THE EFFECT OF ORAL AND INJECTABLE IRON ON THE HEMATOLOGICAL VALUES AND GROWTH WEIGHTS OF HOLSTEIN CALVES

Thesis for the Degree of M. S.

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Samuel M. Getty

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THESIS

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ABSTRACT

THE EFFECT OF ORAL AND INJECTABLE IRON ON THE HEMATOLOGICAL VALUES AND GROWTH WEIGHTS OF HOLSTEIN CALVES

by Samuel M. Getty

Mammals, shortly after birth, exhibit physiologically low hemoglobin values. Numerous theories have been proposed to explain this phenomenon. Because mammalian milk is believed to be a perfect food by many, one exception to this belief stands out in the literature. Milk is known to be sufficiently deficient in iron to produce an iron deficiency with relative ease. Because of the vast amount of material on this subject in the literature only selected references were used in a review of the literature. Clinically, a wide range of hemoglobin values are observed from calves less than twenty weeks of age. A study was undertaken to determine if any effect in body weight or hematology is noticeable when iron is supplied to calves either orally or intramuscularly.

Forty-five holstein calves were obtained when less than 7 days of age. Initial hemoglobin values were arranged in a linear fashion and a group consisted of fifteen calves selected from every third value. One group of calves received 30 mg. of iron orally each day while another group of 15 calves received two injections of iron (1,000 mg.

total) at 7 and 21 days of age. The remaining calves served as a control group.

Calves were weighed and blood samples taken weekly. Body weight gains were not significant; however, the pattern of growth varied. Weight gains were compared to hemoglobin levels. A correlation was observed between the portion of calves receiving oral iron that had a higher mean level of hemoglobin and the increased rate of daily gain. Calves which received intramuscular iron and had low hemoglobin values showed a better rate of daily gain than calves with high hemoglobin values.

Hemoglobin and packed cell volume values showed a significant increase at approximately 7 and 21 days respectively after the calves were started on iron. A reticulocytic response was observed in calves treated with iron. Calves treated with oral iron showed a gradual but uniform response while calves treated with injectable iron showed a peak response for the three weeks during treatment and then returned to the normal range.

Serum iron levels were determined weekly by the dipyridal method. A significant increase ($P < .01$) was observed in all calves receiving injectable iron.

It is concluded from this study that iron either in intramuscular or oral form is beneficial in meeting the clinical requirement of the dairy calf as a supplement to whole milk. Although a great response is not seen in bovine

hemoglobin values, as compared to the response in baby pigs, it was found that the physiological anemia was prevented in calves with the use of supplemental iron.

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By

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Dedicated to

Lucy and the girls

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CHAPTER I

INTRODUCTION

The medicinal value of iron has been realized for some time. The element was a valuable tool in treating blood disorders, battle wounds, chlorosis, and other conditions during the 17th century and probably before that time.

More recently iron studies have been numerous in regards to absorption, excretion, metabolism, and requirements for the various animal species. Radioactive tracer techniques have been employed with much success in studying the role of this element.

A great deal of attention has been focused on the physiological low hemoglobin values of immature animals. The role of iron in relation to hemoglobin formation and body weight is unsettled at this time. Confusion is paramount, as evidenced by the wide range of "normal" hemoglobin values published for calves. A desire to determine the effect of iron administered parenterally and orally on the formation of hemoglobin and on growth of calves stimulated the following study.

CHAPTER II

REVIEW OF THE LITERATURE

The Egyptians and Greeks were probably the first to use iron for medicinal purposes although its function was not known at that time. Fowler (1936) reported that during the 17th century two English physicians, Sydenham and Willis, used the element to treat chlorosis. Later, Lemary, Geoffry and Menghinis found iron to be a necessary constituent of the blood.

Vannotti and Delachaux (1949) believe iron is present in all tissues and is an essential element to the animal. Tint and Reiss (1950), and Bernhart and Skeggs (1943) reported that the element is present in the hemin-chromoproteins and, as such, Coryell and Pauling (1940) are of the opinion that it is directly responsible for oxygenation and oxidation at the cellular level. Hahn et al. (1943) reported that siderophilin and ferritin are two non hemin-chromoproteins which contain iron. Schade and Caroline (1946) believe that siderophilin or transferrin is that protein fraction of the plasma serving as an iron carrier in the plasma iron transport system. Finch and Finch (1955) reported that storage iron is found intracellularly as a protein complex ferritin; while Bessis and Breton-Corius (1959) have demonstrated hemosiderin to be a condensation or

clustering of ferritin molecules. Hahn (1937) reported that blood hemoglobin constitutes the greatest quantity of iron in the body. Later Hahn (1948) reported that iron is present in the cytochrome system but this mechanism is not affected by an iron deficiency. Schultze (1941) reported that the cytochrome oxidase activity of bone is normal or elevated in a state of iron deficiency.

Cartwright (1956), Ullrey (1958), Matrone (1954), and Smith (1944a, 1944b) have reported that a typical iron deficiency produces a hypochromic-microcytic anemia in swine, calves, rats, and rabbits. Follis (1958), Wohl and Goodhart (1960) reported that the mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, and the mean diameter were decreased when an iron deficiency existed.

Numerous theories have been presented regarding the absorption of iron. Copp and Greenberg (1946), and Widdowson and McCance (1937) have reported that most of the absorbed iron is conserved by the animal and very little is excreted. Brown and Justus (1956) have shown that assimilation is greatest in the duodenal region and progressively less in the lower gastrointestinal tract. Moore et al. (1944) demonstrated that ferric iron must be reduced to the ferrous form before absorption can take place. Sharpe et al. (1950) have shown by experimentally increasing bulk or phytic acid content in the diet that there is a decrease

in the absorption of iron. Pirzio-Biroli et al. (1958) reported that large amounts of ascorbic acid in the diet will increase absorption. Hahn (1948) believes that absorption of iron is governed by the need for it. Balfour et al. (1942) proposed that the mucosal cell contained an acceptor mechanism for iron. Granick (1951) proposed that iron is absorbed by combining with a protein apoferritin in the mucosal cell to form ferritin which is absorbed through the capillaries. When the mucosal cell becomes saturated, absorption is decreased due to a "mucosal block." Brown et al. (1958) believes the "mucosal block" theory should be discarded. Hegsted et al. (1952) reported rats gain rapidly when large amounts of iron are present in the diet. They suggested that when essentially all of the phosphate was bound by iron absorption was very rapid. Recently Moore et al. (1961) proposed ferritin to be a storage form of iron in the mucosa and absorption to be controlled by the activity of the transport system which serves to pass iron across a cell membrane. Elvehjen and Sherman (1932) reported that copper does not affect the assimilation of iron. Houk et al. (1946) found that when they added copper to the diet, iron retention doubled.

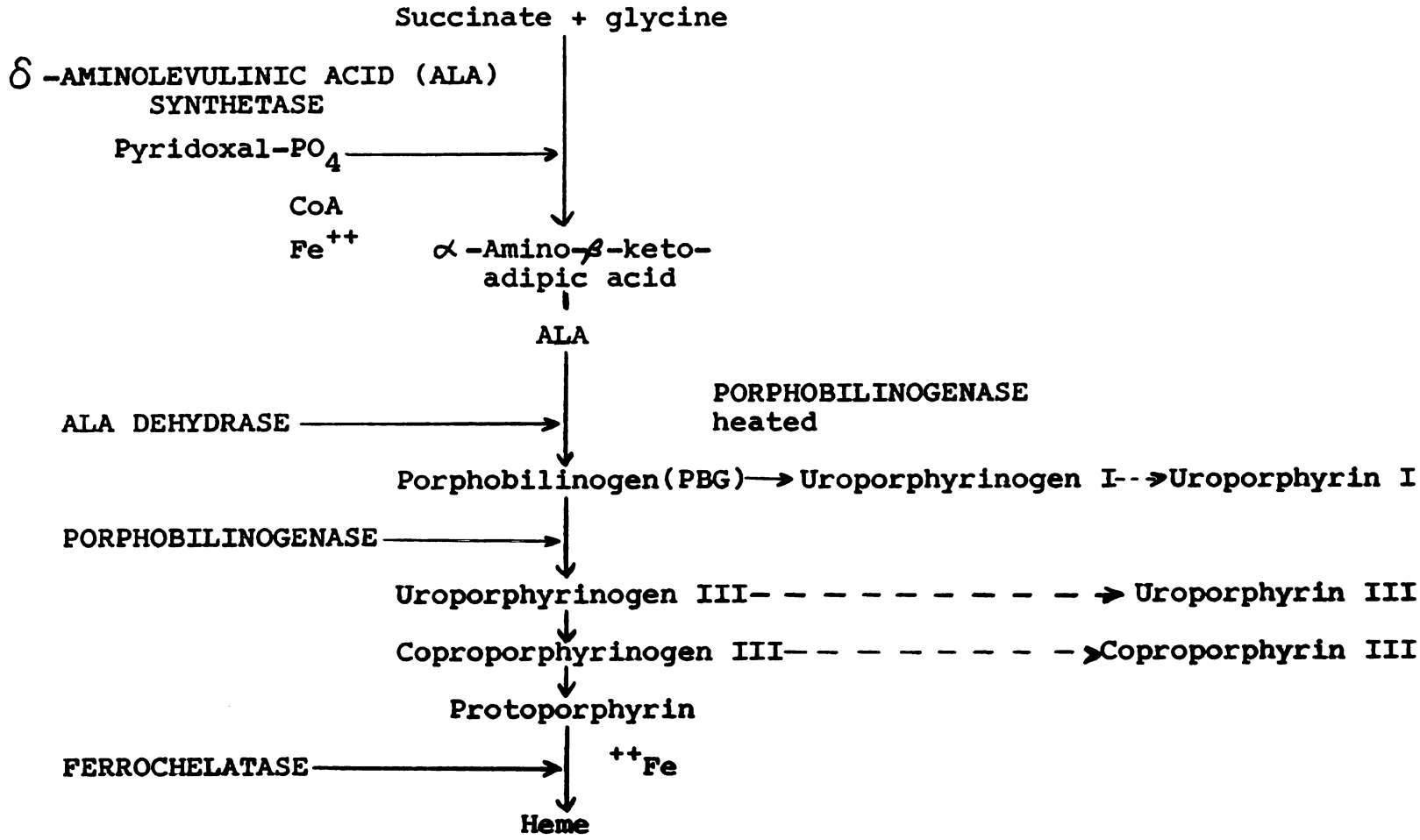
Copp and Greenberg (1946) reported that small amounts of iron are normally excreted. Greenberg et al. (1943) reported that bile was the main pathway for the excretion of iron. Known excretory routes are perspiration (Johnston

et al., 1950), feces (Greenberg et al., 1943), and urine (Heath, 1937).

