

AN ABSTRACT OF THE THESIS OF

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Forty-two fall-calving crossbred cows were equally allotted to six pens of seven cow-calf pairs each. Two treatments (0 and 200 mg lasalocid/head/day) with three replications were used to determine the effects of lasalocid on fall-calving beef cows. The cows were fed grass hay, haylage and pasture ad libitum. The cow-calf pairs were weighed every 28 days during the 196-day trial. Milk yield was determined three times using the weigh-suckle-weigh technique and the milk was analyzed for fat and protein. Average days open from parturition to conception was also determined for the cows.

There was no difference between treatment for cow weight and body condition (scale 0-9) change. The cows lost an average of 9.5 kg throughout the trial. A slight tendency towards increased milk production was observed in the lasalocid-treated cows, but this was not significant. There were no significant differences between treatments or time for percent milk fat and protein. Calf gain was not affected by treatment with average daily gain being 0.77 kg per day for both lasalocid and control calves. Average

days open was also not affected by the use of lasalocid. However, there was a numerical advantage of five days in favor of the lasalocid-fed cows. It is possible that the lasalocid cows may have eaten less, thus making them more efficient; but this was not measured. No detrimental effects were observed on lactation , weight change or reproductive performance with the use of lasalocid.

THE EFFECT OF LASALOCID ON FALL CALVING BEEF COWS

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THE EFFECTS OF LASALOCID ON FALL CALVING BEEF COWS

CHAPTER 1

INTRODUCTION

Beef producers are continually searching for new ways to increase profits while reducing expenses. Lasalocid, an ionophore type of antibiotic, is being used extensively in cattle fed for slaughter to increase gain and feed efficiency. Lasalocid is approved for use at no more than 100-360 mg/head/day in any type of cattle. This includes stocker as well as cattle kept in confinement. Lasalocid is also approved for use in liquid feed supplements. At this time lasalocid is not approved for breeding animals.

Lasalocid exerts its action by altering the microflora of the rumen such as to change the bacterial byproducts. This change provides the animal with a greater amount of metabolizable energy from a given amount of feed, enabling the animal to convert this extra energy into performance. Very little research has been conducted evaluating the use of lasalocid to improve the performance of beef cows. The purpose of this trial was to evaluate the use of lasalocid on fall-calving beef cows. Parameters of cattle production which were examined were cow weight and body condition change, milk yield, milk fat percentage, milk protein percentage, calf gains, 205-day adjusted weaning weight and

cow average days open. Since the profitability of cow-calf production is very poor at this time, it is paramount that ways be found to directly benefit the producer. If lasalocid increases the weight of calf produced or increases efficiency of cow performance, it might possibly increase the profit earned on a cow-calf operation.

The Literature Review included in this thesis discusses the following topics: lasalocid's mode of action, effects of ionophores on slaughter animals, ionophore effects on breeding cattle, beef cattle lactation, fall calving, use of lasalocid for control of diseases of beef cattle, and toxicity of lasalocid. This is followed by a manuscript evaluating the fall-calving lasalocid trial. It is hoped that the reader will gain a greater appreciation for beef production as well as realize the need for further research concerning the use of ionophore feed additives in beef cows.

LITERATURE REVIEW

CHAPTER 2

Lasalocid, developed and marketed by Hoffmann-La Roche Inc., is a polyether, carboxylic type of ionophore that has been shown to have bacteriostatic activity. It has been used as a poultry coccidiostat for many years. Recently, lasalocid (under the trade name of Bovatec) has been used in cattle to improve their nutritional and reproductive performance. Lasalocid exerts its action by altering the rumen microflora such as to change their products and metabolites.

Lasalocid's Mode of Action

An ionophore is a compound which will form complexes with cations and participates in the transport and exchange of cations for protons or other cations across a wide variety of biological membranes. Lasalocid is a divalent compound and thus can transport calcium and magnesium as well as sodium and potassium across cell walls (Brandt, unpublished data). Stuart (1983), in reviewing the action of lasalocid, stated that lasalocid has a high affinity for the potassium ion and produces an initial hydrogen-in potassium-out exchange followed by re-equilibration of pH through a sodium-in hydrogen-out exchange. He also cited a study which demonstrated that in lasalocid sensitive

bacteria, the cause of cell death was the rapid acidification of the cytoplasm and not the loss of potassium.

Lasalocid has been shown to effect ion gradients across mammalian membranes. Due to the large microbial populations in beef cattle, lasalocid, when fed at optimum amounts seems to elicit its effects mainly on ruminant microbial membrane systems (Stuart 1983).

Fuller and Johnson (1981) conducted a study to determine the effects of lasalocid on in vitro fermentation on high grain and high roughage diets. The studies were conducted using a continuous flow type of fermenter, designed to mimic the rumen of cattle. On high grain diets, they found decreased levels of acetic and butyric acid in the fermenter. Methane production was also reduced. The level of propionic acid was increased, but there was no change in total molar volatile fatty acid concentration. On high roughage diets, butyric acid was depressed but no differences in mean acetic and propionic acid concentrations were found. Fuller also noted a decrease in total molar VFA concentration when high roughage diets were utilized. This is in partial agreement with Bartley et al. (1979) who fermented a diet of similar amounts of concentrate and roughage and found that the total molar fatty acid content did not change. They also reported that the molar proportion of acetic and butyric acid decreased while propionic acid increased. They also

observed reduced methane and increased carbon dioxide production.

Bartley and Nagaraja (1982) conducted studies evaluating the effects of lasalocid on in vivo rumen fermentation. They reported decreased rumen acetate and butyrate production and increased propionate production. They also found that the total molar fatty acid content did not change. Reduced methane and increased carbon dioxide production was discovered. These results support the earlier in vitro studies by Bartley et al. (1979).

Lasalocid is effective against gram-positive bacteria but not gram-negative bacteria. Stuart (1983) in reviewing the mode of action of lasalocid, stated that gram-positive bacteria have a cytoplasmic membrane surrounded by a carbohydrate rich peptidoglycan layer. The ionophore can enter the cytoplasmic membranes and upset the cation permeability across the membrane resulting in retardation of growth. Gram-negative bacteria, however, have an outer membrane which is very similar in structure to the cytoplasmic membrane. The ionophore possibly attaches to the outer membrane, thus preventing the ionophore from reaching the cytoplasmic membrane and disrupting the cation balance of the bacteria.

Several studies have been conducted to study the effects of lasalocid on rumen bacteria and protozoa. Dennis et al. (1981) reported that gram-positive bacteria are sensitive and gram-negative bacteria are resistant to

lasalocid. Together with Bartley and Nagaraja (1982), they classified those bacteria which are sensitive to lasalocid as follows: (a) those that produce lactate as a major end product (including Lactobacillus ruminococcus and Streptococcus species); (b) those that produce butyrate as a major end product (including Selenomonas and Eubacterium species); (c) those that produce formate (including Ruminococcus and Eubacterium species); and (d) those that produce hydrogen (Ruminococcus species). Ruminant bacterial species that are resistant to lasalocid include: (a) those that produce succinate as a major end product (including Bacteriodes and Selenomonas species); and (b) those that ferment lactate (including Selenomonas and Megasphaera species). Lasalocid also appears to be unable to inhibit some methane producers. Bartley and Nagaraja (1982) reported that the rumens of cattle fed diets containing lasalocid at the recommended levels will contain 5-10 ug antibiotic/ml of rumen fluid. This level of antibiotic appears to be well above the minimum inhibitory concentration of lasalocid needed for most rumen microbes.

Since lasalocid is an effective coccidiostat, it is reasonable to assume that it has an effect on rumen protozoa. Bartley and Nagaraja (1982) reported that the total number of protozoa in the rumen was not affected in lasalocid-fed cattle. The major protozoa affected were Epidinium, Ophryoscolex and Diplodinium species. These protozoa are starch digesters and produce volatile fatty

acids and hydrogen. With the exception of Epidinium, the other two protozoa were undetectable in the rumen with lasalocid treatment, but were reported present again after long-term treatment with lasalocid. It is clear that lasalocid action on rumen protozoa is quite variable.

Increased levels of ruminal propionate may be promoted from two sources. Succinate production may be increased through a proliferation of succinate producers with subsequent conversion to propionate by other rumen microbes. A second source may occur through transformation of lactate to propionate by lactate utilizing microorganisms. Methane production appears to be indirectly inhibited due to decreased hydrogen and formate production by inhibiting the microbes that produce them. Both hydrogen and formate are substrates for methane synthesis. By decreasing methanogenesis there is a decrease in energy loss by the rumen (Bartley and Nagaraja 1982).

