.

This study was undertaken to investigate the prophylactic activity of "Valsyn Mix", a furaltadone preparation, against coliform enteritis in calves.

EXPERIMENTAL PROCEDURE

Thirty-six newborn calves were purchased from several dairymen and a cattle dealer. Rectal temperatures were recorded during a 3-day preliminary period, and general attitude and behavior were also observed to determine apparent normalcy of all calves.

After individual weighing, calves were permanently identified with numbered tags of distinctive colors, and distributed at random into 3 groups of 12 calves each, so that the total weight of the groups were approximate. Two calves from each of the three treatment schedules were placed in a concrete floored pen of about 10 × 10 feet, thereby forming six groups of six calves each.

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[3] Hagan, W. A., and Bruner, D. W., The Infectious Diseases of Domestic Animals, 3d ed., Comstock Publishing Assoc., Ithaca, N.Y., 193–9, 1957.

Each calf was inoculated orally with a suspension of *E. coli* grown in the laboratory isolated from a spontaneous case of fatal diarrhea that occurred under range conditions in a beef-production project in the hilly Corozal Substation area. Individual oral inoculation of the 36 calves was carried out on 10 consecutive days, with dosage calculated at 5.4×10^9 concentration of *E. coli* per dose. The inoculum used each day had been seeded in brain-heart infusion broth the day before use so as to insure that the culture was at its optimal growth phase, and that it had the possibility of effectively causing diarrhea.

Daily rectal temperatures were recorded for all calves throughout the duration of the trial; weights were recorded on the first day of observation, and at weekly intervals thereafter. Blood samples obtained at each scheduled weighing were used for laboratory determinations of hemoglobin, packed-cell volume, red blood-cell counts, white blood-cell counts, and differential leukocytic counts.

The experimental ration fed to calves under treatment No. 1 was the basal ration, described below, medicated by the addition of "Valsyn Mix" in sufficient quantity to provide 3 mgm. of furaltadone per pound of body-weight. Valsyn Mix contains 15.15 percent of furaltadone.

A commercial milk-replacer containing skim milk and guaranteed to be free from antibiotics was fed as the basal ration to the control group of calves, designated as treatment No. 2.

A 'comparison ration' consisted of the basal ration medicated with TM-10, a feed additive that contains 10 gm. of oxytetracycline hydrochloride per pound, in sufficient amount to provide the manufacturers' recommended level of 0.5 mgm. daily per pound of body-weight. This 'comparison ration' was fed to 12 calves as treatment No. 3.

Group 2 was fed the basal ration exclusively through the 35 days of observations. No therapeutic medication was given to any calves in the control group that developed enteritis or signs of any other disease. Groups 1 and 3 were fed the basal ration during the 3 preobservation days, and thereafter received their corresponding medicated ration for 21 days, after which they were again fed the basal ration for the last 10 days of the observation period. Calves in these two groups did not receive therapeutic treatment for any disease, except for the drugs incorporated in their rations. Daily rations to all calves were fed at 10 percent of their body-weights, apportioned into morning and afternoon feedings.

Separate sets of nipple-buckets and galvanized cans were used for mixing the rations. These were clearly identified with the distinctive color of the color tag of each corresponding group.

Enteritis and any signs of abnormality or disease were recorded. A determination of bacteriological etiology was attempted in all cases of diarrhea, and also in every dead calf that was necropsied.

OBSERVATIONS AND RESULTS

INCIDENCE OF DIARRHEA AND DEATHS

Seven of the twelve infected, unmedicated calves in the control group (treatment No. 2) died during observations. Calves Nos. 17, 20, 23, and 24 were examined on post mortem. All calves in the control group showed diarrhea following dosage with the inocula, some as early as the first post-inoculum day. Death occurred on the 5th, 6th, 15th (2 animals), 23d, and 25th (2 animals) postinoculation days. Besides the diarrhea, five of these calves showed clinical signs of respiratory involvement such as dyspnea, breathing with "puffed cheeks" and extended neck, audible rales, and moist, soft coughing. On post-mortem examination, calves Nos. 23 and 24 had congestion and massive carnification or atelectasis of the lungs with multiple abscesses and adherences to the costal pleura. The left metacarpal region of calf No. 21 was swollen, ulcerated, and fistulous. Three of the four calves examined on post mortem had passive congestion of the liver. The mucous membranes of the gastrointestinal tracts were swollen, hyperemic, congested, and often, hemorrhagic.