Copper deficiency also produces a microcytic hypochromic anemia (Smith et al., 1944; Foster, 1931). Cohen et al. (1927) were the first to report an interrelationship between copper and iron in hemoglobin production. Chase et al. (1952), using radioiron, reported that copper facilitates iron absorption and hemoglobin synthesis in pigs. Jensen et al. (1956) reported that metabolism of iron was not affected in copper deficient pigs but that absorption was less. Because of the great deposits of iron that occur in the livers of sheep and cattle on diets poor in copper, Marston and Lee (1948) believe that copper does not have any great influence on iron absorption in ruminants. Underwood (1962) believes that the evidence on the role of copper in hemoglobin synthesis is very inadequate and that anemia should be explained on the basis of impaired erythrocyte maturation and a reduced survival time of the mature erythrocyte produced.

Rimington (1959) proposed a scheme for the biosynthesis of heme (Figure 1). Iodice et al. (1958) reported that anemia might be related to the lowering of δ-aminolevulinic acid dehydrase which contains 0.1% copper. Later Wilson et al. (1959) reported that the removal of copper did not affect this enzyme.

Drabkin (1951) reported that approximately 97-98%



Steps in heme biosynthesis (Taken from Rimington)

Figure 1

of an animal's iron requirement is supplied by catabolized hemoglobin. He reasoned that the requirement for iron is determined by the hemoglobin turnover rate and the amount of iron accumulated during growth. In 1955, Walsh et al., cited by Underwood (1962) reported that at puberty human males maintain higher hemoglobin values than do women; however, Byers et al. (1953) reported that this condition is not true in cattle.

Knoop et al. (1935) reported that calves on a milk diet were unthrifty, developed rough appearing hair, had very low hemoglobin values, and in some, swollen joints and stiffness appeared. Convulsions were seen in several animals at six months of age. Thomas et al. (1953) reported that calves fed a whole milk diet developed an anemia with significant minimal hemoglobin values occurring during the 30th to 70th days. With one group of calves there was a correlation between hemoglobin level and body weight gains. Raleigh and Wallace (1961) reported that range calves reached the minimal hemoglobin levels at approximately 105 days. They postulated that the minimal values this late in calfhood were due to a diet of low quality forage. Swenson et al. (1957) reported that calves showed minimal hemoglobin values beginning at 2 weeks and lasting until 8 weeks of age.

The data of Swenson et al. (1957) and Thomas et al. (1953) reveal a close correlation between body weight gains and hemoglobin values between the second and eighth week.

Raleigh reports that treatment with iron and copper had no significant effect on rate of gain. Carlson et al. (1961) reported that calves which received injectable iron showed better weight gains at 10 weeks of age but the weights were approximately the same as those of the non-medicated control animals at 24 weeks of age.

CHAPTER III

MATERIALS AND METHODS

A--Experimental Animals

Forty-five Holstein male and female calves, all less than 7 days of age, were obtained from dairy farmers in the Lansing area. Before experimentation, each calf was determined to be in good physical health on the basis of a clinical examination. The animals were housed in the Michigan State University dairy barn in individual pens on sawdust bedding throughout the study. Pens were constructed of plywood with metal bar doors covered with aluminum paint.

B--Experimental Procedures

Prior to experimentation, hemoglobin values were determined for each calf. These values served as the basis for dividing the calves into three experimental groups. Hemoglobin values were arranged in a linear fashion and a group was composed of fifteen calves selected from every third value. Group III received 500 mg. (10 ml.) of iron-dextran* intramuscularly at the 7th day of the experiment and again at the 21st day of the experiment. Calves were

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*Armidextran, Armour Pharmaceutical Company, Kankakee, Illinois.

injected deeply into the posterior groups of muscles of a rear leg. Group II received 30 mg. of iron sulfate powder* suspended in water, orally, each noon. Group I served as the control.

The feeding regime was the same for all calves. They were given whole milk at the level of 10% of body weight daily during this study. Milk allotments were adjusted weekly. Water was available at all times. Beginning at the tenth week of the experiment one pound of grain mixture** was given daily. Third cutting alfalfa hay of good quality was offered ad libitum beginning at the tenth week of the experiment. Calves were weighed weekly.

Clotted blood samples for serum extraction and whole blood samples for complete blood counts were collected once a week from the jugular vein. Dipotassium Ethylenedine Tetraacetate (E.D.T.A.P.)*** was used as the anticoagulant. Serum samples were transferred into chemically**** cleaned

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*Ferrous Sulfate (fine crystal) FE $So_4.7H_20$, Lot #3745. J. T. Baker Chemical Co., Phillipsburg, New Jersey.

**D-16 Grain Ration--762 1/2 lbs. ground shelled corn, 627 lbs. crimped oats, 200 lbs. linseed meal, 133 lbs. soy bean oil meal (44%), 100 lbs. corn distillers solubles, 133 lbs. dexmolasses, 20 lbs. dicalcium phosphate, 20 lbs. trace mineral salt, 3/4 lb. Vit. A and D, and 3/4 lb. Vit. D-9F.

***Dipotassium Ethylenedine Tetraacetate (E.D.T.A.P.). Cambridge Chemical Products, Inc., 5850 Chase Road, Dearborn, Michigan.

****Preparation of 100 gms. sodium dichromate in 200 cc. water plus 800 cc. of commercial sulfuric acid.

glass vials. Serum was stored by freezing within twenty-four hours after collection.

A Coulter Counter* was used for leukocyte and erythrocyte enumeration. Differential leukocyte counts, reticulocyte counts, hemoglobin (cyanmethemoglobin) and microhematcrit procedures were done according to the manual "Outline for Veterinary Clinical Pathology."** Serum iron levels were determined by the dipyridyl method of Ramsey (1962).***

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*Coulter Electronics, Inc., Hialeah, Florida.

**Maxine M. Benjamin, The Iowa State University Press, Ames, Iowa.

***Harold Varley, Practical Clinical Biochemistry, 3rd edition, Interscience Publishers, 1962, New York.

CHAPTER IV

RESULTS AND DISCUSSION

Prior to experimentation all calves were determined to be in good health on the basis of a physical examination. During the first three weeks of this study most calves developed pneumo-enteritis. Calves were treated for the condition with systemic antibiotics (1/2 gm. neomycin plus 1 million units of aqueous penicillin) and neomycin calf scours tablets (Biosol-M).* Whenever a scouring condition was diagnosed, milk allotments were reduced by one-half until cessation of scouring; then milk was gradually increased to the normal amount over a three-day period.

Because of the sporadic outbreaks of calf salmonellosis near the Lansing area, fecal samples were taken for bacteriologic culture. Calves were considered negative for salmonella on the basis of these cultures.

Body weights of the calves were recorded weekly. The three groups of calves showed weekly mean weights differing from each other in pattern. Calves receiving oral iron showed a pattern similar to calves receiving no iron, while calves injected with iron had mean body weights comparatively less the first 6 weeks and greater from the 8th

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*Upjohn Company, Kalamazoo, Michigan.

to the 12th week than those calves receiving oral iron. The mean body weights at the termination of the experiment were very close for the three groups of calves and nearly identical for the two groups receiving some form of iron. There was no significant difference in body weights among the three groups.

Table 1. Mean Body Weights of Calves, by Group

(pounds)

Week	Group I (No Iron)	Group II (Oral Iron)	Group III (Intramuscular Iron)
Initial	99.2 ± 3.98	96.7 ± 3.28	99.8 ± 3.14
1	104.9 ± 4.04	102.4 ± 3.51	104.0 ± 3.19
2	113.0 ± 4.28	113.6 ± 3.67	113.3 ± 3.30
3	123.8 ± 4.61	127.2 ± 3.76	125.0 ± 3.71
4	133.5 ± 4.71	140.6 ± 3.95	136.4 ± 3.92
5	144.7 ± 5.07	152.8 ± 4.22	148.3 ± 4.20
6	156.1 ± 5.16	164.8 ± 4.39	162.0 ± 4.48
7	169.8 ± 5.39	177.4 ± 4.75	177.3 ± 4.93
8	183.6 ± 5.58	189.6 ± 4.91	193.0 ± 5.32
9	195.4 ± 6.07	201.8 ± 5.81	206.3 ± 5.64
10	206.8 ± 6.36	213.4 ± 5.43	217.5 ± 6.05
11	217.6 ± 6.80	225.1 ± 5.77	227.9 ± 6.31
12	228.0 ± 7.06	237.0 ± 5.94	238.2 ± 6.64
13	240.4 ± 7.66	249.3 ± 6.36	248.5 ± 6.82

Average daily gains were calculated at the end of

each week and are presented in Table 2. All the groups of calves increased in average daily gain until about the 6th to 7th week when they tended to level off. Calves receiving iron showed faster daily weight gains than did calves receiving no iron. Raleigh (1962) reported that range calves receiving iron and exposed to forage showed greater weight gains from birth until 3 weeks and an increase in average daily gain until about 6 weeks when they leveled off.

Table 2. Average Daily Gain at Weekly Intervals, by Group (pounds)

7 days to	Group I (No Iron)	Group II (Oral Iron)	Group III (Intramuscular Iron)
2 wks	.82	.82	.61
3 wks	.99	1.20	.97
4 wks	1.17	1.45	1.20
5 wks	1.23	1.57	1.31
6 wks	1.30	1.60	1.39
7 wks	1.36	1.50	1.48
8 wks	1.44	1.65	1.58
9 wks	1.51	1.66	1.66
10 wks	1.53	1.67	1.69
11 wks	1.54	1.67	1.68
12 wks	1.54	1.67	1.66
13 wks	1.53	1.67	1.65
14 wks	1.55	1.68	1.63

A comparison was made within each group of calves between the average total weight gain and the hemoglobin (Hb.) level. Total weight gains of the seven calves with initial low hemoglobin values were compared with the seven calves that had high hemoglobin values. These data are presented in Table 3.

Table 3. Weight Gain in Comparison to Initial Hb. Level

(Pounds Per Day)

Groups of Calves	Hb. Level	1 wk. to 3 wk.	3 wk. to 6 wk.	6 wk. to 9 wk.	9 wk. to 12 wk.
*No Iron	High Hb.	1.24±.15	1.54±.53	1.90±.61	1.65±.59
	Low Hb.	1.07±.74	1.50±.49	1.82±.65	1.48±.64
**Oral Iron	High Hb.	1.57±.32[c]	1.85±.41[b]	1.80±.38	1.74±.21
	Low Hb.	1.37±.41	1.72±.41	1.76±.45	1.67±.47
***I.M. Iron	High Hb.	1.13±.41	1.66±.36	2.05±.51	1.46±.32
	Low Hb.	1.27±.51	1.85±.42[b]	2.14±.52[a]	1.61±.55

[a]Significantly greater than least value ($P < .05$).
[b]Significantly greater than least 2 values ($P < .05$).
[c]Significantly greater than least 2 values ($P < .01$).

