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BLOOD SUGAR, ACETONE BODIES, AND LIVER GLYCOGEN OF DAIRY COWS UNDER VARIOUS PHYSIOLOGICAL CONDITIONS DURING THE PARTURIENT PERIOD

By

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INTRODUCTION

The condition in dairy cows known as ketosis or acetonemia has become one of the dairy farmer's most troublesome problems. In many high producing herds it has been observed that nearly all of the cows exhibit some degree of ketosis following parturition. Economic loss is often high in cases where clinical symptoms develop due to lowered milk production, cost of treatment, and sometimes the loss of animals. It is possible that there are many cases where no symptoms are observed that result in undue loss of body weight and lowered milk production.

Underfeeding has long been considered one of the causes of ketosis, and is thought by many investigators in the field to be the major cause of this disease in dairy cattle and sheep. Fraser, et al. (24,25) and Groenewald, et al. (28,29) were able to produce a ketosis in pregnant ewes by maintaining low levels of energy intake and by fasting. Faw ewes, and especially fat ewes carrying two or more lambs, were more susceptible than thin ewes or ewes carrying a single lamb. Forbes (23) produced a hypoglycemia and ketonemia in dairy cows by restricting feed intake in early lactation. He did not reproduce the complete clinical picture of ketosis.

McKay, et al. (46) showed that the degree and rapidity of onset of ketosis in the fasted rat was inversely proportional to the amount of protein in the diet before fasting. Fraser (24) and his colleagues found that protein as fed in their experiments had no effect on fasting ketosis and that starch or flaked maize was as efficient in promoting recovery from fasting ketosis as were the protein-rich meals. Shaw and

Daugherty (87) reported that pregnant ewes fed low protein diets did not develop a ketosis when feed intake was limited to 50 per cent of requirements. Thus the available data on ruminants have failed to show that the level of protein intake before fasting affects the degree of the subsequent fasting ketosis.

Field observations have shown that ketosis develops most often in well conditioned, high producing cows. This observation has also been made in ewes, and Fraser's experiments (24,25) clearly indicate that fat ewes are more likely to develop ketosis. The ewes fasted by Shaw and Daugherty (87) had not been fattened, and the protein intake for all ewes in the experiments of Fraser, et al. (24,25) was below the recommended amounts. It appeared possible that if palatable rations with a higher content of protein were fed the animals could be fattened and the effect of protein might be observed in the subsequent fasting ketosis.

It has been a common practice in feeding dairy cows just before and immediately after parturition to limit the energy intake in order to prevent udder edema and avoid digestive disturbances. The relationship of energy intake and udder troubles after parturition has long been controversial and many observations indicate that high energy intake may have no detrimental effects.

The present study was designed to

a. Test the effect of quantity and quality of rations before parturition on the blood sugar and acetone bodies and some liver substances of the fasted and full fed cow postpartum.

b. Study the effect of concentrated, high energy rations on udder edema and congestion.

c. Develop calving rations which would maintain body weight and a normal level of blood sugar and acetone bodies after parturition.

Cows were fed to get them very fat before calving and three levels of protein intake were employed in the rations. It was decided to make the postpartal fast severe enough to insure the development of hypoglycemia and ketonemia.

REVIEW OF LITERATURE

Ketosis in Ruminants

What appears to have been ketosis or acetonemia in dairy cows was described as early as 1849 (95). Several case reports were made before 1874 (22) describing symptoms which are so typical of what is now known as the nervous type of the disease as to leave little doubt that at least some of the cases were identical to the spontaneous cases of ketosis of dairy cows that is now so prevalent. Robellet in 1874 first employed chloral hydrate in treatment of a cow apparently suffering from the nervous form of ketosis and reported a very rapid recovery (62).

Sjollema and Van Der Zande (89) in 1923 were the first to present data showing abnormally high levels of acetone bodies in the blood and urine of cows exhibiting symptoms of ketosis. Their description of symptoms and conditions associated with the occurrence of ketosis can hardly be improved upon today. For example, they reported that fat, high producing cows were more susceptible and that the condition usually occurred 7 to 10 days postpartum. Also observed were rapid loss of body weight, lack of appetite, dry feces, rapid decline of milk production and nervous disturbances in some cases. There was a marked improvement when cows were turned to pasture. Sjollema and Van Der Zande (89) reported blood sugar values that they considered normal but questioned the method of determination and felt that the method was not good in the presence of acetone bodies. The alkali reserve of the blood was 60 to 80 per cent of normal. Non-protein nitrogen was normal and cholesterol values were double those found in the blood of normal cows. The blood of cows with ketosis contained 80 to 100 milligrams per cent acetone bodies, while only traces of acetone bodies were found in the blood of normal cows. There was some increase in the blood acetone bodies of apparently normal cows after parturition. Cows with ketosis excreted large amounts of acetone bodies in the urine; there was no glycosuria. Sjollema and Van Der Zande calculated that the cow must metabolise body fat as well as liver fat in order to excrete as many acetone bodies as were found in the urine of affected cows.

Hupka (35), in 1928, demonstrated the hypoglycemia associated with ketosis in cows and believed that the symptoms of ketosis were due to hypoglycemia. Sampson and his colleagues (68) were the first in the United States to verify the high ketonemia of cows with ketosis.

Roderick and Harshfield (58) in 1932 found that crude fat in the livers of ewes with pregnancy disease was greatly increased over the fat levels found in livers of normal ewes. They also reported that pregnancy disease occurred more frequently in flocks that were insufficiently fed. Serum calcium was normal in affected ewes and blood sugar was not always low; in some cases it was very high. These same workers found that the livers of ewes affected with pregnancy disease contained an average of approximately 0.3 per cent glycogen and the livers of normal pregnant ewes contained about 3.5 per cent glycogen.

Sjollema (88), in discussing the etiology of ketosis, concluded that pregnancy and parturition were probably concerned. He excluded a decreased ability to oxidise carbohydrate as a causative factor, as diabetes is seldom seen in cattle and one injection of glucose usually sufficed in the treatment of acetonemia. Sjollema considered the lack of carbohydrate due to reduction of intake and (or) the accelerated depletion of carbohydrate at the onset of lactation to be important.

He noted the possibility that, due to the lack of carbohydrate, fat could not be oxidized beyond the acetoacetic acid stage and that the ketone bodies resulted from this incomplete oxidation of fat.

Boddie (8)(9) frequently found acetone bodies in the blood of apparently normal pregnant or lactating cows. Increases in blood ketones following parturition were mostly due to increases in beta-hydroxybutyric acid. Boddie reported hypoglycemia in cows with ketosis, and found no marked disturbance when the blood sugar level remained above 45 milligrams per 100 milliliters. He also noted that ketosis was more prevalent in the late winter and early spring, and that the condition improved when cows were turned to pasture. Godden and Allcroft(27) found that in normal cows there was a definite rise in the blood sugar level at the time of parturition, followed by a decrease to subnormal levels which persisted for at least a week. Sampson and Hayden (69) reported a lowering of the alkali reserve in acetonemia and a great increase in blood and urine ketones in cows with ketosis and ewes with pregnancy disease. They considered it probable that the cause of severe ketosis was a disturbance of carbohydrate metabolism due either to a lack of sufficient carbohydrate or carbohydrate-forming materials in the ration, or to insufficient carbohydrate storage in the animal tissue. Sampson and Hayden also suggested a close etiological relationship between milk fever and ketosis, although they found that a calcium deficiency was not indicated in pregnancy disease of ewes.

Sampson and Hayden (70) also reported that blood ketones in cows and ewes with ketosis soon returned to levels of 5 milligrams per 100 milliliters or less after treatment and recovery from symptoms. They found that normal ewes in late pregnancy did not exhibit hypoglycemia or ketonemia.

Fraser, *et al.*(24,25) found that pregnant ewes overfed and closely confined so that they became grossly fat maintained high blood sugar levels and developed no ketonemia. Such ewes showed no symptoms of pregnancy disease and on autopsy the livers were found to be macroscopically and microscopically normal. Fasting of fat, pregnant ewes for 48 hours resulted in hypoglycemia and ketonemia, but blood levels returned to normal when full rations were restored. Underfed ewes showed some ketonemia before fasting and marked hypoglycemia and ketonemia with symptoms of pregnancy disease on fasting. There was a positive correlation between ketosis and twin pregnancies and a negative correlation between ketosis and liberal feeding. While underfeeding produced symptoms of pregnancy disease and fatty livers in pregnant ewes, barren ewes showed no symptoms or ketonemia even on fasting. Protein intake had no effect. Fraser, *et al.*, considered that ketosis or pregnancy disease may be a characteristic pathological response of heavily pregnant ewes to a variety of factors, dietary or otherwise.

Groenewald, *et al.* (28,29) concluded that mineral deficiency, lack of exercise, and toxic absorption from the uterus could be discarded as causes for pregnancy disease in ewes. They looked upon changes in feeding, climatic conditions, age and overfatness as predisposing, indirect causes. Pregnancy was considered to be the most powerful predisposing cause acting through the increased tax on the maternal system. They found hypoglycemia, ketonemia, and fatty livers to be constant in cases of ketosis of ewes. This same group also reported that about two-thirds of the total blood ketones in affected ewes was beta-hydroxybutyric acid, and the remaining one-third was acetone and acetoacetic acid. More than 50 per cent of the ketones excreted in urine was acetone and acetoacetic acid. Autopsy of ewes dying from pregnancy disease disclosed, in addition to fatty livers, fatty infiltration of the myocardium, kidneys and adrenals. The adrenals showed marked degenerative changes and the cortex was flabby and yellow. The pancreas and spleen appeared normal. Uteri and foetuses were normal.

Duncan, Huffman and Tobin (19) found calcium, magnesium and chloride metabolism were not indicated in ketosis of dairy cattle. They obtained subnormal inorganic phosphorous values, but believed these to be associated with the generally poor nutritional condition of the cows under study. These workers did not encounter acidosis and found that there was no correlation between the blood-ketone bodies and the carbon-dioxide combining capacity of the blood.

Forbes (23) was able to produce hypoglycemia and ketonemia in partially fasted cows in early lactation, but no cows developed symptoms typical of clinical ketosis. He found goats to be more susceptible to a fasting ketosis in late pregnancy than in early lactation.

Patton (54) believed that ketosis of dairy cows was due to a vitamin A deficiency; however, his data were limited and did not give conclusive evidence of vitamin A deficiency. Shaw, et al. (85) showed that plasma carotene and plasma vitamin A of cows suffering with ketosis were quite normal, that animals with ketosis gave no response to massive oral doses of vitamin A, and that a vitamin A deficiency in cows during late pregnancy and early lactation did not produce a ketosis even when some of these cows were fasted. Hayden, et al (31) confirmed the observation that cows with ketosis did not respond to treatment with massive doses of vitamin A.

Carlstrom (11) and Compton (14) claimed that thiamine hydrochloride was beneficial in the treatment of ketosis. However, Shaw (75) demonstrated conclusively that cows with ketosis did not respond to massive oral and intravenous doses of thiamine and other vitamins in the B complex. Forbes (23) also reported that he was unable to repeat Carlstrom's results with thiamine hydrochloride.

Henderson (32) reported clinical improvement of cows with ketosis following the administration of cobalt sulfate. Hallgren and Lundstedt also reported favorable response on treatment with cobalt. Shaw (73) obtained no response from the use of cobalt. Vitamin B_{12} also was ineffective.

The actual blood picture prior to, during, and following the development of ketosis was first shown by Shaw (74) in 1943. In most cases there was a gradual rise in blood ketones and a decrease in blood glucose for a week or more before the first clinical symptoms were observed. In one case marked symptoms were evident on the day of parturition, which were found to be associated with a sharp drop in blood sugar while the blood ketones were still normal. Severe symptoms as well as marked hypoglycemia and ketonemia were observed five days postpartum. In this same report it was shown that the administration of glucose intravenously resulted in a sharp temporary rise, followed by a decline within two hours to levels below normal but somewhat above the levels observed before injection. Shaw's arteriovenous studies on cows with ketosis demonstrated that the mammary gland continued to remove the normal quantity of glucose from the blood even in marked hypoglycemia. It was also observed in this study that liberal feeding of molasses prior to parturition did not have any beneficial effect.

Maintenance of a high energy intake prior to and following parturition did not prevent ketosis, and the milk production of cows with hypoglycemia and ketonemia was adversely affected even when food consumption remained normal.

Forbes (23) also reported that the addition of 1.5 pounds of molasses or corn sugar or of both, to the rations of dairy cows did not increase the blood sugar levels or lower the blood and urinary ketone levels below those of the control animals.

A rather comprehensive study of acetoacetic acid and beta-hydroxybutyric acid in the blood and urine of dairy cattle of all ages and of milk in the case of lactating cows was made by Knodt, _et at._(40, 41,42). A number of significant observations were made. One was that the blood and urine acetone bodies in the first month after birth are primarily acetoacetic acid. Afterwards the beta-hydroxybutyric acid increases and is responsible for most of the variations observed in total blood and urinary acetone bodies. These blood changes observed early in the life of the calf undoubtedly reflect the development of the rumen as the calf grows older. It was also observed that blood acetone bodies reach a maximum three hours after feeding and then decline rather sharply. Acetone bodies were always found in the milk of normal cows. The acetoacetic acid fraction was always greater than the beta-hydroxybutyric acid fraction, although the reverse was true in the blood. This is no doubt due to the fact that the mammary gland metabolizes beta-hydroxybutyric acid but not acetoacetic acid (79).

Shaw (76) observed that many cows with ketosis recovered without treatment, and that due to this spontaneous recovery it was necessary to exercise caution in assessing the therapeutic value of any substance for ketosis.

Until recently the intravenous administration of glucose was the most effective known treatment for ketosis of dairy cows. The efficacy of this treatment has been well substantiated both clinically and experimentally (61, 67, 86, 91, 93). Sampson (66) in 1947 stated that glucose therapy was so specific for uncomplicated ketosis there was little to be gained from any other treatment. However, many severe cases of ketosis requir repeated treatments with glucose and severe economic loss may be sustained before the symptoms are alleviated. In general veterinary practice glucose intravenously is still the most widely used treatment for ketosis.

Only recently has much attention been given to the possibility that ketosis may be due to an endocrine distrubance. The first definite indication that the adrenals might be involved was Shaw's (77) report of a marked response in four cows with ketosis that had been treated with adrenal cortical extract. As much as 200 milliliters of Cortin per cow was used. It was concluded that these results did not necessarily mean that ketosis in cattle was due to an adrenal insifficiency, since it was recognized that Cortin promotes the formation of new carbohydrate even in normal animals. Fincher and Hayden (21) reported that anterior pituitary preparations appeared beneficial in treating ketosis, though glucose, molasses or chloral hydrate was used on most of these same cows, making it difficult to determine the specific value of anterior pituitary lobe hormones. Dennis (15) reported the use of various hormones and vitamins in the treatment of ketosis, and believed that anterior pituitary extract would be of definite value in such treatment. Vanderplassche (96) reported that desoxycorticorterone was beneificial in cases of ketosis. However, he also used large amounts of sugar to supplement the hormone therapy. The daily dosage of desoxycorticosterone was only 50 milligrams, a quantity which appears to be considerably less than that needed to have a physiological effect on dairy cows.

Extensive biochemical and histopathologic studies of ketosis in dairy cows have been conducted by Shaw, Saarinen, Matsiolas and Leffel during the last five years at the Maryland Agriculture Experiment Station (63,64,65,80,81,82,83,84). In these studies particular attention was given to attempts to reproduce ketosis under various nutritional regimes and to biochemical and histopathologic studies of various organs of the bodies of cows exhibiting both fasting and true spontaneous ketosis. Major emphasis was given to the study of the endocrine glands, and due to the earlier work indicating that Cortin was an effective therapy (77), specific attention was given to adrenals and the pituitary. In 1948 Shaw, et al.(85) presented the first evidence of marked abnormalities in the adrenals and pituitaries of cows with ketosis.

Saarinen and Shaw (63,64,65) reported the analysis of the plasma, liver and adrenal lipids and ascorbic acid of adrenals of livers of cows with ketosis and of cows on various feeding regimes during the period prior to and following parturition. It was observed that most of the changes in the lipids in these tissues could be reproduced by fasting and therefore that most of the alterations of a fatty nature in spontaneous ketosis were probably secondary to the inanition associated with ketosis. In fact, it was found that the fat content of the liver was often normal in the early stages of ketosis. Some of the liver and adrenal ascorbic acid levels of cows with ketosis were low and this could be reproduced by fasting. Many of the histopathologic changes could not be reproduced by fasting. Of considerable significance was the finding that the extremely large and flabby adrenals observed in cows with ketosis could not be reproduced by fasting. These studies culminated in the reports by Shaw, et al. (80,82) in 1950, that ketosis in dairy cattle is due to an adrenal insufficiency, or more specifically, that it represents the alarm reaction phase of the general adaptation syndrome (72) involving the pituitary-adrenal cortical system. Shaw, et al., reported at this time that 7 of 8 cows treated with cortisone made a dramatic response. Shaw, et al.(81,83) later published more extensive data showing that both cortisone and ACTH in sufficient dosage will bring about a very rapid cure of ketosis of dairy cows. 1.5 grams of cortisone acetate injected intramuscularly usually resulted in a dramatic recovery within 24 hours. Smaller dosages were not as effective. Occasionally in very difficult cases it was necessary to give additional cortisone after the first 1.5 gram injection. Three hundred international units of ACTH in gelatin (Armour L-10003) was found to be an effective dose. Small dosages of Compound F were generally effective and indicated that this substance is more potent than cortisone. Desoxycorticosterone given in 2-gram doses was completely ineffective in treatment of ketosis. Dye and Roberts (20) used smaller dosages of cortisone (250 to 500 mg) and reported generally favorable results, although there were some relapses.

Shaw, et al.(83) also reported that sodium acetate and sodium propionate per os were beneficial in several cases of ketosis, with the use of sodium propionate resulting in more consistent and more rapid alleviation of hypoglycemia, acetonemia, and clinical symptoms than did sodium acetate. The response with these substances was, however, much slower and not as consistent as with cortisone and ACTH.

The above results with sodium acetate are in agreement with the earlier report of Miller and Allen (49), that acetate is effective in treating ketosis in dairy cows. Miller and Allen found that acetate was effective as the only treatment for 12 of 23 cows with ketosis, and was less effective or of no effect with the others. Usually, response to sodium acetate was slower than was the case with intravenous glucose administration. The propionate study confirmed the report of Schultz (71) that sodium propionate was often effective.

Holm (34) found that cortisone failed to affect hypoglycemia or ketonemia in pregnant ewes with lambing paralysis. Affected ewes died after several days' treatment with cortisone. It now appears that there may be fundamental differences between the ketosis of dairy cows and the pregnancy disease or ketosis in ewes. The effect of inadequate energy intake seems to be more specific for ewes than for ketosis of cows.

Fasting Ketosis in Non-Ruminants - Influence of Previous Diet

The classic ketogenic ration for rats is a low protein, high fat diet (4,5,13). The effect of this diet was shown to be due to the development of fatty livers which resulted in a ketonemia during fasting. The development of fatty livers could be prevented by increasing the protein content of the diet, and by adding fairly large amounts of choline to the diet. When small amounts of choline were fed the amount of liver fat was conditioned by the quantity of protein irrespective of the action of choline. However, Best and Channon (5) pointed out that in planning diets it was necessary to make them essentially free of choline, betaine and other lipotrophic factors.

Deuel, *et al.* (18) observed a fasting ketonemia following the feeding of high fat diets to rats but found no direct relationship between the height of liver fat and the magnitude of ketonuria. High protein diets resulted in a much lower level of liver fat and only a slight ketonuria on fasting. Female rats had a consistently higher ketonuria on fasting, and the level of liver glycogen was significantly higher in unfasted male rats on both high and low fat diets.

McKay, *et al.*(46) were able to show that the rapidity of onset and the degree of ketosis reached during fasting bore an inverse relationship to the protein content of the preceding diet. The amount of liver fat *per se* and such agents as choline, methionine, or cystine, which are known to influence the amount of fat in the liver, did not have significant effect upon the degree of fasting ketosis in the rat. The amount of protein in the diet preceding fasting apparently determined the amount of antiketogenic material available for catabolism during the fast. Fasted rats, with a previous high protein intake, better maintained liver glycogen and blood sugar levels. McKay (47) also found the degree of fasting ketosis was influenced by the nature of the protein in the preceding diet and bore an inverse relationship to the protein catabolism during fasting. Ketosis was higher after gelatin than after serum albumin feeding. Edestin and casein produced an intermediate level of ketosis and nitrogen excretion upon fasting. The nature of various natural fats fed prior to fasting seemed to have no influence upon the degree of ketosis during fast.

Roberts and Samuels (56) observed a significant early fasting ketosis in rats forcibly fed a high fat diet for 3 to 6 weeks before fasting. This was absent in rats similarly treated but fed a high carbohydrate diet. Protein and nitrogen excretion during the fast were the same in both groups. They concluded that the fasting ketosis was due to the accelerated fat metabolism initiated during the feeding of the high fat diet and continuing after the withdrawal of food. They referred to this phenomenon as "preferential utilisation." The fasting ketosis was evidenced by high levels of blood and urinary acetone bodies and large grossly fatty livers in the fat-fed animals.

Roberts and Samuels (57) demonstrated that rats previously force fed high fat diets by stomach tube exhibited a markedly increased rate of recovery from insulin hypoglycemia over that of animals similarly force fed a high carbohydrate diet. They concluded that the most likely direct cause of the above was the higher level of liver glycogen after a 30 to 36-hour fasting period in the fat-fed animals.

Tidwell and Treadwell (94) were not able to demonstrate any significant differences in the blood ketone levels during fasting periods following both high and low fat diets. They did obtain a significant increase in ketonemia following the feeding of low protein diets, and concluded the preceding protein intake was the major dietary factor affecting the degree of the subsequent fasting ketonemia.

The foregoing observations indicate that the diet received by animals prior to fasting may have a definite influence on the degree of ketonemia and even hypoglycemia during fasting. It also appears that the level of liver glycogen and liver fat must be given consideration in any studies on the possible relationship of preceding diets to the development of a subsequent fasting ketosis.

There are not many data available on the effect of previous diets on ketosis in ruminants. Shaw and Daugherty (87) found that pregnant ewes maintained on low protein diets did not develop hypoglycemia or ketonemia during pregnancy even when the energy intake was limited to 50 per cent of requirements.

Origin of Ketone Bodies, Formation and Utilization

Three substances, acetoacetic acid, beta-hydroxybutyric acid, and acetone, are generally grouped as the acetone bodies. Of these, aceto-acetic acid is the first formed, and is probably the only beta keto acid produced in significant quantities from the oxidation of fatty acids (37). Acetoacetic acid may be readily reduced to beta-hydroxybutyric acid in animal tissues. This reaction is reversible and the direction depends upon the oxygen tension and concentration of the substrates with a quick equilibrium being established in the tissue (37,90,91). Acetone is merely an oxidation product of the first two acetone body substances. It has been well established that the liver is the only important site of ketone body formation. Snapper, Grunbaum and Neuberg (90) and Himrich, *et al.* (33) demonstrated that other tissues, such as kidney, heart, muscle, or brain, may produce ketone bodies in significant amounts but that liver produced many more. Jowett and Quastel (37,38) found that *in vitro*, liver slices produced 10 to 40 times as many ketone bodies as did such tissues as the kidney, spleen and testis. Chaikoff and Soskin (12) found that in the depancreatised dog with a marked ketosis, the ketosis lessened after the removal of the liver. Leites and Odinow (45) showed that hepatotoxic agents used to reduce liver function also decreased the rate of appearance of ketone bodies. Mirsky (50) reported that the pituitary extracts which give a ketogenic effect in intact rabbits do not do so in the absence of the liver.

Acetone bodies are formed from fatty acids, certain amino acids, and pyruvic acid. The amount of acetone bodies from fat so greatly exceeds that from other sources that for practical purposes the amount of ketones may be regarded as an indication of the fat metabolism (91). Raper and Smith (55) demonstrated that perfusion of fatty livers produced more ketones than did livers lower in fat. Stadie, Zapp and Lukens (92) showed that the production of ketones was accompanied by the disappearance of fat in quantities more than enough to account for ketone production on a molar basis.

The oxidation of fat and the formation of ketone bodies was first explained by Knoop's (43) theory of beta oxidation of fatty acids. According to this theory, fatty acids were broken down by the splitting off of two carbon atoms at a time to form acetic acid, which was rapidly oxidized to carbon dioxide and water. Early evidence indicated that ketones were formed only from molecules of fatty acids which had an even number of carbon atoms. It was assumed that the last four carbons in the chain were oxidized at the beta position but did not split, thus one molecule of fatty acid gave rise to one molecule of the ketone regardless of the length of the chain (6,91).

Hurtley (36) looked for the butyric and acetic acids which would be expected to be present in the liver during ketone body formation and could not find them. Hurtley then advanced his theory of multiple alternate oxidation, which proposed that the fatty acid molecule was oxidized at alternate carbon atoms but split into units of four carbon atoms each. If this were the case, a fatty acid would produce one molecule of acetoacetic acid for each four carbon atoms it contained. Deuel, et al. (16,17) found that an animal fed octonoic acid formed more ketones than one fed butyric acid. Jowett and Quastel (38) reported that the amount of ketones formed could not be accounted for if only the last four carbon atoms gave rise to acetoacetic acid. It has been shown that in liver slices and perfused liver in vitro the oxygen consumption was too small to account for production and oxidation of acetic acid (7,92). It has also been shown that in vitro and in intact animals the odd-numbered fatty acids give rise to significant amounts of acetone bodies (37,38,48). The theory of Knoop was not an adequate explanation of these facts, and the above evidence supports Hurtley's hypothesis.

However, there are some serious objections to the multiple alternate oxidation theory. In the first place, if oxidation occurs at every alternate carbon atom, it is difficult to explain why the molecules should split at every fourth carbon instead of every two. Jowett and Quastel (37,38) observed that valeric acid gave rise to ketones. McKay, et al.(48) working with intact animals found that valeric acid produced both glycogen and acetone bodies, while propionic acid led to glycogen formation but produced no acetone bodies. The formation of both glycogen and acetone bodies from a 5-carbon fatty acid can only be explained by assuming that the 3-carbon fragment gives rise to glucose and the 2-carbon compound condenses to form acetoacetic acid. Friedmann (26) in 1913 first demonstrated the condensation of acetic acid to form acetone bodies. In 1940, McKay and his co-workers (48) advanced the theory of beta oxidation-acetic acid condensation. This theory holds that all fatty acid chains are split into 2-carbon fragments except where a 3-carbon chain remains to form propionic acid. The 2-carbon groups then condense to form acetoacetic acid. This hypothesis is the best explanation for the known facts of fatty acid oxidation and ketone body formation.

Burn and Ling (10) were the first to demonstrate that extracts could be obtained from the anterior lobe of the pituitary which would produce a ketosis in fasting rats or rabbits or in such animals receiving a high fat diet. Mirsky (50) confirmed the observation that the anterior pituitary extract caused a rise in blood acetone bodies in intact animals but had no ketogenic effect in the absence of the liver. Mirsky concluded that the anterior lobe principle increased the rate of hepatic glycogenolysis and resulted in less glycogen being available for oxidation by the liver. The increased production of acetone bodies is then due to the increased catabolism of fatty acids when carbohydrate utilisation is decreased.

Mirsky (51) also found that in fasted, adrenalectomised rats injected with extracts of the anterior pituitary no ketonuria developed. The ketonemia of such rats was actually somewhat higher than that observed in intact rats similarly fasted and injected with anterior pituitary extract. Mirsky suggested that the adrenal gland was not necessary for the ketogenic action of the pituitary and that an increased renal threshold for acetone bodies in the absence of the adrenal accounted for the absence of ketonuria.

Insulin decreases the ketosis in the diabetic. This is probably due to the fact that insulin promotes the deposition of liver glycogen and prevents the deposition of liver fat in the diabetic organism. In normal animals there is no evidence that insulin causes an increase in liver glycogen. Actually there may be a loss of liver glycogen caused by insulin injection in the normal animal. Such a loss of liver glycogen may result in increased fat oxidation in the liver, and a rise in ketone production (6).

Acetone bodies are metabolised by many of the body tissues and may provide a considerable part of the energy used by the animal. Chaikoff and Soskin (12) and Stadie, Zapp and Lukens (92) have shown that the acetone bodies are utilised by the tissues of animals with diabetes.

Barnes, _et al_. (1) found that the isolated heart and lung preparations of the dog and goat utilised beta-hydroxybutyric acid. They observed no relation to blood sugar level, but found that oxidation of beta-hydroxybutyric acid increased as its concentration increased up to 100 milligrams per 100 milliliters. Metabolism of beta-hydroxybutyric acid could account for as much as 80 per cent of the total metabolism. Barnes, _et al_.(2) also reported that animals in ketosis due to phloridzin or pancreatic diabetes could utilise as many ketones as could normal animals.

Wick and Drury (97) found that the rate of utilisation of beta-hydroxybutyric acid depended on its concentration in the blood up to the point where utilisation of this substance consumed about 90 per cent of the oxygen used by the animal. Shaw (79) reported the mammary gland of the cow with ketosis used twice as much beta-hydroxybutyric acid as did the gland of the normal cow. Enough beta-hydroxybutyric acid was taken from the blood of the cow with ketosis to account for over 90 per cent of the oxygen consumed if the ketone substance was completely oxidized. Acetoacetic acid was not used by the mammary gland of the dairy cow. The evidence available indicates that except for the needs of the central nervous system the acetone bodies can supply energy in any case where glucose is ordinarily employed.

The acetone bodies are no longer considered abnormal products formed only when there is a failure of carbohydrate metabolism, but are a result of the oxidation of fat in the liver and may have no relationship with carbohydrate oxidation.

PROCEDURE

Twenty-eight cows from the University herd were used in this experiment. Several more cows were started on the test rations but had to be dropped because of abortion, failure to conceive, or mastitis. Thirteen Holstein Friesian, eight Guernsey, four Ayrshire, and three Jersey cows were included in the group. It had been planned to avoid the use of first-calf heifers, but three such heifers were added near the end of the experiment in order to increase the number of cows available. Distribution of the various rations and treatments was made as evenly as practicable with respect to age, breed and production. The incidence of spontaneous ketosis has been very low in the University herd, and none of the cows used in these tests had any record of ketosis.

Table I gives the experimental number, name, breed, date of birth, and experimental dates, concentrate mixture, and postpartal treatment of the cows used in this study.

All but the last six cows were started on the experimental regime approximately six months before the expected parturition. It was this start, so soon after the breeding date, that made it uncertain as to whether all cows were pregnant. This also meant that the cows were being overfed for the last four months of the lactation period.