Sterile-swab technique was used to secure samples of the diarrhea from live calves and at post-mortem examinations. In the laboratory these swabs were inoculated to brain-heart infusion broth, nutrient broth, triple sugar agar, and E.M.B. agar, and incubated at 37°C. overnight. Routine laboratory techniques were followed after the initial incubation of the swabs.

The 12 calves of Group 3 that were fed the 'comparison ration' containing oxytetracycline-HCl additive, were alive at the end of observations. All the calves in this group had diarrhea. Diarrhea started between the 2nd and the 8th day of dosage. Diarrhea in these 12 calves persisted throughout the length of the observation period. Feces were liquid to soft, or semiformed, yellowish, frothy, and fetid.

Four of the twelve calves fed Valsyn Mix under treatment 1 died during observations. Death occurred on the 9th, 13th, 14th, and 30th days. Diarrhea was observed in calves receiving Valsyn Mix, starting on the 2nd day of dosage. Diarrhea was sporadic, and was recorded on 95 occasions out of 306 observations, while being recorded 126 times out of 265 observations in the control calves, and on 142 occasions out of 360 observations in the calves fed the 'comparison ration'. Calf No. 4 died 4 days after the dosage period was over, following 1 week of prostration from a swollen, infected, painful left carpal region, accompanied by a yellow, extremely frothy diarrhea.

Calf No. 5 died on the 9th day after the initial inoculation, after being wobbly and depressed, and unable to stand during the last 2 days. Sunken eyes, rapid respiration, inappetence, and emaciation were noticed. On post mortem, the liver had passive congestion, and the left lung showed conges-

tion from hypostasis, but without pneumonal changes, since pieces of the most pendant part of the apical lobe floated in water. The abomasal and intestinal mucosae were irritated and hyperemic, and covered with a dirty-yellow diarrhea; the mesenteric vessels were congested. Swabs were taken for bacteriological identification.

Calf No. 8 died on the 30th postinoculation day after having diarrhea for the previous 15 days. The diarrhea was yellow and frothy. The calf was noticeably depressed for the 7 days prior to death. On autopsy, swabs were taken from the intestines. Both lungs had extensive adhesions to the costal pleura, were indurated, and had multiple abscesses throughout. Tissues for bacteriological and histopathological determinations were taken.

Calf No. 11 had diarrhea from the 2nd postinoculation day until death on the 13th day. There was a definite rise in temperature during the last 4 days prior to death, with readings of 102.8°, 104.0°, 104.6°, and 105.0°F., before an abrupt terminal decrease to 96.9°F. The calf exhibited clinical symptoms of colic about 19 hours before death. Post-mortem examination showed the abomasum to have very congested vessels and mucosa; an intussusception in which about 18 inches of the small intestine had 'telescoped' was the apparent immediate cause of death. Posterior to the intussusception, massive hemorrhage into the lumen of the cecum, colon, and rectum was noticed. Swabs for bacteriological study were taken.

OBSERVATIONS ON RECTAL TEMPERATURES

The average daily rectal temperature for the 12 controls under treatment 2 fluctuated very narrowly between 101.4 to 102.4°F. (table 1). Daily temperature for individual calves ranged from 94.2°F. for calf No. 19, to 105.9°F. recorded for calf No. 24 on the day preceding its death.

The average daily rectal temperature for calves under treatment 3 ranged from 101.0° to 102.0°F. (table 1). Calf No. 34 had temperatures of 103.2°, 105.0°, 104.2°, and 103.2°F. from the 15th to the 18th postinoculum days. Diarrhea in calf No. 34 had started on the 6th postinoculation day, and persisted until the termination of the observations. Lowest temperature for this group, 99.6°F., was recorded from calf No. 25.