Those calves having "high" hemoglobin values and receiving either no iron or oral iron had greater total

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*

No Iron	High Hb.	Calf Nos. 3, 5, 6, 15, 31, 41, and 45
	Low Hb.	Calf Nos. 1, 2, 14, 22, 33, 37, and 44

**

Oral Iron	High Hb.	Calf Nos. 4, 7, 10, 16, 18, 24, and 27
	Low Hb.	Calf Nos. 8, 12, 13, 19, 34, 35, and 38

***

I.M. Iron	High Hb.	Calf Nos. 21, 29, 30, 32, 36, 40, and 43
	Low Hb.	Calf Nos. 9, 11, 17, 25, 26, 39, and 42

weight gains than did the calves which had initial "low" hemoglobin values. Calves which had initial "low" hemoglobin values and received injectable iron had greater total weight gains than did calves which had initial "high" hemoglobin values. No explanation is offered for this phenomenon.

Blood samples were taken weekly for routine blood counts. The mean hemoglobin values are shown in Table 4. Hemoglobin values were significantly higher ($P < .01$) for the calves receiving oral and injectable iron when calves were 21 days old. The average initial hemoglobin value for all calves was 10.1 gm. per 100 ml. Raleigh and Wallace (1962) reported that range calves receiving iron reached minimal hemoglobin levels at about 105 days while Thomas et al. (1954) reported dairy calves showed a significant hemoglobin increase beginning at the 20th day and gradually increasing up to the termination at 41 days of age. The calves in this experiment varied from previously reported results. Animals in this study receiving no iron reached a minimal hemoglobin value at 91 days of age (termination of experiment). Calves receiving either oral or injectable iron showed a significant hemoblobin increase over the group of calves receiving no iron. Calves receiving oral iron reached maximum hemoglobin readings at approximately 28 days of age and then tended to level off.

Table 4. Mean Hemoglobin Values for the Three Groups of Calves

(Gm. per 100 Ml.)

Treatment	No Iron	Oral Iron	Intramuscular Iron
Age Days			
7	9.95 ± .50	10.12 ± .46	10.03 ± .44
14	9.66 ± .53	10.05 ± .44	9.91 ± .47
21	8.99 ± .47	10.16 ± .46**	9.83 ± .51**
28	8.51 ± .44	10.43 ± .45**	9.94 ± .48**
35	9.29 ± .47	10.47 ± .47**	9.93 ± .49**
42	8.79 ± .44	10.55 ± .47**	10.00 ± .44**
49	8.71 ± .42	10.57 ± .45**	10.30 ± .44**
56	8.60 ± .45	10.46 ± .43**	10.63 ± .45**
63	8.79 ± .49	10.45 ± .43**	10.63 ± .48**
70	8.79 ± .48	10.55 ± .43**	10.41 ± .43**
77	8.69 ± .43	10.47 ± .46**	10.32 ± .47**
84	8.56 ± .45	10.53 ± .46**	10.33 ± .46**
91	8.24 ± .43	10.46 ± .44**	10.45 ± .49**

** $P < .01$

Hubbert and Wallace (1959), using range calves, reported a decrease in packed cell volume (P.C.V.) values until calves reached the age of four weeks. Raleigh and Wallace (1962), studying range calves in the state of Oregon, found that P.C.V. values increased from birth to 3 weeks and at each blood sampling date thereafter. In the work presented here, calves showed a gradual increase in average P.C.V. values from 7 days of age until they were 35 days old. This difference was statistically significant ($P < 0.05$) from the fifth to eighth weeks for calves treated with oral iron and at the fifth, seventh and eighth weeks for calves treated with intramuscular iron. Average P.C.V. values are presented in Table 5.

Red blood cell enumeration was done with the aid of a Coulter counter. Average erythrocyte counts were not statistically different among the experimental groups. These data are presented in Table 6.

Mean corpuscular hemoglobin (M.C.H.) and mean corpuscular volume (M.C.V.) were calculated for each group of calves using the mean values found for hemoglobin, hematocrit and erythrocytes. The following formulas were used.

$$\text{M.C.H. (micro-micrograms)} = \frac{\text{Hb. (gm. per 1000 cc.)}}{\text{R.B.C. } (10^{12})}$$

$$\text{M.C.V. (cubic microns)} = \frac{\text{Volume packed cells per 1000 cc.}}{\text{R.B.C. } (10^{6})}$$

Table 5. Average Packed Cell Volume by Calf Group

P.C.V. (%)

Age Days	No Iron	Oral Iron	Intramuscular Iron
7	33.8 ± 1.4	34.3 ± 1.5	33.2 ± 1.3
14	33.9 ± 1.4	33.5 ± 1.4	33.2 ± 1.3
21	33.7 ± 1.3	34.7 ± 1.4	35.7 ± 1.5
28	33.5 ± 1.1	36.0 ± 1.3	37.3 ± 1.4
35	33.1 ± 1.2	38.2 ± 1.4*	38.5 ± 1.3*
42	34.0 ± 1.3	38.5 ± 1.5*	37.7 ± 1.3
49	33.7 ± 1.4	38.3 ± 1.5*	37.9 ± 1.3*
56	33.7 ± 1.4	37.9 ± 1.5*	37.7 ± 1.3*
63	34.4 ± 1.5	38.0 ± 1.5	36.7 ± 1.4
70	34.0 ± 1.3	38.7 ± 1.4	36.3 ± 1.2
77	33.7 ± 1.4	37.3 ± 1.6	36.5 ± 1.3
84	33.8 ± 1.3	37.9 ± 1.5*	36.1 ± 1.1
91	34.0 ± 1.3	37.8 ± 1.4	36.5 ± 1.0

* $P < .05$

Table 6. Mean Erythrocyte Values for Control and Iron Treated Calves

Age Days	(10^6 per mm.^{3}) No Iron	Oral Iron	Intramuscular Iron
7	8.07 ± .27	8.22 ± .33	8.58 ± .26
14	8.08 ± .26	8.24 ± .31	8.56 ± .24
21	8.12 ± .27	8.21 ± .31	8.58 ± .26
28	8.13 ± .29	8.18 ± .33	8.63 ± .27
35	8.09 ± .29	8.19 ± .31	8.54 ± .30
42	8.11 ± .29	8.27 ± .33	8.45 ± .27
49	8.16 ± .3	8.24 ± .3	8.48 ± .29
56	8.17 ± .3	8.27 ± .3	8.53 ± .24
63	8.20 ± .3	8.26 ± .3	8.51 ± .22
70	8.33 ± .3	8.27 ± .29	8.41 ± .30
77	8.30 ± 1.02	8.26 ± .33	8.72 ± .25
84	8.30 ± .3	8.22 ± .33	8.58 ± .27
91	8.32 ± .3	8.19 ± .33	8.60 ± .27

Calculated blood indices are given in Table 7. Mean corpuscular hemoglobin values decreased gradually in calves which received no iron. Calves treated with iron showed a very slight increase in M.C.H.; however, these values remained somewhat constant. Mean corpuscular volume values showed a gradual increase in calves treated with supplemental iron.

Table 7. Calculated Blood Indices by Calf Group

Age Days	M.C.H. (micro-micrograms) No Iron	Oral Iron	Im. Iron	M.C.V. (cubic microns) No Iron	Oral Iron	Im. Iron
7	12.32	12.31	11.68	41.9	41.8	38.8
14	11.95	12.19	11.57	41.9	40.6	38.8
21	11.07	12.37	11.45	41.5	42.3	41.6
28	10.46	12.75	11.51	41.2	44.0	43.2
35	11.48	12.78	11.62	40.9	46.6	45.1
42	10.83	12.75	11.83	41.9	46.6	44.7
49	10.67	12.82	12.14	41.3	46.5	44.7
56	10.52	12.64	12.46	41.2	45.8	44.2
63	10.71	12.65	12.49	42.0	46.0	43.2
70	10.55	12.75	12.37	40.8	46.7	43.1
77	10.46	12.67	11.83	40.6	45.1	41.9
84	10.31	12.81	12.03	40.7	46.1	42.1
91	9.90	12.77	12.15	40.9	46.2	42.5

The percentage of reticulocytes observed was increased in the calves which received iron. Calves receiving oral iron showed a somewhat gradual and uniform increase over calves receiving no iron. The calves receiving intramuscular iron showed a definite increase in reticulocyte percentage from the 2nd to 5th weeks which was immediately after the iron injections. Table 8 and Figure 1 summarize the reticulocyte findings.

Table 8. Average Reticulocyte Values for the Three Groups of Calves

Age Days	Number Per 100 Erythrocytes		
	No Iron	Oral Iron	Intramuscular Iron
7	0.7	1.0	.7
14	0.8	1.2	8.0
21	0.5	1.3	4.4
28	0.6	1.4	5.2
35	0.4	1.5	1.2
42	0.5	1.3	.4
49	0.5	1.6	.4
56	0.4	1.2	.24
63	0.4	1.1	.2
70	0.4	1.1	.33
77	0.5	1.3	.28
84	0.4	1.1	.3
91	0.4	1.3	.28

Mean values for serum iron content are presented in Table 9. Planas and DeCastro (1960) found serum iron levels for adult cattle to be 142.4 $\pm$ 22.1 micrograms with a range of 95-224 μgm. per 100 ml. The results of this study differ somewhat from the values established for the adult.