TABLE I

Experimental Animals

Experimental Number	Name	Breed	Date of Birth	Experimental Calving Date	Concentrate Mixture Fed	Treatment Postpartum
1	VALENCIA	Jersey	3-19-42	5- 5-48	1	Fasted, 14 days
2	ADVENTURESS	Ayrshire	11-21-44	8- 1-48	1	Fasted, 14 days
3	BOUNTY	Holstein	1-25-43	9-12-48	1	Fasted, 10 days
4	BONITA	Holstein	8-15-43	5-20-48	1	Full fed
5	FAITH	Holstein	6-30-45	8- 7-48	1	Full fed
6	PEGGY	Guernsey	5- 2-42	11-30-48	1	Full fed
7	BUNNY	Guernsey	11-21-44	6-27-48	2	Fasted, 14 days
8	REMEMBRANCE	Holstein	12- 6-43	8-30-48	2	Fasted, 10 days
9	PATIENCE	Guernsey	3-16-42	12-24-48	2	Fasted, 7 days
10	LAURA	Ayrshire	9-17-38	2-23-49	2	Fasted, 10 days
11	MELANIE	Holstein	2-25-43	3-12-49	2	Fasted, 10 days
12	ARABELLA	Holstein	11-11-41	5-14-49	2	Fasted, 10 days
13	DORCAS	Holstein	7- 8-40	7- 2-48	2	Full fed
14	ACACIA	Ayrshire	5- 5-44	8-22-48	2	Full fed
15	POMONA	Guernsey	7-27-43	12-31-48	2	Full fed
16	CHARM	Holstein	5-10-44	4- 6-49	2	Full fed
17	HILDA	Guernsey	2-16-47	4-17-49	2	Full fed
18	MARTHA	Holstein	6-20-42	6-13-48	3	Fasted, 14 days
19	BETH	Guernsey	2-20-44	8-20-48	3	Fasted, 11 days
20	LIZZIE	Guernsey	10-10-41	12-23-48	3	Fasted, 10 days
21	ELINOR	Holstein	11- 3-45	3-22-49	3	Fasted, 10 days
22	BARBARA	Guernsey	7- 2-45	5- 4-49	3	Fasted, 10 days
23	DEE	Holstein	2- 1-40	7- 2-48	3	Full fed
24	ESMERALDA	Holstein	2-16-45	8-26-48	3	Full fed
25	RUBY	Holstein	5-12-44	12-18-48	3	Full fed
26	ANXIETY	Jersey	3-27-45	4- 8-49	3	Full fed
27	VIRGINIA	Jersey	12-27-46	4-16-49	3	Full fed
28	CANARY	Ayrshire	1-22-47	5-20-49	3	Full fed

VALENCIA, 50 per cent fast. All other fasted cows, 65 per cent fast. Full fed cows allowed 70 per cent of requirements the first week postpartum, 80 per cent the second week

Concentrate mixture - 1 Medium Protein
Concentrate mixture - 2 Low Protein
Concentrate mixture - 3 High Protein

The first 13 cows were started on a total digestible nutrient intake of 140 per cent of the Morrison Standards (52) for maintenance and production. The intake was raised, where possible, to 180 per cent 30 to 60 days prior to the end of the lactation period. It had been planned to start at a level of 150 per cent of requirements six months prepartum and raise the ration to 180 per cent 60 days later, but as it was not possible to get the cows to consume this much, the initial level was dropped to 140 per cent and intake was raised to 180 per cent when the cows would take it. All cows were fed the basal or medium protein concentrate mixture until the end of lactation.

Nine cows were fed up to the dry period at a level of 170 per cent of requirements for maintenance, plus 100 per cent of requirements for milk production. This proved to provide about the same rate of intake as 140 per cent of maintenance and production requirements. These nine cows also all received the medium protein concentrate ration until the dry period.

The first 22 cows were fed a fair quality timothy hay at the rate of one pound per 100 pounds body weight daily from the commencement of the experimental period until parturition. Corn silage was fed at the rate of 2 pounds per 100 pounds of body weight for the first 9 months of the experiment. At this time the supply of corn silage was exhausted and citrus pulp was substituted at a rate of one-half pound per 100 pounds body weight per day. Timothy hay and corn silage were used to provide a roughage allowance consistently low in protein, and protein intake was varied by the use of the low, medium or high protein concentrate rations. Citrus pulp, though too high in total digestible nutrients and too low in fiber to be considered a roughage, also furnishes very little digestible protein. After silage feeding was discontinued each cow was given 1 pound of dehydrated alfalfa leaf meal per day to guard against any vitamin A deficiency.

At the beginning of the dry period the total digestible nutrient intake was raised to 200 per cent of the Morrison Standard for maintenance and feeding at this level continued until parturition. The feeding of the high and low protein concentrate mixtures was started as the cows were dried off 60 days before the expected date of parturition. Six cows were maintained on the medium protein ration; all of the rest were given either a high or low protein mixture for the duration of the experimental period.

The last 6 cows to go on the trials were started 60 days prepartum and were immediately fed either the high or low protein rations. These cows were fed at a level of 100 per cent of Morrison's (53) new recommendation for cows in late pregnancy. They received only the concentrate mixtures and 1.5 pounds of timothy hay per 100 pounds of body weight.

Eleven cows received the high protein concentrate prepartum, eleven the low protein concentrate, and six received the medium protein concentrate ration.

On the day of parturition the cows were offered a ration equivalent to 100 per cent of the maintenance requirement with no allowance for milk production. The cows usually failed to clean up even this small allowance on the day of calving.

After parturition 14 cows were "full fed" and 14 were fasted. The "full fed" cows received 70 per cent of requirements for maintenance and milk production the first week, 80 per cent the second week, and 100 per cent thereafter. It was not considered possible to get all of the cows to consume 100 per cent of requirements immediately postpartum, so the ration was fixed at 70 and 80 per cent for the first two weeks in order to be fairly certain that all the cows would consume approximately equal rations. The first cow fasted received 50 per cent of requirements for the first two weeks postpartum. It was then decided to make a more severe fast and all fasted cows thereafter received only 35 per cent of requirements for production and maintenance for ten days to two weeks, after which the ration was raised to 100 per cent of requirements. Fasted cows received one-half pound of timothy hay per 100 pounds live weight per day and the silage or citrus pulp allowance was also halved during fasting.

All of the concentrate mixtures used were designed to be palatable and high in total digestible nutrients. The mixtures were made up as shown in Tables II, III, and IV. Total digestible nutrients, digestible protein, fat and fiber as well as the constituents, are given as pounds per 100 pounds of the mixture.

It may be noted from Tables II, III and IV that all the mixtures contained more than 5 per cent fat and were low in fiber. These rations contained somewhat more fat than the usual concentrate mixtures fed to dairy cows. The estimation of nutrients, made before chemical analysis and feeding, was based on average analyses and digestion coefficients for the component feedstuffs as given by Morrison (52) Chemical analyses and recalculated nutrient values are given in Table XXXIII of the Appendix.

TABLE II

Mixture 1. - Medium Protein Concentrate

Constituents	Pounds	TDN	Digestible Protein	Fat	Fiber
Distillers' grains	30	25.50	6.69	3.18	3.24
Corn meal	18	14.51	1.28	.70	.40
Oats, crushed	35	25.03	3.29	1.65	3.71
Molasses	15	10.17	.06	-	-
Bone meal	1				
Salt	1				
Total	100	75.21	11.32	5.53	7.35

TABLE III

Mixture 2. - Low Protein Concentrate

Constituents	Pounds	TDN	Digestible Protein	Fat	Fiber
Corn and cob meal	50	37.95	3.0	1.65	4.10
Oats, crushed	33	23.60	3.1	1.55	3.50
Molasses	15	10.17	.06		
Bone meal	1				
Salt	1				
Total	100	71.72	6.16	3.20	7.60
Cottonseed oil to be added before feeding	2.5	5.63	-	2.5	-
Total	102.5	77.35	6.16	5.70	7.60

TABLE IV

Mixture 3. - High Protein Concentrate

Constituents	Pounds	TDN	Digestible Protein	Fat	Fiber
Corn meal	5	4.03	.30	0.20	0.11
Oats, crushed	23	16.45	2.16	1.08	2.44
Distillers' grains	25	21.25	5.58	2.65	2.70
Linseed oil meal	30	23.24	10.05	1.68	2.25
Molasses	15	10.17	.06		
Bone meal	1				
Salt	1				
Total	100	75.14	18.15	5.61	7.50

The medium protein mixture was prepared in bulk by a commercial supplier and the same mix was used throughout the entire feeding period. The high protein mixture was prepared in a smaller quantity at the University barns, and three mixes were used. The low protein did not keep well in warm weather, due to the added oil and high content of corn and cob meal, and it was necessary to prepare three mixes of this ration.

Any feed refused by the cows was weighed back and the nutrient intake was later calculated on the basis of feed actually consumed.

The cows were weighed when placed on the experiment and once weekly until parturition. They were weighed immediately after calving and twice weekly for two weeks thereafter. Milk samples were taken one day each week for butterfat determination before the cows were dry. After parturition daily butterfat determinations were made. Rations were calculated, according to body weight and production, once a week before parturition and daily after parturition. All rations were calculated on the basis of total digestible nutrients.

Blood samples were drawn once a week beginning a month before the expected calving date. Blood was drawn on the day of parturition and twice weekly thereafter. Potassium oxalate was used as the anticoagulant, and sodium fluoride and thymol were used as preservatives for the blood.

Blood glucose values were determined by the method of Shaffer, Hartmann and Somogyi (44) and acetone bodies by the method of Barnes and Wick (3).

Liver samples were taken by biopsy for glycogen and fat determinations and histopathologic studies. Liver biopsies were made one week before and a week or ten days after parturition. Liver samples for glycogen analyses were immediately weighed into KOH and glycogen was determined by the method of Good, Kramer, and Somogyi (44).

Observations were made as to the degree of fatness, weight gain and general condition of the cows. Particular attention was paid to the health and condition of the udder, as it was considered possible that such heavy concentrate feeding might cause edema and undue congestion of the mammary gland. Calves were removed immediately after parturition and the cows were milked out. No access to pasture was allowed at any time during this experiment, although the cows were turned into a small exercise lot daily. Salt and water were available at all times. Cows were machine milked twice daily and all milk weights were recorded.

RESULTS

Blood Sugar and Acetone Bodies

Blood sugar and acetone body levels for all cows are presented graphically in Figures 1 to 28 and all data are given in tabular form in Tables V to XXXII in the appendix.

All cows on all rations maintained normal blood sugar levels until the onset of lactation. Acetone body levels were also normal up until the time of parturition. Various levels of protein intake did not affect any significant difference in blood sugar or acetone body values prior to calving.

Average blood sugar levels increased considerably at the time of parturition. Twenty-four blood samples taken within less than 24 hours of parturition averaged 53.17 milligrams of sugar per 100 milliliters of blood with a range of from 44.53 to 79.36 milligrams per 100 milliliters. No attempt was made to be with the cows and draw blood samples immediately after parturition, thus samples from a cow calving in the late afternoon or during the night were not taken until the following morning, sometimes as long as 12 to 16 hours after the birth of the calf. It is probable the average blood sugar would have been higher if all blood samples had been drawn directly at parturition.

Blood sugar and acetone body values for three cows fed the medium protein rations and fasted after parturition are shown in Figures 1 to 3 and Tables V to VII. Cow 1 was restricted to 50 per cent of requirement for 14 days postpartum. This cow developed a marked hypoglycemia by the seventh day of fast, which continued until the end of the fasting period. Fasting at the 50 per cent level did not produce a marked ketonemia. The highest blood acetone body value was 9.28 milligrams per 100 milliliters on the ninth day of fasting. Cow 1 was slaughtered for use in histopathologic studies at the end of the fasting period. Cow 2 and 3, restricted to 35 per cent of requirements during fasting, developed a more marked hypoglycemia and ketonemia. Blood sugar levels fell to below 20 milligrams per 100 milliliters and ketone body values went as high as 25 milligrams per 100 milliliters. When rations were restored to 100 per cent after the fast, blood sugar and ketone body levels quickly returned to normal.

Figures 4 to 6 and Tables VIII to X give the blood sugar and ketone values for three cows fed the medium concentrate mixture and allowed 70 per cent of requirements for the first week postpartum and 80 per cent the second week. All three cows maintained near normal blood sugar values and ketonemia was slight. Blood sugar levels fell below 40 milligrams per 100 milliliters from the fourth to seventh day but were back to normal by the tenth day postpartum. The rise after the seventh day is probably due, at least in part, to the increased feed allowance during the second week.

Blood sugar and acetone body data for six fasted cows fed the low protein rations are shown in Figures 7 to 12 and Tables XI to XVI. Cow 9 developed pneumonia,and cow 10 a severe metritis and did not show hypoglycemia or ketonemia, though restricted to a ration of 35 per cent of requirements. The other four cows in this group developed hypoglycemia and ketonemia of the same order of magnitude as did the fasted cows on the medium protein ration. Cow 7 was slaughtered at the end of the fasting period. Cows 8, 11 and 12 did not recover from the fasting hypoglycemia as rapidly as did fasted cows fed the medium protein ration.

Hypoglycemia and ketonemia persisted in cow 11 for more than a month after the end of the fast and blood values did not return to normal until the cow was turned to pasture. Normal blood sugar and ketone body levels were regained in cows 8 and 12 within two weeks after the return to full feed.

Figures 13 to 17 and Tables XVII to XXI show the blood sugar and acetone body data for five cows fed the low protein concentrate mixture and allowed 70 and 80 per cent of requirements for the first two weeks postpartum. Cows in this group showed somewhat more variation in blood sugar levels postpartum than did the cows fed the medium protein rations, but all but one maintained fairly high levels of blood sugar and were normal by the end of the second week postpartum. Only one cow showed a marked ketonemia. This cow, number 16, developed a marked hypoglycemia and ketonemia by the seventh day postpartum. After the first week the blood sugar gradually increased and exceeded 45 milligrams per 100 milliliters by the twentieth day. Blood acetone bodies returned to below 5 milligrams per 100 milliliters by the seventeenth day postpartum.

Cow 13 lost twin calves 25 days before the expected date of parturition and made a poor lactation response. Blood sugar values of this cow remained high after the onset of lactation.

Blood sugar and acetone body data for five cows fed the high protein concentrate and fasted at a level of 35 per cent of requirements are shown in Figures 18 to 22 and Tables XXI to XXVI. Cow 18 had acute mastitis after parturition and did not show a low blood sugar or high blood ketones, though fasted for 14 days. Cows 19, 20, 21 and 22 all showed marked hypoglycemia and ketonemia by the third to seventh day postpartum. Cow 20 recovered normal blood sugar and ketone levels quickly after the cessation of fast. Cow 19 showed a sharp rise in blood sugar and a fall in blood ketones the first day after full feeding was resumed, but blood sugar fell again and did not again reach a normal level until 11 days after the end of the fast. Cows 21 and 22 also showed a slow recovery from the fasting hypoglycemia and ketonemia.

Figures 23 to 28 and Tables XXVII to XXXII show the blood sugar and acetone body data for six cows fed the high protein rations and 70 and 80 per cent of requirements for the first two weeks following parturition. Cow 23 had mastitis and the blood sugar level remained fairly high after parturition. Cow 24, as was the case with cow 16 fed the low protein ration, developed a considerable hypoglycemia and ketonemia by the seventh day after parturition. Blood sugar remained somewhat low and a mild ketonemia persisted for about three weeks postpartum in cow 24. The other "full fed" cows maintained nearly normal blood sugar and only mildly elevated acetone body levels and were completely normal two weeks after parturition.

There was no significant difference in the degree of hypoglycemia or ketonemia reached during fasting by the cows on various protein intakes. The peak of fasting ketonemia and hypoglycemia was reached on the tenth day of fasting, which was the last day of fast for most of the cows. The hypoglycemia was fully as severe as that noted in field cases of ketosis, but the fasting ketonemia was not so high as that often found in field cases. Considerable difficulty was encountered in getting several of the fasted cows on the low and high protein rations back on feed after the fast. This was probably responsible for the slow recovery from the fasting ketonemia and hypoglycemia observed in several cows.

The various levels of protein intake had no effect on the ability of the cows "full fed" postpartum to maintain normal levels of blood sugar and ketones. There was considerable variation among individual cows. Average blood sugar for all cows fell below 40 milligrams per 100 milliliters of blood for the first ten days after calving and there was a slight elevation in blood ketones, thus the 70 per cent per hundredweight of requirements fed the first week failed to maintain a blood picture that is considered normal. By the end of the second week after calving, after a week of 80 per cent feeding, average blood sugar levels were above 40 milligrams per 100 milliliters. Where cows will consume more than 70 per cent of requirements immediately postpartum it would appear probable that a fall in blood sugar could be avoided.

Average blood sugar and blood acetone body levels for all cows are shown in Tables LXII - LXV on pages 142 and 145 in the Appendix. Analysis of variance (Tables LXVI - LXXI) showed no significant difference in blood sugar and acetone bodies due to level of protein feeding either before or after parturition. A comparison of fasting and full feeding postpartum (Tables LXXII and LXXIII) revealed a highly significant decrease in blood sugar and a highly significant increase in blood acetone bodies due to fasting.

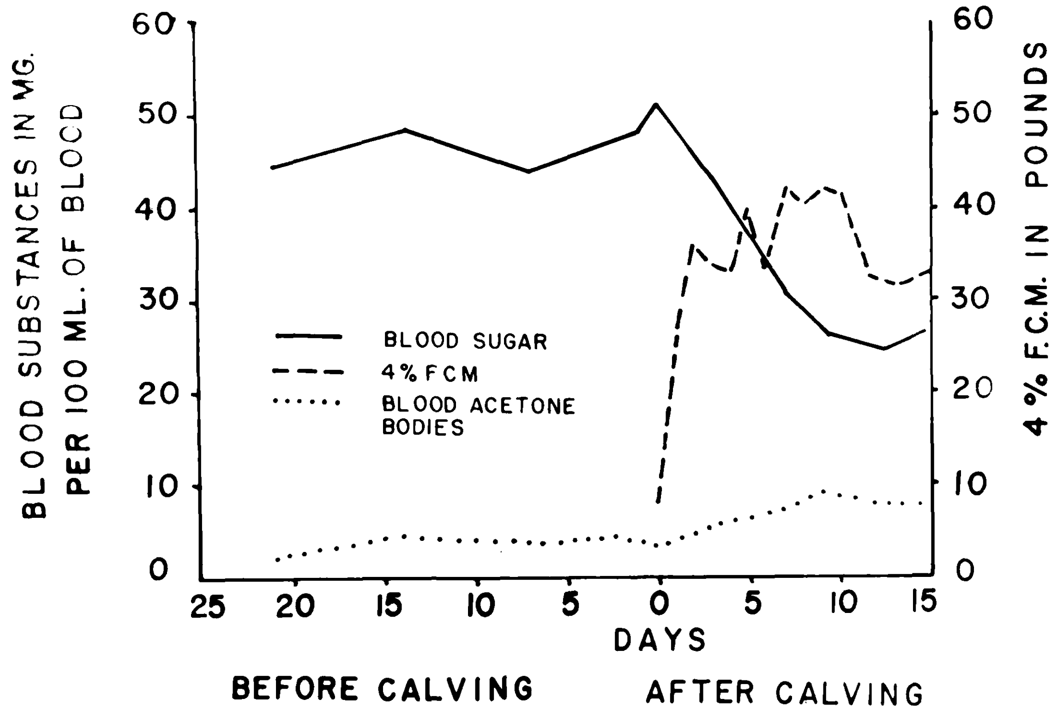

Figure 1. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for VALENCIA, fed Medium Protein Concentrate and Fasted at 50 per cent of Standard for 14 Days Postpartum

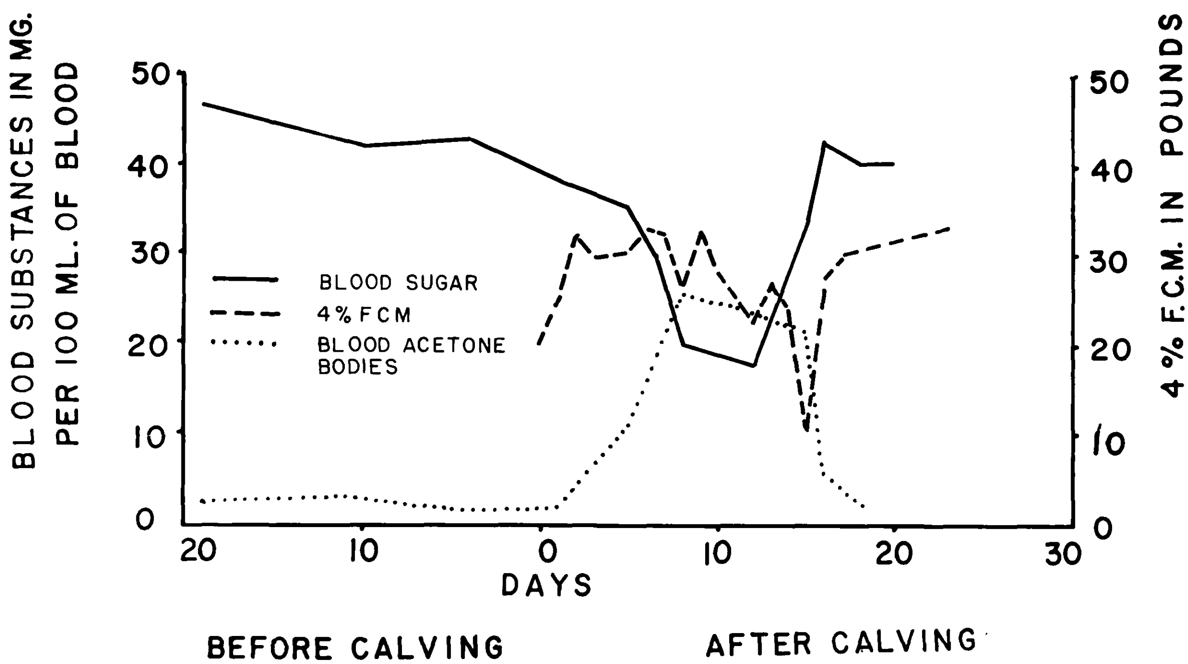

Figure 2. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for ADVENTURESS, fed Medium Protein Concentrate and Fasted at 35 per cent of Standard for 14 Days Postpartum

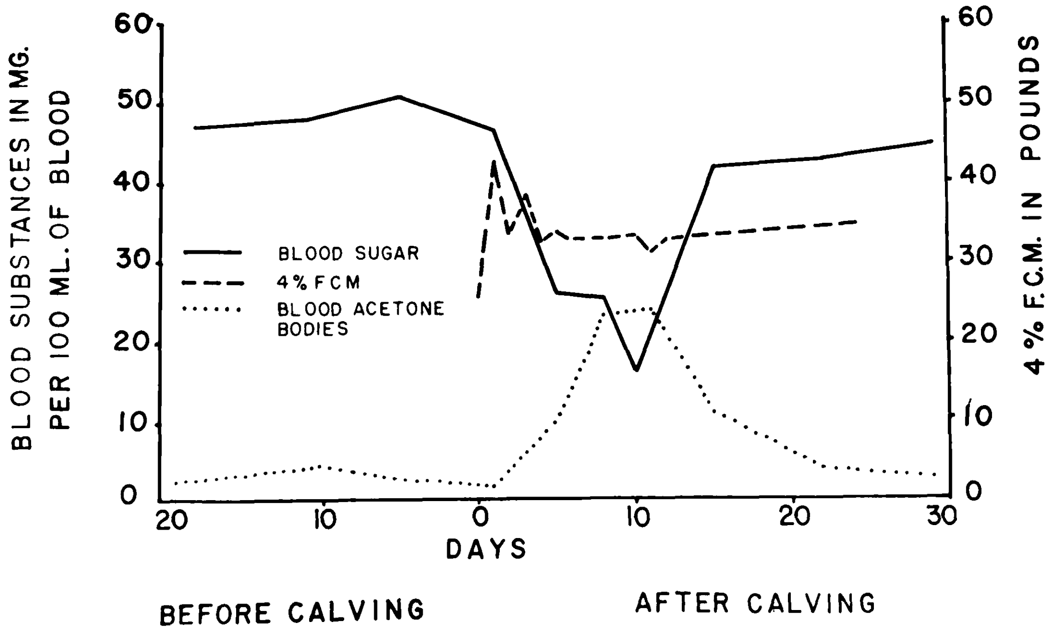

Figure 3. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for BOUNTY, fed Medium Protein Concentrate and Fasted at 35 per cent of Standard for 10 days Postpartum

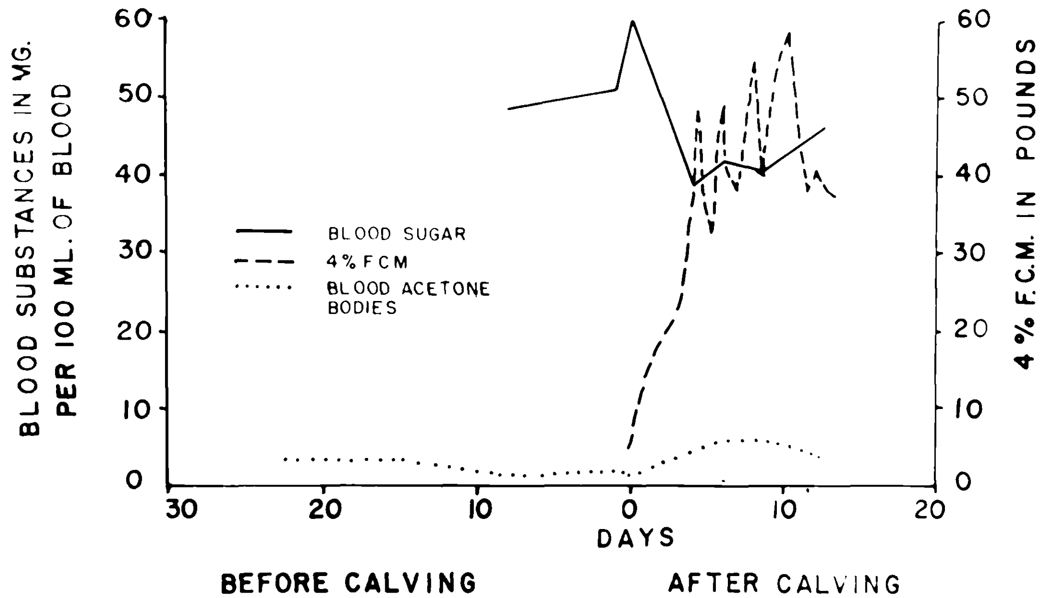

Figure 4. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for BONITA, fed Medium Protein Concentate and Full Fed Postpartum

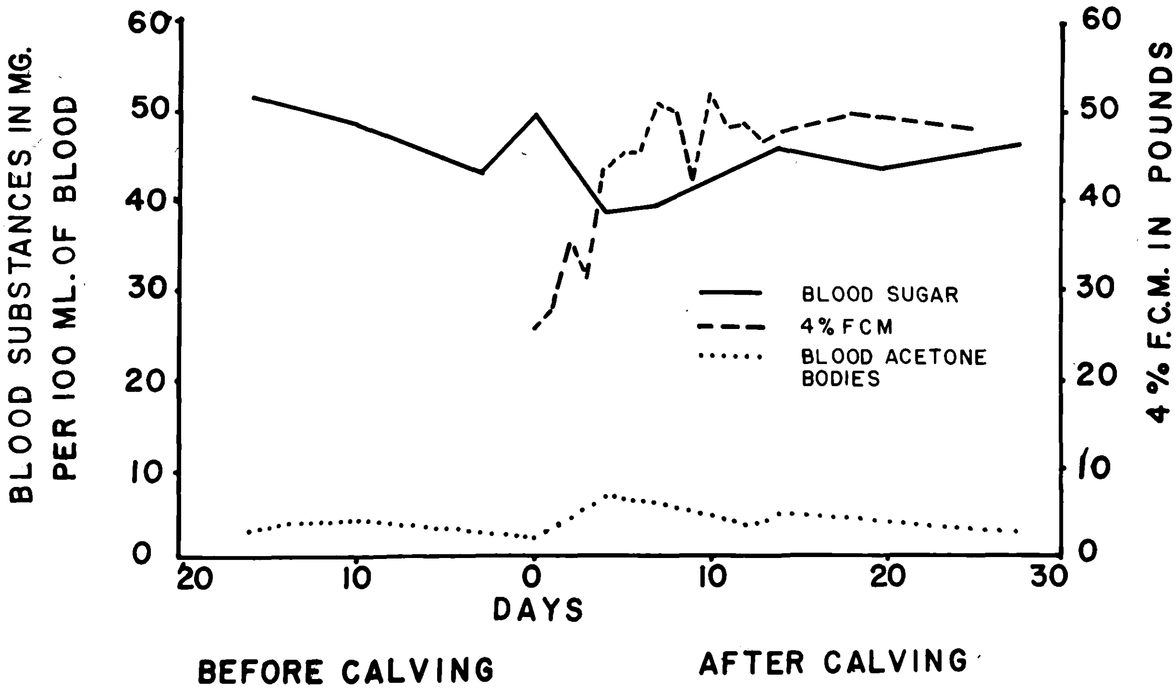

Figure 5. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for FAITH, fed Medium Protein Concentrate and Full Fed Postpartum

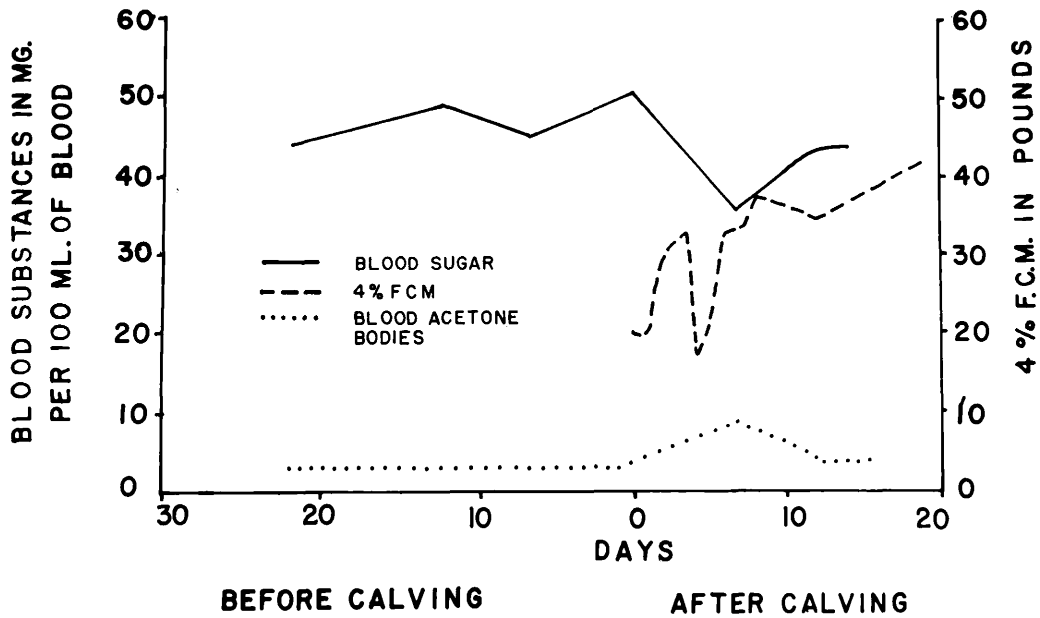

Figure 6. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for PEGGY, fed Medium Protein Concentrate and Full Fed Postpartum

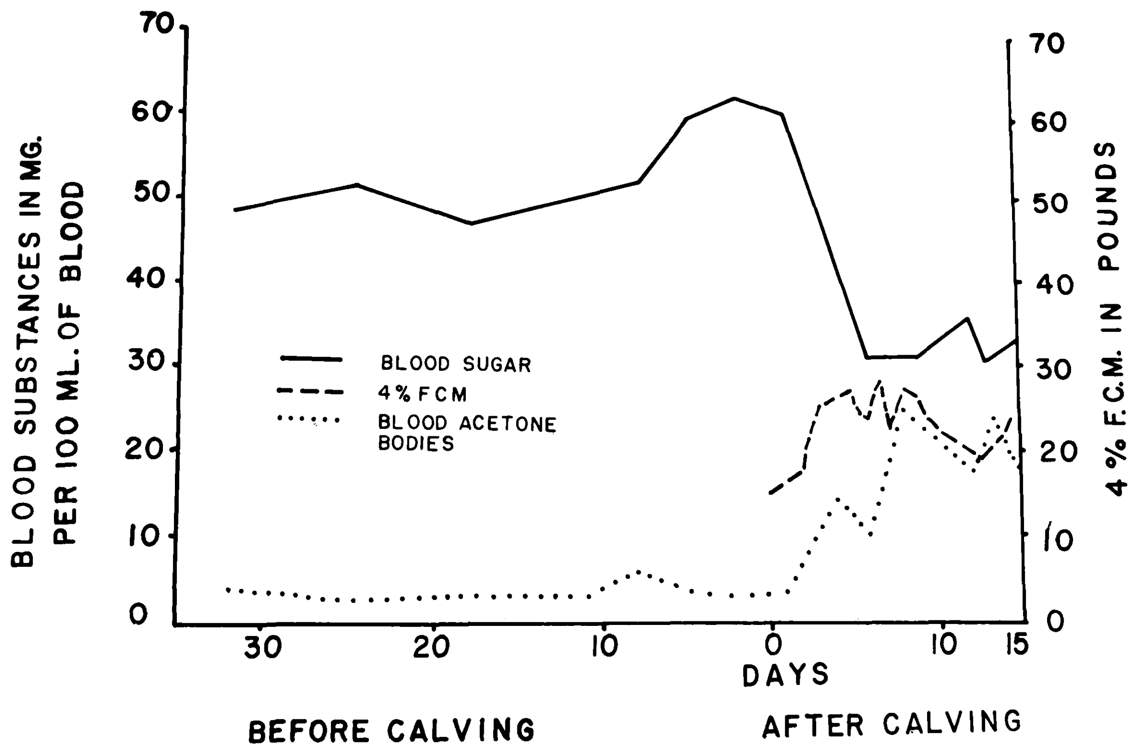

Figure 7. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for BUNNY, fed Low Protein Concentrate and Fasted at 35 per cent of Standard for 14 Days Postpartum