Dennis et al. (1981) and Bartley and Nagaraja (1982) tested the effect of lasalocid on lactate production in the rumen. They found that lasalocid decreased the amount of L lactate and had no effect on D lactate. This does not rule out the possibility that lasalocid may alter catabolic pathways in rumen bacteria. Overall, lasalocid decreased the total amount of lactate produced and increased the pH of the rumen. They concluded that the reduction of lactate may be due to a decreased production and increased

utilization.

Lasalocid may have other effects besides altering energy utilization of the rumen. Paterson et al. (1983) reported that nitrogen digestibility was improved by the feeding of lasalocid to steers on pasture. This is in agreement with Ferrell et al. (1982) who reported increased nitrogen retention, starch digestibility and dry matter digestibility in cattle fed lasalocid.

Stuart (1982) suggested that increased nitrogen digestibility as well as decreased ruminal ammonia levels may be related to a reduction in microbial proteolysis and/or less deamination of amino acids by rumen microbes. This implies that lasalocid may spare dietary protein from degradation in the rumen, so that it may be utilized by the animal directly.

Effects of Ionophores on Animals fed for Slaughter

Numerous trials have been done to substantiate the claim that lasalocid increases feed efficiency as well as improves average daily gain. Studies involving cattle receiving complete growing-finishing diets are examined first followed by studies of cattle fed on pasture.

Horton (1983b) examined fifteen trials used to evaluate the use of lasalocid in growing and finishing cattle. During the growing phase of seven long-term trials, average daily gain was increased by 6.6 percent and feed efficiency improved by 10.4 percent. During the

finishing phase, average daily gain was increased 3.2 percent and feed efficiency by 6.4 percent. The overall results of these seven trials were a 4.8 percent increase in average daily gain and an 8.3 percent advantage in feed efficiency. Eight short-term finishing trials were evaluated to assess the advantages of lasalocid during the first and last half of finishing periods. Cattle fed lasalocid gained 7.7 percent faster than controls during the first half and 2.8 percent faster during the last half of the finishing period. The overall advantage in gain was 5.7 percent in these studies. These results are similar to results reported by Gill et al. (1984a,b), Ferrell et al. (1982), Thonney et al. (1981), Brown and Davidovich (1979) and Davis (1978). Exceptions to these findings include Thonney et al. (1981), who in another study reported no difference in average daily gain between lasalocid and controls, and Gill et al. (1984a), who in a second trial measured a 1.3 percent increase in dry matter intake.

Numerous studies have been conducted on growing cattle to evaluate the use of lasalocid. Horton et al. (1983), Horton et al. (1984), Spears and Harvey (1984), Horn et al. (1984) all reported an increased average daily gain on cattle fed lasalocid. This is in contrast to Gutierrez et al. (1982) and Paterson et al. (1983) who found no change in average daily gain due to lasalocid supplementation. Horton et al. (1984) and Gutierrez et al. (1982) also reported a significant improvement in feed efficiency in

stocker cattle supplemented with lasalocid.

These results indicate larger responses during the growing period than during the finishing period. Horton (1983b) reported that lasalocid has a "protein-sparing" effect on dietary protein due to decreased deamination of protein and/or reduced proteolysis in the rumen. Growing cattle are more responsive to protein supplementation than finishing cattle, thus justifying the results. Another reason growing cattle may exhibit a greater response to lasalocid than finishing cattle is that ionophores have been shown to decrease the incidence of certain diseases plaguing feedlot cattle, such as lactic acidosis, bloat and coccidiosis. Stuart (1982) indicated that increased fat deposition toward the end of the finishing period is less efficient than the deposition of muscle during the growing phase. This supports the contention that animals fed lasalocid are less efficient during the finishing than during the growing phase. It appears that cattle fed lasalocid have a higher average daily gain, improved feed efficiency and decreased dry matter intake compared to unsupplemented cattle.

Effects of Ionophores on Breeding Cattle

Monensin (marketed by Eli Lilly Company) is a polyether antibiotic type of ionophore that is similar to lasalocid. Numerous studies have shown that monensin elicits similar effects in beef cattle to that of

lasalocid. Monensin has recently been approved for use in the developing breeding heifer, as well as cattle fed for slaughter. Several studies have been conducted by Mosely et al. (1977) to determine the effects of feeding monensin on the reproductive performance of beef heifers. In general, they found that heifers had an increased average daily gain, improved feed efficiency and reached puberty earlier when fed monensin. They saw no difference in conception rates between control and monensin supplemented animals. Hixon et al. (1982a) reported heavier weaning weights and shorter postpartum intervals in first calf heifers fed monensin. Males and Coonrad (1984) conducted a comparison study between monensin and lasalocid in replacement heifers. They found that there was no significant difference between controls and ionophore supplemented animals for average daily gain or feed efficiency. From this it can be seen that variable results are obtained in breeding heifers fed ionophores.

Ionophores are not currently approved for beef brood cows. Ionophores are thought to elicit favorable responses by increasing the metabolic energy made available from a feed by increasing the amount of propionate and decreasing the amount of acetate, butyrate and methane produced in the rumen, diverting energy from these products to propionate which is used more efficiently. Also, since ionophores decrease deamination or proteolysis in the rumen, a protein sparing effect is seen. This is supported by work done by

Hixon et al. (1982b), Turner et al. (1980) and Lemenager et al. (1978) on beef cows fed monensin. It is therefore logical that favorable responses may be seen in the mature beef cow. Few studies have been conducted evaluating lasalocid for beef cows. However, several studies are available to evaluate the use of monensin on beef cows.

Randel and Roquette (1976) fed 200 mg monensin to crossbred beef cows and reported that monensin supplemented cows were 12.4 percent more efficient than control cows and that there were no deleterious effects on body condition or milk production, percent butterfat, or percent milk protein. Hixon et al. (1982a) evaluated the use of monensin for lactating beef cows. He found no difference in reproductive efficiency and calf weight gain. He also reported a numerical increase in milk production, but it was not statistically significant. This is in agreement with another study done by Hixon et al. (1982b) on first calf heifers where he failed to demonstrate a difference in lactation performance in monensin-fed cows. However, he did report that the calves of monensin-fed cows were heavier, possibly because of increased energy availability to the cow before calving. Lemenager et al. (1978) fed monensin to cows on winter range. The cows fed monensin had a 20 percent decrease in feed intake as compared to controls. He also found a decrease in postpartum interval to estrus in the ionophore supplemented cows. Monensin cows also spent significantly less time grazing than did

controls. Milk yield and composition were not affected by the use of monensin. Calf gain was increased in monensin fed cows, but Lemenager et al. (1978) suggested that this could have been due to the calves ingesting some of the monensin supplement. In this study, increases in grazing time and weight gain were seen as the forage quality of the pasture increased. This suggests that forage quality may influence gain response in animals fed ionophores.

Males et al. (1984) fed different energy levels without ionophores to first calf heifers and observed that animals receiving a higher amount of energy produced more milk. However, in this study this did not translate into higher calf gains.

In a study conducted by Turner et al. (1980) on spring-calving cows, it was found that cows fed monensin consumed significantly less hay, but postpartum average daily gain was not changed. Post-calving weight loss was the same between treatments. Postpartum interval was also unchanged between treatments. Calf average daily gain was also unaffected by monensin supplementation. This is in contrast to another study by Turner et al. (1977) who reported that feeding monensin significantly shortened the postpartum interval to estrus.

Research on the use of monensin on fall calving cows was conducted by McAskill et al. (1980). Prepartum weight gain was improved, but feed intake was unchanged in cows fed the ionophore. During the postpartum period, the

monensin-fed cows lost less weight. Interval to first estrus was measured and the results showed that the intervals were reduced in monensin-fed cows. It was also found that monensin had no effect on calf birth weight or 205-day adjusted weaning weight. This is in contrast to Clanton et al. (1981), who found no difference between controls and monensin-fed cows for cow and calf weight changes and postpartum estrus interval. Walker et al. (1980) supplemented spring calving cows with monensin and found no effect for calf birth weights, adjusted 205-day weaning weights or first service conception rates of cows. However, the monensin cows did have a significantly lower dry matter intake. This is in agreement with Lemenager et al. (1978) who fed cows on low quality winter range with monensin supplementation and found no significant difference in cow weight change.