The average daily rectal temperature for the calves under treatment 1, fed Valsyn Mix, ranged from 100.5 to 101.9°F. (table 1). The extremes in temperature in this group were recorded from calf No. 11: 96.6°F. on the day of death, and 104.0°, 104.6°, and 105.0°F. on the 3 days immediately preceding death.

EFFECTS ON GROWTH AND BODY-WEIGHT

The average body-weight of all calves was similar at the start (table 2). There was a reduction in average weight in the three groups through the dosage period, as demonstrated in the weighings for the 8th and the 15th

TABLE 1.—*Average daily rectal temperatures observed in 36 calves orally infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Period (days)	Temperatures for group—		
	1, Valsyn Mix	2, control	3, TM 10
Predosage:			
1	101.6	101.8	101.0
2	101.1	101.6	101.2
3	101.5	101.8	101.7
Dosage:			
4	101.7	102.1	101.8
5	101.1	101.8	101.7
6	101.3	102.0	102.0
7	101.3	101.9	101.9
8	101.1	102.0	101.4
9	101.0	102.3	101.9
10	101.2	102.2	101.8
11	101.3	101.9	101.8
12	101.1	101.6	102.0
13	101.2	101.7	101.8
Postdosage:			
14	101.3	101.4	101.5
15	101.6	102.0	101.5
16	101.7	101.7	101.6
17	100.5	101.8	101.3
18	101.5	102.2	101.3
19	101.3	101.9	101.7
20	101.4	102.2	101.8
21	101.5	102.4	101.7
22	100.9	102.4	101.4
23	101.1	102.0	101.1
24	101.4	101.8	101.2
25	101.2	101.5	101.3
26	101.3	102.0	101.5
27	101.2	102.0	101.7
28	101.6	102.1	101.8
29	101.7	101.7	101.7
30	101.3	101.3	101.6
31	101.8	101.9	101.4
32	101.4	101.5	101.5
33	101.4	101.8	102.0
34	101.6	102.0	101.5
35	101.9	102.4	101.8

days. Afterwards, and through the rest of the observations, there was a definite, steady increase in the average weight of calves of all groups. Calf No. 10, of the Valsyn Mix group, gained 34 pounds, the highest increase for all calves.

While the five calves that survived from the control group (treatment 2) gained an average of 13.6 pounds of body-weight, the seven that died had an average loss of 7 pounds. The initial weight of the group was 873 pounds, while the five survivors had an aggregate terminal weight of 475 pounds, representing a net loss of 398 pounds for this treatment schedule.

The 12 calves on the comparison ration of treatment 3 made an average gain of 15.7 pounds of live weight, although calf No. 33 had a net loss of 2 pounds. Initial and terminal aggregate weights for this group were 859, and 1,042 pounds, respectively, for a net gain of 183 pounds in live weight.

The eight calves fed Valsyn Mix in treatment 1 that survived had an average weight gain of 15.4 pounds, while each of the four that died had an average loss of 6.2 pounds. The 12 calves weighed 833 pounds at the start;

TABLE 2.—*Average body-weight (in pounds) of 36 calves infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Period and day	Body-weight for group[1]—		
	1, Valsyn Mix	2, control	3, TM 10
Predosage (1st day)	69.4 (12)	72.7 (12)	71.6 (12)
Dosage (8th day)	67.5 (12)	70.9 (12)	71.8 (12)
Postdosage (15th day)	66.7 (11)	69.6 (10)	70.1 (12)
(22nd day)	72.0 (9)	76.1 (8)	74.3 (12)
(29th day)	79.2 (9)	81.9 (6)	83.0 (12)
(35th day)	86.1 (8)	95.0 (5)	86.8 (12)

[1] Numbers in parentheses indicate number of survivor calves weighed for the corresponding weight average.

the 8 survivors had a terminal weight of 689 pounds, equivalent to a net loss of 124 pounds of live weight.