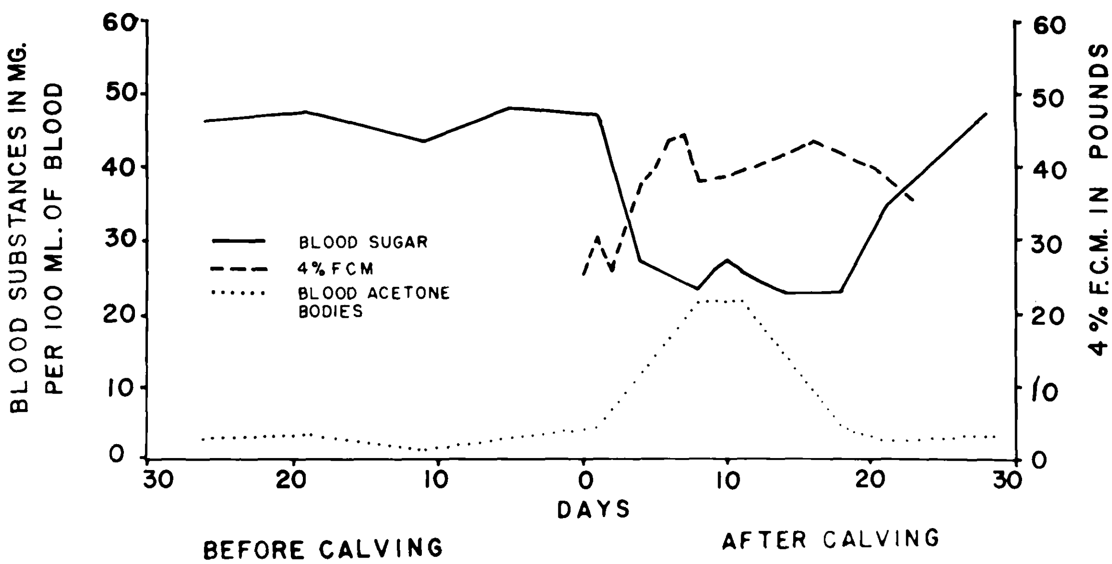

Figure 8. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for REMEMBRANCE, fed Low Protein Concentrate and Fasted at 35 per cent of Standard for 10 Days Postpartum

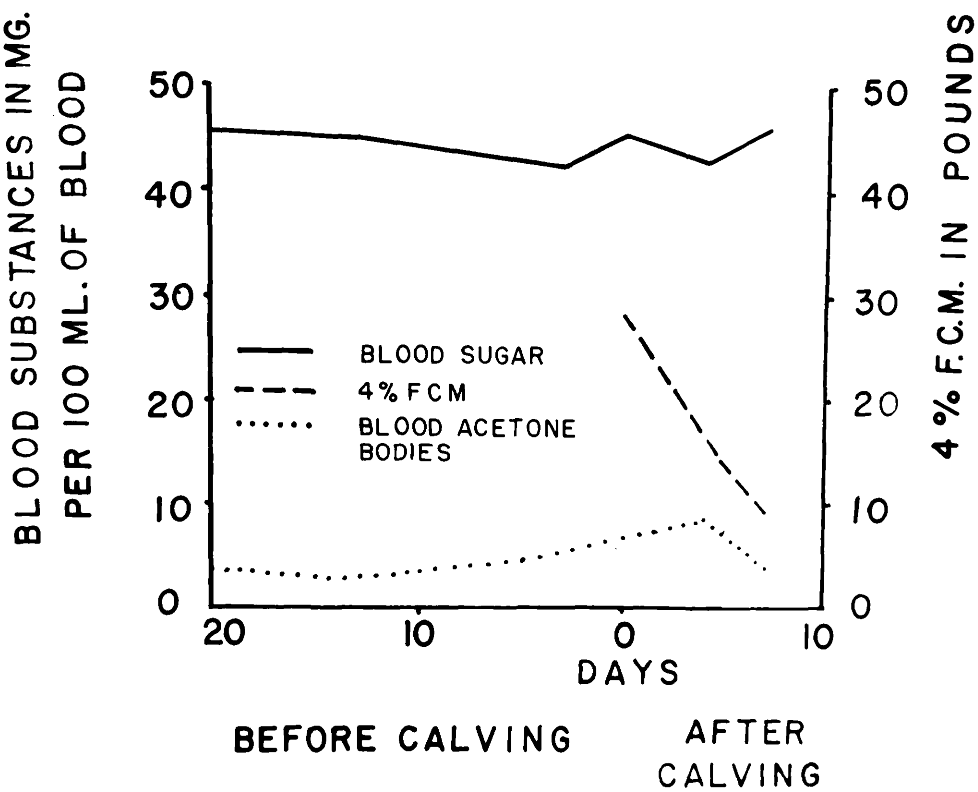

Figure 9. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for PATIENCE, fed Low Protein Concentrate and Fasted at 35 per cent of Standard for 7 Days Postpartum

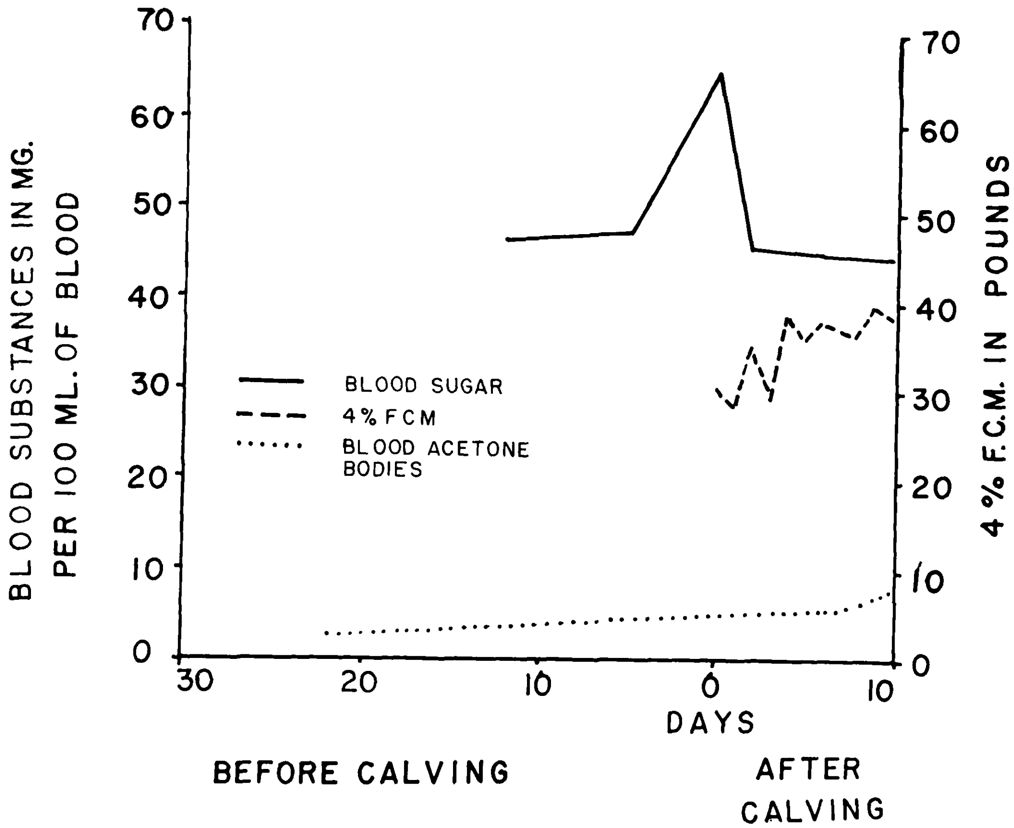

Figure 10. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for LAURA, fed Low Protein Concentrate and Fasted at 35 per cent of Standard for 10 days Postpartum

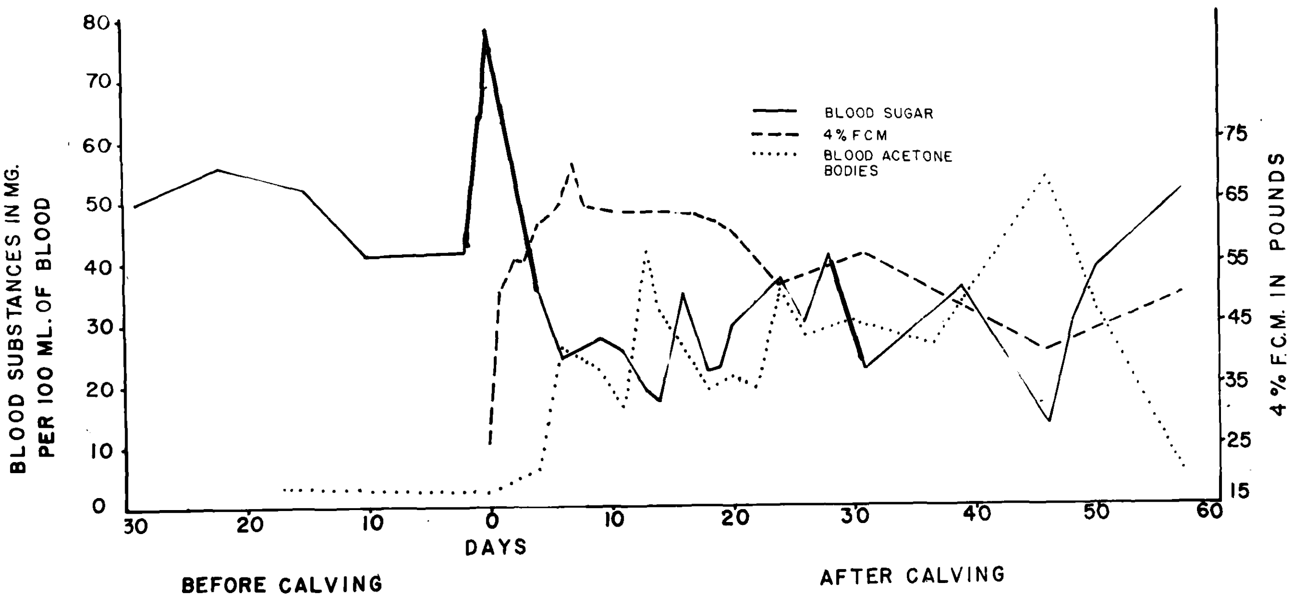

Figure 11. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for MELANIE, fed Low Protein Concentrate and Fasted at 35 per cent of Standard for 10 Days Postpartum.

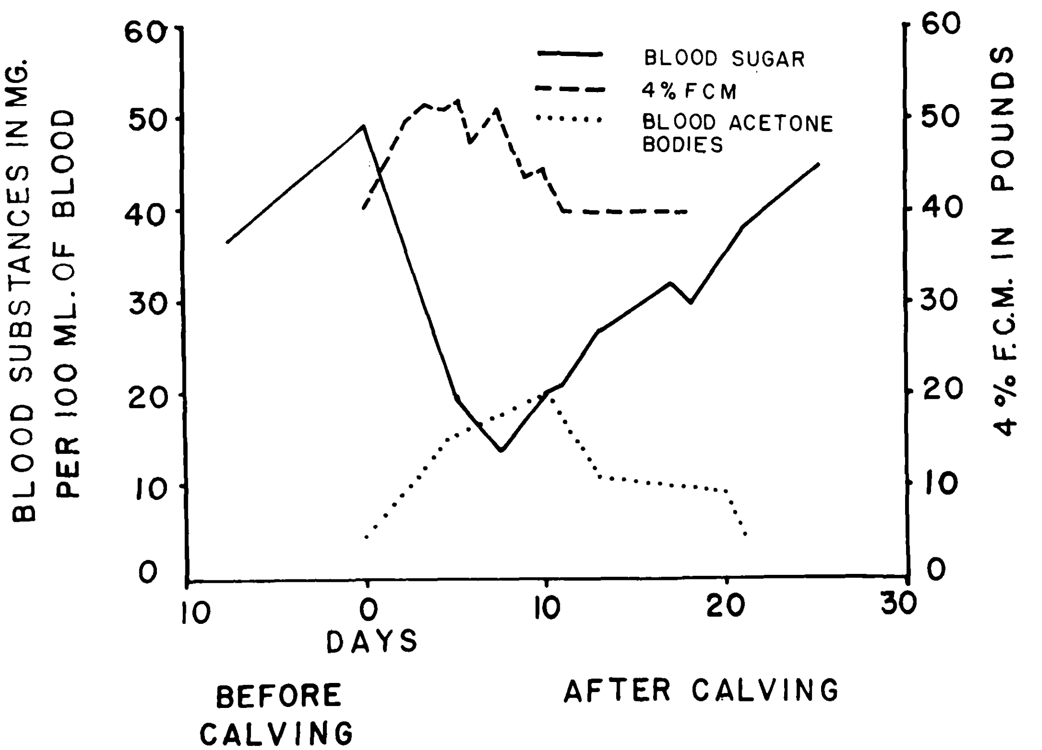

Figure 12. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for ARABELLA, fed Low Protein Concentrate and Fasted at 35 per cent of Standard for 10 Days Postpartum

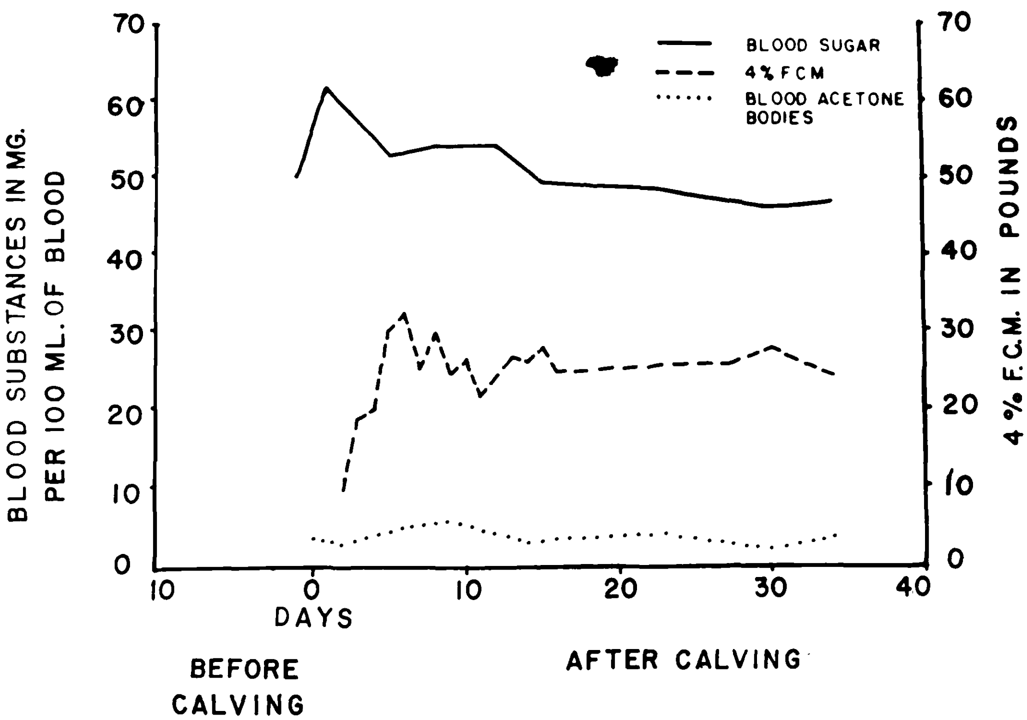

Figure 13. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for DORCAS, fed Low Protein Concentrate and Full Fed Postpartum

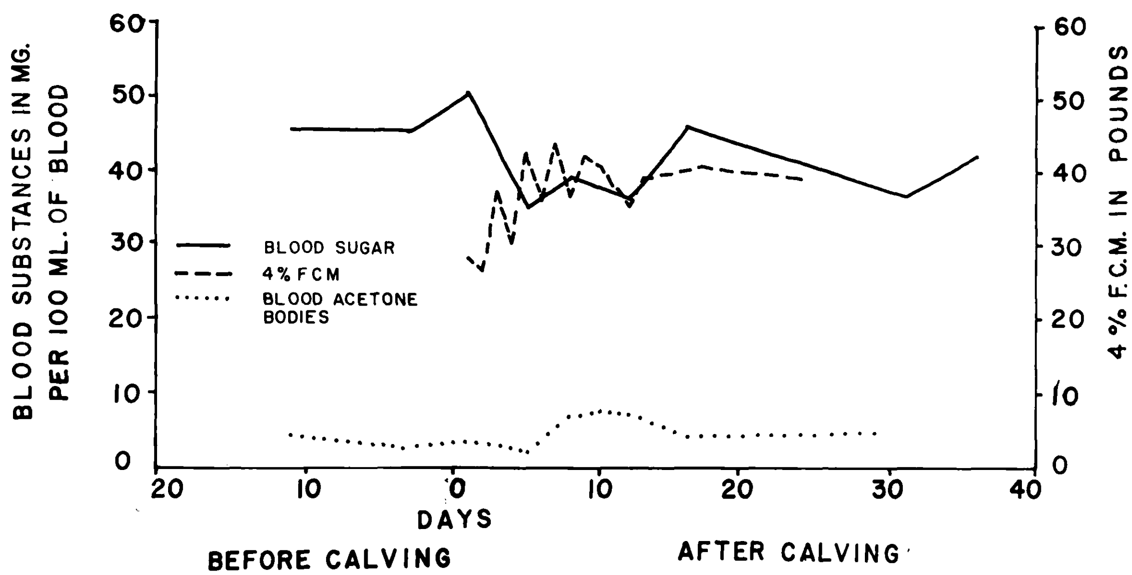

Figure 14. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for ACACIA, fed Low Protein Concentrate and Full Fed Postpartum

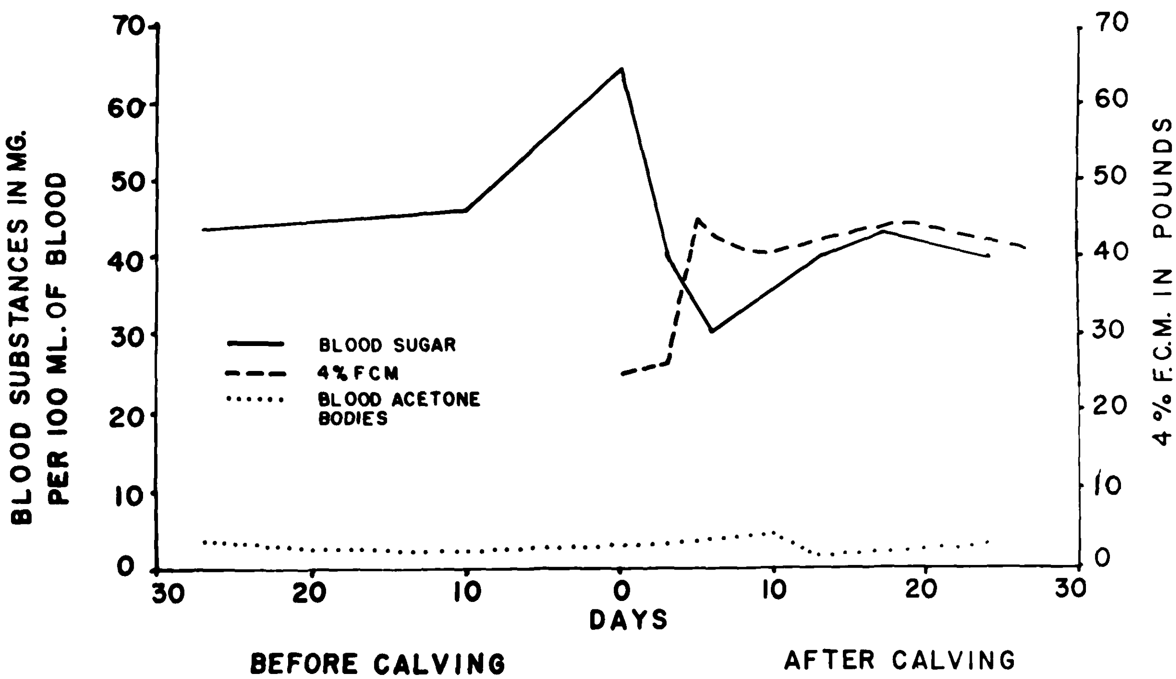

Figure 15. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for POMONA, fed low Protein Concentrate and Full Fed Postpartum

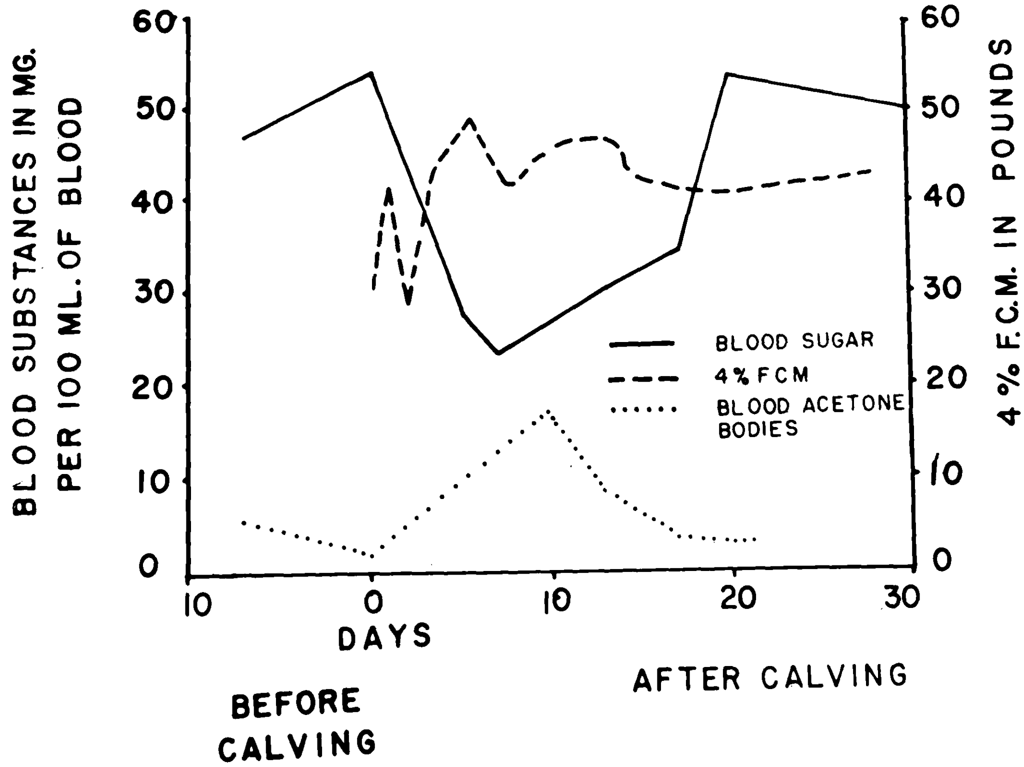

Figure 16. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for CHARM, fed Low Protein Concentrate and Full Fed Postpartum

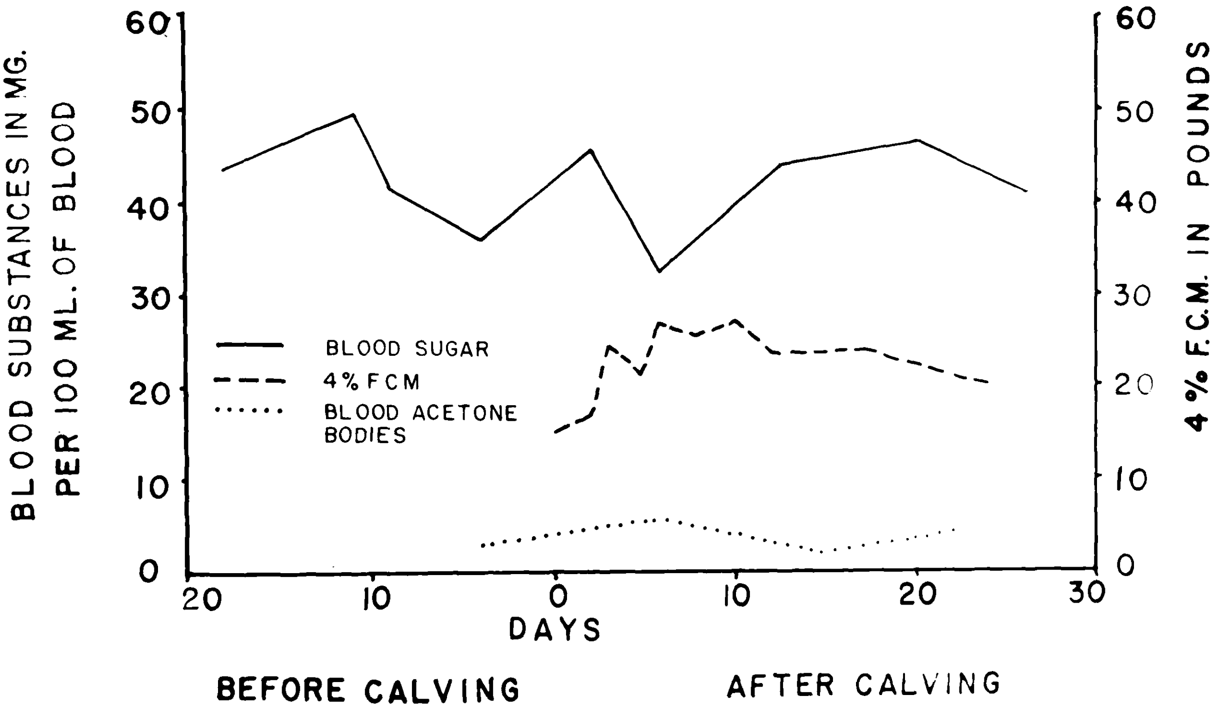

Figure 17. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for HILDA, fed low Protein Concentrate and Full Fed Postpartum

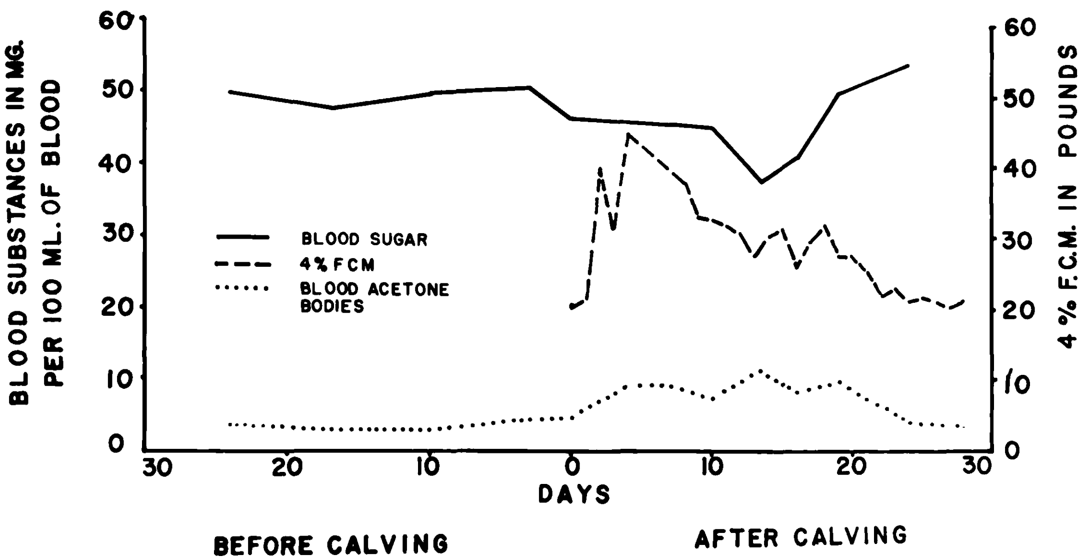

Figure 18. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for MARTHA, fed High Protein Concentrate and Fasted at 35 per cent of Standard for 14 Days Postpartum

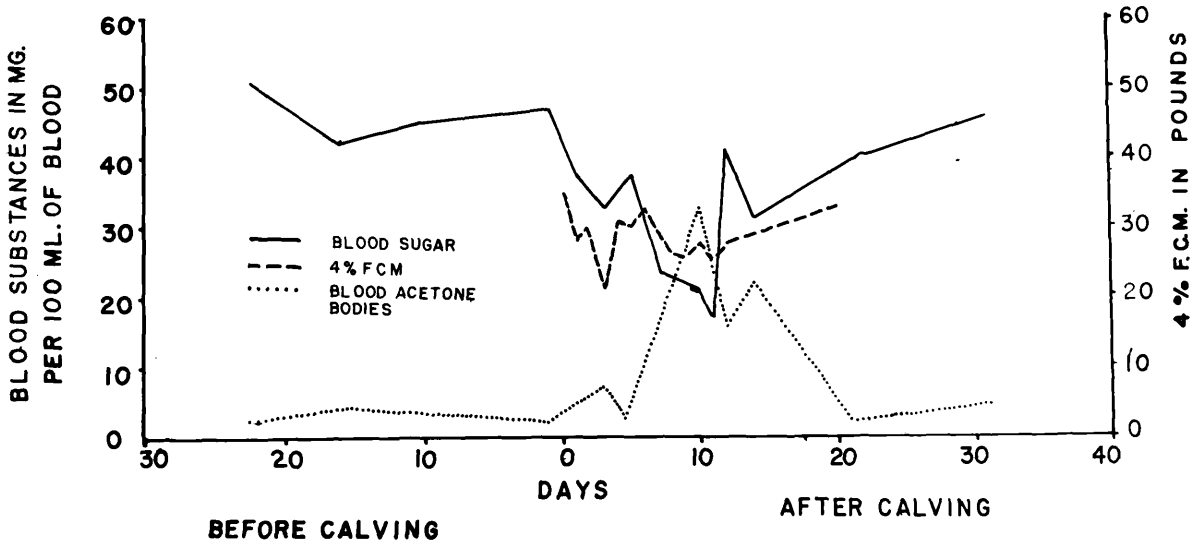

Figure 19. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for BETH, Fed High Protein Concentrate and Fasted at 35 per cent of Standard for 11 Days Postpartum

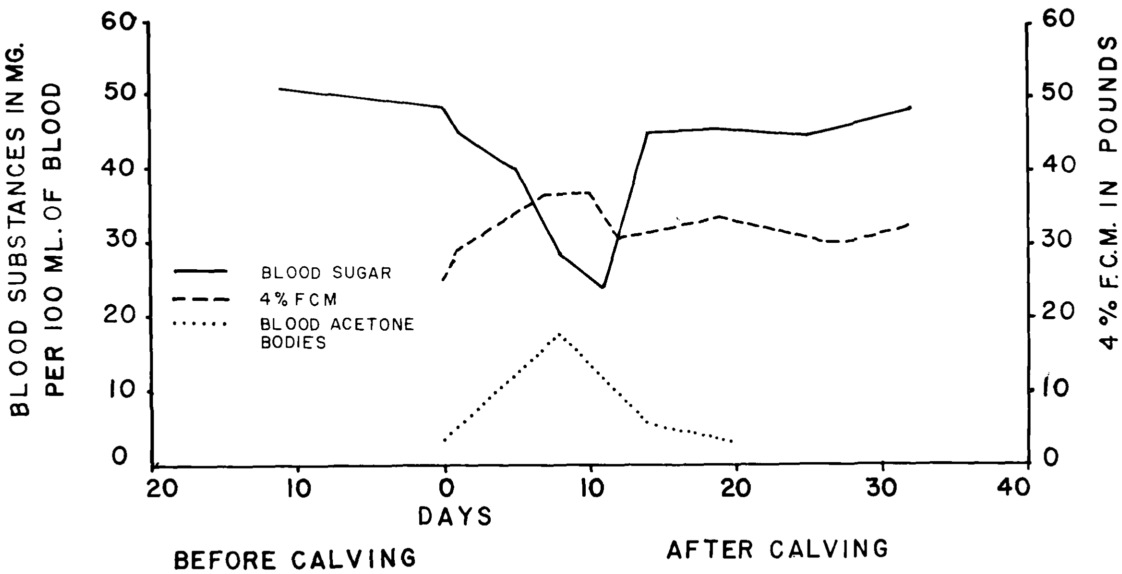

Figure 20. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for LIZZIE, Fed High Protein Concentrate and Fasted at 35 per cent of Standard for 10 Days Postpartum