A study was recently conducted by J. Paterson on spring calving cows to determine the effects of lasalocid on milk production, milk composition, cow weight change, cow dry matter intake, and calf weight change. He found that the cows fed lasalocid lost less weight and body condition than control cows. This is in agreement with Wagner et al. (1984), who reported that cows fed 200 mg lasalocid per head per day lost less weight during the winter months than did controls. Paterson also observed that dry matter intake was significantly reduced with the lasalocid cows. Milk production was found to be higher in

cows fed lasalocid. There was a high correlation between amount of milk produced and calf average daily gain. Calves of lasalocid-fed cows had a higher average daily gain than did the controls. Total milk fat was measured and was depressed slightly at 30 days postpartum, but there was no significant difference between lasalocid cows and controls at 60 and 90 days postpartum (J. Paterson, personal communication). From these studies, it can be seen that performance can be quite varied with the use of ionophores.

Beef Cattle Lactation

Studies have shown that there is a positive correlation between beef cow milk yield and calf weaning weight. Apparently if the calf consumes more milk, the milk will provide more energy to be used for growth. Hence, the calf's gain will increase. If the calf is able to get more milk over a long period of time, he will be heavier at weaning. The milk quantity is of great concern to the producer. J. W. Wilton (unpublished data) in a study to determine the correlation between milk yield and weaning weight determined that for every five pounds increase in daily milk yield, calf weaning weight increased 33 pounds. This is in agreement with Beaver et al. (1981), who found that calves consuming larger amounts of milk from cows fed on pasture were larger, fatter and taller at weaning. This also agrees with Neville (1962), who

reported that the correlation between milk consumption and calf weight gain decreased as the general nutrition of the calf increased. He also reported the greatest correlation between cow milk yield and calf weight gain is during the first 60 days postpartum.

Totusek et al. (1973) suggested that milk quantity is more important than milk quality for affecting calf rate of gain and subsequent weaning weight. He discovered a very low correlation between total milk fat and calf weight. This agrees with Rutledge et al. (1971), who reported that percent fat and percent protein had little correlation with 205-day adjusted weaning weight. He also determined that, all things being equal, 60 percent of the variance in 205-day weaning weight could be attributed to the direct influence of the dam's milk yield.

Casebolt et al. (1982) reported that in general, crossbred cows have higher milk production than do straight bred cows. He also suggested that between day 20 and day 50 is the period in which the energy requirements for a lactating cow are highest. Doornbos et al. (1981) reported that older dams produce more milk than young dams, and that selecting cows on the basis of calf average daily gain from birth to weaning would be an efficient way of selecting high milk producing beef cows.

In a summary prepared by Ainslie (1977), it was recognized that first drawn milk from a dairy cow is very low in fat content and the last drawn milk is quite high.

He also stated that milk fat is extremely variable between breed and individual cows. Percent butterfat is highest during the first lactation and then progressively decreases. Milk will test lower for fat during mid-lactation than at the beginning or end of lactation. Wingert et al. (1984) looked at beef cattle crossed with dairy animals and reported that the dairy crosses produced more milk and had a higher percent butterfat. He also reported that older cows tended to have a higher milk yield. In his study, cows with bull calves produced more milk than those with steer or heifer calves. He thought this may have been due to the more aggressive behavior of the bull calves. Nelms et al. (1978) looked at beef cow breeds and percent butter fat. He determined that there are genetic differences for fatty acid synthesis in the mammary gland. He reported an inverse relationship between percent endogenous fatty acids and dietary fatty acids present in the milk. The mammary gland apparently has the ability to compensate for lack of dietary fatty acids by increasing the production of endogenous fatty acids. The current view of milk fat composition is that shorter chained fatty acids are of mammary and the longer chain fatty acids are of dietary origin.

Milk quantity is primarily controlled by the amount of glucose uptake by the mammary gland. The mammary gland synthesizes lactose from glucose and secretes it. Lactose, after it is secreted, draws water from the secretory cell

osmotically, resulting in an increased volume of milk effectively being formed (Bauman and Elliot 1983). It is possible that anything that would increase glucose uptake by the mammary gland may increase milk production. The major precursor of glucose in the ruminant is the volatile fatty acid propionate. Rumen propionate is transported via the portal system to the liver where it is used to make glucose, which then is systemically transported to the various tissues of the animal. It is therefore possible that when there is an increased supply of propionate, the liver will make more glucose, which in turn means more actual glucose may be available to the lactating mammary glands. If this occurs, more lactose may be produced, which should cause the mammary gland to have a higher milk yield. Thus, it is possible that ionophores could result in an increase in milk production in the cow. However, research has not always supported this.

Studies evaluating the use of ionophores have noted that rumen propionic acid is increased and acetic and butyric acid are decreased. Bauman and Elliot (1983) stated that if there is a marked decrease in acetic acid or butyric acid a depression of milk fat production by the mammary gland will result. Acetate is the major precursor of milk fat in the mammary gland. Acetate travels via the circulatory system (the liver has negligible acetate uptake) to the mammary gland where it is taken up and used for fat synthesis. Butyrate is converted to B-

hydroxybutyrate in the rumen wall and remains in this form for use by the mammary gland. B-hydroxybutyrate is the primary precursor for short and medium chained fatty acids in milk. A decrease in milk fat is generally not seen in lactating beef animals. This may be due to several reasons. The mammary gland produces 25 percent of its own acetate during lactation. During lactation there is increased lipolysis, supplying free fatty acids to the mammary gland to produce acetate (Bauman and Currie 1980). They also suggested that there are genetic differences between breeds of animals concerning the partitioning of nutrients during lactation (Bauman and Currie 1980). Thus, some cows may be able to compensate for decreased dietary mammary precursors more than others. Finally, the diet itself may be important in determining whether or not milk fat depression occurs. Beef cows are usually fed higher roughage diets as compared to high producing dairy cows. High fiber diets tend to cause more acetate production in the rumen as compared to diets with large proportions of concentrates. It is a reasonable conclusion that because of the greater proportion of acetate being produced by the animal fed a very high proportion of roughage that even when an ionophore such as lasalocid is fed, the resulting decrease in acetate is not enough to elicit a decrease in milk fat synthesis.

The protein fraction of milk is synthesized in cells in the mammary gland from a free amino acid pool in

equilibrium with the blood. Larson (1969) suggested that there may be some sort of negative feedback system for milk protein synthesis, limiting the amount produced by the mammary gland. This amount of protein may be genetically determined. This lends credibility to the fact that milk protein is difficult to alter by changing the diet.

Fall Calving

In an effort to try new ways to make more profit from raising cattle, ranchers have attempted innovative production schemes. Managing beef cows so that they calve in the fall instead of the spring is one of these. Fall calving may provide a means to better utilize available forage and realize increased calf gains. Davis and Wheeler (1970) reported that fall calving was economical if the availability of feed sources for winter feeding were greater than 55 percent of the annual feed requirement of the beef enterprise. They also indicated that the market weight of fall calves should be at least 144 percent of spring-born calf market weight. Raleigh et al. (1970) indicated that fall calving provides a larger calf to go on forage in the spring so the forage can be utilized at peak value. Kartchner et al. (1979) reported that fall born calves have a greater capacity for the direct utilization of high quality forage during the spring and summer grazing periods. This conclusion is supported by Hill et al. (1975), who found that a greater quantity of surplus forage

was harvested in pastures grazed by fall calving cow-calf pairs. Parker and Van Keuren (1978) reported a reduced incidence of disease with calves born on pasture, compared with crowded, less sanitary drylot conditions. They especially noted a decreased incidence of calf scours. Weaning fall calves by midsummer allows more flexibility to a pasture management program because by then, the pasture quality is declining, the calves may be sold and the pasture will be available for improvement.

One major disadvantage to fall calving is that the rancher must supply high quality winter feed. It is during the winter that the cows will be at their peak of lactation and be bred. It is paramount that the cow be given adequate nutrition during this period. Another disadvantage to fall calving is that if the area is one that has a harsh cold winter, the animals may be stressed and be susceptible to a variety of diseases such as pneumonia. Kartchner et al. (1979) reported that, in general, fall calving cows need 25 percent more total feed than spring calvers. However, he also reported that fall calves gained an average of 28.7 kg more than spring calves.

Numerous researchers (Kartchner et al. 1978, Parker and Van Keuren 1978, Raleigh 1970) reported that in general, cow performance, calf crop percent, and conception rate is just as good or better for fall calving as spring calving. Rakestraw et al. (1984), reporting on fall

calving cows, stated that weight and body condition losses before breeding can reduce the number of cows in estrus and lengthen the time of postpartum return to estrus. The degree to which reproductive performance is reduced appears to be dependent upon the condition of the cows at calving and the severity of the weight loss after calving and during the breeding season. This is in agreement with Cantrell et al. (1982) and Somerville et al. (1979).