OBSERVATIONS ON HEMOGLOBIN VALUES

Table 3 presents the variations recorded in the hemoglobin values. The controls in group 2 suffered a steady decrease in hemoglobin from 12.7 gm. per 100 ml. of blood, to 7.1 at the conclusion of observations. Groups 1 and 3 showed a plateau effect through the first 15 days, followed by a decrease in the next two readings, and an increase in the terminal sample.

OBSERVATIONS ON HEMATOCRIT VALUES

Hematocrit values showed a general, steady decrease through the observation period (table 4). The average for treatment 2 dropped from 33 percent to 18 percent, and correspondingly, the calves on Valsyn Mix in treatment 1, and those on the comparison ration in treatment 3, dropped from 36 to 22 percent, and from 33 to 23 percent, respectively.

The highest reading for calves under treatment 1 was 45 percent, the lowest was 18; corresponding readings were 40 and 11 percent for calves under treatment 2, and 12 and 16 percent for those under treatment 3, respectively.

OBSERVATIONS ON ERYTHROCYTE COUNTS

The average weekly erythrocyte counts for calves under treatments 1 and 3 increased sharply through the 8th- and 15th-day samples, but showed

TABLE 3.—*Average hemoglobin values (gm. per 100 ml.) observed in 36 calves infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Period and day	Hemoglobin for group—		
	1, Valsyn Mix	2, control	3, TM 10
Predosage (1st day)	12.2	12.7	12.0
Dosage (8th day)	12.2	11.3	12.4
Postdosage (15th day)	12.8	10.6	11.6
(22nd day)	9.7	8.3	10.8
(29th day)	8.8	7.8	9.7
(35th day)	9.2	7.1	11.2

TABLE 4.—*Average hematocrit values (percent) in 36 calves infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Period and day	Hematocrit readings for group—		
	1, Valsyn Mix	2, control	3, TM 10
Predosage (1st day)	36	33	33
Dosage (8th day)	34	33	33
Postdosage (15th day)	31	29	30
(22nd day)	30	25	32
(29th day)	20	22	25
(35th day)	22	18	23

a steady decrease in the subsequent three samples (table 5). The pattern for the controls indicated a steady increment of lesser magnitude in the red-cell counts through the first four samples, followed by a decrease in the last two samples.

OBSERVATIONS ON LEUKOCYTE LEVELS

The average weekly white-blood-cell count for the controls showed a marked increase from an initial level of 7,900 per milliliter of blood to 12,000 for the sample drawn during the dosage period. Thereafter the counts remained around the 11,000 level (table 6). The lowest leukocyte count for

this group was 3,150 per milliliter, while the highest, not only for the controls but for all of the calves, was 50,800.

Initial leukocyte count for the Valsyn Mix group was 8,600 per milliliter, and 8,500 for the 2nd sample; counts for the subsequent four samples fluctuated between 9,500 and 11,800 per milliliter. The lowest leukocyte count for a calf in this group was 3,300 per milliliter; the highest, 19,000.

In calves of the comparison ration fed terramycin-medicated milk, the initial leukocyte count averaged 5,700 per milliliter of blood, and increased

TABLE 5.—*Average erythrocyte values (in millions) for 36 calves infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Period and day	Red blood-cell counts for group—		
	1, Valsyn Mix	2, control	3, TM 10
Predosage: 1st day	4.8	6.1	4.9
Dosage: 8th day	9.3	7.4	8.1
Postdosage: 15th day	9.5	8.0	8.8
22nd day	8.7	8.7	8.7
29th day	7.8	8.0	7.1
35th day	6.6	6.9	6.0

TABLE 6.—*Average leukocyte values (in thousands) for 36 calves infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Period and day	White blood-cell counts for group—		
	1, Valsyn Mix	2, control	3, TM 10
Predosage: 1st day	8.6	7.9	5.7
Dosage: 8th day	8.5	12.0	6.5
Postdosage: 15th day	10.3	10.9	11.0
22nd day	9.5	10.5	10.6
29th day	10.9	11.3	11.9
35th day	11.8	10.9	9.6

to 11,000 by the 3d sample, fluctuating thereafter from 9,600 to 11,900. The lowest count for this group was 3,400 per milliliter, and the highest, 22,850, there being 10 other individual readings of over 11,500 per milliliter.