Reticulocyte Response from Iron Treatment,
for the Three Groups of Calves

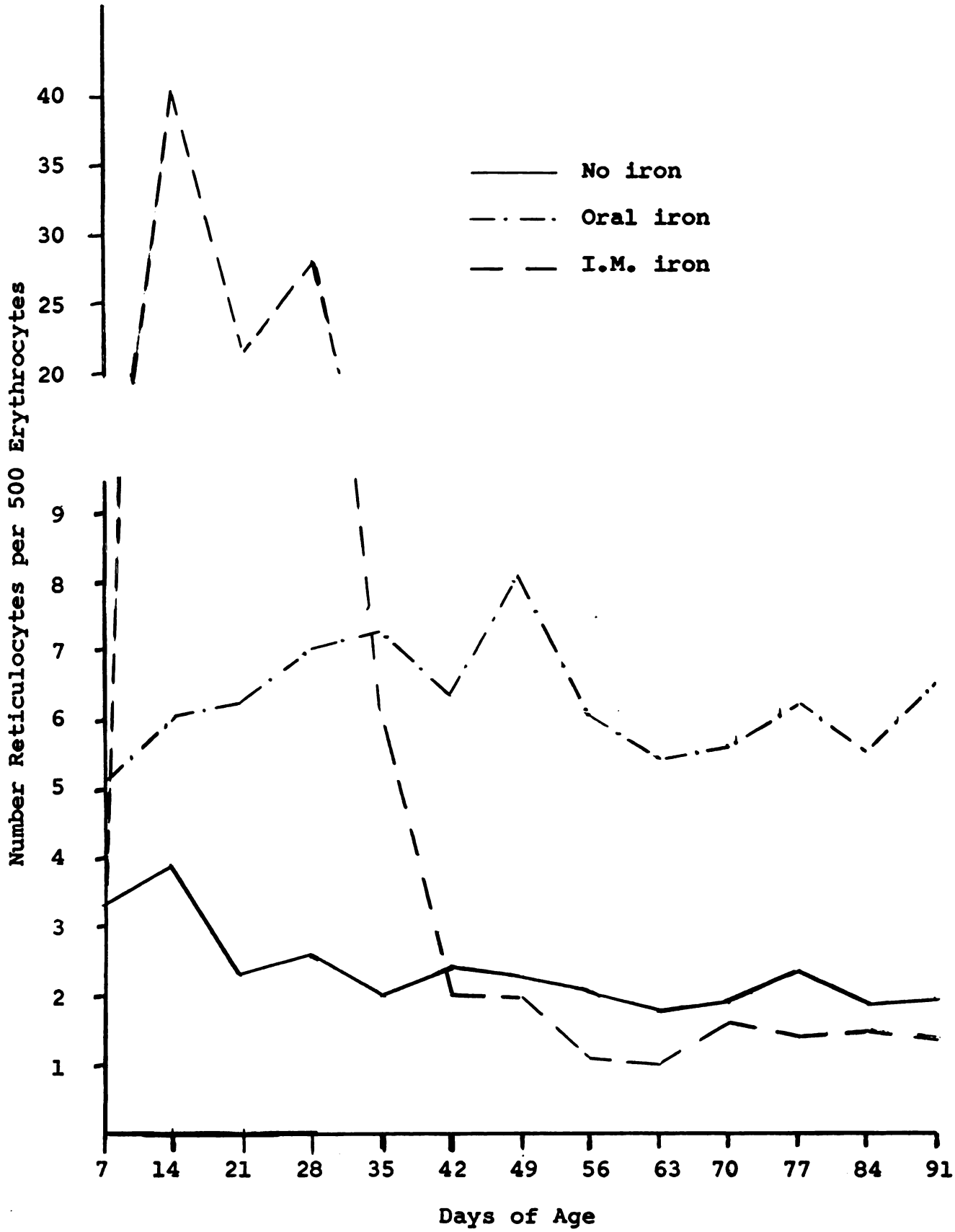

Table 9. Mean Serum Iron Values by Calf Group

(µgm. Per 100 Ml.)

Age Days	No Iron	Oral Iron	Intramuscular Iron
7	96.1 ± 6.8	96.8 ± 6.0	97.8 ± 8.8
14	92.1 ± 7.0	123.7 ± 6.5**	149.0 ± 8.0**
21	93.1 ± 7.8	149.8 ± 5.1**	194.3 ± 8.8**
28	94.1 ± 6.9	149.0 ± 6.0**	198.9 ± 7.5**
35	92.3 ± 7.2	146.5 ± 6.0**	198.7 ± 7.3**
42	96.5 ± 7.0	148.8 ± 5.4**	193.6 ± 8.1**
49	95.7 ± 6.8	152.2 ± 7.0**	200.8 ± 7.2**
56	97.6 ± 7.5	152.3 ± 6.7**	199.5 ± 8.5**
63	95.5 ± 7.1	154.7 ± 6.4**	204.7 ± 9.8**
70	101.5 ± 7.0	155.7 ± 6.2**	195.5 ± 9.4**
77	97.9 ± 7.1	153.9 ± 5.9**	188.1 ± 10.1**
84	103.0 ± 7.6	158.1 ± 6.5**	192.8 ± 10.2**
91	99.4 ± 7.5	156.2 ± 6.3**	186.3 ± 8.9**

** $P < .01$

A significant difference was seen in serum iron levels immediately after the initial iron treatment. Serum iron levels remained constant for calves which received no iron throughout the experiment.

Leukocyte enumeration and differential counting was performed weekly throughout this experiment. These data are presented in the appendix. Values from leukocyte studies were essentially normal. Iron administration had no apparent effect on either the total or differential leukocyte counts; however, this determination was valuable from the standpoint of evaluating the health status of the calves.

V. CONCLUSIONS

1. Calves which received iron showed no statistically significant difference in body weight gains when compared to calves receiving no iron.
2. A difference in total weight gains was seen depending on the iron treatment. The group of calves which received oral iron and had higher hemoglobin values had greater total weight gains while the calves which received intramuscular iron and had low hemoglobin levels had greater total weight gains.
3. Calves which received iron supplement, either oral or intramuscular, showed statistically significant increases in hemoglobin levels and packed cell volumes as compared to calves receiving no iron.
4. Iron supplement, either oral or intramuscular, quickly raised and maintained serum iron levels to a significantly higher level in the young calf in this study.
5. A gradual and uniform increase in reticulocyte response was observed in the calves which received oral iron.
6. Calves receiving injectable iron exhibited a rapid and marked increase in reticulocytes which was sustained, however, only during the treatment period.
7. The physiological anemia, characteristic of most mammals, was not observed in calves on a whole milk diet when an iron supplement was employed.

APPENDIX

TABLE 1. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 1

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												121
7	114	33	9.1	7.79	7	13.1	38	62	0	0	0	130
14	115	34	8.6	7.83	4	11.6	43	53	0	4	0	143
21	119	33	7.8	7.73	5	8.4	27	70	0	2	1	159
28	108	34	7.2	7.88	8	9.3	37	63	0	0	0	171
35	110	33	8.4	7.85	0	7.6	46	53	0	1	0	185
42	125	32	7.0	7.77	0	7.4	41	55	1	3	0	199
49	114	32	7.4	7.70	8	7.8	39	59	0	2	0	214
56	118	32	7.2	7.65	0	7.9	28	71	0	1	0	227
63	110	33	7.6	7.72	2	8.1	35	60	0	5	0	242
70	109	32	7.0	7.80	0	7.4	39	61	0	0	0	255
77	121	32	8.2	7.73	3	7.2	33	67	0	0	0	269
84	117	33	7.4	7.88	1	7.3	41	57	0	2	0	283
91	118	31	7.1	7.91	5	7.2	47	51	0	2	0	299

TABLE 2. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 2

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												88
7	68	32	9.0	7.96	7	11.6	58	42	0	0	0	98
14	60	33	9.0	8.05	0	13.5	51	39	0	0	0	107
21	57	32	8.4	8.24	1	14.2	32	68	0	0	0	118
28	66	33	7.8	8.37	14	10.8	47	51	1	1	0	129
35	58	33	8.6	7.79	0	12.7	43	66	1	0	0	141
42	61	33	8.4	7.87	0	8.3	40	57	1	2	0	155
49	72	33	8.0	7.96	0	5.4	51	49	0	0	0	171
56	77	32	7.8	7.90	0	6.2	47	52	0	0	1	186
63	73	31	8.2	8.05	2	6.8	38	59	0	3	0	200
70	70	33	8.6	8.11	9	6.8	40	60	0	0	0	215
77	71	33	8.0	8.07	1	8.3	37	63	0	0	0	229
84	79	32	8.0	8.12	4	9.1	52	47	1	0	0	238
91	74	32	8.2	7.99	0	8.1	43	67	0	1	0	250

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 3. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 3

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												115
7	141	35	10.1	8.53	0	14.0	41	58	0	1	0	121
14	138	35	10.0	8.49	3	17.2	38	62	0	0	0	130
21	144	35	9.8	8.52	2	16.1	44	56	0	0	0	143
28	151	34	9.0	8.62	2	11.6	50	50	0	0	0	158
35	150	34	9.4	8.77	0	9.8	48	52	0	0	0	174
42	154	34	9.2	8.66	3	10.4	46	54	0	0	0	187
49	139	33	9.2	8.52	0	5.7	39	61	0	0	0	203
56	141	34	9.2	8.56	5	8.1	37	63	0	0	0	220
63	140	35	9.0	8.62	1	9.4	44	56	0	0	0	237
70	145	34	8.6	8.51	0	8.5	51	49	0	0	0	252
77	147	34	9.4	8.56	8	8.0	54	45	0	1	0	266
84	161	34	9.0	8.69	5	8.6	47	53	0	0	0	283
91	152	33	8.9	8.74	0	7.1	38	62	0	0	0	301

TABLE 4. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 4

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												75
7	98	37	11.4	9.22	1	8.9	37	63	0	0	0	79
14	127	37	11.8	9.14	12	11.8	22	78	0	0	0	89
21	148	39	11.6	9.08	3	7.4	39	61	0	0	0	107
28	151	41	12.2	8.97	1	8.2	28	72	0	0	0	123
35	146	44	12.4	9.06	2	13.0	23	77	0	0	0	138
42	159	43	12.6	9.15	6	9.1	25	75	0	0	0	150
49	150	43	12.0	9.22	0	8.6	31	69	0	0	0	163
56	162	41	11.6	9.19	3	8.5	37	63	0	0	0	176
63	171	42	11.8	9.17	5	8.0	35	65	0	0	0	190
70	158	43	12.0	9.25	4	9.1	30	69	0	1	0	201
77	162	42	11.6	9.03	0	8.3	38	62	0	0	0	213
84	163	44	11.8	9.11	4	9.9	39	60	0	1	0	227
91	168	42	11.8	9.23	8	10.4	42	58	0	0	0	240

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 5. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 5

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												98
7	90	37	11.1	9.10	1	6.3	40	60	0	0	0	106
14	84	37	12.2	9.04	0	5.8	44	56	0	0	0	115
21	96	36	9.8	9.03	9	8.6	41	59	0	0	0	126
28	78	37	9.4	8.95	0	12.1	52	48	0	0	0	134
35	81	38	11.0	9.08	0	9.2	58	42	0	0	0	144
42	84	39	10.2	9.11	2	8.7	50	50	0	0	0	154
49	92	39	10.4	9.17	1	10.1	46	47	2	5	0	165
56	96	37	9.6	9.12	0	6.8	48	49	1	2	0	177
63	99	37	10.4	8.91	4	9.4	39	60	1	0	0	186
70	106	39	10.6	8.93	0	10.1	47	51	2	0	0	200
77	95	37	10.0	9.00	1	6.7	44	55	1	0	0	214
84	98	37	10.0	9.12	0	8.9	44	55	0	1	0	226
91	109	36	9.5	9.14	1	8.1	44	59	1	0	0	240