Furr and Nelson (1964) conducted a study on fall calving Hereford cows and reported that milk production generally decreased in the winter and increased with the greater availability of spring grass and then declined as the grass quality declined. He also reported that the correlation between calf average daily gain and the cows milk production was equal to or better in fall calving cows versus spring calving cows.

Use of Lasalocid for Control of Diseases of Beef Cattle

Lasalocid and other ionophores have been shown to decrease the incidence of many diseases, including coccidiosis, bloat, pulmonary emphysema, and lactic acidosis. Stromberg et al. (1982) determined that cattle fed the recommended feedlot dose of lasalocid (30 g per ton of feed) had a much lower incidence of coccidiosis.

Lactic acidosis resulting from over consumption of grain is caused by the accumulation of lactic acid in the rumen. This causes reduced growth of the normal rumen

microflora and a proliferation of S. bovis and Lactobacillus species, both of which produce copious amounts of lactic acid and thus induce acidosis (Nagaraja et al. 1982). It is logical that treatment with an antibiotic such as lasalocid would aid the control of acidosis.

Nagaraja et al. (1982) induced lactic acidosis in cattle and reported that cattle given lasalocid had higher rumen pH and lower lactic acid concentrations than control animals. He also discovered that colony counts of Lactobacillus and S. bovis bacteria were reduced in rumen fluid. Lactate utilizing bacteria were also observed in increased numbers. Lasalocid was discovered to be extremely effective in preventing and treating lactic acidosis.

Grain (feedlot) bloat is a common disorder among animals fed high concentrate diets. A stable foam resulting from the production of extracellular slime by rumen microbes is thought to be the cause (Van Soest 1982). S. bovis has been implicated as the causative agent of feedlot bloat. Lasalocid has been shown to inhibit all important strains of S. bovis (Bartley et al. 1982). Windels (1983) reported that the incidence of feedlot bloat was 5 percent in animals fed lasalocid compared to 40 percent in the bloat induced controls. He also reported that the animals had an improved feed efficiency and that carcass characteristics were not influenced by the use of

the ionophore.

Pasture or frothy bloat usually occurs spontaneously in cattle put out on pasture during a period of rapid forage growth. A stable foam that inhibits eructation is formed causing a build up of rumen gas, and thus bloat. It has been suggested that proteins in the forage may be contributing to the formation of the stable foam (Van Soest 1982). A study conducted by Grigsby (1984), indicated that monensin decreased the incidence of frothy bloat in cattle. He speculated that rumensin may be preventing the bloat by reducing gas production in the rumen or by affecting the stability of the foam directly. It is reasonable to postulate that lasalocid may elicit similar results in preventing pasture bloat.

It has been suggested that lasalocid may reduce the incidence of acidic bovine pulmonary emphysema by reducing the conversion of tryptophan to 3-methyl indole. This may be accomplished by lasalocid inhibiting those strains of Lactobacillus bacteria that contribute to the conversion of the amino acid to 3-methyl indole (Dennis et al. 1981).

Liver abscesses in beef cattle occur when animals have been fed high concentrate diets. It is a sequela to rumenitis caused by lactic acidosis. Fusobacterium species penetrate the lesions caused by the ruminitis and are carried to the liver where they invade and cause tissue destruction resulting in abscesses (Messersmith 1983). Horton (1983a) summarized the results of studies and

concluded that lasalocid plus the antibiotic tylosin reduced the incidence of liver abscesses in beef cattle.

Toxicity of Lasalocid

Lasalocid is a safe and effective ionophore if used properly in beef cattle. However, the misuse or accidental overdose of ionophores can have serious effects in animals. Lasalocid is apparently very safe for use in cattle. Messersmith and Hanson (1982) reported that the only abnormal clinical sign observed in cattle fed five times the recommended dose of lasalocid was a slight diarrhea. The toxic range of lasalocid in cattle is 10 to 100 mg/kg body weight. The recommended dose is approximately 1 mg/kg body weight. In animals fed 10 milligrams lasalocid per kilogram the clinical signs are diarrhea and partial anorexia. It has been suggested that the toxicity of lasalocid is self-correcting since overdose is usually accompanied by anorexia.

The lethal range of lasalocid toxicity in cattle is 50-100 mg/kg body weight. The clinical signs include muscular tremors, anorexia, diarrhea, hypoactivity, tachycardia and sternal recumbency. The cattle ultimately die of myocardial dysfunction and pulmonary congestion (Brandt, unpublished data).

Hanson et al. (1981) conducted a study evaluating the toxic effects of lasalocid on horses. He determined that the lethal dose of lasalocid for horses was 21.5 mg/kg of

body weight. Cause of death was suggested as being progressive hypokalemia with attendant cardiac conduction disturbances. In general, it was observed that horses find lasalocid contaminated feed very unpalatable. From this finding, it was concluded that the danger of accidental intake of a lethal amount of lasalocid was minimal. Studies in swine indicate that the ingestion of 58 mg/kg of body weight of lasalocid will cause mortality. Long term studies of feeding pigs the recommended feedlot dose of lasalocid (30 g/ton of feed) resulted in no adverse effects (Messersmith and Hanson 1982).

Lasalocid is a safe and effective compound when properly used in beef cattle. The ionophore improves cattle performance and reduces the incidence of common cattle disorders. Also, there is no withdrawal period before slaughter for cattle fed lasalocid.

EFFECT OF LASALOCID ON FALL CALVING BEEF COWS

CHAPTER 3

Summary

The effects of lasalocid on fall calving beef cows was examined in a 196-day trial conducted between October 12, 1983 and April 26, 1984. Forty-two crossbred cow-calf pairs were equally allotted to six groups by breed, calving date and sex of calf. Three replications of each of two treatments (0 and 200 mg lasalocid/head/day) were used.

The cows were fed a combination of haylage and grass hay ad libitum. The cow-calf pairs were allowed access to pasture at all times except during the breeding season. At this time they were kept in confinement to facilitate heat detection and artificial insemination.

Cow weight changes and body condition were unaffected ($p > .10$) by feeding lasalocid to the cows. Twelve-hour milk production per cow, percent fat and percent protein were determined separately at three times during the trial. A slight numerical advantage in milk yield was observed in treated cows, but this was not statistically significant ($p > .10$). Percent milk fat and protein were also unaffected by treatment ($p > .10$). Actual calf weights and 205-day adjusted weaning weights were also evaluated. Lasalocid supplementation of cows did not affect calf gain

or 205-day adjusted weaning weight ($p > .10$).

Average days open was evaluated for the cows. Since only 23 of the 42 cows became pregnant, an artificial days open figure was calculated for the cows that did not conceive. These values were then pooled with the actual days open of the pregnant cows to make 42 values available for analysis. There were no significant differences between treatments for either actual average days open or pooled, calculated average days open ($p > .10$).

It is possible that, while no apparent advantage was found by feeding lasalocid during this trial, dry matter intake could have been reduced. This would make the cows more efficient in utilizing their feed. No detrimental effects were observed in long term feeding of lasalocid to fall-calving beef cows.

Introduction

Lasalocid, a carboxylic type of ionophore, has been used in recent years to increase rate of gain and improve feed efficiency of beef cattle fed for slaughter. It alters the microflora of the rumen, selecting for those microbes whose byproducts would result in an increase in rumen propionate and decrease in rumen acetate, butyrate and methane. In this way the metabolizable energy content of the feed is increased and is available for use by the animal. Horton (1983) reported that lasalocid has a protein-sparing effect on dietary proteins, possibly due to

decreased deamination or reduced fermentation of protein in the rumen.

Numerous researchers have reported increased gain and/or increased feed efficiency in slaughter animals (Gill et al. 1984; Ferrell 1982; Gutierrez 1982; Thonney et al. 1981; and Brown and Davidovich 1979).

Recently, there has been interest in the use of ionophores in beef cows. Several studies have been conducted to evaluate the use of monensin, an ionophore similar to lasalocid, on the nutritional and reproductive performance of cows. Turner et al. (1980), Lemenager et al. (1978) and Randel and Rouquette (1976) all reported that cows fed monensin were more efficient than control cows. In these studies, the monensin-treated cows either ate less, lost less weight, or both during lactation. Studies indicate that no detrimental effect on lactation is observed in cows fed monensin (Hixon et al. 1982a,b; Lemenager et al. 1978; and Randel and Rouquette 1976). Clanton et al. (1981) and McAskill et al. (1980) reported that the feeding of monensin to cows did not affect calf gain or 205-day adjusted weaning weight.