OBSERVATIONS ON DIFFERENTIAL LEUKOCYTIC COUNTS

Table 7 presents weekly average differential counts for the three groups. Lymphocyte level varied between 67.0 and 76.5 percent in the Valsyn Mix group of calves, between 70.0 and 77.3 for the controls, and between 70.3 and 74.2 percent for the terramycin-fed group.

Neutrophiles ranged from 21.0 to 29.0, from 19.9 to 28.2, and from 23.0

to 26.6 percent for the Valsyn Mix, the controls, and the comparison groups, respectively. Monocytes, basophiles, and eosinophiles were at levels considered to be normal. There was a transient increase to 4.1 percent in eosinophiles in the 5th sample in the Valsyn Mix group, and to 3.0 percent in the controls.

TABLE 7.—*Average differential leukocyte counts in 36 calves infected with* **E. coli**; *Puerto Rico Agricultural Experiment Station, 1965*

Group	Type of leukocyte						
	Cell type	Predosage (first day)	Dosage (8th day)	Postdosage			
				15th day	22nd day	29th day	35th day
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1	Lymphocyte	69.3	72.0	76.5	73.8	67.0	70.8
	Neutrophile	29.0	24.0	21.0	23.4	27.0	25.8
	Monocyte	1.0	2.0	1.1	2.0	1.0	1.8
	Basophile	.4	1.4	1.0	.4	.9	.6
	Eosinophile	.3	.6	.4	.4	4.1	1.0
2	Lymphocyte	70.2	71.8	77.3	71.7	70.0	73.0
	Neutrophile	28.2	25.5	19.9	25.4	25.0	25.2
	Monocyte	1.2	1.5	.8	1.0	1.0	1.2
	Basophile	.2	.8	1.2	1.0	1.0	.6
	Eosinophile	.2	.4	.8	.9	3.0	0
3	Lymphocyte	72.0	70.3	72.9	74.6	72.0	74.2
	Neutrophile	26.0	26.2	23.7	24.0	25.2	23.0
	Monocyte	1.2	1.6	1.2	.8	.8	1.5
	Basophile	.5	1.3	1.2	.4	1.2	.8
	Eosinophile	.3	.6	1.0	.2	.8	.5

DISCUSSION

Twelve newborn calves were fed reconstituted, antibiotic-free skim milk at the daily rate of 10 percent of body weight. Another group of 12 calves was similarly fed the basal ration to which Valsyn Mix, a furaltadone preparation from Norwich Laboratories, was added at the rate of 3 mgm. per pound of body weight, while a third group was fed the basal ration plus TM-10, an oxytetracycline hydrochloride additive, at the rate of 0.5 mgm. per pound of body-weight. These rations were fed for 21 consecutive days, after which all calves were put back on the basal ration for 10 additional days. Each calf was orally inoculated once a day with a culture of *E. coli* for the first 10 days of the observation period.

Average rectal temperatures for the three groups had similar ranges. It

was noticed that hyperthermia of sick calves usually preceded a sudden drop to subnormal temperature immediately anteceding death.

Seven control calves died from diarrhea, ulcerative carpitis, and/or acute suppurative bacterial pneumonia. All these conditions are directly related to the presence of *E. coli*, as described by Hagan and Bruner.[3] The histopathological report obtained from the U.S. Army Tropical Research Laboratory at San Juan, P.R.[4] eliminates the suggested possibility of foreign-body pneumonia that could have developed from inhalation of dust from the bagasse bedding. The report clearly states that the pleuritic adhesions, the carnification, and the multiple abcessing of the lungs more probably result from aspiration of the inoculum while it was being given *per os*, or to aspiration of vomitus. Diarrhea was recorded on 126 occasions out of 265 observations in the calves of the control group.

Four calves from the group fed Valsyn Mix died from diarrhea, carpitis, and suppurative pneumonia. After 11 days with diarrhea, including 4 of concurrent hyperthermia, calf No. 11 suffered a severe colic, and had a terminal temperature of 96.6°F. Autopsy showed an extensive intussusception of the small intestine. Diarrhea was recorded on 95 occasions out of 306 observations in the calves fed the Valsyn Mix rations.