TABLE 6. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 6

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												84
7	90	36	9.5	8.55	2	7.8	37	63	0	0	0	90
14	92	36	9.2	8.62	2	8.3	47	53	0	0	0	99
21	100	36	8.0	8.67	0	9.4	41	57	0	2	0	107
28	97	36	7.8	8.63	4	13.3	39	58	0	3	0	116
35	98	36	9.5	8.48	1	14.2	54	44	0	2	0	124
42	103	37	8.6	8.52	0	11.7	46	52	0	2	0	134
49	99	36	8.0	8.55	0	10.8	48	50	0	2	0	146
56	109	37	8.1	8.69	7	11.0	46	53	0	1	0	157
63	96	37	8.0	8.62	2	9.7	39	61	0	0	0	168
70	115	36	8.4	8.58	0	8.7	43	53	0	0	0	180
77	98	36	8.0	8.44	4	9.3	44	54	0	2	0	189
84	111	37	8.0	8.	0	9.5	40	57	0	3	0	203
91	104	37	7.5	8.49	3	10.4	48	50	0	2	0	215

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 7. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 7

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												93
7	90	38	11.7	9.18	2	7.8	49	51	0	0	0	97
14	112	37	11.4	9.23	11	12.4	56	44	0	0	0	109
21	151	37	11.8	9.21	0	8.2	62	38	0	0	0	124
28	148	38	12.3	9.06	4	9.4	47	52	0	1	0	137
35	139	39	12.6	9.10	6	9.2	47	53	0	0	0	150
42	146	42	12.8	9.33	6	9.4	45	55	0	0	0	161
49	141	44	12.6	9.06	8	9.6	49	51	0	0	0	175
56	144	41	12.1	9.11	2	7.2	38	60	0	0	2	187
63	154	42	12.2	8.85	5	8.4	40	58	0	2	0	197
70	150	42	12.4	8.67	2	9.8	39	57	0	4	0	209
77	153	41	12.2	9.23	6	9.9	37	63	0	0	0	218
84	161	41	12.6	9.25	16	10.4	47	51	0	2	0	232
91	152	40	12.1	9.34	7	8.3	50	50	0	0	0	244

TABLE 8. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 8

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												99
7	111	31	8.6	7.95	4	11.1	53	47	0	0	0	102
14	139	31	8.6	8.30	9	12.6	51	49	0	0	0	110
21	171	33	8.6	8.38	9	9.4	49	50	0	1	0	121
28	160	35	9.0	8.24	15	9.4	49	50	0	1	0	131
35	161	36	8.8	8.41	0	10.1	46	53	0	1	0	140
42	159	34	9.0	8.46	7	11.4	39	61	0	0	0	151
49	181	35	9.4	8.10	12	8.9	33	66	0	1	0	163
56	170	35	9.2	8.21	11	9.0	38	62	0	0	0	173
63	172	35	9.2	8.25	7	10.2	40	58	0	2	0	185
70	168	35	9.4	8.39	13	7.8	47	53	0	0	0	195
77	169	34	9.0	8.32	7	9.4	39	61	0	0	0	206
84	176	34	9.8	8.37	10	10.0	40	60	0	0	0	215
91	161	33	9.8	8.30	2	9.7	40	60	0	0	0	225

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 9. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 9

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												110
7	110	24	7.5	7.56	2	8.4	38	62	0	0	0	118
14	154	28	7.4	7.28	32	5.3	36	64	0	0	0	131
21	198	27	7.2	7.31	29	4.8	43	57	0	0	0	146
28	206	29	7.3	7.40	30	8.9	40	59	0	1	0	160
35	198	31	7.4	6.96	9	10.2	42	58	0	0	0	173
42	197	29	8.0	7.20	4	7.8	39	61	0	0	0	189
49	211	29	8.2	7.72	2	8.6	37	60	0	3	0	207
56	205	30	8.1	7.28	1	8.8	40	60	0	0	0	224
63	202	28	8.0	7.44	0	9.0	48	49	0	2	1	240
70	183	29	8.2	7.93	0	10.1	46	54	0	0	0	254
77	195	29	8.0	8.44	2	9.6	42	58	0	0	0	266
84	197	30	7.8	8.27	1	7.3	47	53	0	0	0	280
91	192	30	7.7	7.22	0	8.2	48	51	0	1	0	294

TABLE 10. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 10

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												108
7	86	40	11.7	9.26	10	7.1	62	38	0	0	0	116
14	104	40	11.4	9.36	7	6.7	57	43	0	0	0	127
21	140	41	11.8	9.30	7	12.2	68	32	0	0	0	141
28	131	43	12.0	9.18	9	8.4	59	39	0	2	0	154
35	138	44	12.0	9.41	12	9.3	53	46	0	1	0	165
42	135	44	12.0	9.48	14	14.1	56	43	0	1	0	179
49	146	42	12.0	9.50	8	8.2	55	41	0	4	0	193
56	131	42	11.8	9.06	8	9.4	60	40	0	0	0	207
63	140	42	11.6	9.23	6	10.1	59	39	0	2	0	221
70	139	43	12.0	9.36	6	8.2	61	37	0	2	0	234
77	146	43	12.2	9.47	5	7.4	56	44	0	0	0	246
84	148	43	11.6	9.12	4	6.9	52	45	0	3	0	256
91	151	44	11.9	9.32	0	8.0	60	40	0	0	0	271

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 11. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 11

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												105
7	82	25	6.2	7.68	3	8.5	52	48	0	0	0	104
14	148	23	6.4	7.51	54	9.3	56	44	0	0	0	112
21	173	24	6.0	7.56	28	7.6	39	61	0	0	0	123
28	189	27	6.6	7.28	24	14.8	40	59	0	1	0	135
35	188	28	6.4	7.32	5	9.9	45	55	0	0	0	146
42	178	28	6.6	7.47	5	10.6	40	60	0	0	0	158
49	197	30	6.8	7.33	4	11.7	38	62	0	0	0	172
56	179	29	7.4	7.71	2	9.3	42	57	0	0	1	187
63	201	28	7.1	7.	3	15.3	44	56	0	0	0	197
70	190	28	7.3	7.15	2	14.3	37	61	0	2	0	199
77	188	28	7.0	7.71	2	10.2	40	60	0	0	0	211
84	180	30	7.2	6.98	2	9.6	42	58	0	0	0	220
91	174	29	6.7	7.31	3	12.1	45	55	0	0	0	228

TABLE 12. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 12

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												92
7	96	30	7.8	5.82	12	9.5	61	39	0	0	0	96
14	126	29	7.6	6.30	0	12.1	65	35	0	0	0	109
21	139	30	7.6	6.06	10	18.2	63	37	0	0	0	124
28	143	31	7.6	5.88	13	9.4	66	43	0	1	0	138
35	152	34	7.6	6.04	8	10.1	65	35	0	0	0	150
42	152	34	7.8	5.93	7	9.8	59	40	0	1	0	164
49	158	34	7.6	6.30	9	10.9	61	38	0	1	0	181
56	161	32	8.0	6.18	10	9.6	58	40	0	2	0	193
63	171	30	7.8	6.08	8	12.2	60	39	0	1	0	207
70	182	32	8.0	6.26	11	11.8	55	44	0	1	0	220
77	158	34	8.0	6.07	17	13.2	58	41	1	0	0	235
84	163	33	8.0	6.17	3	9.8	56	43	0	1	0	247
91	160	33	8.1	6.06	11	12.1	59	40	1	0	0	261

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 13. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 13

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												96
7	101	33	9.8	8.02	1	7.6	61	39	0	0	0	101
14	136	32	9.6	7.96	13	5.4	59	41	0	0	0	110
21	152	35	9.8	7.85	12	6.1	63	37	0	0	0	125
28	153	35	10.0	7.88	8	7.8	50	50	0	0	0	138
35	163	39	9.8	8.03	13	6.4	64	36	0	0	0	148
42	150	37	10.2	8.10	2	6.8	57	63	0	0	0	162
49	157	37	10.2	7.93	14	8.4	56	44	0	0	0	174
56	141	37	10.0	7.83	2	9.3	52	48	0	0	0	185
63	155	38	9.8	8.07	9	7.8	53	47	0	0	0	196
70	157	38	10.4	8.31	10	6.1	49	51	0	0	0	206
77	150	35	10.6	8.12	7	9.6	61	39	0	0	0	218
84	146	35	10.6	7.88	8	8.3	57	42	0	1	0	230
91	148	37	10.8	7.96	8	9.4	56	44	0	0	0	242

TABLE 14. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 14

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												113
7	92	25	6.8	6.40	0	11.4	69	31	0	0	0	113
14	81	25	5.8	6.48	1	14.9	64	36	0	0	0	117
21	80	25	6.4	6.53	2	13.1	59	41	0	0	0	124
28	94	26	6.0	6.47	2	9.6	67	33	0	0	0	130
35	72	25	6.2	6.63	9	12.4	62	38	0	0	0	138
42	88	26	6.2	6.71	1	11.7	70	29	0	1	0	145
49	79	26	6.2	6.88	7	9.8	59	40	0	1	0	153
56	76	26	6.0	6.55	0	12.1	56	41	0	3	0	161
63	70	27	5.8	6.58	5	11.4	53	45	0	2	0	169
70	88	26	6.2	7.20	1	8.3	57	40	1	2	0	175
77	93	25	6.2	6.57	6	9.1	60	39	0	1	0	182
84	90	26	6.0	6.61	2	10.9	58	40	0	2	0	189
91	91	26	5.8	6.53	0		64	33	0	3	0	198

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 15. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 15

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												76
7	129	39	11.5	9.33	10	9.8	65	35	0	0	0	82
14	135	39	11.0	9.27	18	9.6	68	32	0	0	0	91
21	138	39	10.6	9.36	5	8.5	67	33	0	0	0	104
28	126	37	9.6	9.44	0	8.3	62	38	0	0	0	116
35	131	36	11.8	9.51	0	11.3	58	41	0	0	1	129
42	128	38	10.4	9.33	9	10.1	63	37	0	0	0	142
49	141	38	10.0	9.40	0	9.6	57	43	0	0	0	157
56	139	39	10.0	9.51	1	9.4	58	42	0	0	0	171
63	137	40	10.8	9.45	3	9.0	59	41	0	0	0	184
70	141	39	10.4	10.40	0	7.8	60	40	0	0	0	197
77	130	39	9.8	10.02	5	8.8	59	41	0	0	0	207
84	140	40	9.5	9.92	5	9.4	57	43	0	0	0	221
91	144	40	9.0	9.97	3	10.1	63	37	0	0	0	234