Several researchers have reported a decreased postpartum return to estrus interval in cows supplemented with monensin (McAskill et al. 1980; Lemenager et al. 1978). However, other researchers, including Clanton et al. (1981) and Turner et al. (1980), reported that supplementing cows with ionophores had no effect on

postpartum interval to estrus.

Wagner et al. (1984) fed lasalocid to spring-calving cows and reported that those cows lost less weight during lactation than did the controls. Recently, a study was conducted evaluating the nutritional and lactational performance of spring-calving cows fed lasalocid. Treated cows had a lower dry matter intake than controls. The treated cows also lost less weight and body condition during lactation. Milk yield was increased with a subsequent increase in calf gain in lasalocid supplemented cows. Total milk fat was measured and was depressed slightly at 30 days postpartum. But there was no difference between cows fed lasalocid and controls at 60 and 90 days postpartum (J. Paterson, personal communication).

The purpose of this study was to determine the effects of supplementing fall-calving beef cows with 200 mg lasalocid per head per day. The parameters measured were: (1) cow weight changes, (2) cow condition changes, (3) milk yield, (4) percent milk fat, (5) percent milk protein, (6) calf gain, (7) calf 205-day adjusted weaning weight, and (8) average days open of the cows.

Materials and Methods

Forty-two fall calving beef cows were equally allotted to six groups based on breed, age and sex of calf. These cows contained varying percentages of Hereford, Angus,

Holstein, Santa Gertrudis, Limousin and Charbray breeding. Each group of seven cow-calf pairs was allowed access to barn space, drylot space and a six acre pasture. The cows ranged in age from three to twelve years. The average birth weight of the calves was 41.1 kg and 42.1 kg for treatment and controls respectively. The average age of the calves, at the beginning of the experiment, was 25.8 days for the controls and 25.3 days for the treated. The range of starting age for all calves was 3 to 38 days. The male calves were implanted with 36 mg of zeranol¹ at birth. Since there were four male calves in each group, the zeranol was administered equally between treatments. Figure 1 is a schematic of the facilities at Oregon State University's Berry Creek Ranch, where this trial was conducted. Three of the groups were fed 200 mg lasalocid in .91 kg ground corn and barley carrier per head per day. The other three groups were fed the carrier without any ionophore present. The cows were group-fed the concentrate each morning throughout the trial. Care was taken as to prevent the calves from ingesting the grain. The trial began on October 12, 1983 after a two week adjustment period in which the cows were each fed .91 kg of control grain daily. The 196-day trial was terminated on April 26, 1984. After mixing the carrier, grab samples were taken

¹ Zeranol (Ralgro) -- International Minerals and Chemical Corporation.

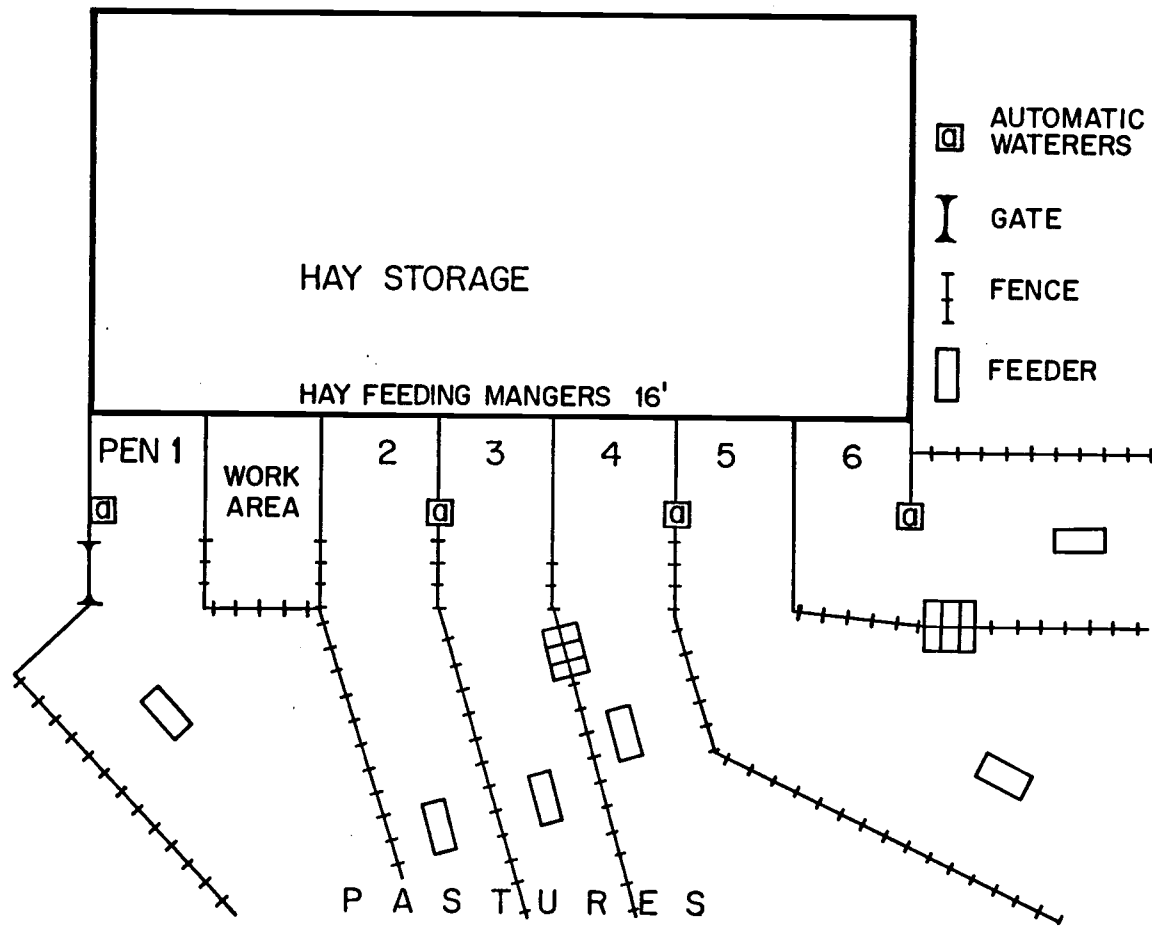


Figure 1. Experimental facilities located at Berry Creek Ranch utilized throughout the 196-day trial.

and sent to Hoffmann-La Roche Inc. to be analyzed for lasalocid in a manner described by Osadca and Araujo (1975). Their analyses indicated that average quantity of lasalocid present in the treated grain carrier was 229 mg/kg, and there was no measurable amount of lasalocid in the control grain. This was considered to be within acceptable limits by Hoffmann-La Roche Inc.

The cow-calf pairs were allowed to graze pasture ad libitum except during the breeding season. At this time (November 29, 1983 through January 12, 1984) the cattle were confined to drylot to facilitate heat detection and breeding. The pastures were composed of mixed grass species (including orchard, timothy and ryegrass) and subterranean clover. Pasture samples were taken from each of the six pens in the fall and spring by clipping 10 randomly selected 0.09 m² samples. Haylage samples were taken in the fall by cutting a slit in the side of the "ag bag" storage unit and grabbing approximately 0.5 kg of haylage. The hay was sampled in the fall and spring by the use of a core sampler. A grab sample was also taken of the ground grain carrier and analyzed. There were two types of mixed grass and legume haylage used in this study. Also, hays from three fields were used in the trial. The haylage and hay that the cow-calf pairs received on any given day was of the same type.

Mixed grass haylage was given at the approximate rate of 39 kg/head/day (as fed basis) during the period of

October 12 and December 20. Haylage was discontinued in mid-December because the muddy conditions made it impossible to transport the feed to the animals. Throughout the study hay was offered ad libitum to the cattle. Water and a loose salt-mineral mix was offered ad libitum. The allotted pastures had variable growth between seasons, with moderate, minimal and rapid growth in the fall, winter and spring, respectively. It was felt that the cattle received adequate protein and energy levels as described by the National Research Council's nutrient requirement for above average milking beef cows. The cows' nutrient needs were determined to be approximately 12.9 kg dry matter, 1.41 kg total protein (10.9 percent), 7.1 kg total digestible nutrients (55 percent) (NRC, 1976). Dry matter, crude protein and acid detergent fiber percentages were determined on fall pasture, fall hay supplies, grain carrier, spring hay supplies and spring pasture. The composition of the feedstuffs (on a dry matter basis) for the various seasons of the year is shown in table 1. A complete proximate analysis was not performed, and thus Total Digestible Nutrients (TDN) was not calculated. It was thought that because the cows maintained a reasonable condition score of 4 to 6 that they were consuming enough to meet their energy requirements.