All the calves fed the ration containing oxytetracycline-HCl (TM-10) suffered from persistent diarrhea throughout the observation period. Diarrhea was recorded on 142 occasions out of 360 observations. There were no deaths in this group.

Diarrheas from calves of the three groups were yellowish or dirty-gray, and extremely frothy, considered characteristic of *E. coli* infection. Bacteriologically, the organisms recovered were O127:B8 and O86:B7.

After a decrease during the 10-day dosage period, the average body weight of the calves increased steadily throughout the rest of the observation period.

As mentioned under Observations and Results, (p. 282 ff.) the initial weight per group of 12 calves was 873 pounds for the controls, 859 for the comparison ration, and 833 for the Valsyn Mix, or 72.7, 71.6, and 69.4 pounds for the average individual in those respective groups. The terminal weight was 475 pounds for the 5 survivors in the control group, 1,042 pounds for the 12 of the comparison-ration group, and 689 pounds for the 8 survivors in the "Valsyn Mix" group. It should be noted that a net loss of 398 pounds in live weight occurred in the control group. Similarly, a net loss of 124 pounds in live weight was recorded in the Valsyn Mix group. On the other hand, a net gain of 183 pounds of live weight was obtained by the 12 calves under the comparison-ration treatment.

[4] The authors wish to express their appreciation to Captain Larry Jones, U.S. Army, V.C.

If the terminal weight of each group be divided by the number of survivors therein, the 5 surviving calves of the control group average 95.0 pounds of live weight, the 12 under the comparison ration average 86.8 pounds, and the 8 survivors from the Valsyn Mix regime average 86.1 pounds. However, if the terminal weight be divided by the original number of calves per group so that the net loss in weight for the group, and the reduction in number of calves per group are brought to bear, then the average individual weight would drop to 39.6 pounds for the controls, to 57.4 pounds for the Valsyn Mix calves, while remaining unchanged at 86.8 pounds for the comparison ration treatment.

Hemoglobin dropped continuously in the control calves from 12.7 to 7.1 gm. per 100 ml. of blood. The oxytetracycline-HCl group showed a plateau effect in average hemoglobin values through the first three readings, and a definite increase in the terminal one. Similar fluctuations were recorded for average hemoglobin values of the Valsyn Mix calves, but the drop was more pronounced in the 4th and 5th samples, and the upswing less acute in the terminal reading.

Hematocrit values for all calves underwent a steady decrease of no statistical significance.

Erythrocyte levels peaked rapidly to the 15th day in the Valsyn Mix and 'comparison ration' groups, and dropped acutely thereafter; the controls had a similar general pattern except for a slower increase.

Leukocyte counts increased sharply in the control calves during the *E. coli* dosage period, and subsequently decreased slightly to fluctuate between 10,500 and 11,300 per milliliter of blood. Both the Valsyn Mix and the comparison ration groups showed no relevant increase in leukocyte levels until after the *E. coli* dosage period, whence the counts went up to levels similar to those of the controls.

Schalm[5] cited several investigators who claimed higher leukocyte counts for calves than for adult bovines and mentioned that, although a few calves showed counts under 4,000, a high proportion of calves had physiological leukocytosis. Reference is made to Moberg's statement that the total white count and absolute numbers of neutrophiles, lymphocytes, and monocytes decrease with the age of the calf, while with the eosinophiles the opposite is the case. Schalm indicated that the newborn calf had low numbers of circulating lymphocytes because of the underdeveloped state of its lymphocytic organs. Later, to supply the need for antibodies, the lymphocytic tissues expand, producing an increase in the numbers of circulating lymphocytes. Still later, with age and the atrophy of the thymus, the circulating lymphocytes again decrease.

[5] Schalm, O. W., Veterinary Hematology, Lea & Febiger, Philadelphia, Pa., 151-6, 1961.