TABLE 16. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 16

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												87
7	99	42	13.0	9.69	8	7.8	56	44	0	0	0	93
14	136	41	13.0	9.80	3	12.6	62	37	0	1	0	102
21	160	42	12.8	9.77	10	9.3	55	45	0	0	0	113
28	153		13.4	9.87	0	14.1	50	50	0	0	0	126
35	144	46	13.2	9.83	8	13.3	46	52	0	2	0	137
42	154	45	13.6	9.96	10	10.9	43	54	0	1	2	146
49	168	47	14.0	9.80	7	7.8	53	41	1	0	3	155
56	167	46	13.8	9.92	11	12.1	54	44	2	0	0	167
63	148	45	13.8	10.07	14	8.4	55	43	0	2	0	174
70	149	47	13.4	9.79	5	9.3	59	41	0	0	0	185
77	151	45	13.6	9.84	4	11.1	58	40	0	0	2	195
84	163	47	13.8	9.97	0	9.3	63	37	0	0	0	207
91	161	46	13.6	9.73	14	10.4	58	39	0	3	0	218

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 17. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 17

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												107
7	60	28	10.2	8.85	5	14.2	61	39	0	0	0	110
14	121	26	10.0	9.25	48	12.4	45	55	0	0	0	118
21	168	32	9.6	9.42	22	9.0	58	41	0	1	0	130
28	165	33	10.0	9.29	41	8.1	39	60	0	1	0	141
35	176	35	10.4	9.21	5	7.6	42	58	0	0	0	154
42	163	35	10.8	9.19	2	5.4	42	55	1	0	2	166
49	170	35	10.8	9.36	4	9.4	45	55	0	0	0	182
56	174	34	11.0	8.97	0	8.6	46	51	1	2	0	197
63	183	33	11.0	9.25	1	12.1	48	48	1	0	3	211
70	158	33	11.0	9.34	3	10.8	53	47	0	0	0	227
77	159	29	10.6	9.53	0	7.8	47	49	0	4	0	232
84	179	33	10.6	9.12	0	9.5	46	53	0	0	1	240
91	163	33	10.8	8.97	0	10.3	49	51	0	0	0	251

TABLE 18. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 18

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												107
7	91	35	10.4	8.58	0	8.4	63	37	0	0	0	114
14	116	34	10.6	8.69	5	9.6	60	39	0	1	0	127
21	151	36	10.2	8.81	10	10.8	70	29	0	1	0	142
28	148	37	9.8	8.60	14	9.5	73	27	0	0	0	159
35	149	40	9.8	8.59	7	9.0	70	29	0	1	0	175
42	153	39	10.0	8.46	0	9.8	57	41	1	0	1	187
49	147	38	10.0	8.69	6	7.3	58	40	2	0	0	201
56	144	39	10.0	8.75	0	8.1	62	38	0	0	0	215
63	153	41	10.4	8.67	5	9.8	63	37	0	0	0	227
70	143	39	9.8	8.63	9	12.1	58	41	1	0	0	241
77	162	39	9.0	9.08	4	9.6	59	39	0	2	0	255
84	162	38	9.4	8.96	6	10.4	64	36	0	0	0	268
91	171	38	9.0	8.79	7	11.1	61	38	0	0	1	282

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 19. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 19

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												91
7	102	34	10.1	8.24	4	5.6	62	38	0	0	0	98
14	133	33	9.6	8.11	10	8.1	64	36	0	0	0	107
21	154	35	9.6	8.10	1	8.6	58	41	0	0	1	119
28	162	36	9.9	8.11	9	10.4	55	44	1	0	0	128
35	151	38	9.8	8.30	5	11.3	63	37	0	0	0	140
42	151	39	9.8	8.38	12	9.8	65	33	0	2	0	150
49	169	38	10.0	8.25	7	8.4	59	41	0	0	0	159
56	163	38	10.3	8.19	5	12.6	58	42	0	0	0	171
63	150	38	10.2	8.16	8	9.4	52	44	0	1	3	183
70	168	38	10.4	8.25	3	8.4	58	41	1	0	0	195
77	161	36	9.8	8.12	4	7.8	65	35	0	0	0	206
84	164	36	10.0	8.25	9	9.3	58	39	0	3	0	217
91	166	37	9.7	8.19	0	10.3	61	38	0	1	0	226

TABLE 20. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 20

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												92
7	56	30	10.1	8.96	6	9.8	72	28	0	0	0	93
14	108	32	10.2	8.84	44	10.1	70	29	0	1	0	104
21	135	30	9.5	8.88	34	9.6	73	76	0	1	0	117
28	160	33	10.3	9.08	21	9.9	91	9	0	0	0	129
35	157	35	9.6	9.06	4	9.8	88	11	1	0	0	140
42	141	34	10.1	9.02	0	11.7	68	31	0	1	0	156
49	161	34	10.4	8.91	2	10.3	73	25	0	2	0	173
56	158	33	10.5	9.04	0	8.2	69	28	2	0	1	190
63	137	34	10.7	8.77	1	7.9	70	28	0	2	0	204
70	144	32	10.5	9.18	0	10.6	72	27	0	1	0	216
77	124	34	10.0	9.25	1	8.4	68	31	0	1	0	225
84	133	31	9.8	8.79	2	9.3	66	33	0	1	0	233
91	123	33	10.5	8.69	2	8.1	69	30	0	1	0	240

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 21. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 21

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												108
7	75	31	9.8	10.49	0	12.3	72	28	0	0	0	115
14	131	32	10.2	9.71	37	9.0	59	41	0	0	0	125
21	166	36	10.6	9.97	9	8.7	75	25	0	0	0	142
28	183	37	9.6	9.87	28	8.9	56	44	0	0	0	153
35	174	41	9.8	10.40	31	14.0	64	36	0	0	0	167
42	165	42	10.0	10.27	2	13.3	61	39	0	0	0	184
49	183	40	10.8	10.33	0	9.6	57	43	0	0	0	204
56	165	36	11.2	9.53	0	8.9	53	47	0	0	0	222
63	179	37	11.6	9.60	0	10.6	51	48	0	1	0	238
70	163	36	11.0	10.12	5	7.8	49	51	0	0	0	250
77	156	36	11.2	10.49	0	11.2	60	40	0	0	0	263
84	160	36	11.2	9.96	0	9.3	56	43	0	1	0	275
91	170	35	11.0	10.23	3	9.6	62	37	0	1	0	287

TABLE 22. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 22

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												96
7	104	28	7.2	7.02	5	8.4	61	39	0	0	0	99
14	94	27	6.8	6.94	0	10.1	70	30	0	0	0	105
21	102	28	6.0	6.85	1	7.4	57	43	0	0	0	113
28	96	28	6.4	6.87	0	8.3	68	32	0	0	0	122
35	101	28	6.6	7.00	1	9.6	58	42	0	0	0	132
42	93	28	6.6	7.12	4	7.9	67	33	0	0	0	141
49	82	27	6.8	7.19	0	11.4	59	41	0	0	0	152
56	96	28	6.4	7.27	1	9.6	64	34	0	2	0	163
63	100	28	6.4	7.20	0	10.8	59	40	1	0	0	172
70	96	28	6.2	7.31	4	6.5	70	29	0	1	0	183
77	93	27	6.2	7.33	1	8.4	62	38	0	0	0	191
84	101	27	6.2	7.36	0	9.3	57	43	0	0	0	205
91	89	27	5.8	7.40	1	10.9	60	39	1	0	0	217

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 23. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 23

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												116
7	73	34	9.8	8.67	7	8.7	70	30	0	0	0	122
14	68	34	9.4	8.73	5	8.9	67	33	0	0	0	132
21	68	34	9.2	8.78	2	10.6	62	38	0	0	0	145
28	69	34	9.2	8.71	7	7.8	59	41	0	0	0	154
35	74	34	9.4	8.52	8	11.3	54	44	0	2	0	167
42	80	35	9.4	8.66	1	9.4	53	47	0	0	0	178
49	72	34	9.0	8.81	2	10.6	63	36	0	0	1	193
56	69	34	9.2	8.97	8	10.2	59	41	0	0	0	207
63	80	34	9.0	8.91	3	9.8	57	39	0	4	0	222
70	89	34	9.4	9.14	2	7.9	55	43	0	2	0	234
77	82	31	8.4	9.22	0	9.3	59	41	0	0	0	246
84	86	31	8.8	9.15	4	9.6	55	44	0	0	1	251
91	88	34	8.6	9.10	1	9.6	47	50	0	3	0	266

TABLE 24. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 24

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												121
7	106	36	10.4	9.21	4	7.6	54	45	0	1	0	131
14	133	36	10.0	8.71	4	8.4	55	45	0	0	0	142
21	149	35	10.4	8.48	0	10.3	48	51	0	1	0	157
28	163	36	10.0	8.93	13	9.4	53	47	0	0	0	171
35	168	38	10.2	8.75	4	6.8	52	48	0	0	0	185
42	163	41	10.2	8.71	12	5.4	47	53	0	0	0	199
49	148	39	10.2	8.79	4	9.6	60	40	0	0	0	212
56	159	40	10.4	8.84	0	12.3	57	41	0	2	0	224
63	151	40	10.2	8.59	2	8.4	44	55	0	1	0	238
70	162	41	10.4	8.95	0	9.4	57	43	0	0	0	250
77	149	37	10.8	9.17	3	10.3	51	49	0	0	0	262
84	167	39	10.4	9.03	2	9.1	54	46	0	0	0	276
91	154	39	10.2	8.86	8	7.5	53	47	0	0	0	289

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
- N = Neutrophil (%)
- L = Lymphocyte (%)
- M = Monocyte (%)
- E = Eosinophil (%)
- B = Basophil (%)

B.W. = Body weight (pounds)

TABLE 25. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 25

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												99
7	79	32	7.2	8.15	1	12.4	62	38	0	0	0	103
14	148	31	7.0	8.03	24	14.2	57	43	0	0	0	114
21	187	33	6.8	7.85	18	16.8	59	37	1	2	1	128
28	188	34	7.0	8.00	30	15.4	72	28	0	0	0	143
35	193	36	7.0	7.87	8	13.6	59	41	0	0	0	158
42	210	37	7.2	7.53	0	14.7	60	37	0	3	0	171
49	206	35	7.2	7.02	1	10.3	58	39	1	0	2	186
56	211	37	7.6	7.26	2	12.1	71	29	0	0	0	204
63	214	35	7.4	7.92	0	11.7	58	42	0	0	0	220
70	213	37	7.6	6.95	2	9.8	60	37	0	3	0	235
77	201	36	7.0	7.48	0	10.6	56	44	0	0	0	248
84	257	33	7.2	7.81	4	11.4	59	39	1	1	0	262
91	192	37	7.6	8.08	1	11.8	59	41	0	0	0	275