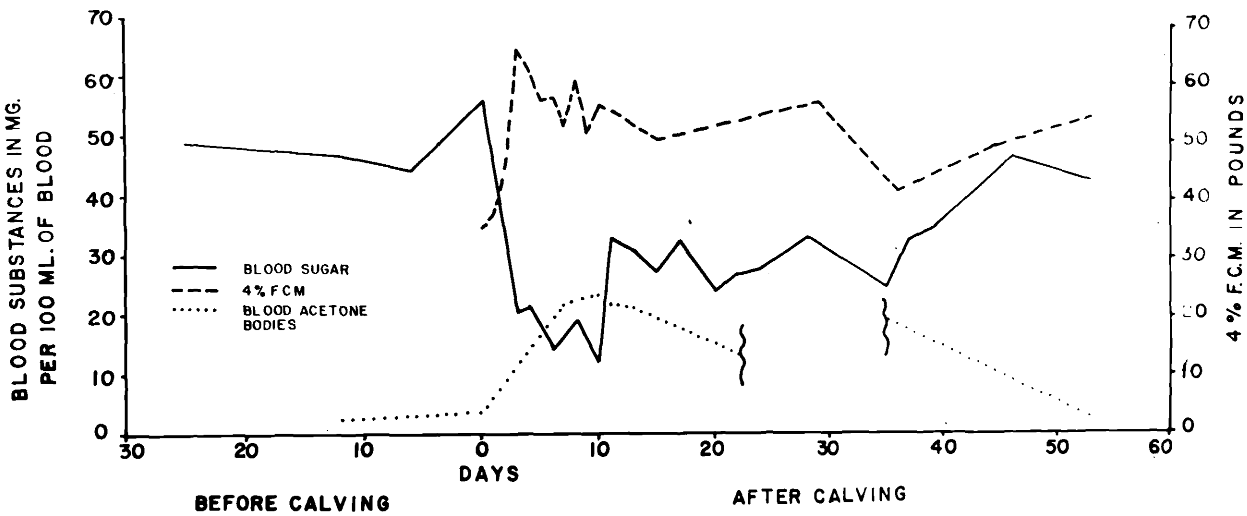

Figure 21. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for ELINOR, Fed High Protein Concentrate and Fasted at 35 per cent of Standard for 10 Days Postpartum

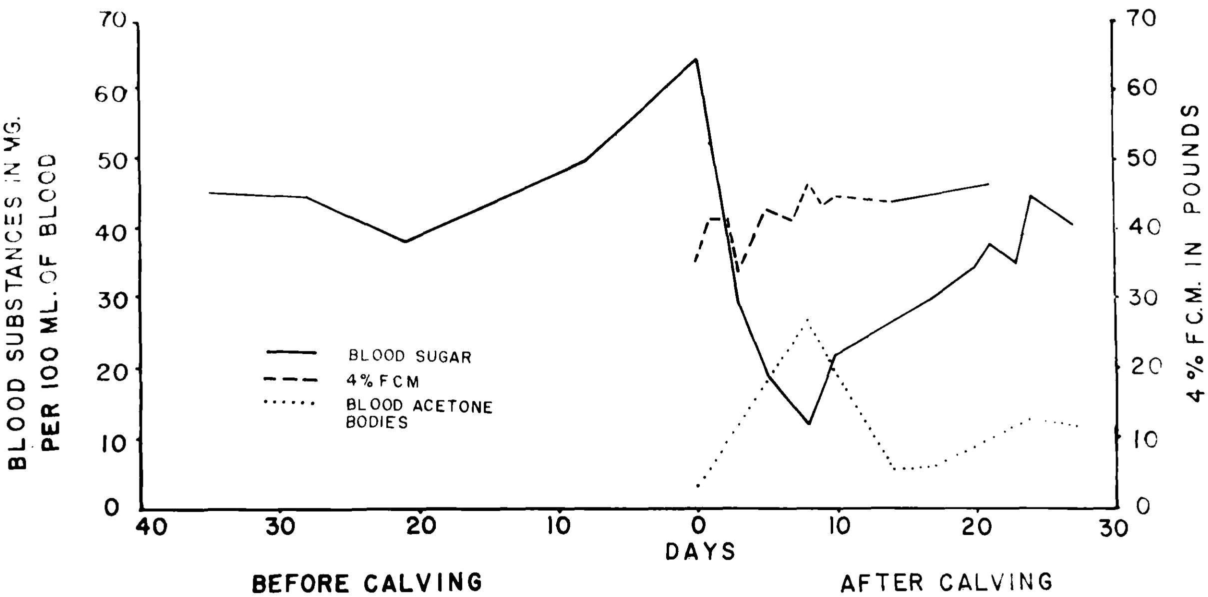

Figure 22. **Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for BARBARA, Fed High Protein Concentrate and Fasted at 35 per cent of Standard for 10 Days Postpartum**

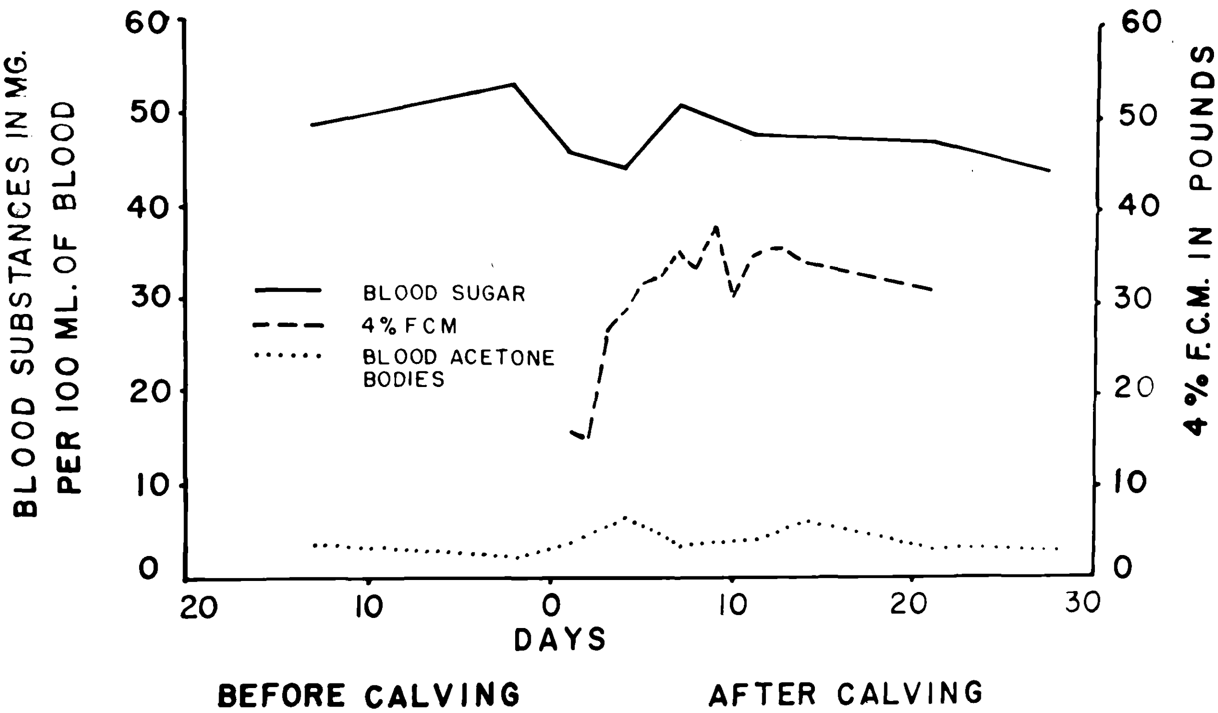

Figure 23. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for DEE, Fed High Protein Concentrate and Full Fed Postpartum

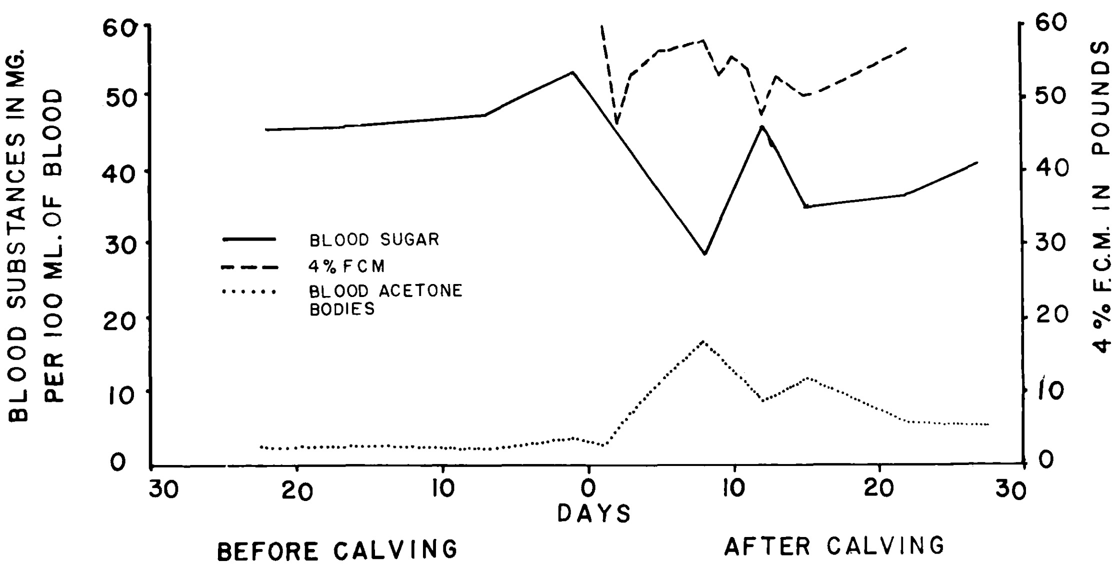

Figure 24. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for ESMERALDA, Fed High Protein Concentrate and Full Fed Postpartum

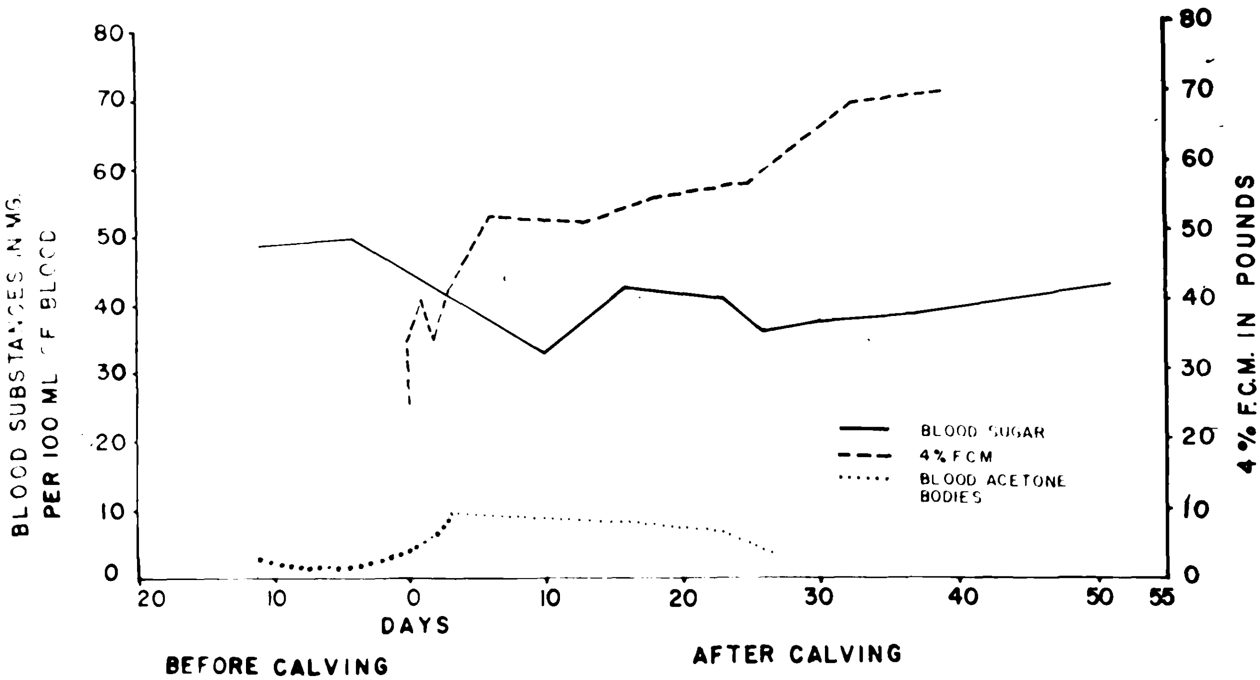

Figure 25. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for RUBY, Fed High Protein Concentrate and Full Fed Postpartum

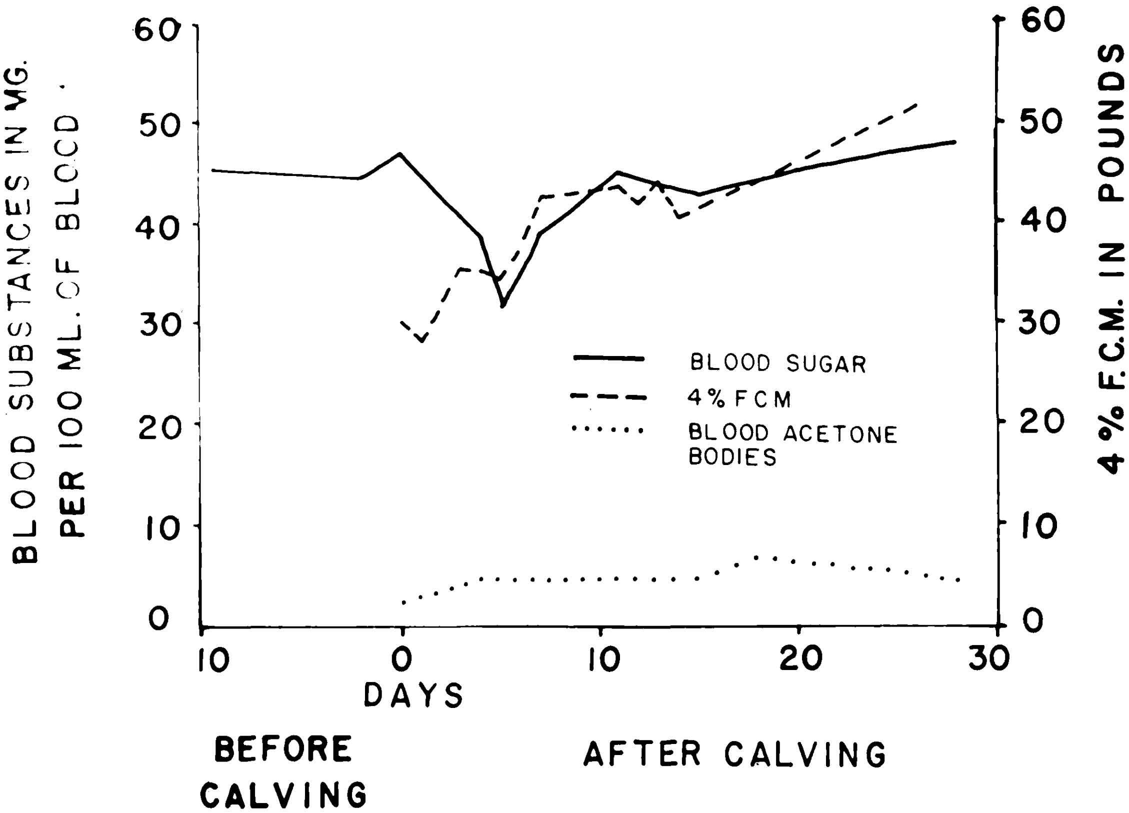

Figure 26. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for ANXIETY, Fed High Protein Concentrate and Full Fed Postpartum

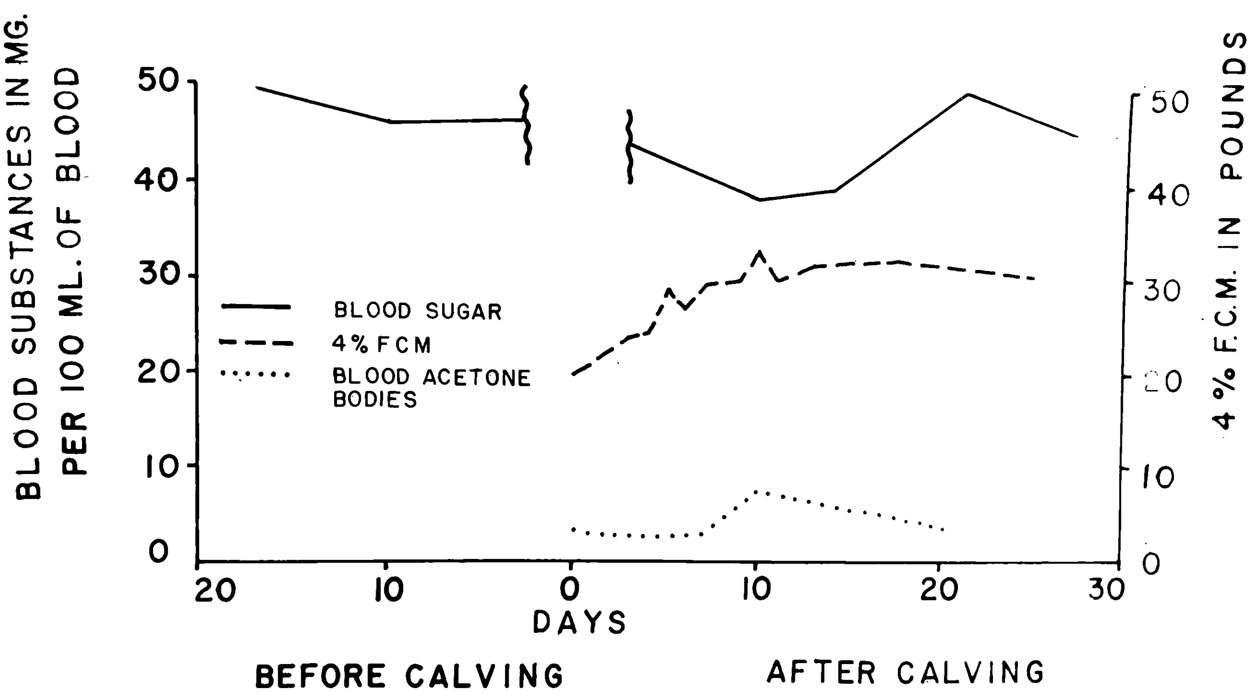

Figure 27. Blood Sugar, Acetone Bodies, and 4 per cent Fat Corrected Milk for VIRGINIA, Fed High Protein Concentrate and Full Fed Postpartum

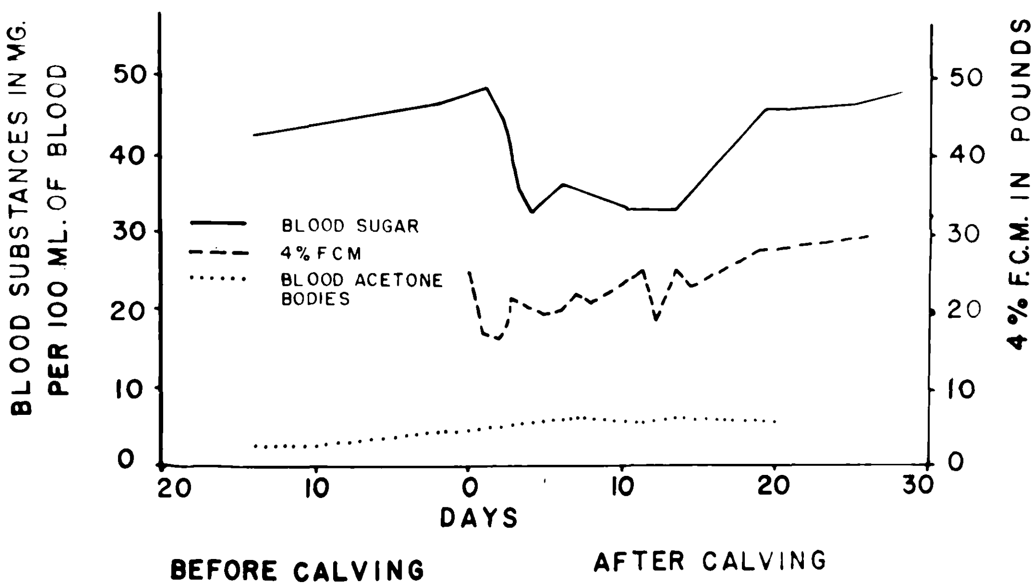

Figure 28. Blood Suagar, Acetone Bodies, and 4 per cent Fat Corrected Milk for CANARY, Fed High Protein Concentrate and Full Fed Postpartum

Liver Glycogen

Knodt and Petersen (39) found the average glycogen content of the livers of 20 dairy cows to be .25 per cent, with a range of from .15 to .38 per cent. Liver samples were taken from slaughtered cows which probably had not been fed for 24 hours or more previous to slaughter, and the low glycogen values were considered to be due, at least in part, to fasting. Roderick, Harshfield and Merchant (60) found an average liver glycogen content of 3.77 per cent in healthy pregnant ewes.

In this study liver samples were taken from 21 cows about one week before calving, from 5 cows at parturition, and from 25 cows approximately 10 days postpartum. Samples were taken by biopsy with a trocar and trephine, and the average sample for glycogen determination weighed about 50 milligrams. Usually there was no difficulty in obtaining the samples, though no liver samples could be obtained from cows 6 and 10 on any of the several attempts made, and no postpartum samples could be taken on cows 15 and 18.

Liver glycogen content for individual cows is shown in the appendix, Tables V to XXXII.

The average liver glycogen level for 21 cows prepartum was 2.90 per cent on the basis of fresh liver weight, with a range of from 1.11 to 4.86 per cent. Glycogen content of the livers of 5 cows on the day of parturition averaged 1.35 per cent, with a range of from 0.80 to 1.70 per cent. A considerable amount of the liver glycogen is mobilized from the liver at the time of parturition. This is undoubtedly associated with the stress of parturition and the high levels of blood sugar observed at this time.

The one cow fasted at a level of 50 per cent of requirements postpartum had a liver glycogen content of 1.17 per cent on the 14th day of fast. Glycogen content of the livers of all other fasted cows averaged 0.38 per cent after 10 to 14 days of fast, with a range of from 0.09 to 0.80 per cent. Twelve cows allowed 70 and 80 per cent of requirements for the first and second week after calving had an average postpartal liver glycogen level of 2.33 per cent, with a range of from 0.58 to 4.20 per cent.

The various levels of protein intake had no effect on liver glycogen either before or after parturition. When cows were fed at the 70 and 80 per cent level postpartum the liver glycogen levels rose above the parturition level within two weeks, though the liver glycogen remained somewhat lower than it was before parturition. The glycogen content observed in fasted cows compares with that of cows with clinical ketosis.

Milk and Milk Fat Production

Actual milk production postpartum, per cent milk fat, and 4 per cent fat corrected milk for all cows is given in Tables V to XXXII. Four per cent fat corrected milk is calculated by the formula:

Pounds 4 per cent FCM equals 15 times pounds of fat
plus 0.4 times pounds of milk

Average production of 4 per cent fat corrected milk was fairly constant for all fasted cows during the short period studied. Variations in individual cows were due more to fluctuations in fat percentage than in pounds of milk produced. Fat percentage of the milk of all fasted cows was very high and tended to increase as the fast progressed. Pounds of milk produced declined during the fast. When full rations were allowed after the fast the milk production increased and milk fat percentage fell to a level approaching the lactation normals for the cows involved. Though the study was not continued long after the fast, the data available indicate that the rise in milk production was not great enough to offset the decline in fat percentage and thus affect a rise in 4 per cent fat corrected milk produced.

For the cows not fasted, 4 per cent fat corrected milk increased somewhat during the first week or 10 days postpartum and then leveled off. Milk fat percentages for all cows were higher than the expected normals for the respective breeds, though not nearly so high as those observed in fasted cows. Fat content of the milk reached a peak about 7 days postpartum and then declined to near normal percentages for the cows involved by the end of the second week. Milk production increased as the percentage of fat declined.

Where mastitis was involved (cows 18 and 23), milk production and milk fat percentage remained low. Cow 13 had difficulty calving and milk production was low thereafter. Cow 10 developed a uterine infection, and while milk production was low, milk fat percentage was very high.

Milk production among individual cows varied so greatly that it is not possible to assess any effect of the protein content of the rations. Average production for cows fed the low protein concentrate in this experiment was fully as high as that of the high protein group. The level of concentrate feeding was so high prior to parturition that most of the cows on the low protein ration received as much protein as is recommended in the feeding standards.

Condition and Weight Changes of the Cows

With one exception, all the cows that were put under the experimental regime approximately six months prepartum were very fat at the time of calving. Cow 13, in addition to calving several weeks early, was lame due to soreness in the rear feet and legs and was not in good condition at calving. Cows 12, 16, 17, 26, 27 and 28 were started on the test rations only 60 days before calving and did not reach the high degree of fatness of the cows fed for the longer period, though all were in good condition at time of parturition. It must also be considered that the last 6 cows were fed a ration 100 per cent of the new allowances for cows in late pregnancy (53). This ration is considerably higher than previous recommendations but does not reach the 200 per cent of the older recommendations which was fed to the other cows before parturition.

Table LXII shows the initial weight, weights just before and after parturition, final weights and weight changes for all cows. All cows lost weight postpartum, but the loss was significantly higher for fasted cows as compared to those not fasted after calving. The daily loss for fasted cows from parturition to the end of fast was 12.8 pounds, while the non-fasted cows lost an average of 3.7 pounds per day for the first two weeks postpartum. There were no significant differences in the weight gains prepartum or in the parturition losses due to the protein content of the ration, nor were weight losses postpartum affected by protein intake as fed in this experiment.

All cows, both "full fed" and fasted postpartum, that were started on the experimental rations only two months before calving, weighed considerably less at the end of the test period than they did when placed on the experiment. This could be expected because the cows were heavy with calf when the initial weights were taken. All other cows "full fed" postpartum that remained in good health weighed more at the end of the experiment than they did when started on the study six months earlier. Most of the final weights of fasted cows were less than the initial weights.

Feed Consumption

As stated in the procedure, it was originally planned to start the cows four months before the beginning of the dry period on a total digestible nutrient intake of 150 per cent of the Morrison Standards,(52) to raise to 180 per cent in 60 days and then to 200 per cent when the cows were dried off. It was soon found, however, that the lactating cows would not take 150 per cent or 180 per cent of requirements. The initial feeding was then reduced to 140 per cent and later was set at 170 per cent of requirements for maintenance, plus 100 per cent of requirements for production. The actual percentage of total digestible nutrients consumed was about the same for cows fed at either level.

Table XXXIII gives the chemical analyses of the feeds used and the calculated total digestible nutrients and digestible protein content of such feeds. Samples of the corn silage, citrus pulp and alfalfa leaf meal were lost in the laboratory and no analyses were obtained. The nutrient content of these feeds was taken from Table I of Morrison's Feeds and Feeding (53), and the calculated nutrient content of the analyzed feeds was obtained by employing the digestion coefficients and the average nutrient contribution of the various feedstuffs as taken from Morrison. This method of computation has several discrepancies and can give only an approximation of actual nutrient content. However, it does take into consideration the actual analyses of the feeds used, and should be more accurate than the estimation made before analysis and given in Tables II, III and IV. The protein content of the low protein concentrate was somewhat higher than expected and there was not too much difference between the low and medium protein concentrates. The designations A, B or C given for the low and high concentrates in the table indicate the different mixes of the feeds. Mix A of the low protein concentrate was used until July 14, 1948, mix B from July 15 to September, and mix C from October until the end of the experiment. High protein concentrate A was used from April 21, 1948 until September 1948, and mix B was used from November 1948 until the end of the experiment. High protein mix C contained distillers' solubles in the dried distillers' grains and was fed to cows 26, 27 and 28. The timothy hay 1 was fed from November 7, 1947 until June 30, 1948, and hay 2 from July 1, 1948 until the end of the experiment.

The total digestible nutrient intake and feeds used for the entire experimental period are shown in Tables XXXIV to LXI.

Generally the animals would not consume more than 150 per cent of requirements before the dry period, with feed consumption varying from about 130 to 150 per cent for the late lactation period. Cows 3, 4, 10, 11, 18 and 23 were producing so small a quantity of milk that they were dried off before the scheduled dry date. After the cessation of lastation all cows consumed the feed offered up to 78 per cent of requirements. All cows refused part of the timothy hay, while there were no weigh-backs on the other feeds. Early in the experiment, when the feeding level attempted was found to be too high, the ration was immediately reduced to what the cows would consume. The actual feed prior to the dry period amounted to a fixed roughage allowance, plus all of the concentrate mixture the cows would consume.

When the cows reached the end of the lactation period the ration was brought to 200 per cent of the maintenance requirements. Actually, all cows received as much or more feed before they were dry as they did after the cessation of lactation. While dry, the cows consumed all feed except small amounts of the timothy hay.

Cows 12, 16, 17, 26, 27 and 28 were fed 100 per cent of the later recommendations for cows in the last few months of pregnancy (53). These cows readily consumed the concentrate allowance but refused small quantities of the hay.

After parturition all cows readily consumed the feed offered, except that in cows "full fed" postpartum there was some weigh-back of the timothy hay. There was some difficulty with a few of the fasted cows, and especially with cow 11, in getting them back on feed after the end of the fast.

The level of concentrate feeding before calving was so high that all cows actually received 100 per cent or more of the requirements for digestible protein, even when fed the low protein concentrate. This was true even for cows 12, 16 and 17. The concentrate fed these last three cows contained 12.33 per cent total protein and 9.22 per cent digestible protein, which appears surprisingly high when the make-up of the ration is considered (Table III).

Health of the Cows

Special attention was paid to the udder health of the cows postpartum because of the possibility that such heavy feeding, and especially such heavy concentrate feeding before calving, might cause udder edema and congestion.

Cows 1, 5 and 6 showed no udder congestion, and 1 and 5 otherwise were in good condition postpartum. Cow 6 waw partially off feed. Sluggish, and constipated on the fourth day after the veterinarian removed a retained placenta and the cow recovered promptly.

Cows 2 and 4 had a mild congestion of the udder at parturition. The congestion disappeared within 10 days without treatment.

Cow 2 was observed to be staggering and very nervous the 14th day of fast. Upon examination, this cow was found to be blind. There was a marked hypoglycemia and ketonemia but the cow readily consumed feed when a full ration was offered. Physical examination and blood analysis did not indicate any vitamin A deficiency. After the full ration was restored the blood sugar and acetone bodies soon returned to normal levels (Table VI, Fig. 2), but the animal did not regain her sight. Nervous symptoms disappeared after the cow apparently became accustomed to blindness.

Cow 3 suffered a mild attack of mastitis in one quarter four days after parturition, but recovered on treatment with penicillin.

Cows 7, 8, 9, 10 and 12 had no udder congestion. Cow 7 was somewhat weak and unsteady towards the end of the fasting period but had a voracious appetite and recovered promptly when full rations were restored.