Cows were weighed every 28 days at 0, 28, 56, 84, 112, 140, 168 and 196 days on trial. The weights at 0 and 196 days were shrunk weights, meaning the cows were taken off

TABLE 1. PERCENT DRY MATTER, CRUDE PROTEIN, AND
ACID DETERGENT FIBER OF FEEDSTUFFS SAMPLED IN THE FALL
AND SPRING (100% DRY MATTER BASIS)

| Item | Fall | | | Spring | | |
|---------------|------|------|------|--------|------|------|
| | DM% | CP% | ADF% | DM% | CP% | ADF% |
| Pastures: | | | | | | |
| Pen 1 | 53.0 | 7.8 | 37.8 | 23.0 | 14.5 | 31.2 |
| Pen 2 | 48.7 | 8.6 | 43.3 | 24.6 | 13.0 | 33.1 |
| Pen 3 | 45.3 | 9.3 | 44.3 | 22.1 | 12.6 | 32.0 |
| Pen 4 | 40.0 | 9.8 | 40.3 | 21.6 | 16.0 | 29.8 |
| Pen 5 | 50.3 | 9.3 | 41.7 | 23.6 | 12.4 | 30.5 |
| Pen 6 | 47.5 | 10.7 | 40.4 | 19.6 | 19.9 | 27.7 |
| Haylage: | | | | | | |
| Ag Bag 1 | 26.1 | 11.4 | 39.9 | | | |
| Ag Bag 2 | 23.5 | 10.9 | 41.7 | | | |
| Grass Hay: | | | | | | |
| Field 1 | 85.1 | 10.0 | 42.0 | | | |
| Field 2 | 86.2 | 8.7 | 42.8 | | | |
| Field 3 | 85.7 | 7.2 | 40.0 | 86.3 | 10.5 | 44.2 |
| Grain Carrier | 87.3 | 10.3 | 6.1 | | | |

feed and water for 16 hours before weighing. The other six weights were unshrunk.

Each group was rotated clockwise to the adjoining pen every 28 days to minimize the effect of pasture quality differences.

Twelve-hour milk production was determined on Days 63, 126 and 190 of the trial. The weigh-suckle-weigh technique similar to that described by Hixon et al. (1982b) was employed. The calves were separated from their dams for approximately six hours, after which the calf was allowed to nurse its dam completely. The cow-calf pairs were then separated again. Twelve hours later, the calves were weighed and then allowed to nurse until it was felt the calf had completely nursed its dam. The calves were then weighed and the difference was the twelve-hour milk yield.

On days 0, 58, 112 and 168 milk samples were taken and analyzed for fat and protein by infrared spectroscopy by the Willamette Dairy Herd Improvement Association. A 50 ml sample was hand-milked from each cow. The sample was taken from as many quarters as necessary to acquire the quantity of milk required. The cows were not separated from their calves before the collection.

The calves were weighed at 0, 28, 56, 84, 112, 140, 168 and 196-days. Since the calves were not separated from the cows before the weighing, they had access to their dams' milk. For this reason all calf weights are considered unshrunk. The calves were not given creep feed

and were allowed to eat hay and silage ad libitum along with the cows. The 205-day weaning weights, which are adjusted for sex of calf and age of dam, were calculated for each calf. Average daily gain was also calculated for the calves.

Condition scores of the cows were determined at the beginning and end of the trial. Measurements by two individuals were taken for each cow, and the scores averaged for one condition score. The method of scoring is described by Lowman et al. (1976). Lowman used a 0 to 5 scale (0 = very thin, 5 = very fat) and felt that a score of 2.5 is necessary to achieve optimum performance for fall calving cows during the breeding season. The scoring system employed in this study was slightly different than Lowman's. A 0 to 9 scale (0=very thin, 9=very fat), similar to the method described by Beverly et al. (1981), was used, and a score of 4 to 6 was considered optimum for fall calving cows.

The cows were confined to drylot during the breeding season and heat checked twice daily. Those cows exhibiting estrus were artificially inseminated. Since few cows had exhibited estrus by mid-December, they were palpated by a veterinarian on December 15, 1983, which was 65 days into the trial, to evaluate estrous activity. All but five of the cows were found to have significant ovarian structures. Those cows that were determined to have corpora lutea or have no ovarian structures were given Estrumate², a

synthetic prostaglandin, to regress the corpora lutea and allow the cow to come into heat naturally. The prostaglandin was administered on December 20, 1983. All cows that exhibited estrus between the prostaglandin injection and January 11, 1984 were artificially inseminated with appropriate semen.

The winter of 1983-1984 was one of the harshest recorded in recent years in the Willamette Valley. An ice storm occurred the day after the prostaglandin was administered.

On April 3, 1984, the cows were palpated for pregnancy and the average number of days open was calculated. Since only 23 out of the 42 cows conceived, it was felt that some sort of measure, penalizing those cows that failed to conceive, should be employed and used in lieu of actual average days open, as was used for the pregnant cows. On those cows that did not get bred a modified average days open was calculated. This was done by determining the length of time between parturition and January 11, 1984, the last day the cow could have been inseminated. This number was then used as an average days open score.

Routine health procedures were conducted on these animals throughout the study. The cows were vaccinated with a 3-way (G.H.P.) Leptospirosis vaccine in November and were also given a pour-on organophosphate to control

² Estrumate -- Haver-Lockhart, Inc.

warbles. No vaccine was administered to the calves during the trial.

During the course of the trial, two very minor cases of footrot were detected and treated with antibiotics. Neither of these cases were serious enough to cause a problem for this study. No other health problems were encountered during the duration of the experiment.

All data were analyzed statistically as a split-plot over time in accordance with Steel and Torrie (1980). The split-plot over time consisted of two treatments, three replications and the number of periods appropriate for the parameter measured. The only exceptions were the average days open and 205-day adjusted weaning weight, which were analyzed as a randomized complete block design with treatments and replications as factors, also as described by Steel and Torrie (1980). In addition, a regression analysis was performed on the milk production data to determine if there was any difference in persistency in lactation between the two treatments.

The trial was originally planned to include a dry matter intake study to be conducted during the breeding season when the cow-calf pairs were in drylot. After several attempts, it was determined that the facilities and equipment available were inadequate to deliver a specified amount of feed and weigh it back accurately.

Results and Discussion

Weight loss by the cows was similar between lasalocid-fed cows and controls. The lasalocid-fed cows lost $12^{\pm}12.5$ kg and the controls lost $7^{\pm}12.5$ kg during the 196-day trial. Statistical analyses revealed no difference ($p >.10$) in cow weight loss between the groups or the treatments. The mean weight of cows at 28-day intervals is illustrated in figure 2. There was no difference ($p >.10$) between the unshrunk weights by treatment or period. The cows followed an expected weight change based on the feeding regime and a fairly constant weight was maintained throughout the trial. The shrunk weights are naturally lower than the unshrunk because most of the error caused by rumen fill is eliminated. This was supported by the fact that condition scores between treatments did not significantly change ($p >.10$) over time. The change in condition scores among treatments between Day 0 and Day 196 is shown in table 2. Condition scores of the lasalocid-fed cows were $4.29^{\pm}.24$ and $4.48^{\pm}.21$ on Day 0 and Day 196 of the trial, respectively. Condition scores of the control cattle were $4.26^{\pm}.24$ on Day 0 and $4.26^{\pm}.19$ on Day 196. The average cow weight and condition score values were consistent with previous work done at this station and is representative of fall calving cows managed in this manner.