TABLE 26. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 26

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												104
7	143	33	8.5	6.47	8	9.8	62	38	0	0	0	112
14	211	34	8.2	6.67	41	7.2	53	47	0	0	0	122
21	236	38	8.6	6.63	15	13.1	60	39	0	1	0	136
28	249	39	8.3	6.55	19	12.6	60	40	0	0	0	150
35	254	40	8.4	6.30	6	9.8	56	44	0	0	0	165
42	240	39	8.4	6.73	4	11.1	58	41	0	1	0	181
49	256	37	8.8	6.44	2	11.0	57	43	0	0	0	196
56	260	38	9.1	6.64	3	12.1	60	40	0	0	0	215
63	268	33	8.8	7.19	2	9.3	63	37	0	0	0	230
70	249	37	9.2	6.38	0	9.4	57	43	0	0	0	243
77	246	36	8.8	6.66	3	8.6	65	35	0	0	0	256
84	252	37	8.8	6.32	2	11.7	60	38	0	2	0	266
91	238	37	8.9	6.71	0	13.1	68	30	0	2	0	276

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 27. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 27

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												99
7	54	44	13.0	10.13	5	8.6	59	41	0	0	0	112
14	72	41	12.8	9.90	4	14.1	52	47	0	1	0	125
21	106	43	13.4	10.02	14	11.8	71	29	0	0	0	137
28	104	44	13.2	10.06	5	8.0	80	20	0	0	0	150
35	99	47	13.6	9.51	21	7.9	61	39	0	0	0	163
42	118	48	13.2	9.76	1	9.4	52	47	0	1	0	174
49	101	47	13.0	9.64	10	8.6	56	44	0	0	0	187
56	109	47	13.0	9.80	9	10.2	63	36	0	1	0	198
63	103	46	12.6	9.93	7	12.3	59	41	0	0	0	213
70	117	47	13.0	9.71	15	11.4	66	33	1	0	0	226
77	105	48	13.4	9.69	7	8.6	56	43	0	1	0	239
84	112	48	13.6	9.67	5	10.1	58	42	0	0	0	250
91	108	46	13.2	9.58	10	11.4	60	40	0	0	0	264

TABLE 28. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 28

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												118
7	138	34	9.8	7.97	0	12.3	69	31	0	0	0	115
14	160	32	9.6	8.05	4	14.2	67	33	0	0	0	130
21	174	33	10.0	8.13	6	16.6	62	38	0	0	0	143
28	176	34	10.4	8.37	0	15.5	63	37	0	0	0	158
35	171	36	10.2	8.21	7	14.7	56	44	0	0	0	170
42	169	38	10.2	8.34	3	17.3	56	42	1	0	2	179
49	191	37	10.2	8.39	6	14.8	54	46	0	0	0	189
56	186	38	10.4	8.52	13	11.7	58	41	0	0	1	201
63	182	38	10.4	8.60	5	12.4	55	43	0	0	2	212
70	189	39	10.0	8.16	2	10.8	56	44	0	0	0	220
77	180	38	10.0	8.07	9	13.2	59	37	0	1	3	229
84	192	38	9.6	8.12	3	11.9	71	28	0	0	1	240
91	175	38	8.6	8.13	7	12.6	66	31	0	2	1	249

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 29. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 29

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												112
7	100	34	12.4	9.12	3	8.6	68	31	0	1	0	115
14	153	33	12.0	9.21	53	10.4	71	29	0	0	0	122
21	210	35	12.0	9.17	14	9.6	63	37	0	0	0	131
28	205	38	11.8	9.30	28	7.3	53	46	0	1	0	140
35	202	37	12.0	9.33	8	5.9	56	43	1	0	0	150
42	196	37	11.6	9.18	5	5.4	49	51	0	0	0	163
49	206	36	11.8	9.40	0	5.8	52	48	0	0	0	179
56	189	37	12.2	9.37	1	7.4	46	54	0	0	0	192
63	214	38	12.4	9.07	0	6.3	58	41	1	0	0	203
70	201	35	12.4	9.02	2	9.4	45	55	0	0	0	211
77	182	36	12.0	9.23	1	9.8	55	44	0	1	0	221
84	175	35	12.2	9.50	0	9.1	49	51	0	0	0	229
91	186	36	12.4	9.47	2	9.9	58	42	0	0	0	239

TABLE 30. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 30

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												113
7	76	34	12.7	9.76	11	8.7	60	40	0	0	0	117
14	118	34	12.5	9.90	34	9.8	61	38	0	1	0	127
21	179	38	12.8	10.10	25	12.1	56	41	1	2	0	139
28	182	37	12.9	9.94	39	7.6	46	52	0	2	0	151
35	178	38	12.8	9.89	12	11.4	57	42	0	1	0	165
42	175	37	13.0	9.37	0	8.6	43	55	0	2	0	179
49	180	38	12.6	8.92	0	9.3	53	47	0	0	0	195
56	179	38	13.1	9.30	2	10.4	43	54	0	3	0	213
63	180	38	13.2	9.50	2	8.7	56	43	0	1	0	228
70	172	38	13.0	9.90	2	9.6	41	58	0	1	0	238
77	160	39	13.0	9.71	0	9.4	49	50	1	0	0	250
84	173	38	12.8	9.79	2	10.0	41	57	0	0	0	260
91	174	38	13.5	10.07	1	11.4	49	51	0	0	0	267

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 31. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 31

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												123
7	81	37	10.8	9.12	2	7.8	56	44	0	0	0	130
14	70	37	10.6	9.18	12	12.1	41	57	1	0	1	139
21	63	36	10.2	9.21	0	9.4	39	61	0	0	0	149
28	72	36	9.6	9.25	1	10.3	53	47	0	0	0	156
35	64	35	10.4	9.11	0	9.5	36	63	0	0	1	165
42	80	38	9.8	9.33	5	9.4	51	49	0	0	0	176
49	76	36	9.6	9.37	0	7.8	40	58	2	0	0	190
56	71	36	9.4	9.45	0	9.6	45	54	0	1	0	203
63	61	36	9.6	9.37	0	8.6	42	57	0	1	0	214
70	79	35	9.6	9.47	2	9.6	45	55	0	0	0	223
77	66	36	9.6	9.42	2	8.3	40	60	0	0	0	231
84	72	36	9.6	9.40	2	8.9	44	56	0	0	0	240
91	68	38	9.0	9.53	2	7.9	38	62	0	0	0	251

TABLE 32. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 32

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												106
7	68	35	11.1	10.02	0	9.6	41	58	0	1	0	109
14	123	34	10.7	9.83	41	11.4	48	51	1	0	0	118
21	181	39	10.8	9.90	28	8.6	45	55	0	0	0	127
28	182	39	11.1	10.19	15	10.8	53	47	0	0	0	138
35	175	41	11.1	10.26	0	11.7	43	54	0	3	0	148
42	168	40	10.8	10.07	2	10.3	44	54	0	2	0	160
49	169	42	11.1	10.42	2	11.4	46	53	0	1	0	175
56	170	40	11.5	9.74	0	7.8	47	51	0	2	0	191
63	171	38	11.4	9.90	0	9.3	60	38	0	2	0	200
70	160	35	11.4	9.97	3	9.8	51	45	0	4	0	212
77	150	39	11.0	9.84	3	8.4	63	36	0	1	0	220
84	143	39	11.0	9.93	3	10.6	48	48	0	4	0	232
91	138	39	11.7	9.97	3	9.7	57	41	0	2	0	241

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 33. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 33

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												86
7	85	24	7.2	5.97	2	11.6	50	49	0	1	0	90
14	80	24	6.8	6.09	3	9.8	51	48	0	1	0	97
21	82	25	6.6	6.20	5	12.0	41	58	0	1	0	106
28	86	26	5.8	5.76	2	13.1	56	44	0	0	0	115
35	82	25	6.4	5.52	2	11.5	60	40	0	0	0	125
42	83	26	6.0	5.38	4	8.3	58	42	0	0	0	136
49	88	25	6.0	5.42	0	7.6	49	50	0	1	0	149
56	88	25	5.8	5.48	0	10.4	46	54	0	0	0	164
63	81	25	6.0	5.60	5	11.1	46	53	1	0	0	176
70	90	25	6.0	5.82	1	7.5	42	56	0	2	0	187
77	85	25	6.4	5.53	0	11.6	49	49	0	2	0	196
84	86	26	5.8	5.72	0	10.1	53	47	0	0	0	206
91	80	26	5.6	5.84	0	11.7	50	48	1	1	0	215

TABLE 34. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 34

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												79
7	90	32	8.2	6.38	12	7.6	46	54	0	0	0	81
14	118	30	8.0	6.55	4	12.7	55	45	0	0	0	93
21	151	32	8.5	6.48	2	13.8	47	52	0	1	0	103
28	136	34	9.0	6.23	8	13.3	54	44	2	0	0	115
35	138	35	9.4	6.19	5	12.4	47	50	0	3	0	124
42	127	35	9.4	6.52	0	11.6	52	48	0	0	0	135
49	133	37	9.2	6.42	8	9.5	43	57	0	0	0	143
56	144	36	8.6	6.57	4	10.7	48	51	0	0	1	154
63	147	36	8.8	6.69	3	14.0	40	58	0	2	0	165
70	148	37	9.2	7.02	10	12.8	46	54	0	0	0	174
77	141	33	9.0	6.47	12	16.7	49	49	0	2	0	182
84	148	36	8.4	6.21	0	9.8	44	55	0	1	0	191
91	149	36	8.2	6.22	6	10.4	39	56	1	3	1	201

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 35. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 35

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												95
7	53	23	7.6	6.77	10	7.3	61	39	0	0	0	104
14	79	23	7.8	6.72	4	5.3	57	43	0	0	0	113
21	118	23	8.0	6.76	9	5.9	55	44	0	1	0	127
28	110	25	8.4	6.59	11	6.7	53	47	0	0	0	141
35	98	27	8.4	6.81	8	5.4	49	51	0	0	0	153
42	106	27	8.0	6.69	16	7.3	44	55	0	0	1	168
49	104	27	8.4	6.74	9	8.4	53	47	0	0	0	183
56	103	26	8.6	6.78	6	6.5	46	53	0	1	0	196
63	117	26	8.6	6.51	8	5.3	47	49	0	4	0	208
70	109	28	8.8	6.57	5	8.0	52	48	0	0	0	221
77	109	25	8.2	6.68	12	9.1	45	54	0	0	1	235
84	106	26	8.8	6.60	11	7.4	57	41	0	2	0	249
91	110	27	9.4	6.67	3	7.6	58	39	0	3	0	263

TABLE 36. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 36

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												93
7	151	36	11.4	7.77	2	12.5	60	39	0	1	0	97
14	190	37	11.6	8.11	32	16.2	55	44	0	1	0	105
21	256	38	11.0	8.00	16	15.0	52	47	0	0	1	115
28	253	40	11.6	7.91	12	14.3	57	43	0	0	0	124
35	239	38	11.8	8.12	4	9.8	58	42	0	0	0	133
42	230	36	10.8	7.67	3	12.3	53	45	0	2	0	145
49	228	40	11.6	7.91	3	11.5	61	39	0	0	0	155
56	261	39	12.2	7.93	3	14.2	50	46	1	2	1	169
63	264	35	12.0	8.05	2	10.6	62	38	0	0	0	182
70	259	37	11.4	7.65	0	9.8	55	41	1	3	0	193
77	257	39	11.0	7.83	2	10.4	57	40	0	2	1	203
84	246	38	11.6	8.56	0	11.7	52	47	0	1	0	211
91	240	38	11.9	8.05	0	12.1	51	45	0	4	0	222