Cow 8 had no trouble except for veterinary aid required in removing the placenta. Cow 9 was down immediately after parturition but got up and was apparently returning to normal when she developed pneumonia. This cow was destroyed one week after calving. Cow 10 was sore in the rear feet before parturition and developed a severe metritis after parturition. As shown in Figures 9 and 10, neither cow developed a significant ketonemia or hypoglycemia. This is in contrast with cases in the field where ketonemia and ketonuria have been observed in complications postpartum that are not spontaneous ketosis. Usually in such cases the blood sugar remains high.

Cow 11 had considerable caking and congestion in the udder which was relieved in 10 days by bathing with hot and cold water. This cow was observed to be scoured and had a dull appetite nine days after calving but appeared improved the next day. After the 10-day fast was over for cow 11 she would not take 100 per cent of requirements when full feeding was resumed (Table XLIV). The cow was sluggish and refused part of the feed for more than a month after the end of the fast. As mentioned earlier, ketonemia and hypoglycemia persisted throughout this period (Figure 11, Table XV). One half pound of glucose in solution was administered intravenously on March 31, 1949, nine days after the end of the fast. There was practically no response in blood sugar (Table XV), and no improvement in appetite or appearance of the animal. Though the cow consumed 11.8 pounds of grain, 8 pounds of citrus pulp and most of the hay ration daily during the first three weeks after the end of the fast, the feed consumption fell considerably short of requirements (Table XLIV). The concentrate mixture was changed back to the medium protein after fasting in an attempt to stimulate the appetite of the cow. By April 13, 1949, appetite had improved until the cow was consuming almost a full ration and was turned back to the herd, though the drawing of blood samples continued. On April 26 the cow was almost completely off feed and blood acetone bodies were 52.78 milligrams per 100 milliliters, the highest level observed in any cow during the entire experiment. The cow was turned to pasture on this day, and appetite improved immediately. By April 30 the blood picture was near normal and the cow had no further difficulty.

Cows 13, 14 and 15 had no udder congestion, and cows 16 and 17 showed a mild caking of the udder which disappeared within a week after calving. Cow 13 required veterinary assistance at parturition, when she lost twin calves. After parturition, 13 had a considerable uterine discharge and lactation response was less than expected, production never exceeding 30.4 pounds of milk per day during the first month post-partum. Cow 17 developed a mild attack of mastitis three weeks after parturition.

Cows 18 and 28 developed mastitis soon after parturition and this condition persisted in these two cows for the remainder of the experimental period. Cow 19 was weak and sluggish towards the end of the fasting period and was secured and partially off feed the first day full rations were restored, but recovered promptly.

Cow 21 showed considerable caking congestion of the udder after parturition, which was soon alleviated with the aid of massage and bathing. After full feeding was resumed at the end of the fast, cow 21 had a fairly good appetite but, as noted earlier, hypoglycemia and ketonemia persisted for several weeks (Table XXV and Figure 21). One half pound of glucose was given intravenously on April 13, 1949 without apparent effect. Cow 21 was turned to pasture on April 26 and a normal blood sugar was regained within 10 days.

Cow 22 had considerable uterine discharge after calving and a mild attack of mastitis 12 days postpartum. Hypoglycemia also persisted in this cow after the resumption of full feeding, and glucose administration on May 25, 1949 was again without effect in raising the blood sugar level by the next day. This cow was turned to pasture on May 27, and there was a prompt rise in blood sugar.

Cow 24 required massage and bathing to relieve a congested udder following parturition. Cows 25 and 26 had no difficulty after calving. Cows 27 and 28 had some milk caking of the mammary gland which disappeared without treatment. The udder of cow 28 was considerably distended before calving and was prepartum milked on May 19, 1949, though only 1.9 pounds of milk could be removed from the udder.

DISCUSSION

Partial fasting of normal dairy cows immediately postpartum resulted in a definite ketonemia and hypoglycemia. The degree of fasting appeared to be specific for the effect produced. Restricting the intake to 35 per cent of requirements resulted in a greater ketonemia than 50 per cent fasting (73), and 70 and 80 per cent feeding for the first and second weeks postpartum usually maintained near normal levels of blood sugar and acetone bodies.

Level of protein feeding, as followed in this experiment, did not have any effect on blood sugar and acetone bodies postpartum. Because of the very high level of concentrate feeding employed to insure a high nutrient intake, the cows receiving the low protein concentrate were fed as much protein as is recommended for cows during the dry period. Inasmuch as no protein deficiency was involved, the argument that protein has no effect on fasting ketosis may not be valid. It is significant, however, that the degree of hypoglycemia and ketonemia reached during fasting was the same for all cows receiving both high and low protein concentrate. The low blood sugar values observed in the high protein fed cows indicate that there is no influence exerted by glucogenic or anti-ketogenic catabolites during fasting as a result of previous feeding of excess protein.

The level of liver glycogen in cows several days before parturition was found to be considerably higher than that reported for slaughtered pregnant cows by Knodt and Petersen (39) and was somewhat less than that found in normal pregnant ewes (60). About half of the glycogen disappeared from the liver at the time of parturition. Cows fed 70 and 80 per cent of requirements for the first and second weeks postpartum were able to regain most of the liver glycogen lost at calving by the 10th to 14th day postpartum. Cows restricted to 35 per cent of requirements postpartum had lost virtually all of their liver glycogen by the end of the fast. Liver glycogen in cows with clinical ketosis has also been observed to be very low soon after first symptoms were noticed. Saarinen and Shaw (65) determined liver lipids on some of the cows used in this experiment as well as on normal cows and on cows with spontaneous clinical ketosis. Where biopsy samples were taken within five days after the first symptoms of ketosis were observed, liver fat was found to be about the same as that observed in normal cows postpartum. Eleven to twenty-one days after the first symptoms liver fat in cows with ketosis was considerably increased. Cows fasted postpartum developed fatty livers comparable with those in advanced stages of ketosis. Thus it is apparent that the fatty liver is often developed after the onset of ketosis, and is most probably due to inanition associated with the syndrome. Though liver glycogen disappears rapidly, the liver is producing large quantities of acetone bodies before there is any appreciable fatty infiltration.

The fasting ketosis does not appear to be the same as the condition observed in the spontaneous clinical ketosis of dairy cows. Forbes (23) reported that he also failed to observe the clinical picture while producing a fasting ketosis, but felt that clinical ketosis may still be primarily a ketosis of inanition.

In this study the author consistently failed to observe any marked similarity between fasting and clinical ketosis. While the degree of hypoglycemia was fully as severe, the blood acetone level during fasting did not reach that so often seen in field cases of ketosis (81). The inappetence and marked drop in milk production were also lacking. Cows with fasting hypoglycemia and ketonemia generally showed good appetite when full rations were restored, and the blood picture soon returned to normal.

In the four cows 11, 12, 21 and 22 where the low blood sugar persisted for some time after the resumption of full feeding, only in cow 11 was the appetite seriously impaired. Glucose administration to three of these cows had no apparent effect. In uncomplicated clinical ketosis some effect is almost invariably noted from the intravenous injection of glucose. On the day cow 11 was turned to pasture her condition could not be distinguished from that seen in clinical ketosis. Ketonemia and hypoglycemia were extreme, the animal refused to eat, and there was a sudden drop in milk production. The alleviation of hypoglycemia and ketonemia by pasture grass is not easy to explain. Probably there was some increase in total energy intake and it is possible that the grass contains some nutritive substance or substances lacking in the barn-fed ration.

The absence of a significant ketonemia in fasted cows which developed such complications as metritis or mastitis after parturition was surprising. Ketonemia and ketonuria have been observed in many abnormal conditions after calving and this often leads to faulty diagnosis as ketosis. It may be that the 10 to 14-day fast employed was not long enough to produce a ketonemia under such conditions, though inanition must surely have been as severe as it is in many such cases reported in the field. It is true that the average ketonemia observed in complications first diagnosed as ketosis is not so high as that seen in uncomplicated clinical ketosis. Hypoglycemia was not expected in such cows, as normal to high blood sugar values were observed in most of the complicated field cases.

Though fasting does not appear to be a major cause of ketosis, there seems to be no good reason for the common practice of restricting feed intake during the parturition period. Underfeeding is surely a stress, and ketosis appears to be a failure under stress. If this is true, then the supplying of an adequate ration should work to alleviate the burden carried by cows subject to ketosis.

The uninterrupted feeding of a heavy concentrate ration from late lactation through the dry period, and in the case of the non-fasted cows, immediately postpartum, did not appear to aggravate udder congestion or mastitis. Three of the five cows which showed mastitis in this study were producing 5 pounds or less of milk per day at the end of the previous lactation period. With production this low, it is not probable that continued heavy feeding at the time milking was discontinued could have caused any damage to the udder. There was not a high incidence of udder congestion postpartum. When congestion existed, it could be overcome with local treatment even when a high level of concentrate feeding was maintained. Prepartum concentrate feeding in this study was much higher than that necessary to provide an adequate ration under good herd feeding conditions, due to the fact that the roughage intake was limited and concentrates were used to make up most of the ration. It would seem advisable, in the case of udder congestion postpartum, to use local treatment rather than to severely limit the feed intake, since underfeeding may intensify the stress at the onset of lactation and would surely cause loss of weight and some diminution of milk flow.

CONCLUSIONS

Restricting the feed intake to 35 per cent of requirements immediately after parturition resulted in a marked hypoglycemia and ketonemia. This "fasting ketosis" does not appear to be the same as clinical ketosis.

Feeding at a level of 70 and 80 per cent of requirements postpartum prevented fasting ketonemia and hypoglycemia in most cases. The blood picture for glucose and acetone bodies was normal by the end of the second week.

Previous high protein intake had no effect on the blood sugar and acetone bodies postpartum regardless of whether or not the cows were fasted.

Liver glycogen decreases at the time of parturition, but cows fed a level of 70 and 80 per cent of requirements are able to regain a near normal liver glycogen content within two weeks. Liver glycogen of cows fed at 35 per cent of requirements virtually disappeared within 10 days.

Feeding concentrates at a high level during the dry and freshening period did not aggravate congestion or diseases of the udder.

It is considered advisable on the basis of these data, to feed a liberal ration during the dry and freshening period in order to help overcome the stress associated with parturition and the onset of lactation.

APPENDIX

TABLE V

Blood Sugar and Acetone Bodies, Liver Glycogen, and Milk Production for VALENCIA

D a t e .	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
4-14-48	45.10	2.15				
21	45.90	4.97				
28	44.30	3.77				
5- 3	48.30	4.06				
4	54.83	-				
5	51.30	3.36	-	6.5	5.5	7.8
6				26.5	4.0	26.5
7				29.7	5.4	35.9
8	43.16	5.22		26.6	5.8	33.8
9				24.5	6.4	33.3
10				28.3	6.8	40.2
11				25.5	6.2	33.9
12	30.93	7.19		27.7	7.4	41.8
13				27.8	7.0	40.3
14	26.54	9.28		26.2	8.0	41.9
15				27.4	7.4	41.5
16				27.7	5.6	34.3
17	24.90	8.12		25.2	5.8	32.0
18				24.2	6.1	31.8
19	26.81	8.24	1.17	23.7	6.6	32.9

Calved 5-5-48

TABLE VI

Blood Sugar and Acetone Bodies, Liver Glycogen, and Milk Production for ADVENTURESS

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
7-13-48	48.46	2.45				
22	42.20	3.02				
28	42.72	2.20				
29	-	-	1.11			
8- 2	38.58	2.05		23.0	4.4	24.4
8- 3	-	-	-	28.0	5.0	32.2
4				27.0	4.7	29.8
6	35.33	9.50		26.8	5.0	30.8
7				28.1	5.2	33.2
8				25.8	5.7	32.4
9	20.19	25.29		21.2	5.5	26.0
10			0.66	23.4	6.7	32.9
11				20.7	6.3	27.8
12				20.2	5.8	25.6
13	17.61	23.55		17.7	5.8	22.5
14	-	-		20.0	6.3	26.9
15				18.5	6.0	24.0
16	33.92	20.50	0.80	9.0	5.0	10.4
17	42.41	5.91				
18	-			25.1	4.6	27.2
19	40.39	2.09		25.9	4.5	27.8
20	-			27.5	4.6	30.0
21	40.13	2.32				
25	-	-	-	32.8	4.1	33.3
27	45.57					
28	-	2.78		-	-	-

Calved 8-1-48

TABLE VII

Blood Sugar and Acetone Bodies, Liver Glycogen, and Milk Production for BOUNTY

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
8-25-48	46.60	2.20				
9- 1	47.64	4.06				
7	50.49	2.67				
9	-	-	3.87		4.7	42.5
13	46.08	1.51	1.11	38.5		
14				34.0	3.8	33.0
15	-	-	-	35.5	4.4	37.8
16	-	-	-	26.0	5.5	31.9
17	25.90	9.98		29.2	5.0	33.6
18				27.8	5.2	32.8
20	25.11	20.30		26.4	5.6	32.7
22	15.89	23.32		25.8	5.9	33.2
23	30.29	23.55	0.47	23.4	6.1	30.8
24				25.2	5.9	32.4
27	41.42	10.56		-	-	-
29	-	-		33.2	4.1	33.7
10- 4	42.15	4.12		-	-	-
6	-			39.3	4.0	39.3
11	44.27	2.89		-	-	

Calved 9-12-48

TABLE VIII

Blood Sugar and Acetone Bodies, Liver Glycogen, and Milk Production for BONITA

Date .	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
4-28-48	47.54	4.30				
5-12	48.60	1.39				
5-15	-	-	3.76			
19	50.89	2.49	-			
20	60.00	3.03				
21	-	-		30.0	4.8	33.6
22				40.7	3.9	40.0
23				42.9	4.1	43.6
24	39.40	4.35		49.5	6.7	68.7
25				50.2	4.3	52.6
26	41.68	5.85		51.8	6.2	68.9
27				52.9	4.6	57.7
28				52.3	6.9	75.1
29	40.49	5.95		56.1	4.5	60.3
30				58.4	6.0	75.9
31				55.9	6.8	79.4
6- 1	-	-		57.3	4.1	58.2
2	46.24	4.29	1.33	58.9	4.3	61.6
3	-	-	-	57.6	4.0	57.6

Calved 5 - 20 - 48

TABLE IX

Blood Sugar and Acetone Bodies, Liver Glycogen, and Milk Production for FAITH

Date .	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
7-22-48	51.00	3.60				
28	48.31	3.25				
8- 4	42.72	2.92				
7	49.45	1.80	1.58			
8				28.0	3.9	27.6
9	-	-	-	34.7	4.5	37.3
10				34.1	3.8	33.1
11	37.54	5.70		39.6	4.6	43.2
12				37.5	5.3	45.1
13				38.4	5.2	45.3
14	38.84	5.91		38.0	6.2	50.5
15				40.2	5.6	49.8
16	-	-		37.0	4.7	40.9
17				44.3	5.1	51.6
18				38.9	5.5	47.7
19	43.75	3.13		41.1	5.1	47.9
20			1.89	41.0	4.8	45.9
21	45.31	3.60		41.5	4.9	47.1
25				45.6	4.5	49.0
27	43.24			-		-
9- 1	-	-		45.0	4.4	47.7
3	45.83	2.84		-		-

Calved 8-7-48

TABLE X

Blood Sugar and Acetone Bodies, Liver Glycogen, and Milk Production for PEGGY

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
11- 8-48	44.01	4.06				
18	46.86					
24	45.31	3.19				
30	50.74			20.0	4.0	20.0
12- 1	-	-		16.6	5.5	20.3
2				26.4	5.2	31.3
3	44.53	5.80		25.7	6.6	32.9
4	41.42	7.77		9.4	9.7	17.4
6	-	-		14.4	8.2	23.5
7	35.21	8.12		21.1	7.7	32.8
8				21.3	7.7	33.1
9				23.9	6.9	32.9
10	-	-		24.6	6.3	33.1
11	42.46	3.71		29.0	6.0	37.7
14	33.40			-	-	-
15	-	-		27.2	5.8	34.5
22	40.65			32.4	5.9	41.6
28	50.79			-	-	-
31	46.78					

Calved 11-30-48

TABLE XI

Blood Sugar and Acetone Bodies, Liver Glycogen
and Milk Production for BUNNY

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
5-26-48	48.43	3.77				
6- 2-48	51.98	2.61				
9	47.06	3.13	3.34			
19	52.26	5.16				
22	60.19	3.71				
25	62.93	3.30				
28	60.74	3.71		18.5	3.6	17.4
29				24.7	4.2	25.4
30				24.4	4.5	26.2
7- 1-49	41.58	14.27		27.2	4.0	27.2
2				22.6	4.3	23.6
3	31.18	10.20		23.5	5.3	28.1
4				19.5	4.6	21.3
5				23.9	5.2	27.7
6	31.48	24.80		21.5	5.6	26.7
7				19.0	5.5	23.3
8				17.8	5.5	21.8
9	35.84	17.17	0.28	17.0	5.2	20.1
10	30.92	23.99		16.4	5.9	21.1
11	33.38	17.51	0.22	18.0	6.3	24.2

Calved 6 - 27 - 48

TABLE XII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for REMEMBRANCE

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
8- 4-48	46.05	3.31				
8-11	47.90	2.90				
8-19	43.50	1.04				
8-20			2.62			
8-25	48.16	2.61				
8-31	47.38	4.06	0.80	30.0	4.0	30.0
9- 1				24.2	4.4	25.7
9- 2				30.8	4.4	32.6
9- 3	26.93	11.31		29.2	5.8	37.1
9- 4				30.0	5.7	37.7
9- 5				29.0	6.5	39.9
9- 6				31.4	6.6	43.6
9- 7	23.30	21.24		30.8	6.9	44.3
9- 8	26.41	21.58		30.9	5.5	37.7
9- 9	27.18	-	0.15			
9-10	24.08	21.46		28.5	6.3	38.3
9-11				30.1	6.2	40.0
9-13	23.30	-		37.7	5.0	43.4
9-17	23.31	4.29				
9-20	34.69	2.32				
9-22				35.0	4.1	35.5
9-27	47.12	2.67				

Calved 8 - 30 - 48

TABLE XIII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for PATIENCE

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
12- 4-48	45.82	3.65				
12-11	45.31	2.90				
12-21	42.46	-	3.40			
12-24	45.44	-		25.0	5.0	28.75
12-28	43.30	8.76				
12-31	45.98	3.83		6.0	8.0	9.6

Calved 12 - 24 - 48

TABLE XIV

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for LAURA

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
2-11-49	46.51	2.55				
2-18	47.31					
2-23	65.49			30.0	4.0	30.0
2-24			No	18.8	7.3	28.1
2-25	45.98			25.0	6.6	34.8
2-26			samples	20.4	6.6	28.4
2-27				27.3	7.0	38.6
2-28			obtained	27.4	6.0	35.7
3- 1	45.71			27.9	6.4	37.9
3- 2	44.91	5.57		26.4	6.7	37.1
3- 3				25.8	6.6	35.9
3- 4				26.4	6.4	39.9
3- 5	45.71	7.19		29.9	5.8	38.0

Calved 2 - 23 - 49

TABLE XV

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for MELANIE

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
2-11-49	49.45	-				
2-18	55.60	-				
2-25	51.59	3.43	4.06			
3- 2	41.16	-				
3-10	41.70	-				
3-12	79.36	2.33				
3-13	-	-				
3-14	-	-		35.0	6.8	49.7
3-15	-	-		46.2	5.3	55.2
3-16	35.82	5.80		47.0	5.2	55.5
3-17	-	-		46.9	6.1	61.7
3-18	24.59	25.75		48.2	6.1	63.4
3-19	-	-		46.7	6.5	64.2
3-20	-	-		44.2	7.0	64.0
3-21	27.53	22.26		49.1	7.0	71.2
3-22	-	-		47.8	6.3	64.3
3-23	25.13	-		47.7	6.2	63.4
3-24	-	-	.09			
3-25	18.28	41.64				
3-26	17.27	31.44				
3-27	-	-				
3-28	31.99					
3-30	22.09	19.33		46.4	6.4	63.1
3-31	26.60					
4- 1	29.45	21.12				
4- 2	30.98					
4- 4	36.56	13.92				
4- 6	29.71	35.14		47.5	4.5	51.1
4- 8	40.62	27.84				
4-12	24.12	30.39				
4-13	24.12	-		48.6	5.0	55.9
4-19	35.55	26.22	0.12			
4-20	-			54.2	-	-
4-26	13.20	52.78				
4-27				32.7	6.0	42.5
4-28	29.45	31.28				
4-29				58.5	3.3	52.4
4-30	39.10					
5- 6	51.28	5.48				
5-13	44.69					

Calved 3 - 12 - 49

TABLE XVI

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for ARABELIA

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
5- 6-49	37.32					
5-12-49	37.32					
5-14	49.51	4.87	2.86			
5-16				36.8	6.3	49.5
5-17				38.0	6.4	51.7
5-18	19.30	14.96		38.0	6.3	51.1
5-19				38.6	6.3	51.9
5-20				34.9	6.4	47.5
5-21	14.22	16.36		35.9	6.8	51.0
5-23				31.7	6.6	44.1
5-24	20.31	19.72		32.1	6.5	44.1
5-25	21.07	17.52		31.6	5.9	40.6
5-27	26.66	10.90				
5-31	32.24					
6- 1	30.21			41.2	3.9	40.6
6- 2	32.24					
6- 3	35.55	9.74				
6- 4	38.59	5.22				
6- 8	44.94					

Calved 5 - 14 - 49

TABLE XVII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for DORCAS

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
6-30-48	50.07	3.83				
7- 2	61.56	3.13	1.70	14.5	1.7	9.6
7- 3				25.8	2.3	19.2
7- 4				24.2	2.8	19.8
7- 5				30.3	4.0	30.3
7- 6	52.81	5.16		29.3	4.6	31.9
7- 7				25.6	3.9	25.2
7- 8				27.7	4.5	29.7
7- 9	54.17	5.78		26.9	3.6	24.6
7-10				28.1	3.5	26.0
7-11				29.7	3.2	21.4
7-12				27.0	3.6	24.4
7-13	54.17			30.3	3.2	26.7
7-14				28.7	3.5	26.5
7-15				30.1	3.5	27.8
7-16	49.71	4.06	1.95	27.8	3.1	24.0
7-23	48.43	4.29		29.2	3.1	25.3
7-28				30.4	3.0	25.8
7-30		2.17		30.4	3.3	27.2
8- 4				29.0	3.0	24.7

Calved 7 - 2 - 48

TABLE XVIII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for ACACIA

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
8-11-48	45.31	3.60				
8-13			2.54			
8-19	45.05	2.78				
8-23	50.74	3.48		27.1	4.2	27.9
8-24				26.9	3.9	26.5
8-25				34.9	4.4	37.0
8-26				28.2	4.4	29.9
8-27	34.95	1.86		35.0	5.5	42.9
8-28				30.7	5.3	36.7
8-29				37.0	5.2	43.7
8-30	38.84	7.05		31.4	5.1	36.6
8-31				35.7	5.2	42.1
9- 1				34.7	5.1	40.4
9- 2				32.7	5.1	38.1
9- 3	35.95	7.13	1.66	33.9	4.2	34.9
9- 4				35.9	4.6	39.1
9- 7	46.08					
9- 8				40.1	4.1	40.6
9-15				41.4	3.6	38.9
9-17	39.54	4.06				
9-22	36.52	4.00				
9-27	41.94					

Calved 8 - 22 - 48

TABLE XIX

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for POMONA

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
12- 4-48	43.75	3.83				
12- 7	44.53					
12-21	46.34	2.26	2.67			
12-31	64.69					
1- 3-49	40.09	3.13		23.0	5.0	26.5
1- 4				31.0	5.2	36.6
1- 5				33.6	6.2	44.7
1- 6	35.55			33.8	5.8	42.9
1- 7				31.6	6.2	42.0
8				33.6	5.5	41.2
10	36.62	4.52		33.3	5.5	40.8
12				30.2	6.6	42.0
13	40.36	1.62				
14				32.8	6.0	42.6
17	43.64					
19				35.7	5.7	44.8
24	40.09	3.13				
26				36.5	4.9	41.4

Calved 12 - 31 - 48

TABLE XX

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for CHARM

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
3-30-49	46.95	5.34				
4- 6	54.08	2.32	3.05			
4- 7				36.5	5.0	42.0
4- 8	41.39	6.61		30.4	3.6	28.6
4- 9				41.6	4.3	43.5
4-11				44.0	4.7	48.6
4-12	27.42	12.18		41.2	4.6	44.9
4-13	23.36			41.1	4.3	42.9
4-14				40.1	4.3	41.9
4-15	25.39	16.70		40.5	4.7	44.8
4-19	30.47	8.12		43.4	4.5	46.7
4-20			0.58	42.8	4.2	44.1
4-23	34.28	3.48				
4-26	54.08	2.90				
4-27				45.7	3.4	41.6
5- 4	49.51			47.2	3.4	43.0

Calved 4 - 6 - 49

TABLE XXI

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for HILDA

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
3-30-49	43.42					
4- 6	49.51					
4- 8	41.64		2.65			
13	36.31	2.78				
19	45.70			16.1	4.3	16.8
20				19.5	5.7	24.5
21				18.8	5.5	23.0
22				20.7	4.3	21.6
23	32.50	5.10		23.1	5.1	26.9
25				21.5	5.2	25.4
26	36.81	2.67		23.3	4.9	26.4
27				24.7	4.6	26.9
29			4.49	21.6	4.5	23.2
30	48.18	1.86				
5- 4				22.5	4.5	24.1
6	46.72					
11				20.9	3.7	20.2
12	40.88					

Calved 4 - 17 - 49

TABLE XXII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for MARTHA

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
5-19-48	50.89					
5-26	48.15	3.19				
6- 2	50.88	3.13				
9	50.80	4.64	2.13			
14	46.50			18.3	4.9	20.8
15				32.3	5.5	39.6
17				28.1	4.5	30.2
18				33.5	6.2	44.6
19	46.00	6.44		30.7	6.5	42.2
20				31.8	6.0	41.3
21				31.4	5.3	37.5
22	45.40	7.44		28.8	4.9	32.7
23				28.0	5.0	32.2
24				27.1	5.1	31.6
25	37.75	12.64		25.5	5.3	30.5
26				24.7	4.7	27.3
27				24.2	5.6	30.0
28	41.04	8.12		25.5	5.4	30.9
7- 1	50.34	9.30		25.9	5.5	31.7
6	54.18	4.08		22.4	4.1	22.7
9	54.72	3.92		21.5	3.8	20.9
13	56.63	2.60		23.0	3.5	21.3

Calved 6-13-48

TABLE XXIII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for BETH

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
7-28-48	50.49	2.78				
8- 4	42.19	4.47				
11	44.79	2.60				
13			1.67			
19	46.86	1.87				
21	37.28	4.41		24.6	4.9	27.9
22				27.6	4.6	30.1
23	32.36	7.42		21.1	4.0	21.1
24				29.9	4.1	30.3
25	37.80	2.44		29.1	4.2	30.0
26				30.1	4.6	32.8
27	23.56	14.50		25.1	5.4	30.4
28				22.8	5.0	26.2
29				22.3	5.0	25.6
30	21.23	32.48		20.3	6.4	27.6
31	16.83		0.22	19.7	5.8	25.0
9- 1	41.17	15.54		21.0	6.0	27.3
3	30.84	22.21				
8				27.4	5.1	31.9
10	39.56	2.31				
15				30.7	4.8	34.4
22	46.08	4.50				

Calved 8 - 20 - 48

TABLE XXIV

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for LIZZIE

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
12-21-48	51.26		3.44			
12-23	48.38	3.72				
12-24	44.91			25.0	5.0	28.8
28	40.09					
31	28.33	17.86		22.9	8.0	36.6
1- 3-49	24.06		0.13	22.9	8.0	36.6
5				26.4	5.0	30.4
6	45.17	5.34				
12				24.2	6.5	33.3
17	44.64					
19				26.1	5.1	30.4
24	48.11					
26				26.8	5.3	32.0

Calved 12 - 23 - 48

TABLE XXV

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for ELINOR

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
2-25-49	48.92					
3-10	46.78	3.07				
11			1.74			
16	44.64					
22	56.64					
23				34.1	4.8	38.2
24				40.4	5.1	47.1
25	20.57			51.3	5.8	65.2
26	21.23			46.3	6.1	60.9
27				44.6	5.8	56.6
28	13.96			44.3	5.9	56.9
29	19.30	22.16		40.1	6.0	52.1
30				45.7	6.1	60.1
31				38.5	6.2	51.2
4- 1	12.19	23.67	0.55	41.2	6.4	56.0
2	33.26	22.04				
4	31.23	21.67				
6	27.68			47.3	4.4	50.1
8	32.75					
12	22.09	13.36				
13	27.42			46.0	3.9	45.3
15	28.46					
19	33.56					
26	25.14					
27				33.8	4.4	57.0
28	33.01					
30	35.04	19.26				
5- 4				44.7	3.5	41.5
6	47.48					
13	43.42					

Calved 3 - 22 - 49

TABLE XXVI

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for BARBARA

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. Per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
3-23-49	40.37					
30	44.94					
4- 6	44.43					
13	37.83					
26	49.51					
29			2.93			
5- 4	63.98					
5				29.9	6.5	41.1
6				30.0	6.5	41.3
7	28.18			29.0	5.0	33.4
9	19.04			27.6	7.8	42.5
10				27.3	7.8	42.0
11				26.4	7.8	40.7
12	11.93	26.68		27.7	8.4	46.0
13			.11	26.0	8.5	43.6
14	21.84	18.79		27.6	8.1	44.6
18	28.94	5.10		35.1	5.6	43.5
21	29.96	5.60				
24	37.52					
25	34.28			39.3	5.1	45.8
26	36.05					
27	34.53					
28	43.69	7.19				
31	40.37					

Calved 5 - 4 - 49

TABLE XXVII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for DEE

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
6-19-48	48.97	3.60				
6-29			3.54			
6-30	53.63	2.44				
7- 3	45.96	3.94		21.2	3.1	18.3
4				22.0	2.7	17.7
5				27.7	3.7	26.5
6	44.60	6.26		32.0	3.4	29.1
7				32.3	4.0	32.3
8				32.2	4.1	32.8
9	50.89	3.60		36.7	3.6	35.5
10				35.0	3.7	33.4
11				37.7	4.1	38.2
12				34.1	3.3	30.5
13	48.43	4.45		37.8	3.5	35.0
14				36.2	3.9	35.7
15				35.9	3.9	35.4
16	48.16	3.25	2.89	35.1	3.8	34.0
23	47.90	3.94		34.4	3.4	31.3

Calved 7 - 2 - 48

TABLE XXVIII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for ESMERALDA

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
8- 4-48	43.24	2.84				
8-11	46.00	2.70				
19	47.64	2.67				
20			3.24			
25	53.33	3.25				
27	40.91	2.55		47.9	5.7	60.1
28				42.3	4.6	46.1
29				51.0	4.3	53.3
30	37.54	9.25		47.2	5.1	55.0
31				50.0	4.8	56.0
9- 1				46.1	5.5	56.5
2				48.8	5.1	56.9
3	29.00	16.59		48.1	5.3	57.5
4				48.8	4.6	53.2
5				47.8	5.1	55.7
6				48.3	4.8	54.1
7	46.34	8.87		43.4	4.7	48.0
8				45.2	5.2	53.3
9			1.58			
10	34.69	11.60		41.7	5.3	49.8
11				43.4	5.1	50.6
17	36.50	5.57		51.8	4.6	56.5
22	40.91	5.05				

Calved 8 - 26 - 48

TABLE XXIX

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for RUBY

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
12- 7-48	48.67	3.03				
12-14	49.45	1.74				
18	44.53		1.57	25.0	4.0	25.0
19				31.3	6.0	40.7
20				29.9	5.1	34.8
21	40.65	9.62		34.7	5.4	42.0
22				35.6	5.8	45.2
24				41.8	5.7	52.5
28	33.41					
31	36.62			48.1	4.5	51.7
1- 3-49	41.97	8.16				
1- 4			2.81			
5				50.5	4.6	55.0
10	45.44	6.50				
12				53.1	4.5	57.1
13	35.55	3.94				
17	37.15					
19				55.8	5.5	68.4
24	37.68					
26				58.8	5.3	70.3
2- 8-49	42.23					