These results are in agreement with Hixon et al. (1982a), Turner et al. (1980), Lemenager et al. (1978),

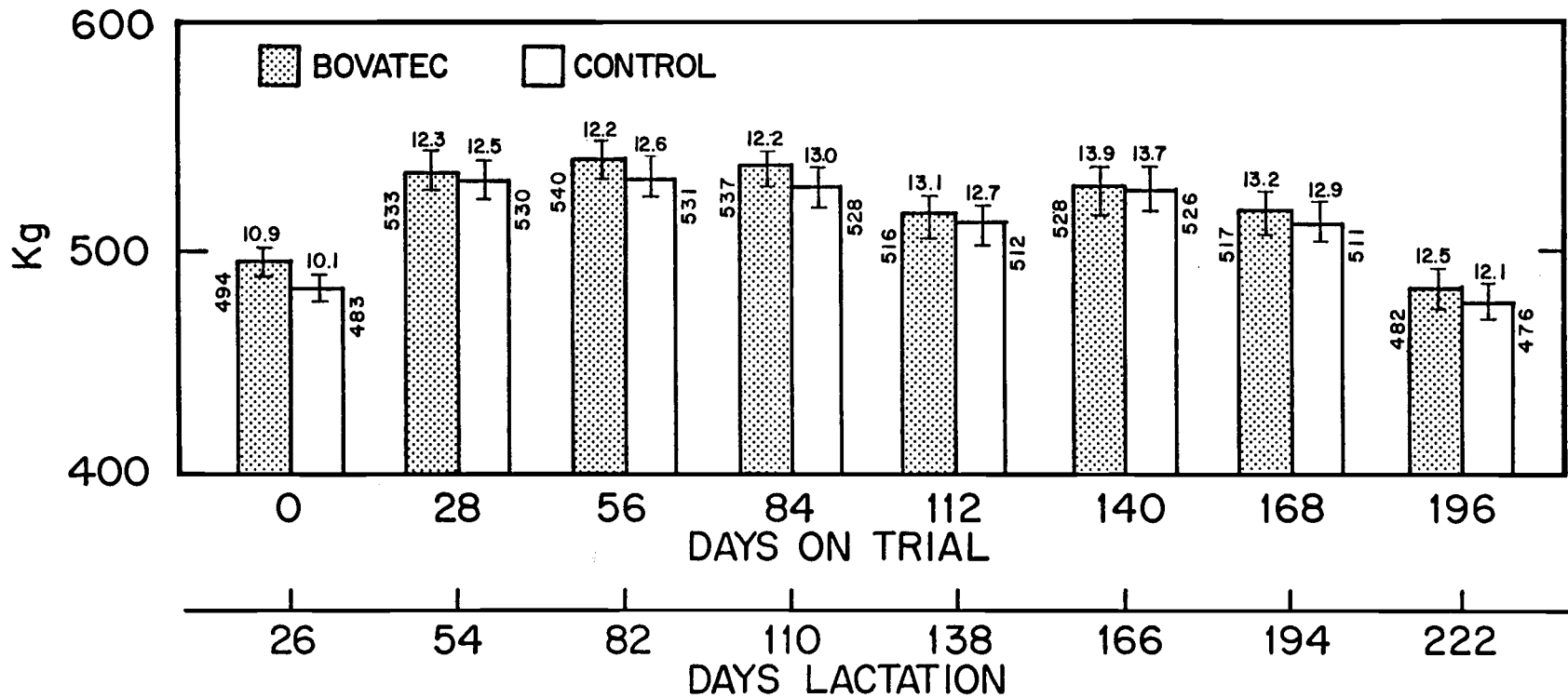


Figure 2. Mean cow weights (kilograms) at 28-day intervals, of cows fed 0 or 200 mg lasalocid per head per day. Treatment means do not differ ($p > .10$).

TABLE 2. MEAN COW CONDITION SCORES (SCORE 0 TO 9)
OF BEEF COWS FED 0 OR 200 MG LASALOCID PER HEAD PER DAY

| Treatment | Day 0 | SEM | Day 196 | SEM |
|-----------|-------|-----|---------|-----|
| 0 mg | 4.26 | .24 | 4.26 | .19 |
| 200 mg | 4.29 | .24 | 4.48 | .21 |

Treatment means do not differ ($p > .10$)

and Randel and Rouquette (1976) who reported that beef cows fed monensin lost the same amount of weight and body condition as controls in trials conducted over the winter. In contrast, Wagner et al. (1984) found that beef cows receiving 200 mg lasalocid lost less weight than control cows. This is in agreement with McAskill et al. (1980), who reported less weight loss in monensin-fed cows.

It appears that a great deal of improved cattle performance by ionophores is due to change in animal feed intake. McAskill et al. (1980), Lemenager et al. (1978), and Turner et al. (1977) all found that beef cows supplemented with monensin showed a decreased dry matter intake and/or increased feed efficiency.

It is possible that while there was no difference between treatment in cow weight change or body condition, there could have been a difference in dry matter intake. Twelve-hour milk production was evaluated using the weigh-suckle-weigh technique. The results of the three weighings are shown in table 3. Lasalocid supplemented cows produced $4.42 \pm .26$, $4.12 \pm .42$ and $3.78 \pm .46$ kg milk on Day 63, 126 and 190, respectively. The non-supplemented cows produced $4.14 \pm .28$, $3.88 \pm .33$ and $3.30 \pm .34$ kg milk on Day 63, 126 and 190, respectively. Split-plot over time analyses indicated that there was no difference ($p > .10$) between lasalocid-fed cows or controls. Regression analysis revealed that persistency of lactation between the two treatments was similar. There was a difference ($p < .05$) between

TABLE 3. MEAN 12-HOUR MILK PRODUCTION (KILOGRAMS) OF BEEF COWS FED 0 OR 200 MG LASALOCID PER HEAD PER DAY

| Days on Trial | Ave. Days Lactation | Treatment | | | |
|---------------|---------------------|-----------------|-----|-------------------|-----|
| | | kg milk 0 mg | SEM | kg milk 200 mg | SEM |
| 63 | 88 | 4.14 | .28 | 4.42 | .26 |
| 126 | 151 | 3.88 | .33 | 4.12 | .42 |
| 190 | 215 | 3.30 | .34 | 3.78 | .46 |

Treatment means do not differ ($p > .10$).

weighings, indicating that both the lasalocid-fed as well as the control cows experienced a decreased milk yield as lactation advanced. There was, however, a numerical advantage of 0.33 kg more milk in favor of the lasalocid cows. This is consistent with the findings of Hixon et al. (1982a). Lemenager et al. (1978) reported exactly the same milk yield in cows fed monensin as those not fed the ionophore. Randel and Rouquette (1976) found that monensin had no effect on milk production.

Bauman and Elliot (1983) reviewed the mechanism of milk production and indicated that the more glucose the mammary gland has available to it, the more lactose is produced, and thus the actual milk synthesized increases. This is thought to occur by the secretion of lactose which increases the osmolarity in the lumen of the alveoli and causes water to be drawn out of the secretory cells, resulting in an increase in milk volume. It is possible, if there is an increase in propionate production, which is a major precursor of hepatic gluconeogenesis, that more glucose could be available for use by the lactating mammary gland. This may be why some researchers are finding a numerical increase in milk yield in cows fed lasalocid. It is also possible that even with an increase in gluconeogenesis that the extra glucose will be taken up equally by other tissues that require it, and the mammary gland would not get a significant increase in available glucose. Therefore, one would not expect to find a

significant increase in milk yield. The results of this study indicate that there were no apparent detrimental effects on milk yield in cows supplemented with lasalocid.

The mean percent values of milk fat and protein as determined by infrared spectroscopy are shown in table 4. The mean percent milkfat was $2.77^{\pm}.28$, $3.19^{\pm}.38$, $2.64^{\pm}.17$ and $2.98^{\pm}.25$ in lasalocid-fed cows and $2.93^{\pm}.31$, $3.39^{\pm}.28$, $3.05^{\pm}.14$ and $3.08^{\pm}.20$ in control cows on Day 0, 56, 112 and 168, respectively. Analysis by split-plot over time showed no significant difference ($p >.10$) between treatments nor over time for percent fat in the milk. These results are consistent with those obtained by Hixon et al. (1982a), Lemenager et al. (1978) and Randel and Rouquette (1976). These researchers, however, studied the effects of monensin, rather than lasalocid, on lactation.

Bauman and Elliot (1983) suggested that significant reductions in the availability of acetate and butyrate result in a depression in milk fat. The use of lasalocid causes a reduction in rumen acetate and butyrate, but it does not result in milk fat depression. A possible explanation may be that since the beef cows studied were fed at least a 95-percent roughage diet, there was enough acetate and butyrate produced to provide adequate substrate for milk fat synthesis.