Referring to Holman's data, Schalm mentioned that:

> lymphocytes represent only 33 percent at birth and rose to 72 percent in 4 months after which there was a slow fall to the adult level of 50–60 percent at about 2 years of life. In the application of hematology to clinical medicine in the very young bovine, it must be realized that neutrophiles will exceed the lymphocytes in number during the first weeks of life. During the period 4–12 months, the neutrophile number is at its lowest and the lymphocytes may contribute 75–80 percent to the differential count.

The above citations and figures refer to normal newborn calves. However, the fact that the 36 calves used in the observations herein reported upon were purposely infected *per os* with a virulent culture of *E. coli* must be kept in mind, as this might cause normal hematological values to be considered inapplicable to them.

Leukocytosis was noticeable in the majority of the 36 calves from the initial or preobservation samples through the duration of the observation period. Peak leukocytosis reading was 16,250 for one survivor of the Valsyn Mix group, 15,200 for one survivor of the controls, and 22,850 for one of the comparison-ration group. The peak leukocyte reading for each of the four dead calves from the Valsyn Mix group was 18,050, 18,700, 18,800, and 19,000, while it was 10,800, 10,900, 15,050, 16,250, 18,660, 20,000, and 50,800 for the seven calves which died from the control set.

As corroboration, the leukocyte levels of 2 normal calves from the regular calf barn, comparable in age to the 36 used in the observations, were recorded at 13,100 and 14,950 leukocytes per milliliter of blood.

Contrary to Schalm, the differential leukocyte counts in these 36 calves from birth to about 40 days of age, had a lymphocyte level in excess of 72 percent, with a neutrophile level of around 24 percent, and a monocyte level that never exceeded 2 percent.

Corroboratively, differentials made on two normal calves of contemporary age, under routine calf-barn management, showed 74.5-percent lymphocytes, 24.5-percent neutrophiles, and 1-percent monocytes.

It would appear that leukocytosis of over 10,000 white blood cells per milliliter of blood, and differentials in the order of about 75-percent lymphocytes and 24-percent neutrophiles is to be found rather frequently in calves under 2 months of age.

SUMMARY

A group of 12 newborn calves was fed antibiotic-free reconstituted skim milk, at a 10-percent body weight daily level, for 35 days. Each of two other calf-groups was fed the basal ration with an oxytetrocycline-HCl additive, and the basal ration with "Valsyn Mix", a furaltadone preparation. All calves were orally inoculated for 10 consecutive days with doses of *E. coli*.

Daily temperature and physical observations, and weekly clinico-hematological data were recorded for each calf.

Statistical analyses showed that there were no significant differences between treatment groups in relation to the hematocrit level and death of calves, or the leukocyte level and death of calves, and also that gain in body-weight of survivor calves is independent of treatment-schedule influence.

However, there is statistical significance at the 5-percent level between the ability of Valsyn Mix to protect calves from *E. coli* diarrhea when compared with oxytetracycline hydrochloride, and no medication.

RESUMEN

Durante 35 días se alimentó un grupo de terneros recién nacidos con leche descremada reconstituída, libre de antibióticos, a razón de un 10 por ciento de su peso vivo diario. A un segundo grupo se le suministró esa dieta básica con un aditivo de oxitetraciclina clorhídrica y a otro la misma dieta básica con "Valsyn Mix", un derivado de furaltadona.

Se inocularon oralmente todos los terneros por 10 días consecutivos con una dosis de *E. coli*.

A cada ternero se le hicieron observaciones diarias de temperatura y condición física, y semanalmente se le tomaron datos clínico-hematológicos. Los análisis estadísticos demostraron que no existen diferencias significativas entre los grupos sometidos al tratamiento en cuanto al nivel hematocrítico y la muerte de terneros, así como tampoco entre el nivel leucocítico y la muerte de terneros. Se demostró, además, que la ganancia en peso de los terneros sobrevivientes no dependió del régimen del tratamiento experimental.

Sin embargo, se encontraron diferencias significativas al nivel del 5 por ciento entre la capacidad del "Valsyn Mix" para proteger los terneros contra las diarreas causadas por *E. coli* y la de la oxitetraciclina clorhídrica y la ausencia de medicación.