Calved 12 - 18 - 48

TABLE XXX

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for ANXIETY

Date.	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
3-30-49	44.94					
4- 6	44.94		3.05			
8	46.95	2.09		30.0	4.0	30.0
9				23.2	5.4	28.1
11				29.8	5.3	35.6
12	38.59	4.69		29.0	5.4	35.1
13	31.48			31.3	4.7	34.6
14				29.8	5.9	38.3
15	38.85			34.3	5.6	42.5
19	44.94	5.37		35.1	5.6	43.5
20			4.20	35.5	5.2	41.9
21				36.5	5.3	43.6
22				35.6	4.9	40.4
23	42.40	4.50				
26	44.43	7.40				
27				41.6	4.6	45.3
5- 6-49	47.99	4.87		40.1	5.9	51.5

Calved 4 - 8 - 49

TABLE XXXI

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for VIRGINIA

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies Mg/100 ml	Liver Glycogen per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
3-30-49	49.51					
4- 6-49	46.46					
4-13	46.72					
19	43.92			21.7	4.7	24.0
20				21.6	4.9	24.5
21				23.6	5.5	28.8
22				22.4	5.3	26.8
23	40.62	2.67		22.8	5.5	29.9
25				23.7	5.8	30.1
26	36.31	7.88		26.3	5.8	33.4
27				26.0	5.0	29.9
29			2.92	25.6	5.5	31.4
30	39.86					
5- 4-49				28.0	5.0	32.2
6	50.27	3.60				
11				27.3	4.9	31.0
12	45.70					

Calved 4 - 16 - 49

TABLE XXXII

Blood Sugar and Acetone Bodies, Liver Glycogen and Milk Production for CANARY

Date	Blood Sugar Mg/100 ml	Blood Acetone Bodies. Mg/100 ml	Liver Glycogen. per cent	Milk (lbs)	Milk Fat per cent	4 per cent FCM (lbs)
5- 4-49			2.24			
6	42.66	2.55				
12	42.15	2.78				
18	46.72					
20						
21	48.19			16.9	4.1	17.2
23				15.4	4.5	16.6
24	32.75			17.1	5.8	21.7
25				16.5	5.2	19.5
26				17.8	4.7	19.7
27	36.05	6.26		19.0	5.2	22.4
28				19.5	4.6	21.3
31	32.75	5.57		23.0	4.6	25.1
6- 2				23.5	4.6	25.6
3	32.75	6.38	1.69	21.3	4.6	23.2
4	36.05					
8	45.70			27.4	4.0	27.4
13	46.61					
15				30.4	3.8	29.5

Calved 5 - 20 - 49

TABLE XXXIII

Analyses and Calculated Digestible Nutrients of Feeds

Feeds	Analyses						Nutrients	
	Protein (NX 6.25) %	Fat %	Fiber %	Ash %	Nitrogen free Extract %	Moisture %	TDN %	Digestible Protein %
Concentrate Medium	14.39	5.71	9.14	5.21	57.51	8.01	77.08	10.94
Concentrate Low A	10.49	6.00	6.67	4.70	63.08	9.06	79.28	7.84
Concentrate Low B	10.46	5.39	7.53	4.31	66.03	8.64	81.13	7.82
Concentrate Low C	12.33	7.27	5.75	5.08	60.10	9.47	79.91	9.22
Concentrate High A	22.82	5.14	9.36	6.38	47.62	8.68	73.47	18.02
Concentrate High B	23.56	6.14	9.26	6.77	45.81	8.76	75.76	18.61
Concentrate High C	20.88	5.55	8.43	6.28	51.27	7.59	75.02	16.49
Timothy Hay 1	7.55	1.45	38.26	5.07	41.07	6.60	50.50	3.32
Timothy Hay 2	6.99	1.83	35.06	5.44	44.27	6.62	50.83	3.14
Corn Silage							18.7	1.3
Citrus Pulp							74.8	2.8
Alfalfa Leaf Meal							57.3	15.3

TABLE XXXIV

Feeds and Total Digestible Nutrients Fed to VALENCIA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Require-ments Consumed	Concen-trate Fed (lbs)	Timo-thy Hay Fed (lbs)	Timothy Hay re-fused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
11- 4-47	13.47	20.18	19.36	143.7	15.0	10.0	1.4	20.0	
11-12	13.45	18.83	18.81	139.8	13.2	10.0	0.3	20.0	
19	14.03	19.64	19.31	137.6	14.2	10.0	1.2	20.0	
26	14.46	20.24	20.08	138.8	14.8	10.0	0.6	21.0	
12- 3	13.61	19.05	19.49	143.2	13.4	10.0	0.3	21.0	
10	14.55	20.37	19.78	135.9	15.0	10.0	1.5	21.0	
17	14.24	19.93	19.13	134.3	14.0	10.0	2.2	20.0	
23	14.41	20.87	19.31	128.3	15.8	11.0	1.6	21.0	
1- 7-48	15.47	21.66	20.82	134.5	16.0	10.0	2.0	21.0	
1-14	16.33	22.88	21.30	130.5	16.8	11.0	1.9	21.0	
21	15.31	21.43	20.59	134.5	15.8	11.0	2.1	22.0	
28	14.95	20.93	19.53	130.6	14.8	11.0	3.1	22.0	
2- 4	13.49	18.89	17.81	131.9	12.2	11.0	2.5	22.0	
2-11	12.31	17.23	21.26	172.7	16.4	11.0	2.1	22.0	
18	13.59	24.95	23.18	170.5	19.4	11.0	2.6	23.0	
25	13.67	24.60	22.98	168.1	19.4	11.0	3.2	23.0	
3- 4	13.75	24.74	23.16	168.4	19.6	11.0	3.3	23.0	
10	13.05	23.48	19.58	150.0	14.0	12.0	3.1	23.0	
17	9.39	18.78	17.32	184.4	11.0	12.0	3.0	23.0	
24	9.32	18.64	17.13	183.7	11.0	12.0	3.4	23.0	
31	9.47	18.94	16.30	172.1	11.2	12.0	5.3	23.0	
4- 8	9.42	18.84	17.39	184.5	11.0	12.0	2.9	23.0	
4-14	9.60	19.19	16.78	174.8	11.4	12.0	5.1	24.0	
21	9.70	19.40	16.78	172.9	11.6	12.0	2.4	24.0	
28	9.64	19.27	16.96	176.0	11.4	12.0	4.7	24.0	
5- 5	11.12	8.62	8.74	78.6	5.4	5.0	-	11.0	
6	18.26	9.13	9.20	50.3	6.0	5.0	-	11.0	
7	19.08	9.54	9.67	50.6	6.6	5.0	-	11.0	
8	18.75	9.38	9.49	50.6	6.6	5.0	-	11.0	
9	18.64	9.32	9.49	50.9	6.6	5.0	-	11.0	
10	20.75	10.38	10.51	51.0	8.0	5.0	-	11.0	
11	18.74	9.37	9.49	50.6	6.6	5.0	-	11.0	
12	21.08	10.54	10.57	50.1	8.0	5.0	-	11.0	
13	20.67	10.34	10.41	50.3	7.8	5.0	-	11.0	
14	20.96	10.48	10.57	50.4	8.0	5.0	-	11.0	
15	20.95	10.48	10.57	50.4	8.0	5.0	-	11.0	
16	18.83	9.41	9.49	50.4	6.6	5.0	-	11.0	
17	18.65	9.33	9.49	50.8	6.6	5.0	-	11.0	
18	17.81	8.92	8.99	50.4	6.0	5.0	-	11.0	
19	18.07	9.04	9.18	50.8	6.2	5.0	-	11.0	

VALENCIA started 11-4-47 at 150 per cent of requirements for maintenance and production.

Dry 3 - 17 - 48

TABLE XXXV

Feeds and Total Digestible Nutrients Fed to ADVENTURESS

Date	TDN Required (lbs)	TDN to be Fed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
2- 4-48	15.03	21.04	20.49	136.3	15.8	10.0	1.3	21.0	
2-11	15.85	22.29	22.01	138.8	17.4	10.0	0.8	21.0	
18	15.34	21.47	21.67	141.3	15.8	11.0	-	21.0	
25	15.72	22.00	21.79	138.6	16.4	11.0	0.6	21.0	
3- 4	14.70	20.57	19.75	134.3	14.6	11.0	2.0	21.0	
3-10	15.59	21.83	21.77	139.6	16.2	11.0	0.4	21.0	
17	15.27	21.38	21.51	140.8	15.6	11.0	-	21.0	
24	15.35	21.53	21.67	141.2	15.8	11.0	-	21.0	
31	14.79	20.70	20.48	138.4	14.6	11.0	0.7	22.0	
4- 8	14.29	25.72	25.09	175.6	21.0	11.0	1.5	22.0	
4-14	16.31	29.26	23.14	141.8	18.0	11.0	1.2	23.0	
21	15.86	28.56	22.86	144.0	18.0	11.0	1.8	23.0	
28	15.64	28.15	23.09	147.6	18.0	11.0	1.3	23.0	
5- 5	15.34	27.62	22.95	149.5	18.0	11.0	1.5	23.0	
5-12	15.50	23.25	22.60	145.6	17.6	11.0	1.7	23.0	
19	15.49	23.23	22.66	150.1	17.6	11.0	1.5	23.0	
26	17.04	25.82	25.12	147.6	20.8	11.0	1.5	23.0	
6- 2	15.18	22.78	22.15	145.8	17.0	11.0	1.5	23.0	
9	14.27	21.40	20.81	145.8	15.2	11.0	1.6	23.0	
16	9.34	18.67	18.29	195.9	12.0	11.0	1.5	24.0	
23	9.51	19.02	17.99	189.1	11.2	12.0	2.6	24.0	
30	9.76	19.51	18.66	191.2	12.2	12.0	2.3	24.0	
7- 7	9.63	19.26	18.31	190.1	11.6	12.0	2.3	24.0	
14	9.90	19.80	18.68	188.7	12.2	12.0	3.5	24.0	
21	9.80	19.61	18.60	189.7	12.0	12.0	3.4	24.0	
28	9.70	19.40	18.15	187.1	11.8	12.0	2.9	24.0	
8- 1			6.06						
2	16.49	5.77	5.90	35.7	0.8	6.0	-	12.0	
3	18.97	6.64	6.82	35.9	2.0	6.0	-	12.0	
4	17.80	6.23	6.36	35.7	1.4	6.0	-	4.0	2.0
6	18.12	6.34	6.57	35.8	1.6	6.0	-		3.0
7	18.60	6.51	6.67	35.8	1.8	6.0			3.0
8	18.28	6.38	6.51	35.6	1.6	6.0			3.0
9	16.33	5.71	5.90	36.1	0.8	6.0			3.0
10	18.51	6.47	6.67	36.0	1.8	6.0			3.0
11	16.73	5.86	6.01	35.9	1.6	5.0			3.0
12	16.03	5.61	5.70	35.5	1.2	5.0			3.0
13	15.03	5.26	5.40	35.9	0.8	5.0			3.0
14	16.06	5.62	4.69	29.1	1.2	5.0			3.0
15	15.15	5.30	4.64	30.6	0.8	5.0			3.0
16	14.02	14.02	13.17	93.4	12.0	5.0			3.0
19	16.34	16.34	15.79	96.6	10.0	9.0			5.0

TABLE XXXV, Cont'd

D a t e	TDN Required (lbs)	TDN to be Fed (lbs)	TDN Consumed (lbs)	Per cent Require- ments Consumed	Concen- trate Fed (lbs)	Timo- thy Hay Fed (lbs)	Timothy Hay re- fused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
8-20-48	17.01	17.01	15.94	93.7	10.8	9.0			5.0
8-25	17.95	17.95	17.05	94.9	12.0	9.0			5.0
9- 1-48	17.63	17.63	17.58	99.7	11.6	9.0			5.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48.

ADVENTURESS started 2-4-48 at 140 per cent of requirements for maintenance and production.

Dry 6-16-48

TABLE XXXVI

Feeds and Total Digestible Nutrients Fed to BOUNTY

Date	TDN Required (lbs)	TDN to be Fed (lbs)	TDN Consumed (lbs)	Per cent Require-ments Consumed	Concen-trate Fed (lbs)	Timo-thy Hay Fed (lbs)	Timothy Hay re-fused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
3-10-48	18.04	25.25	25.50	141.3	19.4	12.0	-	24.0	
3-17	20.00	28.08	28.28	140.9	23.0	12.0		24.0	
24	19.57	27.34	26.94	137.6	22.0	12.0	2.1	24.0	
31	18.41	25.77	25.23	136.5	20.0	12.0	1.7	24.0	
4- 8	17.06	23.88	23.80	139.4	17.6	12.0	0.6	24.0	
4-14	16.92	23.68	23.81	144.7	17.2	12.0	-	24.0	
21	17.25	24.15	23.75	137.7	18.0	12.0	1.3	24.0	
28	16.93	23.70	23.38	138.1	17.2	12.0	0.8	24.0	
5- 5	16.37	22.91	22.72	138.7	16.2	12.0	0.6	24.0	
5-12	16.14	24.22	23.73	146.9	18.0	12.0	1.4	24.0	
19	15.49	23.23	22.62	146.0	16.8	12.0	1.7	24.0	
26	13.78	20.67	19.89	144.3	13.4	12.0	1.9	24.0	
6- 2	11.89	17.84	17.43	146.5	9.8	12.0	1.3	24.0	
6- 9	10.01	15.01	14.57	145.5	6.2	12.0	3.5	24.0	
16	10.09	15.13	14.66	145.3	5.2	13.0	3.5	26.0	
23	10.10	15.16	14.87	147.1	5.2	13.0	1.3	26.0	
30	10.33	15.50	15.35	148.5	5.8	13.0	1.1	26.0	
7- 7	10.34	15.51	15.31	148.0	5.8	13.0	1.2	26.0	
7-14	10.78	16.17	16.53	153.3	6.6	13.0	1.1	26.0	
21	10.52	21.05	20.39	193.7	12.8	13.0	3.6	26.0	
28	10.71	21.41	20.02	186.9	13.2	13.0	3.1	26.0	
8- 4	10.83	21.67	20.35	187.8	13.6	13.0	3.2	14.0	3.0
6	10.83	21.67	20.42	188.4	13.2	13.0	2.5		7.0
11	10.82	21.64	20.60	190.4	13.0	13.0	2.5		7.0
18	10.90	21.79	21.02	192.8	13.2	12.0	2.0		7.0
25	10.78	21.56	20.18	187.2	13.0	12.0	3.3		7.0
9- 1	10.97	21.94	20.38	185.8	13.4	12.0	3.5		7.0
8	10.91	21.83	20.31	186.1	13.2	12.0	2.4		7.0
13	23.37	8.17	8.27	35.3	3.2	6.0	-		3.0
14	19.89	6.96	7.14	35.8	2.4	6.0	1.0		3.0
15	21.37	7.48	8.11	37.9	3.0	6.0	-		3.0
16	19.51	6.83	7.65	39.2	2.4	6.0	-		3.0
17	20.07	7.02	7.65	38.1	2.4	6.0	-		3.0
18	19.82	6.94	7.65	38.5	2.4	6.0			3.0
20	19.79	6.93	7.65	38.6	2.4	6.0			3.0
22	18.91	6.62	7.34	38.8	2.0	6.0			3.0
23	18.17	6.16	6.48	35.7	2.0	6.0			3.0
24	18.67	18.67	18.48	99.0	10.2	12.0	1.7		6.0
29	19.52	19.52	19.33	99.0	11.2	12.0	0.9		6.0
10-6	21.34	21.34	21.57	101.0	13.6	12.0	0.5		6.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48. BOUNTY started 3-10-48 at 140 per cent of requirements for maintenance and production. Dry 6-9-48. 200 per cent feeding began 7-21-48.

TABLE XXXVII

Feeds and Total Digestible Nutrients Fed to BONITA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Require-ments Consumed	Concen-trate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay re-fused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
11- 7-47	16.66	25.15	24.93	149.6	18.4	13.0	0.7	25.0	
11-12	17.01	23.81	23.87	140.3	16.6	13.0	0.3	25.0	
19	17.20	24.08	23.90	138.9	16.8	13.0	0.9	26.0	
26	17.28	24.19	24.10	139.4	16.8	13.0	0.6	26.0	
12- 3	17.47	24.48	24.55	140.4	17.2	13.0	0.3	26.0	
12-10	17.64	24.70	24.59	145.0	17.4	13.0	0.5	26.0	
17	17.21	24.09	24.06	139.7	16.8	13.0	0.6	26.0	
23	17.34	24.28	24.54	141.5	17.0	13.0	-	26.0	
1- 7-48	17.44	24.42	24.39	139.8	16.8	13.0	-	27.0	
1-14	16.63	23.28	23.50	141.3	15.4	13.0	-	27.0	
21	15.77	22.08	22.42	142.1	14.0	13.0	-	27.0	
28	15.01	21.01	22.34	148.8	13.0	14.0	-	28.0	
2- 4-48	14.83	20.00	20.34	142.4	10.4	14.0	-	28.0	
2-11	13.61	19.05	23.74	174.4	14.6	14.0	-	29.0	
18	13.17	23.70	23.73	180.2	14.8	14.0	-	29.0	
25	13.58	24.45	24.09	177.3	15.2	15.0	-	29.0	
3- 4	11.86	21.34	21.46	181.0	11.0	15.0	-	30.0	
3-10	12.17	21.90	22.29	183.1	11.8	15.0		30.0	
17	12.22	24.43	22.75	186.2	15.0	15.0	2.4	30.0	
24	12.33	24.66	24.98	202.5	14.4	16.0	2.0	31.0	
31	12.45	24.90	24.48	196.5	14.6	16.0	3.2	31.0	
4- 8	12.37	24.75	24.14	195.1	14.6	16.0	2.0	31.0	
14	12.56	25.11	22.44	178.7	14.8	16.0	6.0	32.0	
21	12.88	25.75	23.90	185.6	15.6	16.0	4.3	32.0	
28	12.85	25.71	24.23	188.5	15.8	16.0	4.0	32.0	
5- 5	13.08	26.15	23.40	178.9	15.2	17.0	5.0	33.0	
5-12	12.98	25.96	22.71	174.9	15.0	17.0	6.2	33.0	
19	12.90	25.81	24.23	187.7	15.2	16.0	1.0	33.0	
21	22.40	15.68	15.74	70.2	12.2	7.0	-	15.0	
22	24.23	16.96	17.13	70.6	14.0	7.0		15.0	
23	25.43	17.80	17.39	68.3	15.0	7.0		15.0	
24	33.70	23.59	23.19	68.8	22.2	7.0	1.0	15.0	
25	28.23	19.76	19.24	68.1	17.4	7.0	0.5	15.0	
26	33.39	23.37	22.79	68.2	22.0	7.0	1.0	15.0	
27	29.78	23.73	22.79	76.5	19.0	7.0	1.0	15.0	
28	35.18	28.14	27.10	77.0	24.6	7.0	2.0	15.0	
29	30.53	24.43	23.76	77.8	20.0	7.0	1.6	15.0	
30	35.45	28.36	27.71	78.1	25.0	7.0	1.4	15.0	
31	36.50	29.20	28.89	79.1	26.6	7.0	1.5	15.0	
6- 1	29.61	23.68	22.83	77.1	19.0	7.0	1.9	15.0	
6- 2	30.75	24.60	23.96	77.9	29.2	7.0	1.5	15.0	

BONITA started 11-7-47 at 150 per cent of
requirements for maintenance and production.
Dry 2-25-48. 200 per cent feeding began 3-17-48.

TABLE XXXVIII

Feeds and Total Digestible Nutrients Fed to FAITH

Date	TDN Required (lbs)	TDN to be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed (per cent)	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
2-11-48	15.84	22.18	22.32	140.9	16.4	11.0	-	21.0	
18	16.28	27.70	22.90	140.6	17.4	11.0		22.0	
25	17.38	24.27	24.48	140.8	19.2	11.0		22.0	
3- 4	17.49	24.48	24.61	140.7	19.6	11.0	0.3	23.0	
10	17.85	24.99	25.17	141.0	19.2	12.0	-	23.0	
17	17.84	24.97	24.94	139.7	19.2	12.0	0.1	23.0	
24	17.65	24.71	24.34	137.8	19.0	12.0	1.3	23.0	
31	17.63	24.69	24.37	138.2	19.0	12.0	2.2	23.0	
4- 8	17.93	25.10	24.93	139.0	19.6	12.0	1.7	23.0	
14	18.16	32.68	24.82	136.7	20.0	12.0	2.3	24.0	
21	18.28	32.90	24.71	135.1	20.0	12.0	3.5	24.0	
28	16.94	30.27	24.79	146.3	20.0	12.0	2.3	24.0	
5- 5	18.28	32.90	25.10	137.3	20.0	12.0	1.7	24.0	
12	18.25	27.37	24.77	135.7	20.0	12.0	2.4	24.0	
19	18.58	27.86	24.83	133.6	20.0	12.0	2.2	24.0	
26	18.39	27.58	25.19	136.9	20.0	12.0	1.5	24.0	
6- 2	18.32	27.48	25.08	136.9	20.0	12.0	1.7	24.0	
9	17.19	25.78	25.18	146.4	20.0	12.0	1.6	24.0	
16	16.26	24.39	23.68	145.6	17.0	13.0	1.7	26.0	
23	10.38	20.76	20.17	194.2	12.4	13.0	1.6	26.0	
30	10.41	20.83	19.77	189.8	12.6	13.0	2.7	26.0	
7- 7	10.43	20.86	20.08	192.5	12.6	13.0	2.1	26.0	
14	10.73	21.46	20.95	195.2	13.4	13.0	1.6	26.0	
21	10.71	21.41	20.14	188.1	13.2	13.0	2.9	26.0	
28	10.73	21.46	19.91	185.5	13.4	13.0	3.7	26.0	
8- 4	10.78	21.56	20.24	187.0	13.4	13.0	1.9	14.0	3.0
8	18.03	12.62	13.36	74.0	3.6	12.0	-		6.0
9	21.21	14.82	15.06	71.0	5.8	12.0			6.0
10	19.81	13.86	14.14	71.3	4.6	12.0			6.0
11	23.07	16.15	16.45	71.3	7.6	12.0			6.0
12	23.68	16.58	16.91	71.4	8.2	12.0			6.0
13	23.75	16.62	16.91	71.2	8.2	12.0			6.0
14	25.23	20.19	20.46	81.0	12.8	12.0			6.0
15	24.88	19.92	20.15	80.9	12.4	12.0			6.0
16	22.17	17.74	17.13	77.2	9.6	12.0	1.7		6.0
17	25.55	20.44	18.47	72.0	13.2	12.0	2.3		6.0
18		20.44	20.76	85.4	13.2	12.0	2.3		6.0

TABLE XXXVIII, cont'd

Date	TDN Required (lbs)	TDN to be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed (per cent)	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
8-19-48	24.39	19.52	18.97	77.8	12.0	11.0	1.7		6.0
20	23.80	19.04	18.26	78.8	11.4	11.0	1.2		6.0
21	24.25	24.25	24.30	100.1	17.8	11.0	-		6.0
25	24.42	24.42	24.15	98.8	18.2	11.0	3.6		6.0
9- 1-48	23.89	23.89	23.71	99.2	17.6	11.0	6.1		6.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48.

FAITH started 2-11-48 at 140 per cent of requirements for maintenance and production.

Dry 6-23-48

TABLE XXXIX

Feeds and Total Digestible Nutrients Fed to PEGGY

Date	TDN Required (lbs)	TDN to be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed (per cent)	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
6- 2-48	13.28	18.59	18.46	139.0	13.8	9.0	0.6	19.0	
7	14.25	19.95	19.48	136.7	14.6	10.0	1.1	20.0	
16	14.63	20.49	19.96	136.4	15.4	10.0	1.4	20.0	
23	15.10	20.91	20.29	134.4	16.0	10.0	1.5	20.0	
30	15.55	21.76	20.71	133.2	17.0	10.0	1.5	20.0	
7- 7-48	15.16	20.98	20.34	134.2	16.0	10.0	1.5	20.0	
14	15.06	20.94	20.51	136.2	16.0	10.0	1.2	20.0	
21	14.48	20.35	19.66	135.8	15.2	10.0	1.6	20.0	
28	14.75	20.76	19.15	129.8	14.0	10.0	1.6	22.0	
8- 4	13.95	19.94	18.67	133.8	13.0	10.0	1.4	14.0	2.0
11	14.81	20.82	20.56	138.8	12.6	10.0	1.7	-	6.0
18	16.41	22.39	21.71	132.3	14.8	9.0	0.8		6.0
25	16.56	21.62	22.57	136.3	16.8	10.0	0.9		6.0
9- 1	15.43	21.46	29.42	137.1	15.2	10.0	0.9		6.0
8	14.12	20.19	19.99	141.6	15.0	10.0	0.8		6.0
22	12.57	18.73	18.45	146.6	13.4	10.0	0.6		6.0
29	11.62	17.82	17.96	154.6	11.6	10.0	0.2		6.0
10- 6-48	8.84	17.69	15.37	196.5	10.2	10.0	1.1		6.0
13	9.13	18.26	18.07	197.8	11.0	10.0	1.2		6.0
20	9.10	18.20	17.94	197.1	11.0	10.0	1.4		6.0
27	9.33	18.65	17.65	189.2	11.4	10.0	1.6		6.0
11-10	9.39	18.78	18.46	196.9	11.4	10.0			6.0
17	9.59	19.18	19.31	201.4	12.0	10.0			6.0
24	9.68	19.35	19.47	201.1	12.2	10.0			6.0
30	14.94	10.46	10.70	71.6	0.8	10.0			6.0
12- 1	15.11	10.57	10.68	70.7	0.8	10.0			6.0
2	18.52	12.96	12.96	70.0	3.8	10.0			6.0
7	18.85	15.08	15.31	81.2	6.8	10.0			6.0
8	18,37	14.70	15.00	81.6	6.4	10.0			6.0
9	18.48	14.78	15.01	81.2	6.4	10.0			6.0
10	18.54	14.83	15.00	80.9	6.4	10.0			6.0
11	19.97	15.98	16.24	81.3	8.0	10.0			6.0
15	18.87	18.87	19.00	100.7	11.6	10.0			6.0
22	20.78	20.78	21.49	103.4	14.8	10.0			6.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48. PEGGY started 6-2-48 at 170 per cent of requirements for maintenance, plus 100 per cent of requirements for production.

Dry 10-6-48

TABLE XL

Feeds and Total Digestible Nutrients Fed to BUNNY

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
12-17-47	12.47	17.46	16.78	134.5	12.6	9.0	1.3	17.0	
23	13.30	18.61	17.13	128.8	14.0	9.0	3.1	18.0	
1- 7-48	13.56	18.98	18.72	138.0	14.6	9.0	0.9	18.0	
14	13.93	19.40	19.05	136.7	15.2	9.0	1.2	18.0	
21	14.20	19.88	19.38	136.4	15.6	9.0	1.1	18.0	
28	13.65	19.11	17.61	129.0	13.4	9.0	1.3	18.0	
2- 4	13.64	19.09	18.38	134.7	14.6	9.0	1.5	18.0	
11	13.37	18.71	18.80	137.5	14.0	9.0	1.0	19.0	
18	13.49	24.44	19.61	139.3	14.0	10.0	1.2	19.0	
25	14.47	20.26	20.07	135.4	15.4	10.0	1.7	19.0	
3- 4	15.04	21.05	18.40	133.4	16.4	10.0	2.3	19.0	
10	14.99	20.98	18.60	122.7	16.4	10.0	2.0	19.0	
17	13.64	19.10	17.85	136.3	13.8	10.0	1.3	19.0	
24	13.36	18.70	18.17	133.6	13.0	10.0	1.9	20.0	
31	13.77	19.28	17.37	131.9	13.8	10.0	2.5	20.0	
4- 8	14.74	20.64	16.43	117.8	12.0	10.0	1.3	20.0	
14	13.77	19.27	16.50	119.3	12.0	10.0	3.3	20.0	
21	13.91	19.56	15.97	118.6	12.0	10.0	3.1	21.0	
28	8.36	16.72	15.96	190.9	10.4	10.0	2.0	21.0	
5- 5	8.44	16.88	16.53	195.9	10.8	10.0	2.1	21.0	
12	8.54	17.09	16.77	196.4	11.2	10.0	2.3	21.0	
19	8.57	17.13	16.69	195.7	11.2	10.0	3.5	21.0	
26	8.58	17.16	16.84	196.3	11.2	10.0	2.2	21.0	
6- 2	8.49	16.98	16.70	196.7	11.0	10.0	2.1	21.0	
9	8.66	17.32	17.37	200.6	10.6	11.0	3.5	22.0	
15	8.70	17.40	17.34	199.4	10.6	11.0	1.6	22.0	
23	8.76	17.51	17.30	197.5	10.8	11.0	2.0	22.0	
28	12.91	4.52	5.69	44.1	1.6	5.0	-	10.0	
29	15.55	5.44	5.69	36.6	1.6	5.0		10.0	
30	15.76	5.51	5.69	36.1	1.6	5.0		10.0	
7- 1	15.97	5.59	5.86	36.7	1.8	5.0		10.0	
2	14.91	5.22	5.36	35.9	1.2	5.0		10.0	
3	15.83	5.54	5.69	35.9	1.6	5.0		10.0	
4	13.68	4.79	5.04	36.8	0.8	5.0		10.0	
5	15.87	5.55	5.85	36.8	1.8	5.0		10.0	
6	15.38	5.38	5.69	37.0	1.6	5.0		10.0	
7	14.17	4.96	5.20	36.6	1.0	5.0		10.0	
8	13.71	4.80	5.02	36.6	0.8	5.0		10.0	
9	13.16	4.60	4.72	35.8	0.4	5.0		10.0	
10	13.24	6.64	4.72	35.6	0.4	5.0		10.0	
11	14.25	5.00	5.20	36.4	1.0	5.0		10.0	

BUNNY started 12-17-47 at 140 per cent of requirements for maintenance and production.