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 37. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 37

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												93
7	57	30	9.8	6.80	0	11.7	60	40	0	0	0	95
14	60	30	10.0	6.87	0	12.4	61	38	0	0	1	101
21	54	30	8.6	6.79	0	8.3	53	46	0	1	0	110
28	59	29	8.0	6.88	1	6.5	63	37	0	0	0	119
35	62	28	8.8	6.95	1	9.4	56	43	0	0	1	130
42	63	29	8.2	6.98	0	10.2	62	38	0	0	0	145
49	68	29	8.4	6.85	7	9.6	48	52	0	0	0	163
56	59	32	8.0	6.87	4	7.8	57	43	0	0	0	182
63	64	31	8.0	7.02	0	11.3	50	49	1	0	0	188
70	70	32	8.4	6.98	3	9.4	48	51	1	0	0	196
77	66	31	7.8	7.04	3	9.6	49	50	0	0	1	204
84	63	31	8.2	7.10	2	10.4	46	54	0	0	0	210
91	58	32	8.0	7.14	4	11.1	47	53	0	0	0	217

TABLE 38. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 38

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												91
7	137	26	8.3	6.94	3	8.8	52	48	0	0	0	98
14	164	26	9.0	6.84	1	9.6	53	46	0	1	0	112
21	183	27	8.4	6.79	1	12.1	54	46	0	0	0	125
28	197	28	9.3	6.72	5	9.3	51	48	0	1	0	140
35	181	30	9.2	6.64	4	8.7	55	45	0	0	0	155
42	190	31	9.5	6.78	0	9.6	56	44	0	0	0	167
49	194	30	9.8	6.81	7	10.0	60	39	1	0	0	183
56	200	30	9.1	7.05	8	11.3	61	37	0	2	0	198
63	206	31	9.3	6.99	1	8.6	58	41	1	0	0	211
70	196	31	9.0	6.77	0	9.7	46	52	1	0	1	224
77	203	28	9.6	6.53	8	8.3	46	54	0	0	0	238
84	201	31	9.6	6.57	3	9.2	41	58	0	0	1	251
91	210	31	10.5	6.61	8	10.1	50	49	0	0	1	265

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 39. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 39

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												80
7	115	37	10.1	8.53	0	4.7	72	28	0	0	0	84
14	160	36	10.2	8.49	60	6.3	61	39	0	0	0	94
21	208	39	9.8	8.75	31	5.1	71	29	0	0	0	106
28	210	41	9.7	8.62	40	8.4	64	34	0	2	0	118
35	203	43	9.5	8.24	7	9.3	63	37	0	0	0	130
42	211	40	10.2	8.36	2	7.8	68	28	0	4	0	145
49	205	42	10.6	8.69	0	8.4	60	40	0	0	0	162
56	206	40	11.1	8.75	1	9.6	54	43	0	3	0	178
63	197	38	11.4	8.52	4	10.1	44	48	0	6	0	193
70	188	39	10.7	8.56	2	7.9	67	33	0	0	0	206
77	181	38	10.5	8.62	0	8.3	59	40	0	1	0	218
84	175	38	10.7	8.75	1	9.4	69	29	1	1	0	229
91	172	39	10.7	8.78	3	10.4	69	31	0	0	0	240

TABLE 40. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 40

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												69
7	170	38	11.7	8.56	3	9.1	59	41	0	0	0	75
14	203	38	11.4	8.70	27	9.4	59	40	0	1	0	83
21	258	37	11.8	8.62	28	8.5	52	48	0	0	0	90
28	242	41	11.3	8.81	34	8.9	49	50	0	0	1	100
35	246	42	11.2	8.73	2	7.6	47	43	0	0	0	112
42	256	41	11.2	8.31	1	9.0	46	54	0	0	0	123
49	251	41	11.6	8.52	6	10.3	51	49	0	0	0	135
56	243	42	11.9	9.39	0	11.4	43	56	0	1	0	149
63	271	43	12.0	8.24	0	9.8	52	48	0	0	0	162
70	259	41	11.4	8.39	1	11.9	49	49	1	1	0	171
77	259	41	12.0	8.73	2	12.6	58	40	1	1	0	180
84	246	38	11.6	8.82	2	9.8	60	40	0	0	0	188
91	242	38	11.7	9.07	1	10.3	57	42	1	0	0	198

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 41. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 41

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												86
7	66	41	13.4	8.38	3	9.9	61	39	0	0	0	93
14	65	41	12.5	8.24	0	13.2	56	44	0	0	0	100
21	59	41	11.8	8.30	0	11.5	59	41	0	0	0	111
28	70	38	11.4	8.41	0	14.3	46	53	0	1	0	120
35	68	38	11.8	8.51	8	10.8	58	47	0	0	0	131
42	70	38	11.2	8.60	2	9.6	44	55	0	1	0	143
49	70	40	11.4	8.66	0	12.4	52	48	0	0	0	159
56	63	42	11.1	8.55	4	11.0	49	51	0	0	0	178
63	68	43	11.6	8.59	0	8.8	56	44	0	0	0	192
70	61	42	11.0	8.69	1	9.7	52	47	0	1	0	202
77	64	41	11.4	8.96	0	10.4	55	43	0	2	0	214
84	71	40	11.4	8.70	2	11.1	60	40	0	0	0	222
91	66	41	11.0	8.77	0	12.6	58	42	0	0	0	234

TABLE 42. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 42

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												98
7	81	40	10.4	8.23	4	12.4	62	37	0	0	1	103
14	119	38	10.6	8.32	39	7.6	61	39	0	0	0	111
21	173	45	10.0	8.03	22	8.4	61	39	0	0	0	121
28	178	44	10.8	8.73	44	9.6	58	40	1	0	1	130
35	190	46	11.0	7.97	10	10.3	72	28	0	0	0	139
42	181	44	10.5	8.10	0	8.7	53	45	0	2	0	152
49	190	44	10.8	8.15	3	6.8	55	41	0	3	1	164
56	183	46	10.8	8.37	3	7.4	50	46	0	4	0	175
63	184	43	10.8	8.58	2	8.4	56	43	1	0	0	186
70	189	44	10.0	8.39	4	9.3	50	48	0	2	0	195
77	178	44	11.0	8.53	3	10.1	55	45	0	0	0	205
84	180	43	10.6	7.63	1	7.9	55	40	0	5	0	216
91	183	43	10.2	8.08	2	8.8	55	44	1	0	0	228

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 43. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 43

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												101
7	101	42	11.1	8.62	6	12.5	60	39	0	1	0	106
14	148	42	10.2	8.51	36	9.3	59	41	0	0	0	114
21	187	44	11.0	8.53	15	10.6	60	40	0	0	0	125
28	192	47	10.8	8.42	17	14.1	49	50	0	1	0	134
35	208	47	10.6	8.38	0	11.2	42	54	0	4	0	145
42	193	47	10.8	8.30	2	7.5	43	56	1	0	0	159
49	199	46	11.4	8.04	2	9.0	49	49	0	2	0	175
56	209	47	11.7	8.63	0	9.8	47	53	0	0	0	189
63	206	47	11.6	8.32	0	9.4	42	55	0	3	0	201
70	195	43	11.0	7.28	0	10.1	41	58	0	1	0	213
77	186	44	11.7	8.78	2	9.8	44	54	0	2	0	221
84	196	43	11.8	8.51	3	7.8	44	55	1	0	0	233
91	208	43	11.5	8.24	0	11.1	49	49	0	1	1	242

TABLE 44. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 44

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												85
7	136	33	10.8	8.19	1	8.5	49	51	0	0	0	91
14	130	33	10.4	8.75	0	5.3	52	48	0	0	0	99
21	133	33	9.6	8.39	0	4.6	53	47	0	0	0	110
28	130	33	9.2	8.32	0	7.3	54	46	0	0	0	121
35	123	33	9.6	8.30	0	9.6	61	39	0	0	0	132
42	128	35	9.4	8.44	5	12.9	53	47	0	0	0	144
49	138	33	9.4	8.38	9	10.3	58	41	0	1	0	158
56	141	34	9.6	8.51	1	12.1	60	40	0	0	0	172
63	139	34	9.6	8.37	0	9.1	61	38	0	1	0	185
70	136	33	9.2	8.53	4	10.0	60	36	0	4	0	197
77	140	35	9.4	8.81	0	7.9	65	35	0	0	0	211
84	145	34	9.0	8.65	0	8.7	60	39	0	0	1	219
91	138	35	8.4	8.34	5	8.1	57	43	0	0	0	231

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

TABLE 45. HEMATOLOGICAL FINDINGS AND BODY WEIGHTS, CALF NO. 45

Age (days)	S.I.	Hc.	Hb.	RBC	Ret.	WBC	Differential N	L	M	E	B	B.W.
initial												108
7	115	43	13.2	9.19	2	9.5	53	47	0	0	0	114
14	109	43	12.6	9.15	11	7.3	54	46	0	0	0	121
21	101	43	12.0	9.25	2	6.8	51	49	0	0	0	133
28	110	41	11.2	9.32	0	7.6	46	53	0	1	0	142
35	111	40	11.4	9.37	0	8.3	49	51	0	0	0	154
42	108	42	11.2	9.23	0	9.0	52	47	0	0	1	163
49	106	44	10.8	9.51	1	7.8	50	48	0	2	0	174
56	121	43	11.6	9.48	1	11.5	57	43	0	0	0	186
63	114	45	11.8	9.96	0	9.6	64	34	0	2	0	197
70	128	42	12.2	9.42	1	7.9	58	41	0	1	0	207
77	118	43	11.6	9.80	0	8.4	67	30	0	2	1	216
84	125	43	11.5	9.63	2	8.8	59	41	0	0	0	225
91	112	42	11.2	9.87	5	9.4	55	44	0	1	0	238

S.I. = Serum Iron (micrograms/100 ml. blood)
Hc. = Hematocrit (percent)
Hb. = Hemoglobin (grams/100 ml. blood)
RBC = Red blood cell (10^6)
Ret. = Reticulocyte (number/500 erythrocytes)
WBC = White blood cell (10^3)
Differential
N = Neutrophil (%)
L = Lymphocyte (%)
M = Monocyte (%)
E = Eosinophil (%)
B = Basophil (%)
B.W. = Body weight (pounds)

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