Dry 4 - 28 - 48

TABLE XLI

Feeds and Total Digestible Nutrients Fed to REMEMBRANCE

Date	TDN Required (lbs)	TDN To be Consumed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
2-25-48	18.64	26.16	26.31	140.8	20.2	12.0	-	25.0	
3- 4	20.49	28.69	28.75	140.2	23.0	13.0	0.4	25.0	
3-10	20.85	29.19	29.44	141.2	23.6	13.0	-	25.0	
17	21.16	29.61	21.17	137.8	23.8	13.0	1.2	26.0	
24	21.14	29.59	28.40	134.3	23.8	13.0	2.9	26.0	
31	20.89	29.27	28.65	137.1	23.4	13.0	1.6	26.0	
4- 8	20.94	29.32	28.93	138.1	23.4	13.0	1.1	26.0	
14	21.54	30.15	29.01	134.7	24.2	13.0	2.5	27.0	
21	21.43	29.99	28.88	134.7	24.0	13.0	2.5	27.0	
28	21.75	39.14	29.79	136.9	24.0	14.0	1.7	27.0	
5- 5	22.07	39.72	29.50	133.6	24.0	14.0	2.6	28.0	
12	22.20	33.31	31.82	143.2	27.4	16.0	3.2	28.0	
19	20.59	30.88	29.35	142.5	24.2	14.0	3.2	28.0	
26	20.67	31.00	29.65	143.5	24.6	14.0	3.2	28.0	
6- 2	19.81	29.71	28.41	143.5	22.8	14.0	2.9	28.0	
9	19.80	29.70	28.59	144.3	22.8	14.0	2.6	28.0	
16	20.60	30.89	29.89	145.1	24.4	14.0	3.5	28.0	
23	21.72	32.58	29.31	134.9	24.0	14.0	3.4	29.0	
30	21.25	31.88	28.92	136.0	24.0	14.0	3.8	28.0	
7- 7	11.10	22.19	21.66	195.1	13.6	14.0	3.3	28.0	
14	11.40	22.79	21.99	192.9	14.4	14.0	4.0	28.0	
21	11.36	22.73	21.55	189.7	14.4	14.0	5.0	28.0	
28	11.49	22.98	22.01	191.6	14.6	14.0	4.3	28.0	
8- 4	11.75	23.49	23.20	197.4	15.4	14.0	3.1	16.0	3.0
11	11.82	23.65	23.24	196.6	15.6	14.0	3.7		7.0
18	11.91	23.82	23.37	196.2	15.8	13.0	3.5		7.0
25	11.92	23.84	21.87	183.5	15.2	14.0	4.5		7.0
31	19.83	6.94	6.98	35.2	1.4	6.0	-		3.0
9- 1	18.56	6.50	6.98	37.6	0.8	6.0			3.0
2	20.74	7.26	7.26	35.0	1.8	6.0	-		3.0
3	22.16	7.75	7.72	34.4	2.4	6.0			3.0
4	22.34	7.82	7.88	35.3	2.6	6.0			3.0
5	23.09	8.08	8.05	34.9	2.8	6.0			3.0
6	24.25	8.49	8.53	35.2	3.4	6.0			3.0
7	23.45	8.08	8.17	34.8	3.0	6.0			3.0
8	21.49	7.52	7.36	34.2	2.0	6.0			3.0
10	21.67	7.58	7.05	32.5	2.0	6.0	0.6		3.0
11	22.21	22.21	16.33	73.5	16.2	12.0	2.4		6.0
15	23.05	23.05	23.59	102.4	17.0	12.0	3.5		6.0
22	20.36	20.36	21.47	105.5	13.6	12.0	1.3		6.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48. REMEMBRANCE started 2-25-48 at 140 per cent of requirements for maintenance and production. Dry 7 - 7 - 48.

TABLE XLII

Feeds and Total Digestible Nutrients Fed to PATIENCE

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
7-14-48	15.18	21.36	20.40	134.4	15.2	11.0	-	22.0	
21	14.76	20.90	21.09	142.9	14.8	11.0		22.0	
28	15.51	21.29	22.27	143.6	15.4	11.0		22.0	
8- 4	15.53	21.57	22.01	141.7	15.6	11.0	0.3	14.0	2.0
11	17.04	23.31	23.98	140.7	15.2	11.0	0.1		6.0
18	17.07	23.29	23.47	137.5	16.2	10.0			6.0
25	16.25	22.26	22.56	138.8	17.4	10.0	0.6		6.0
9- 1	17.05	23.35	23.48	137.7	16.2	10.0	0.7		6.0
8	16.46	22.94	22.75	138.2	17.4	10.0	1.1		6.0
22	17.45	23.90	23.92	137.1	16.8	10.0	1.4		6.0
29	16.12	22.59	22.29	138.3	18.0	10.0	0.9		6.0
10- 6	17.42	23.94	23.76	136.4	16.4	10.0	2.1		6.0
13	16.43	23.01	23.03	140.2	18.0	10.0	1.2		6.0
20	16.32	22.85	23.04	141.2	16.8	11.0	1.6		6.0
27	9.45	18.89	19.33	204.6	11.4	11.0	2.6		6.0
11- 3	9.79	19.57	19.71	201.3	11.4	11.0	1.8		6.0
10	9.79	19.57	18.40	187.9	12.4	11.0	1.4		6.0
17	9.37	19.46	17.80	198.9	12.2	11.0	1.7		6.0
24	9.79	19.57	18.57	189.6	12.4	11.0	0.8		6.0
12- 1	9.77	19.54	18.49	189.2	12.4	11.0	0.9		6.0
8	9.40	18.81	18.16	193.2	11.4	11.0	2.1		6.0
15	9.44	19.89	18.64	197.5	11.4	11.0	1.6		6.0
22	9.41	18.82	18.88	200.6	11.4	12.0	1.1		6.0
24	17.21	6.02	6.25	36.3	1.2	6.0	0.4		3.0
31	10.79								

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8 - 19 - 48.

Started 7 - 14 - 48 at 170 per cent of requirements for maintenance plus 100 per cent of requirements for production.

Dry 10 - 27 - 48

TABLE XLIII

Feeds and Total Digestible Nutrients Fed to LAURA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Percent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
9-11-48	16.49	23.91	24.16	146.5	17.6	11.0	-	-	6.0
22	16.52	22.98	23.10	140.5	16.4	11.0			6.0
29	15.97	22.42	22.60	141.5	15.6	11.0			6.0
10- 6	15.48	22.06	21.94	141.7	15.0	11.0			6.0
13	14.53	21.25	21.52	148.1	14.2	11.0	0.5		6.0
20	13.87	20.48	20.65	148.9	13.0	11.0	0.4		6.0
27	13.46	20.27	20.59	153.0	13.0	11.0	1.0		6.0
11-10	13.28	20.32	20.24	152.4	12.0	12.0	0.8		6.0
17	12.42	19.60	20.03	161.3	11.6	12.0	0.3		6.0
24	12.23	19.52	19.91	162.8	11.6	12.0	1.2		6.0
12- 1	12.96	20.25	20.05	159.3	12.4	12.0	0.8		6.0
8	10.75	18.27	18.64	173.4	9.8	12.0	1.3		6.0
15	10.81	18.38	18.80	173.9	10.0	12.0	1.8		6.0
22	10.54	17.92	18.18	172.5	9.2	13.0	2.0		6.0
1- 5-49	10.95	18.62	18.95	173.1	10.2	13.0	1.7		6.0
12	11.29	22.58	22.33	197.8	15.8	13.0	2.7		6.0
19	11.54	23.07	23.15	200.6	16.4	13.0	1.8		6.0
26	11.58	23.16	23.12	199.7	16.6	13.0	1.6		6.0
2- 9	11.72	23.44	23.54	200.9	17.0	13.0	2.0		6.0
16	11.71	23.42	23.00	196.4	17.0	13.0	1.5		6.0
23	19.72	6.90	7.25	36.8	1.8	7.0	-		3.0
24	19.15	6.70	6.88	35.9	1.6	7.0			3.0
25	21.34	7.45	7.71	36.1	2.4	7.0			3.0
26	18.69	6.54	6.76	36.2	1.2	7.0			3.0
27	-	6.54	6.76	-	1.2	7.0			3.0
28	20.96	7.34	7.72	36.8	2.4	7.0			3.0
3- 1	-	7.34	7.72	-	2.4	7.0			3.0
2	21.14	7.45	7.70	36.4	2.4	7.0			3.0
3	20.76	7.27	7.55	36.4	2.2	7.0			3.0
4	20.78	7.28	7.55	36.3	2.2	7.0			3.0
5	21.17	7.40	7.72	36.5	2.4	7.0			3.0

Fed one pound of dehydrated alfalfa leaf meal per day from 9-11-48 until 12-15-48. LAURA started 9-11-48 at 170 per cent of requirements for maintenance and 100 per cent of requirements for production.

Dry 12-8-48

200 per cent feeding began 1-12-49

TABLE XLIV

Feeds and Total Digestible Nutrients Fed to MELANIE

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed Per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Citrus Pulp Fed (lbs)
9-11-48	19.47	27.11	26.74	137.3	19.4	13.0	1.1	7.0
22	19.87	27.38	27.39	137.8	19.8	13.0	0.4	7.0
29	19.28	26.84	28.02	145.3	20.6	13.0	0.4	7.0
10- 6	20.37	27.99	28.88	141.7	22.0	13.0	0.8	7.0
13	19.34	27.14	28.44	147.6	21.0	13.0	0.2	7.0
20	19.28	27.07	28.28	146.7	20.8	13.0	0.2	7.0
27	19.91	27.88	29.15	146.4	21.8	13.0	-	7.0
11-10	19.03	27.16	28.54	149.9	21.0	13.0		7.0
17	18.86	27.13	28.54	151.3	21.0	13.0		7.0
24	19.11	27.50	28.84	150.9	21.4	13.0		7.0
12- 1	16.75	25.30	27.04	160.9	18.4	14.0		7.0
8	15.47	24.26	28.12	161.4	19.8	14.0		7.0
15	14.43	22.40	26.31	181.7	16.8	15.0		7.0
22	13.90	23.04	26.57	182.3	16.8	16.0		8.0
1 - 5-49	13.21	22.46	25.95	191.1	16.0	16.0		8.0
12	13.46	26.92	30.07	223.4	22.2	16.0	3.6	8.0
19	13.74	27.47	29.50	214.7	23.2	16.0	6.2	8.0
26	13.70	27.41	30.29	221.1	23.0	16.0	4.4	8.0
2 - 9	14.04	28.08	30.67	218.4	24.0	16.0	5.2	8.0
16	14.14	28.27	29.46	208.3	24.2	16.0	8.0	8.0
23	14.26	28.51	29.47	206.7	24.6	16.0	8.6	8.0
3 - 2	14.33	28.65	29.63	206.8	24.2	16.0	8.6	8.0
9	14.38	28.77	31.19	216.9	24.2	16.0	5.5	8.0
14	28.09	9.83	11.12	39.6	3.4	8.0		4.0
15	29.84	10.44	10.21	34.2	4.2	8.0		4.0
16	30.01	10.50	10.85	36.2	4.2	8.0		4.0
17	31.98	11.19	10.91	34.1	5.2	8.0		4.0
18	32.29	11.30	11.72	36.3	5.4	8.0		4.0
19	32.99	11.54	11.88	36.0	5.6	8.0		4.0
20	32.48	11.37	12.04	37.1	5.6	8.0		4.0
21	34.15	11.96	12.04	35.3	6.2	8.0		4.0
22	32.61	11.41	11.86	36.4	5.4	9.0		4.0
23	32.10	32.10	19.64	61.2	11.8	15.0	6.0	8.0
30	31.33	31.33	21.02	67.1	11.8	15.0	3.3	8.0
4 - 6	27.13	27.13	21.52	79.3	11.8	14.0	1.3	8.0
13	27.69	26.69	27.39	98.8	19.0	14.0	0.6	8.0

Fed one pound of dehydrated alfalfa leaf meal per day until 12-22-48 and after 3-2-49. MELANIE started 9-11-48 at 170 per cent of requirements for maintenance plus 100 per cent of requirements for production
Dry 1-5-49, 200 per cent feeding beginning 1-12-49

TABLE XLV

Feeds and Total Digestible Nutrients Fed to ARABELLA

Date	TDN Required. (lbs)	TDN To be Fed (lbs)	TDN Consumed. (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)
3-18-49	19.09	19.09	20.19	105.7	10.0	23.0	1.6
23	19.09	19.09	19.89	104.1	10.0	24.0	1.6
4- 6	19.38	19.38	19.35	99.8	10.4	24.0	2.3
13	19.42	19.42	18.81	96.9	10.4	24.0	3.4
20	19.43	19.43	19.04	97.9	10.4	24.0	3.9
27	19.55	19.55	18.48	94.5	10.6	23.0	4.3
5- 4	19.62	19.66	19.34	98.4	10.8	23.0	2.9
11	19.32	19.32	19.04	97.3	10.4	23.0	1.5
14	24.30	8.40	8.89	36.6	5.4	8.0	
16	27.62	9.67	10.17	36.8	7.0	8.0	
17	28.37	9.93	10.49	36.9	7.4	8.0	
18	27.39	9.59	10.17	37.1	7.0	8.0	
19	22.65	9.68	10.33	37.8	7.2	8.0	
20	26.01	9.10	9.69	37.2	6.4	8.0	
21	27.31	9.54	10.17	37.2	7.0	8.0	
23	25.25	8.84	9.37	37.1	6.0	8.0	
24	25.25	17.68	18.71	74.1	14.0	14.0	
25	23.08	23.08	22.72	98.6	21.2	14.0	3.6
6- 1	23.42	23.42	24.40	104.3	21.6	14.0	1.0

Fed one pound of dehydrated alfalfa leaf meal per day

ARABELLA started 3-18-49 at 100 per cent of requirements

TABLE XLVI

Feeds and Total Digestible Nutrients Fed to DORCAS

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Require-ments Consumed	Concen-trate Fed (lbs)	Timo-thy Hay Fed (lbs)	Timothy Hay re-fused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
1-28-48	19.59	27.43	27.74	141.5	20.0	14.0	-	28.0	
2- 4	21.99	30.79	30.76	139.8	24.2	14.0	0.4	28.0	
11	21.95	30.73	30.91	140.8	24.0	14.0	0.2	29.0	
18	21.70	30.37	30.86	142.2	22.8	15.0	-	29.0	
25	21.87	30.62	30.25	138.3	23.2	15.0		29.0	
3- 4	21.42	29.99	30.17	140.8	22.4	15.0	1.7	29.0	
10	22.50	31.05	30.99	139.2	23.4	15.0	0.5	30.0	
17	21.93	30.70	30.90	140.8	23.0	15.0		30.0	
24	21.17	29.64	29.82	140.8	21.6	15.0		30.0	
31	21.56	38.80	37.74	175.0	33.4	15.0	1.5	30.0	
4- 8	20.74	37.34	33.21	160.1	26.0	15.0		30.0	
14	21.93	39.48	32.98	150.3	26.0	15.0	0.9	31.0	
21	20.90	37.61	33.06	158.2	26.0	15.0	0.7	31.0	
28	21.98	39.55	33.14	150.8	26.0	15.0	0.5	31.0	
5- 5	20.67	37.21	31.58	152.7	26.0	15.0	0.6	31.0	
12	19.24	28.86	28.44	147.8	24.0	15.0	1.3	31.0	
19	19.28	29.92	28.23	146.4	20.4	15.0	1.7	31.0	
26	12.10	24.20	24.31	201.0	15.0	15.0	1.9	31.0	
6- 2	12.58	25.16	25.20	202.9	16.0	15.0	1.7	31.0	
9	12.58	25.16	24.91	200.6	16.0	15.0	2.2	32.0	
16	12.46	24.91	25.20	202.1	15.0	16.0	2.5	32.0	
23	12.40	24.80	24.29	197.9	14.8	16.0	3.0	32.0	
30	12.34	24.68	24.79	201.0	14.6	16.0	1.7	32.0	
7- 2	13.98	9.79	10.07	72.1	14.6	10.0	-	27.0	
3	16.71	11.70	12.08	72.2	4.4	7.0		27.0	
4	16.74	11.61	12.08	72.0	4.4	7.0		27.0	
5	20.20	14.14	14.62	72.2	7.6	7.0		27.0	
6	20.82	14.56	15.10	72.4	8.2	7.0		27.0	
7	17.93	12.55	13.00	72.4	5.8	7.0		26.0	
8	19.47	15.57	16.17	83.1	9.8	7.0		26.0	
9	17.89	14.31	14.75	82.3	8.0	7.0		26.0	
10	17.94	14.35	14.91	83.0	8.2	7.0		26.0	
11	17.91	14.33	14.91	83.1	8.2	7.0		26.0	
12	17.77	14.22	14.75	82.9	8.0	7.0		26.0	
13	18.07	14.46	14.91	82.4	8.2	7.0		26.0	
14	17.90	14.32	14.91	83.2	8.2	7.0		26.0	
15	18.30	14.64	15.23	83.1	8.6	7.0		26.0	
16	17.05	17.74	18.19	106.4	9.4	12.0		26.0	
23	17.39	17.39	17.75	107.0	9.0	12.0		26.0	
30	18.23	18.23	18.39	100.8	9.8	12.0		26.0	

DORCAS started 1 - 28 - 48 at 140 per cent of requirements for maintenance and production.

Dry 5 - 26 - 48

TABLE XLVII

Feeds and Total Digestible Nutrients Fed to ACACIA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
3- 4-48	18.47	25.85	25.95	140.6	23.2	9.0	-	22.0	
10	20.09	28.10	25.06	124.7	22.0	9.0		22.0	
17	19.37	27.12	24.51	126.5	22.0	9.0	1.1	22.0	
24	17.67	24.74	24.19	136.8	21.8	9.0	1.4	22.0	
31	18.85	26.39	23.86	126.5	22.0	9.0	2.4	22.0	
4- 8	17.92	25.07	24.49	136.6	22.2	9.0	1.4	22.0	
14	18.62	25.97	26.02	139.7	22.6	10.0	1.7	22.0	
21	17.89	25.04	23.77	132.8	21.4	10.0	2.6	22.0	
28	18.42	25.79	22.82	123.8	20.0	10.0	2.4	22.0	
5- 5	12.92	32.26	22.87	127.5	20.0	10.0	2.3	22.0	
12	17.43	26.15	25.18	144.4	23.0	10.0	2.3	22.0	
19	16.55	24.82	23.76	143.5	21.0	10.0	2.4	20.0	
26	15.88	23.81	22.53	141.9	19.4	10.0	2.4	20.0	
6- 2	13.65	20.47	19.48	142.7	15.6	10.0	2.3	20.0	
9	14.36	21.54	20.68	144.0	16.8	10.0	2.1	20.0	
16	13.23	19.84	18.97	143.4	14.6	10.0	2.1	20.0	
23	12.89	19.84	18.35	142.3	13.4	10.0	2.3	22.0	
30	12.13	19.34	17.36	143.1	12.2	10.0	2.4	22.0	
7- 7	8.48	16.96	16.93	198.8	10.8	10.0	2.0	22.0	
14	8.64	17.28	17.56	203.4	11.2	10.0	1.4	22.0	
21	8.80	17.59	18.06	205.4	11.2	10.0	1.3	22.0	
28	8.57	17.15	16.64	194.2	10.4	11.0	2.9	22.0	
8- 4	8.79	17.58	17.45	198.7	11.0	11.0	2.3	14.0	2.0
11	8.73	17.46	16.86	193.2	10.2	11.0	2.9		6.0
18	8.89	17.78	16.83	189.4	10.4	10.0	0.7		6.0
23	16.59	11.61	12.08	71.8	3.4	10.0			5.0
24	16.12	11.28	11.75	72.7	3.0	10.0			5.0
25	19.84	13.89	14.51	73.0	6.4	10.0			5.0
26	17.22	12.05	11.91	69.0	4.0	10.0	1.3		5.0
27	21.38	14.96	15.14	70.1	7.8	10.0	1.0		5.0
28	12.44	13.61	13.68	70.2	6.0	10.0	1.0		5.0
29	21.64	17.31	17.74	81.9	11.0	10.0	1.0		5.0
30	19.41	15.53	15.64	80.4	8.6	10.0	1.3		5.0
31	20.91	16.73	16.32	78.0	10.0	10.0	1.0		5.0
9- 1	20.38	16.30	16.83	82.5	9.6	10.0	.5		5.0
2	19.64	15.71	16.17	82.2	8.8	10.0	.5		5.0
3	17.56	14.05	15.69	88.7	8.8	10.0	1.7		5.0
4	19.61	15.97	16.78	84.0	9.2	10.0			5.0
5	19.80	19.80	18.72	94.5	14.4	10.0	4.5		5.0
8	20.29	20.29	20.54	101.2	15.0	10.0	.9		5.0
9-15	19.45	19.45	20.66	106.2	14.6	10.0			5.0

Fed one pound of dehydrated alfalfa leaf meal daily beginning 8-19-48. ACACIA started 3-4-48 at 140 per cent of requirements for maintenance and production. Dry 7-7-48.

TABLE XLVIII

Feeds and Total Digestible Nutrients Fed to POMONA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
7-21-48	13.49	18.50	18.71	138.7	14.0	9.0	-	18.0	
28	13.76	19.95	20.10	146.0	15.8	9.0	-	18.0	
8- 4	14.47	19.83	19.96	137.9	15.6	9.0	-	10.0	2.0
11	15.65	20.88	20.95	133.8	16.4	9.0	-		5.0
18	13.90	19.31	18.70	134.5	14.4	8.0	1.4		5.0
25	14.27	19.40	19.56	137.0	14.6	8.0	-		5.0
9- 1	13.05	18.24	18.33	140.4	13.0	8.0	-		5.0
8	12.91	18.07	18.10	140.2	12.8	8.0	0.1		5.0
22	13.70	20.13	18.25	133.2	15.6	8.0	0.1		5.0
29	13.35	18.83	19.10	143.0	14.0	8.0			5.0
10-6	13.62	19.06	19.25	141.3	14.2	8.0			5.0
13	13.28	18.78	19.10	143.8	14.0	8.0			5.0
20	14.26	19.75	19.91	139.6	14.4	8.0			5.0
27	8.09	16.18	16.63	205.7	9.8	9.0			5.0
11-10	8.15	16.29	16.97	208.4	10.2	9.0			5.0
17	8.22	16.44	16.97	206.6	10.2	9.0			5.0
24	8.45	16.90	17.13	202.9	10.4	9.0			5.0
12- 1	8.52	17.04	18.13	212.9	11.0	10.0			5.0
8	8.65	17.29	17.80	206.1	10.6	10.0			5.0
15	8.84	17.68	18.13	205.1	11.0	10.0			5.0
22	9.41	18.33	19.41	206.4	12.6	10.0			5.0
1- 3-49	16.40	11.48	11.88	72.3	3.0	11.0			5.0
4	19.43	13.60	14.13	72.6	6.0	11.0			5.0
5	21.74	15.22	15.90	73.0	8.2	11.0			5.0
6	21.16	14.81	15.57	73.4	7.8	11.0			5.0
7	20.99	16.79	17.65	84.0	10.4	11.0			5.0
8	20.60	16.48	17.72	84.0	10.0	11.0			5.0
10	20.49	16.46	16.47	80.3	10.0	11.0			5.0
12	20.94	16.75	16.25	77.5	10.2	11.0	1.7		5.0
14	21.03	21.03	21.06	100.1	15.6	11.0	2.4		5.0
19	21.33	21.33	21.30	99.9	16.0	11.0	-		5.0
26	20.49	20.49	20.70	101.0	14.8	11.0	0.6		5.0

Fed one pound of dehydrated alfalfa leaf meal per day from 8-19-48 until 12-22-48. POMONA started 7-21-48 at 170 per cent of requirements for maintenance, plus 100 per cent of requirements for production.

Dry 10-27-48

TABLE XLIX

Feeds and Total Digestible Nutrients Fed to CHARM

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed Per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)
2-16-49	17.70	17.70	18.51	104.5	10.2	21.0	0.6
23	17.60	17.60	18.32	104.0	10.0	21.0	0.7
3- 2	17.68	17.68	18.62	105.2	10.2	20.0	0.4
9	17.72	17.72	18.08	102.0	10.2	20.0	1.5
16	17.94	17.94	18.34	102.1	10.4	20.0	1.1
23	18.06	18.06	19.14	106.0	10.6	21.0	
4- 6	17.94	17.94	17.98	100.1	10.4	21.0	0.3
7	23.70	16.36	17.34	74.1	9.6	19.0	
8	20.20	14.14	14.92	74.5	6.6	19.0	
9	23.92	16.75	17.82	74.4	10.2	19.0	
11	25.61	17.93	19.10	74.5	11.8	19.0	
12	25.27	17.70	18.94	74.9	11.6	19.0	
13	23.83	19.07	20.22	84.8	13.2	19.0	
14	23.49	18.87	19.88	84.5	12.8	19.0	1.0
15	24.44	19.55	20.67	84.5	13.8	19.0	1.0
19	24.89	19.91	20.16	80.9	14.4	19.0	1.0
20	23.91	23.91	25.64	107.3	19.6	19.0	0.4
27	22.83	22.83	23.23	101.8	18.2	19.0	0.9

Fed one pound of dehydrated alfalfa leaf meal per day from 2-16-49 until 4- 6-49 and from 4-21-49 until 4-27-49

CHARM started 2-16-49 at 100 per cent of requirements

TABLE L

Feeds and Total Digestible Nutrients Fed to HILDA

Date	TDN Required. (lbs)	TDN To be Fed (lbs)	TDN Consumed. (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)
2-16-49	13.10	13.10	13.31	101.6	9.2	13.0	1.3
23	13.16	13.16	13.02	98.9	9.2	13.0	1.9
3- 2	13.25	13.25	13.73	103.6	9.4	13.0	0.8
9	13.34	13.34	13.41	100.5	9.4	13.0	1.4
16.	13.39	13.39	13.35	99.7	9.6	13.0	1.8
23	13.44	13.44	12.93	96.2	9.6	13.0	2.7
4- 6	13.67	13.67	13.34	97.6	10.0	13.0	2.5
13	13.77	13.77	13.22	96.0	10.0	13.0	2.7
19	12.40	8.68	7.81	63.0	3.2	13.0	2.7
20	14.92	10.44	9.76	65.4	5.6	13.0	2.0
21	14.48	10.11	9.41	65.1	5.2	12.0	2.0
22	13.96	11.17	10.55	75.6	6.6	12.0	1.7
23	15.53	12.42	11.82	76.2	8.2	12.0	2.3
25	15.05	12.04	11.50	76.5	7.8	12.0	2.4
26	15.37	12.30	11.67	76.0	8.0	12.0	1.8
27	15.32	12.26	11.54	75.6	8.0	12.0	1.8
29	14.14	14.14	13.46	95.2	10.4	12.0	2.0
5- 4	14.34	14.34	14.05	98.0	10.8	12.0	2.3
11	13.75	13.79	14.60	106.2	10.0	12.0	-

Fed one pound of dehydrated alfalfa leaf meal per day except from 4- 6-49 until 4-19-49

HILDA started 2-16-49 at 100 per cent of requirements

TABLE LI

Feeds and Total Digestible Nutrients Fed to MARTHA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed Per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)
12-10-47	14.69	20.57	20.80	141.5	12.2	13.0	0.1	26.0
17	14.41	20.17	20.23	140.4	11.6	13.0	0.3	26.0
23	14.72	20.61	20.82	141.4	12.4	13.0	-	25.0
1- 7-48	15.08	21.12	21.34	141.4	12.6	13.0		27.0
14	15.60	21.62	21.34	136.7	12.6	13.0		27.0
21	15.26	21.36	21.50	140.8	12.8	13.0		27.0
28	14.68	20.56	21.00	143.0	11.4	14.0		27.0
2- 4	14.68	20.55	20.84	141.8	11.4	14.0	0.4	28.0
11	14.48	20.27	26.27	181.4	18.2	14.0		28.0
18	15.11	27.19	27.08	179.2	18.8	15.0	0.8	29.0
25	15.50	27.91	26.81	172.9	19.6	15.0	2.6	29.0
3- 4	15.37	27.67	27.78	180.7	19.2	15.0	0.4	30.0
10	14.90	26.83	25.83	173.3	18.0	15.0	2.1	30.0
17	14.71	26.47	25.88	175.9	17.4	15.0	2.0	31.0
24	14.02	25.29	24.45	174.3	15.2	16.0	2.2	31.0
31	12.39	22.30	20.50	165.4	11.4	16.0	4.3	31.0
4- 8	12.17	21.90	20.63	169.4	10.8	16.0	3.1	31.0
14	12.36	22.24	19.95	161.4	11.4	16.0	5.4	31.0
21	12.67	25.35	23.30	183.4	15.6	16.0	4.5	32.0
28	12.92	25.84	23.40	181.1	15.4	16.0	4.3	33.0
5- 5	13.12	26.23	23.66	180.3	15.8	17.0	5.4	33.0
12	13.19	26.38	23.41	177.4	16.0	17.0	6.2	33.0
19	13.29	26.58	23.46	176.5	16.0	17.0	6.4	34.0
26	13.45	26.90	23.69	176.1	16.4	17.0	6.7	34.0
6- 2	13.40	26.79	23.40	174.6	16.2	17.0	7.0	34.0
9	13.20	26.39	23.16	175.4	15.8	17.0	3.8	34.0
6-14	18.42	6.45	6.53	35.4	0	7.0	-	16.0
15	24.32	8.51	7.73	31.7	2.2	7.0		16.0
16	23.34	8.17	8.38	35.8	2.4	7.0		16.0
17	21.00	7.35	7.45	35.4	1.2	7.0		16.0
18	25.63	8.97	9.15	35.7	3.4	7.0		16.0
19	24.83	8.69	7.68	30.9	2.0	7.0		14.0
20	24.51	8.58	8.78	35.8	3.4	7.0		14.0
21	23.31	8.16	8.32	35.6	2.8	7.0		14.0
22	21.79	7.62	7.85	36.0	2.2	7.0		14.0
23	21.15	7.40	7.55	35.6	1.8	7.0		14.0
24	20.95	7.33	7.55	36.0	1.8	7.0		14.0
25	20.60	7.21	7.39	35.8	1.6	7.0		14.0
26	19.23	6.73	6.93	36.0	1.0	7.0		14.0
27	20.07	7.03	7.24	36.0	1.4	7.0		14.0
28	20.34	7.12	7.24	35.5	1.4	7.0		14.0

TABLE LI, cont'd

D a t e	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)
6-29-48	18.48	7.12	7.24	39.1	1.4	7.0	-	14.0
30	19.38	13.85	13.96	72.0	7.2	7.0		26.0
7- 7	16.90	16.90	14.26	84.4	11.2	7.0		26.0
8	16.91	16.91	16.69	98.6	11.4	7.0		26.0
15	16.34	16.34	16.43	100.5	10.4	7.0		26.0
21	15.67	15.67	15.66	99.9	9.4	7.0		26.0

MARTHA started 12 - 10 - 47 at
140 per cent of requirements

Dry 3 - 24 - 48

200 per cent feeding began 4 - 21 - 48

TABLE LII

Feeds and Total Digestible Nutrients Fed to BETH

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Per cent Requirements Consumed	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
2-18-48	14.62	20.47	20.60	140.8	17.6	8.0	-	16.0	
25	13.90	19.46	19.38	139.4	16.2	8.0	0.3	16.0	
3- 4	13.98	19.57	19.45	139.0	16.2	8.0	0.1	16.0	
10	13.63	19.09	19.17	140.6	15.8	8.0		16.0	
17	14.76	20.66	20.64	139.8	17.6	8.0	0.3	17.0	
24	13.76	19.28	19.79	136.5	15.8	8.0	1.2	17.0	
31	13.82	19.34	19.05	137.8	15.8	8.0	0.7	17.0	
4- 8	13.72	19.80	19.71	143.6	16.2	8.0		17.0	
14	13.97	13.56	19.75	141.3	15.6	9.0		17.0	
21	13.33	24.09	20.74	155.6	18.0	9.0	1.7	17.0	
28	14.93	26.88	20.81	139.3	18.0	9.0	1.9	18.0	
5- 5	14.43	25.97	21.42	148.4	18.0	9.0	0.7	18.0	
12	13.17	20.95	20.44	146.3	17.0	9.0	1.1	18.0	
19	14.30	21.44	21.01	146.9	17.8	9.0	1.2	18.0	
26	14.56	21.84	21.33	146.5	18.2	9.0	1.3	18.0	
6- 2	14.29	21.44	20.99	146.8	17.8	9.0	1.1	18.0	
9	14.30	21.45	21.06	147.2	17.8	9.0	1.2	18.0	
16	14.20	21.30	20.64	145.3	17.6	9.0	1.7	18.0	
23	14.08	21.11	20.30	144.2	17.2	9.0	1.3	18.0	
30	7.55	15.11	13.86	183.5	9.4	9.0	1.9	18.0	
7- 7	7.41	14.82	13.70	184.8	9.2	9.0	1.9	18.0	
14	7.51	15.02	14.02	186.6	9.4	9.0	1.6	18.0	
21	7.58	15.15	14.76	194.8	10.0	9.0	1.0	18.0	
28	7.61	15.22	14.17	186.2	10.0	9.0	2.1	18.0	
8- 4	7.75	15.50	14.45	186.4	10.4	9.0	2.2	10.0	2.0
11	7.66	15.33	14.47	188.8	9.6	9.0	1.8		5.0
18	7.88	15.76	14.60	185.3	10.2	8.0	0.7		5.0
20	12.89	6.26	6.91	38.6	2.2	5.0			3.0
21	15.89	5.56	5.41	34.0	1.4	4.0	0.8		3.0
22	16.56	5.80	5.96	35.9	1.6	4.0			3.0
23	13.66	4.78	4.93	36.0	0.2	4.0			3.0
24	16.56	5.80	5.96	35.9	1.6	4.0			3.0
25	16.55	5.70	5.96	36.0	1.6	4.0			3.0
26	17.50	6.03	6.10	34.8	1.8	4.0			3.0
27	16.75	5.86	5.96	35.5	1.6	4.0			3.0
28	15.44	5.41	5.51	35.6	1.0	4.0			3.0
29	15.26	5.34	5.37	35.1	0.8	4.0			3.0
30	15.90	5.56	5.66	35.6	1.2	4.0			3.0
31	14.14	4.95	9.99	70.6	6.4	6.0	1.0		3.0
9- 1	14.85	14.85	14.50	97.6	10.0	8.0	0.8		4.0
8	16.48	16.48	15.82	96.0	12.0	8.0	0.6		4.0
15	17.31	17.31	17.35	100.2	14.0	8.0			4.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48. BETH started 2-18-48 at 140 per cent of requirements.

Dry 6-30-48

TABLE LIII

Feeds and Total Digestible Nutrients Fed to LIZZIE

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
7-14-48	15.54	20.95	21.02	135.2	17.0	9.0	-	18.0	
21	15.97	21.05	20.79	130.1	17.2	9.0	5.3	18.0	
28	15.14	20.26	20.20	133.4	16.2	9.0	2.9	18.0	
8- 4	15.18	20.34	20.15	132.7	16.0	9.0	1.7	10.0	2.0
11	14.87	19.97	20.18	135.7	15.4	9.0	-		5.0
18	13.56	18.70	18.71	137.9	13.6	8.0	1.0		5.0
25	14.11	19.30	19.41	137.5	14.4	8.0			5.0
9- 1	14.38	19.51	19.72	137.1	14.8	8.0			5.0
8	14.61	19.87	20.03	137.0	15.2	8.0			5.0
22	14.76	20.12	20.33	137.7	15.6	8.0			5.0
29	13.30	18.77	18.79	141.2	13.6	8.0			5.0
10- 6	12.28	17.63	17.87	145.4	12.4	8.0			5.0
13	12.36	17.80	18.02	145.8	12.6	8.0			5.0
20	12.21	17.72	17.91	146.6	11.8	9.0			5.0
21	12.06	17.65	17.75	147.1	11.6	9.0			5.0
11-10-48	8.30	16.59	16.69	201.1	10.4	9.0			5.0
17	8.40	16.80	16.99	202.2	10.8	9.0			5.0
24	8.49	16.97	17.14	201.9	11.0	9.0			5.0
12- 1	8.46	16.91	17.20	203.4	10.4	10.0			5.0
8	8.51	17.02	17.35	203.8	10.6	10.0			5.0
15	8.72	17.43	17.65	202.4	11.0	10.0			5.0
22	8.89	17.78	18.11	203.6	11.6	11.0			5.0
24	16.98	5.94	6.07	35.7	2.0	6.0			2.0
31	18.73	6.56	6.67	35.6	2.8	6.0			2.0
1- 3-49	18.73	18.73	19.15	102.2	13.4	10.0			5.0
5	17.62	17.62	17.76	100.8	11.6	10.0			5.0
12	17.43	17.43	16.93	97.1	11.4	10.0	1.3		5.0
19	16.46	16.46	16.11	97.8	10.2	10.0	1.1		5.0
26	17.02	17.02	17.12	100.6	11.0	10.0	0.4		5.0

Fed one pound of dehydrated alfalfa leaf meal per day from 8-19-48 until 12-22-48

LIZZIE started 7-14-48 at 170 per cent of requirements for maintenance plus 100 per cent for production

TABLE LIV

Feeds and Total Digestible Nutrients Fed to ELINOR

D a t e	TDN Required. (lbs)	TDN To be Fed (lbs)	TDN Consumed. (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Citrus Pulp Fed (lbs)
10-27-48	19.83	26.54	26.73	141.9	21.0	11.0	0.1	6.0
11-10	19.06	25.47	25.84	135.5	19.8	11.0		6.0
17	20.69	26.84	27.08	130.8	21.4	11.0		6.0
24	21.27	27.81	28.00	131.6	22.6	11.0		6.0
12- 1	20.06	26.63	26.77	133.4	21.0	11.0		6.0
8	19.67	26.23	26.46	134.5	20.6	11.0		6.0
15	19.92	26.68	26.26	131.8	21.0	10.0		6.0
22	19.77	26.63	26.78	135.4	21.0	12.0		6.0
1- 5-49	19.57	26.33	26.62	136.0	20.8	12.0		6.0
12	18.33	25.41	25.54	139.3	19.4	12.0		6.0
19	18.74	25.82	26.01	138.7	20.0	12.0		6.0
26	18.73	25.96	26.01	138.8	20.0	12.0		6.0
2- 5-49	10.33	20.66	21.04	203.6	13.8	12.0		6.0
9	10.51	21.03	21.35	203.0	14.2	12.0		6.0
16	10.70	21.41	21.80	203.6	14.8	12.0		6.0
23	10.98	21.96	22.41	204.0	15.6	12.0		6.0
3- 2	11.18	22.37	22.91	204.8	15.6	12.0		6.0
9	11.54	23.17	23.31	202.0	16.6	12.0	0.7	6.0
16	11.43	22.85	22.86	200.0	16.2	12.0		6.0
23	22.54	7.89	8.02	35.5	4.0	6.0		3.0
24	25.30	8.86	9.08	35.8	3.6	6.0		3.0
25	30.62	10.72	10.90	35.6	5.0	6.0		3.0
26	28.61	10.01	10.29	35.9	7.4	6.0		3.0
27	-	10.01	10.29	-	6.8	6.0		3.0
28	27.59	9.66	9.84	35.6	6.8	6.0		3.0
29	25.85	9.05	9.23	35.7	6.0	6.0		3.0
30	28.03	9.81	9.99	35.6	5.2	6.0		3.0
31	25.21	8.82	9.08	36.0	6.2	6.0		3.0
4- 1	26.75	18.72	19.07	71.2	5.0	12.0		6.0
2	26.75	22.74	22.92	85.6	11.0	12.0		6.0
3	26.75	26.75	26.64	99.5	16.0	12.0	1.7	6.0
6	26.64	24.64	24.33	98.7	21.2	12.0	6.0	6.0
13	22.80	22.80	22.59	99.0	18.4	12.0	6.7	6.0

Fed one pound of dehydrated alfalfa leaf meal per day from 10-27-48 until 12-22-48, and from 3-2-49 until 3-16-49. ELINOR started 10-27-48 at 170 per cent of requirements for maintenance plus 100 percent for production

TABLE LV

Feeds and Total Digestible Nutrients Fed to BARBARA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Citrus Pulp Fed (lbs)
10-27-48	16.57	21.75	21.96	132.5	16.4	10.0		5.0
11-10	18.34	24.14	24.27	132.3	19.4	10.0		5.0
17	17.17	23.06	23.19	135.0	18.0	10.0		5.0
24	16.35	22.18	22.42	137.0	17.0	10.0		5.0
12- 1	17.33	22.43	23.66	136.5	18.6	10.0		5.0
8	16.92	22.84	23.96	141.6	19.0	10.0		5.0
15	16.84	27.50	23.66	140.4	18.6	10.0		5.0
22	17.91	23.74	25.40	141.7	20.2	11.0		5.0
1- 5-49	16.87	22.56	26.67	158.1	18.6	11.0		5.0
12	17.24	23.03	23.72	137.6	19.2	11.0	0.8	5.0
19	15.73	21.52	22.06	140.2	17.4	11.0	1.3	5.0
26	17.39	23.31	23.89	137.3	19.6	11.0	1.1	5.0
2- 9	16.23	22.11	22.89	141.0	18.2	11.0	0.9	5.0
16	15.91	21.71	22.70	142.7	17.8	11.0	0.7	5.0
23	16.59	22.56	23.67	142.7	19.0	11.0	0.6	5.0
3- 2	16.25	22.28	22.82	140.4	17.8	11.0	0.4	5.0
9	8.35	16.70	17.35	207.7	10.6	10.0	-	5.0
16	8.51	17.02	17.81	209.2	11.2	10.0		5.0
23	8.75	17.49	17.76	203.0	11.2	11.0	0.1	5.0
4- 6	8.98	17.96	17.97	200.1	11.8	11.0	0.6	5.0
13	8.99	17.98	18.07	201.0	11.8	11.0	0.4	5.0
20	9.11	18.22	19.07	209.3	12.2	11.0	-	5.0
27	9.21	18.43	17.36	188.4	11.6	11.0	1.5	5.0
5- 5	21.65	7.58	7.86	36.3	3.4	5.0		3.0
6	21.19	7.61	7.86	37.0	3.4	5.0		3.0
7	19.17	6.71	6.80	35.4	2.0	5.0		3.0
9	22.08	7.73	7.86	35.4	3.4	5.0		3.0
10	21.09	7.38	7.55	35.8	3.0	5.0		3.0
11	20.65	7.23	7.40	35.8	2.8	5.0		3.0
12	21.93	7.68	7.86	35.8	3.4	5.0		3.0
13	20.87	7.30	7.70	36.8	2.8	5.0		3.0
14	21.32	14.92	13.28	62.3	6.8	10.0	2.2	6.0
15	21.32	21.32	19.80	92.8	15.4	10.0	-	6.0
18	21.33	21.33	19.80	92.8	15.4	10.0		6.0
25	22.24	22.24	22.04	99.1	16.6	10.0		6.0

Fed one pound of dehydrated alfalfa leaf meal per day except for periods from 10-27-48 to 12-22-48, and from 3-2-49 to 5-25-49

BARBARA started 10-27-48 at 170 per cent of requirements for maintenance plus 100 per cent of requirements for production

TABLE LVI

Feeds and Total Digestible Nutrients Fed to DEE

Date	TDN Required. (lbs)	TDN To be Fed (lbs)	TDN Consumed. (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Corn Silage Fed (lbs)
1-14-48	20.94	29.32	29.04	138.6	22.6	14.0	1.0	27.0
21	19.99	27.99	26.68	133.4	20.8	14.0	2.9	27.0
28	20.82	29.15	28.41	136.4	22.2	14.0	2.0	28.0
2- 4	20.64	28.89	28.31	137.1	21.6	14.0	1.7	29.0
11	20.05	28.07	28.45	141.8	20.8	14.0	1.0	28.0
18	19.46	27.25	27.43	140.9	19.6	14.0		28.0
25	20.17	28.24	27.99	138.7	20.2	15.0	1.0	29.0
3- 4	19.85	27.79	26.67	134.3	19.6	15.0	2.8	29.0
10	19.21	26.99	25.67	133.6	18.2	15.0	3.1	30.0
17	18.06	32.56	31.13	172.4	25.4	15.0	3.2	30.0
24	16.63	29.93	28.73	172.7	22.0	15.0	2.8	30.0
31	16.17	29.00	26.66	164.8	20.8	15.0	5.1	30.0
4- 8	15.16	27.28	25.89	170.8	18.6	15.0	3.2	30.0
14	14.69	26.44	25.21	171.6	17.4	15.0	3.1	31.0
21	14.60	26.27	24.43	167.3	16.4	15.0	4.1	31.0
28	13.42	24.16	23.63	176.0	13.8	15.0	1.8	31.0
5- 5	12.57	22.73	21.33	169.6	12.0	15.0	3.5	31.0
12	12.42	24.84	21.98	176.9	15.0	16.0	5.7	31.0
19	12.58	25.16	21.91	174.1	15.4	16.0	6.5	31.0
26	12.89	25.78	22.60	175.3	16.4	16.0	6.6	31.0
6- 2	12.81	25.63	22.47	175.3	16.0	16.0	6.3	31.0
9	12.92	25.83	22.87	177.0	16.2	16.0	6.1	32.0
16	12.93	25.86	22.63	174.9	16.2	16.0	6.6	32.0
23	13.23	26.46	23.27	175.9	16.6	16.0	6.7	34.0
30	12.97	25.94	23.04	177.6	16.4	16.0	6.1	32.0
7- 3	16.75	11.73	11.73	70.0	4.0	7.0		28.0
4	16.49	11.54	11.58	70.2	3.8	7.0		28.0
5	19.35	13.55	13.49	69.7	6.4	7.0		28.0
6	20.01	14.00	13.93	69.6	7.0	7.0		28.0
7	21.27	14.89	21.13	99.5	16.8	7.0		28.0
8	21.44	15.01	15.11	70.4	8.6	7.0		28.0
9	21.84	17.47	17.46	79.9	11.8	7.0		28.0
10	21.29	17.04	17.02	79.9	11.2	7.0		28.0
11	22.91	18.32	18.34	80.0	13.0	7.0		28.0
12	20.19	16.15	16.14	79.9	10.0	7.0		28.0
13	21.71	17.37	17.31	79.7	11.6	7.0		28.0
14	21.94	17.57	17.61	80.2	12.0	7.0		28.0
15	21.85	17.47	17.46	79.8	11.8	7.0		28.0
16	21.41	21.71	21.72	101.0	12.8	14.0		28.0
23	20.23	20.23	19.75	97.6	11.0	14.0	1.3	28.0

DEE started 1 - 14 - 48 at 140 per cent of
requirements for maintenance and production

TABLE LVII

Feeds and Total Digestible Nutrients Fed to ESMERALDA

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
2-25-48	15.26	21.36	21.65	141.8	14.4	12.0	-	24.0	
3- 4	18.86	26,41	26.58	140.9	20.8	12.0		24.0	
10	20.70	28.98	28.88	139.5	24.0	12.0	0.3	24.0	
17	21.53	30.14	29.68	137.8	25.4	12.0	0.7	24.0	
24	21.12	29.57	28.59	135.3	24.6	12.0	2.2	25.0	
31	21.17	29.64	29.14	137.6	24.8	12.0	1.4	25.0	
4- 8	21.50	30.09	29.46	137.0	25.2	12.0	1.4	25.0	
14	22.45	31.43	31.60	140.7	26.4	13.0		25.0	
21	22.00	30.80	30.67	139.4	25.4	13.0	0.3	25.0	
28	22.40	40.32	32.75	146.2	28.0	13.0	0.5	26.0	
5- 5	23.83	43.88	31.65	132.8	28.0	13.0	2.7	26.0	
12	23.20	34.80	31.37	135.2	28.0	13.0	3.3	26.0	
19	22.95	34.42	31.45	137.0	28.0	13.0	3.0	26.0	
26	21.93	32.88	31.31	142.7	28.0	13.0	3.4	26.0	
6- 2	21.09	31.64	30.05	142.4	26.4	13.0	3.4	26.0	
9	20.52	30.77	29.10	141.8	25.0	13.0	3.2	26.0	
16	19.59	29.38	27.87	142.2	23.6	13.0	3.5	26.0	
23	20.74	31.01	28.85	139.0	25.0	13.0	3.4	28.0	
30	10.62	21.23	19.28	181.6	12.6	13.0	3.6	28.0	
7- 7	10.18	20.35	19.04	187.1	12.0	13.0	2.4	26.0	
14	10.67	21.33	20.76	194.6	13.6	13.0	1.3	26.0	
21	10.98	21.97	20.72	188.6	14.4	13.0	2.6	26.0	
28	10.97	21.94	20.99	191.3	14.4	13.0	2.0	26.0	
8- 4	11.35	22.70	22.04	194.2	14.2	14.0	1.5		3.0
11	11.51	23.01	22.17	192.6	14.4	14.0	1.5		7.0
18	11.66	23.33	22.69	194.5	15.0	13.0	1.3		7.0
25	11.63	23.26	20.96	180.1	15.0	13.0	1.4		7.0
27	25.88	18.11	18.29	70.6	9.8	12.0	-		6.0
28	24.83	17.38	18.29	73.6	8.8	12.0			6.0
29	27.02	18.91	19.02	70.4	10.8	12.0			6.0
30	27.63	19.34	19.49	70.4	11.4	12.0			6.0
31	28.17	19.72	19.91	70.6	12.0	12.0			6.0
9- 1	28.30	19.81	19.91	70.3	12.0	12.0			6.0
2	28.44	19.91	20.05	70.5	12.2	12.0			6.0
3	28.61	22.89	22.85	79.8	16.0	12.0			6.0
4	27.28	21.82	21.82	79.9	14.6	12.0			6.0
5	28.07	22.46	22.55	80.3	15.6	12.0			6.0
6	27.57	22.06	22.11	80.1	15.0	12.0			6.0
7	25.06	20.05	20.20	80.6	12.4	12.0			6.0
8	26.40	21.12	21.23	80.4	13.8	12.0			6.0
10	25.66	20.52	21.23	82.7	13.8	12.0			6.0
11	25.81	25.81	25.78	99.9	20.0	12.0			6.0
17	27.84	27.84	27.78	99.7	23.4	12.0			6.0

Fed one pound of dehydrated alfalfa leaf meal per day beginning 8-19-48. ESMERALDA started 2-25-48 at 140 per cent of requirements for maintenance and production

TABLE LVIII

Feeds and Total Digestible Nutrients Fed to RUBY

D a t e	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed Per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)	Corn Silage Fed (lbs)	Citrus Pulp Fed (lbs)
7- 7-48	17.29	23.66	23.48	135.8	18.2	11.0	0.8	23.0	
14	18.32	24.70	24.82	135.5	19.4	11.0		23.0	
21	17.34	23.78	23.90	137.8	18.2	11.0		23.0	
28	17.71	24.22	24.36	137.5	18.8	11.0		23.0	
8- 4	17.16	23.65	23.93	139.4	18.2	11.0	-	15.0	2.0
11	17.39	23.84	24.11	138.6	18.2	11.0	-		6.0
18	17.99	24.39	24.34	135.3	18.8	10.0	0.4		6.0
25	17.67	24.48	24.61	139.2	18.2	11.0			6.0
9- 1	19.27	25.65	26.15	135.6	20.2	11.0			6.0
8	17.87	24.54	24.61	137.6	18.2	11.0			6.0
22	17.10	24.00	24.15	141.2	17.6	11.0			6.0
29	16.74	23.55	23.84	142.3	17.2	11.0			6.0
10- 6	16.08	22.92	23.22	144.3	16.4	11.0			6.0
13	16.39	23.36	23.53	143.5	16.8	11.0			6.0
20	15.77	22.90	23.11	146.5	15.6	12.0			6.0
27	15.00	22.18	22.50	150.0	14.8	12.0			6.0
11-10	10.65	21.30	22.14	207.8	13.6	12.0			7.0
17	10.75	21.51	22.45	208.7	14.0	12.0			7.0
24	10.98	21.97	22.90	208.4	14.6	12.0			7.0
12- 1	10.09	22.19	23.11	208.2	14.2	13.0			7.0
8	11.27	22.54	23.56	209.0	14.8	13.0			7.0
15	11.36	22.73	23.71	208.6	15.0	13.0			7.0
18	18.05	14.04	14.42	79.9	3.4	12.0			7.0
19	22.66	15.86	16.08	70.9	5.6	12.0			7.0
20	19.76	13.83	14.26	72.1	3.2	12.0			7.0
21	22.90	16.03	16.23	70.8	5.8	12.0			7.0
22	23.93	16.75	17.15	71.6	7.0	13.0			7.0
24	26.19	18.34	18.52	70.7	8.8	13.0			7.0
25	26.19	20.96	20.79	79.3	11.8	13.0			7.0
31	25.49	25.49	25.72	100.8	18.0	13.0			7.0
1- 5-49	26.67	26.67	26.96	101.0	19.6	13.0			7.0
12	27.41	27.41	27.73	101.1	20.6	13.0			7.0
19	30.89	30.89	30.97	100.3	25.0	13.0	0.3		7.0
26	31.63	31.63	31.02	98.0	25.8	13.0	1.4		7.0

Fed one pound of dehydrated alfalfa leaf meal per day from 8-18-48 until 12-22-48. RUBY started 7-7-48 at 170 per cent of requirements for maintenance plus 100 per cent for production

TABLE LIX

Feeds and Total Digestible Nutrients Fed to ANXIETY

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)
2-16-49	13.83	13.83	13.64	98.6	8.8	15.0	1.2
23	13.71	13.71	12.97	94.6	8.6	15.0	2.2
3- 2	13.85	13.85	13.87	100.1	8.8	14.0	0.7
9	13.85	13.85	12.08	87.2	8.8	14.0	2.2
16	13.92	13.92	14.37	103.2	9.0	14.0	0.8
23	14.13	14.13	14.33	101.4	9.2	15.0	0.8
4- 6	14.24	14.24	14.02	98.4	9.4	15.0	1.3
8	17.03	11.92	11.65	68.4	7.6	13.0	-
9	16.57	11.60	11.35	68.4	7.2	13.0	-
11	18.99	13.29	11.95	62.9	9.4	13.0	
12	18.86	13.20	11.95	63.3	9.2	13.0	
13	18.85	13.19	11.96	63.4	9.2	13.0	
14	20.04	14.03	13.76	68.6	10.4	13.0	1.1
15	21.51	17.20	16.91	78.6	14.6	13.0	
19	21.73	17.38	17.06	78.5	14.8	13.0	
20	21.11	16.89	15.92	75.4	14.2	12.0	1.1
21	21.71	17.37	16.36	75.3	14.8	12.0	
22	20.58	20.58	19.51	94.7	19.0	12.0	1.2
27	22.12	22.12	22.06	99.7	21.2	12.0	

Fed one pound of dehydrated alfalfa leaf meal per day from 2-16-49 until 3-23-49 and from 4-21-49 until 5- 4-49.

ANXIETY started 2-16-49 at 100 per cent of requirements

TABLE IX

Feeds and Total Digestible Nutrients Fed to VIRGINIA

D a t e	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed Per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)
2-16-49	11.65	11.65	11.27	96.7	8.4	11.0	1.2
23	11.73	11.73	11.35	96.7	8.6	11.0	1.4
3- 2	11.86	11.86	11.96	100.8	8.8	10.0	0.4
9	11.95	11.95	11.59	96.9	9.0	11.0	1.5
16	12.00	12.00	11.61	96.7	8.4	11.0	1.5
23	12.05	12.05	11.99	99.5	8.4	12.0	1.6
4- 6	12.26	12.26	11.74	95.7	8.8	12.0	1.9
13	12.33	12.33	11.77	95.4	8.8	12.0	1.8
19	14.27	9.99	9.37	65.6	5.6	12.0	
20	14.46	10.12	9.87	68.2	5.8	12.0	1.1
21	15.94	11.16	10.91	68.4	7.2	12.0	
22	15.19	12.15	11.81	77.7	8.4	11.0	
23	15.55	12.44	12.11	77.8	8.8	11.0	
25	16.19	12.95	12.71	78.5	9.6	11.0	
26	17.27	13.82	13.61	78.8	10.8	11.0	
27	16.38	13.08	12.93	78.9	9.8	11.0	1.0
29	16.48	16.48	16.23	98.4	14.2	11.0	
5- 4	16.64	16.64	15.35	92.2	14.4	11.0	1.1
11	16.27	16.27	15.03	98.5	14.0	11.0	

Fed one pound of alfalfa leaf meal per day except for period from 3-23-49 to 4-21-49.

VIRGINIA started 2-16-49 at 100 per cent of requirements

TABLE LXI

Feeds and Total Digestible Nutrients Fed to CANARY

Date	TDN Required (lbs)	TDN To be Fed (lbs)	TDN Consumed (lbs)	Requirements Consumed per cent	Concentrate Fed (lbs)	Timothy Hay Fed (lbs)	Timothy Hay Refused (lbs)
3-18-49	13.78	13.78	14.22	103.1	8.8	14.0	-
22	13.72	13.72	13.59	99.0	8.8	15.0	2.5
4- 6	13.85	13.85	12.66	91.4	9.0	15.0	3.4
13	13.92	13.92	12.30	88.3	9.0	15.0	4.1
20	14.07	14.07	12.74	90.5	9.2	15.0	4.5
27	14.17	14.17	12.35	87.1	9.0	14.0	3.9
5- 4	14.40	14.40	12.97	90.0	9.4	14.0	3.4
11	14.47	14.47	12.26	84.7	9.4	14.0	3.7
18	14.58	14.58	13.07	89.6	9.6	14.0	
20	15.49	10.84	9.47	61.1	4.8	14.0	
21	15.49	10.84	9.47	61.1	4.8	14.0	
23	13.88	9.71	8.27	59.5	3.2	14.0	
24	14.53	10.17	8.87	61.0	4.0	14.0	
25	13.52	9.46	8.76	64.7	3.0	14.0	2.2
26	13.59	9.51	8.76	64.4	3.0	14.0	2.0
27	14.39	11.51	10.86	75.4	5.8	14.0	2.3
28	14.03	11.23	10.56	75.2	5.4	14.0	2.1
31	15.28	12.22	11.46	75.0	6.6	14.0	1.7
6- 1	13.06	10.44	9.81	75.1	4.4	14.0	2.9
2	15.33	12.26	11.61	75.7	6.8	14.0	2.0
3	14.51	14.51	14.73	101.5	9.8	14.0	1.3
8	15.81	15.81	16.32	103.2	11.6	14.0	0.3
15	17.49	17.49	17.97	102.7	13.8	14.0	

Fed one pound of dehydrated alfalfa leaf meal per day except from 3-23-49 until 4-21-49

CANARY started 3-18-49 at 100 per cent of requirements

TABLE LXII

Weights of Experimental Animals

Name	Initial Weight (lbs)	Final Weight Prepartum (lbs)	Gain (lbs)	Weight after Parturition (lbs)	Parturition Loss (lbs)	Final Weight Post Partum (lbs)	Total Loss Post Partum (lbs)	Daily Loss Post Partum (lbs)
VALENCIA	1000	1216	216	1087	129	983	104	7.43
ADVENTURESS	1050	1224	174	1115	109	957	158	12.15
BOUNTY	1206	1377	171	1222	155	1070	152	15.20
BONITA	1263	1648	385	1492	156	1441	51	3.64
FAITH	1080	1365	285	1196	169	1179	17	1.31
PEGGY	968	1221	253	1100	121	1011	89	6.36
BUNNY	866	1105	239	960	145	834	126	10.50
REMEMBRANCE	1240	1504	264	1325	179	1186	139	12.64
PATIENCE	1112	1188	76	1030	158	987	43	6.14
LAURA	1158	1481	323	1311	170	1164	147	14.70
MELANIE	1377	1831	454	1575	256	1532	43	4.30
ARABELLA	1624	1654	30	1483	171	1291	192	17.55
DORCAS	1380	1557	177	1360	197	1230	130	9.28
ACACIA	950	1122	172	997	125	966	31	2.21
POMONA	904	1188	284	1000	188	961	39	3.00
CHARM	1412	1442	30	1283	159	1262	21	1.62
HILDA	884	979	95	860	119	810	50	3.85
MARTHA	1303	1701	398	1500	201	1323	177	11.80
BETH	820	994	174	896	98	790	106	9.64
LIZZIE	910	1122	212	1068	54	907	161	14.64
ELINOR	1135	1433	298	1338	95	1139	199	19.90
BARBARA	1041	1182	141	1094	88	955	139	13.90
DEE	1368	1637	269	1412	225	1372	40	2.86
ESMERALDA	1200	1468	268	1292	176	1260	32	2.28
RUBY	1150	1434	284	1224	210	1165	59	4.52
ANXIETY	988	1043	55	929	114	914	15	1.07
VIRGINIA	744	841	97	800	41	756	44	3.38
CANARY	980	1096	116	936	160	862	74	5.29

TABLE LXIII

Average Blood Sugar and Acetone Body Levels Before and at Parturition

tion	No. of Cows	Blood Sugar 7 Days Prepartum	Blood Sugar Parturition	Blood Acetone Bodies 7 Days Prepartum	Blood Acetone Bodies Parturition
1	6	46.54	51.31	2.82	3.05
2	11	44.90	57.86	3.55	3.41
3	11	47.34	50.35	3.12	2.87

TABLE LXIV

Average Blood Sugar Levels During the First Two Weeks Postpartum

			Blood Sugar in Milligrams Per 100 Milliliters			
			Days Postpartum			
tion	Treatment	No. of Cows	3	7	10	14
1	Full fed	3	40.49	38.58	44.14	44.67
1	Fasted	3	34.78	25.43	20.01	34.05
2	Full fed	5	42.99	36.88	37.99	42.96
2	Fasted	4	31.44	23.32	26.26	24.55
3	Full fed	6	39.63	39.08	40.40	40.52
3	Fasted	4	30.30	20.78	19.83	34.04

TABLE LXV

Average Blood Acetone Body Levels During the First Two Weeks Postpartum

			Blood Acetone Bodies in Milligrams Per 100 Milliliters			
			Days Postpartum			
tion	Treatment	No. of Cows	3	7	10	14
1	Full fed	3	5.28	6.63	9.66	7.89
1	Fasted	3	8.23	17.58	18.72	13.10
2	Full fed	5	5.00	6.42	7.76	3.92
2	Fasted	4	11.59	18.39	21.99	22.11
3	Full fed	6	7.46	7.28	6.36	6.78
3	Fasted	4	7.42	20.30	24.98	10.88

TABLE LXVI

Analysis of Variance of Blood Sugar Levels of All Cows Before Parturition

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Rations	2	6.7414	3.3707	.291
Among Cows	22	255.0850	11.5949	
Total	24	261.8264		

TABLE LXVII

Anaylsis of Variance of Blood Sugar Levels of Cows Fasted Postpartum

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Rations	2	17.3688	8.6844	.295
Among Cows	8	235.4415	29.4302	
Total	10	252.8103		

TABLE LXVIII

Analysis of Variance of Blood Sugar Levels of Cows Full Fed Postpartum

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Rations	2	2.6989	1.3495	.038
Among Cows	11	394.0272	35.8207	
Total	13	396.7261		

TABLE LXIX

Analysis of Variance of Blood Acetone Body Levels of All Cows Before Parturition

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Rations	2	2.6081	1.3041	2.62
Among Cows	20	9.9448	.4972	
Total	22	12.5529		

TABLE LXX

Analysis of Variance of Blood Acetone Body Levels of Fasted Cows After Parturition

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Rations	2	25.3282	12.6641	0.411
Among Cows	8	246.0712	30.7814	
Total	10	271.3994		

TABLE LXXI

Analysis of Variance of Blood Acetone Body Levels of Full Fed Cows After Parturition

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Rations	2	4.2945	2.1473	.520
Among Cows	11	45.4356	4.1305	
Total	13	49.7301		

TABLE LXXII

Comparison of Blood Sugar Levels of Fasted and Full Fed Cows

atment	No. of Cows	Degrees of Freedom	Mean Blood Sugar Levels (Mg/100 Ml)	Sum of Squares
l Fed	14	13	40.27	252.8103
ted	11	10	26.36	396.7261
		Sum = 23	Difference = 13.91	Sum = 649.5364

$$\text{Pooled Variance} = \frac{649.5364}{23} = 28.2407$$

$$\sqrt{\frac{28.2407\ (25)}{154}} = \sqrt{4.5845} = 2.141$$

$$t = \frac{13.91}{2.141} = 6.50^{**}$$

TABLE LXXIII

Comparison of Blood Acetone Body Levels of Fasted and Full Fed Cows

atment	No. of Cows	Degrees of Freedom	Mean Acetone Body Levels (Mg/100 Ml of Blood)	Sum of Squares
l Fed	14	13	5.83	271.3994
ted	11	10	17.83	49.7301
		Sum = 23	Difference = 12.00	Sum = 321.1295

$$\text{Pooled Variance} = \frac{321.1295}{23} = 13.9621$$

$$t = \frac{12.00}{1.505} = 7.97^{**}$$

- Statistically significant at the 1 percent level

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Studies on Ketosis in Dairy Cattle
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(2) Shaw, J. C., Hatziolas, B. C., Leffel, E. C., Chung, A. C., Gill, W. M., and Gilbert, J. Pituitary-Adrenal Cortical Syndrome in Ketosis of Dairy Cows. Miscellaneous Publication No. 139. Md. Agr. Exp. Sta., College Park, 1952

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