There was virtually no change ($p >.10$) in percent milk protein between treatments or over time. The mean percent milk protein was $3.04^{\pm}.07$, $3.10^{\pm}.06$, $3.02^{\pm}.07$ and $3.02^{\pm}.05$

TABLE 4. MEAN PERCENT FAT AND PROTEIN CONTENT OF MILK OF BEEF COWS FED 0 OR 200 MG LASALOCID PER HEAD PER DAY

| Days on Trial | Treatment | Fat | SEM | Protein | SEM |
|---------------|-----------|------|-----|---------|-----|
| 0 | 0 mg | 2.93 | .31 | 3.19 | .16 |
| | 200 mg | 2.77 | .28 | 3.04 | .07 |
| 56 | 0 mg | 3.39 | .28 | 3.03 | .08 |
| | 200 mg | 3.19 | .38 | 3.10 | .06 |
| 112 | 0 mg | 3.05 | .14 | 3.19 | .07 |
| | 200 mg | 2.64 | .17 | 3.02 | .07 |
| 168 | 0 mg | 3.08 | .20 | 2.95 | .05 |
| | 200 mg | 2.98 | .25 | 3.02 | .05 |

Treatment means do not differ ($p > .10$).

in lasalocid supplemented cows and $3.19 \pm .16$, $3.03 \pm .08$, $3.19 \pm .07$ and $2.95 \pm .05$ in the non-supplemented cows on Day 0, 56, 112 and 168, respectively. This result is similar to that obtained by Randel and Rouquette (1976). It is generally accepted to be very difficult to alter protein production of the mammary gland because of inherent genetic protein production limitations and a possibility of a negative feedback system for actual amount of protein produced. The existence of a feedback mechanism was suggested by Larson (1969). The values of milk yield, fat, and protein determined in this study are numerically consistent with values found in other studies.

Day 0, Day 196, 205-day adjusted weaning weights and average daily gain of the calves are shown in table 5. Calves of lasalocid-fed cows weighed 68 ± 2.8 and 218 ± 5.6 kg on Day 0 and 196, respectively. Calves of the control cows weighed 67 ± 2.6 and 217 ± 4.7 kg on Day 0 and 196, respectively. Calf Average Daily Gain was the same ($.77 \pm .10$ kg) in treated and untreated groups. There was no difference ($p > .10$) between calf weight gain and thus average daily gain for progeny of treated and untreated cows. This is consistent with the other data from this study. Numerous researchers, including Totusek et al. (1973), have reported a high positive correlation between milk yield and calf gain. Since supplementing the cows with lasalocid did not increase milk yield and care was taken to prevent the calves from ingesting the treated

TABLE 5. MEAN CALF WEIGHT (KILOGRAMS) FROM BEEF COWS
FED 0 OR 200 MG LASALOCID PER HEAD PER DAY

| | 0 mg | SEM | 200 mg | SEM |
|------------------------------------|------|-----|--------|-----|
| Trial Day 0 | 67 | 2.6 | 68 | 2.8 |
| Trial Day 196 | 217 | 4.7 | 218 | 5.6 |
| 205-day adjusted weaning weight | 205 | 5.7 | 209 | 5.0 |
| ADG | .77 | .10 | .77 | .10 |

Treatment means do not differ ($p > .10$).

grain carrier, an increase in calf gain would not be expected. Turner (1980) reported no change in calf gain with monensin treated cows. Lemenager et al. (1978) reported a significant increase in calf gain with monensin-fed dams, but he suggested that this may have been due to the calves accidentally ingesting some of the treated carrier throughout the trial. There was no difference ($p > .10$) between treatments for 205-day adjusted weaning weight. The 205-day adjusted weaning weight was 209 ± 5.0 and 205 ± 5.7 kg in calves of lasalocid supplemented and non-supplemented cows, respectively. This agrees with the findings of Hixon et al. (1982a) and others who reported on the effects of monensin on beef animals. The 24 male calves that were implanted with zeranol were evenly divided between groups. The average ages of the calves when the zeranol effects were diminishing were similar. It was felt that this would not cause any artificial treatment variations. As expected, the average daily gain of the calves was highest during the period that the zeranol was active. J. M. Bonner (unpublished data) in reviewing growth implants reported that steers administered 36 mg zeranol gained an average of .18 kg more per day than those not implanted. His review also suggested that steers fed lasalocid and implanted were nearly twice as efficient as those animals only fed lasalocid.

Twenty-three of 42 cows became pregnant. As mentioned previously, palpation on December 15, 1983, revealed that

in all but five of the cows there was evidence of cycling. Any cow which exhibited estrus was artificially inseminated with appropriate semen. A single synthetic prostaglandin injection was administered to all cows that had not come into estrus by December 20, 1983.

Twenty cows had exhibited estrus and were inseminated by December 20. Eighteen of the 20 were confirmed pregnant on the April 3, 1984, pregnancy check. Of the 22 cows given the prostaglandin, estrus was detected in only nine. These nine cows were inseminated, of which five were determined to be pregnant. The rest of the cows never were observed in estrus.

It is possible that the severe ice storm that hit the day after the animals were synchronized could have contributed to the lack of estrus expression in these animals. Between treatments, 10 control animals and 13 lasalocid-fed cows were confirmed bred by the April 3, 1984, pregnancy check.

Average Days Open was calculated and evaluated two ways. One method was to only calculate average days open for those cows which were later determined to be pregnant. The other method assigned a value to all open cows which penalized them for failing to conceive. This calculated value was then pooled with the Average Days Open of the bred cows and analysis of variance was performed on the data.

Actual Average Days Open and calculated pooled Average

Days Open data are presented in table 6. There was no difference (84.92 ± 4.07 vs. 89.90 ± 5.27) between lasalocid supplemented and non-supplemented cows for actual Average Days Open ($p > .10$). There was also no difference (97.91 ± 4.57 vs. 103.48 ± 4.18) in pooled Average Days Open ($p > .10$). Several researchers, including Hixon et al. (1982a), Walker et al. (1980), and Lemenager et al. (1978) have reported no difference in first service conception rate with the use of monensin. However, Hixon et al. (1982b), Lemenager et al. (1978) and Turner et al. (1977) have found that in monensin-fed cows there was a significant reduction in length of days to first postpartum estrus. Several researchers, including Rakestraw et al. (1984) and Cantrell et al. (1982) have reported that significant losses of body weight and condition may lengthen the postpartum interval to first estrus in fall calving cows. These studies concluded that fall calving cows should have minimal body condition losses and be provided with adequate nutrition if they are to become pregnant. By increasing the metabolizable energy of the feed that is available to the animal, lasalocid may reduce the loss of body condition of cows during the winter breeding season, thus allowing the animal to improve reproductive performance.

Research has suggested that supplementing cows with ionophores may increase an animal's nutritional and reproductive performance. The use of lasalocid on fall

TABLE 6. MEAN AVERAGE DAYS OPEN (ADO) OF BEEF COWS
FED 0 OR 200 MG LASALOCID PER HEAD PER DAY

| | N | ADO | SEM |
|------------------------|----|--------|------|
| Actual ADO | | | |
| 0 mg | 10 | 89.80 | 5.27 |
| 200 mg | 13 | 84.92 | 4.07 |
| Calculated, Pooled ADO | | | |
| 0 mg | 21 | 103.48 | 4.18 |
| 200 mg | 21 | 97.91 | 4.57 |

Treatment means do not differ ($p > .10$).

calving beef cows has been evaluated. In this study, no significant differences in cow weight change, cow condition change, milk yield, milk composition, calf gain or cow average days open were observed. There was, however, a slight numerical advantage in milk yield in the treated cows. This advantage did not result in increased calf gain. Recent work by J. Paterson (personal communication) produced results contrary to what was reported at this station. He indicated that beef cows fed lasalocid had a reduced dry matter intake and body condition loss. He also reported an increase in milk yield and a corresponding increase in calf weight gain. Total milk fat was measured and was depressed slightly at 30 days postpartum, but there was no significant difference between lasalocid-fed cows and controls at 60 and 90 days postpartum. Dr. Paterson also discovered an increase in total milk protein. From these studies it is unclear if supplementing beef cows with lasalocid is advantageous.

It is possible that in this study the cows' dry matter intake may have been reduced. With all the evidence indicating that ionophores increase feed efficiency by either decreasing intake or increasing gain, it seems unlikely that there would be no effect on the performance of fall calving beef cows fed lasalocid. Further study is needed in this area. The results of this study lend support to Hoffmann-La Roche, Inc.'s claim that long term feeding of lasalocid causes no detrimental effects on animal

performance.

The type and amount of response of cattle fed lasalocid may be partially dependent on the quality of forage fed to the animals. The greatest response seems to occur in animals fed high quality forages. Decreased dry matter intake and increased gain resulting in increased feed efficiency are the predominant responses seen. Animals fed lower quality forages are also more efficient. But often only a decrease in dry matter intake is observed. These are only generalities and many exceptions can be referenced.

If a similar study were to be conducted evaluating the use of lasalocid in beef cows, several additions and changes in the procedure of this research could be employed. A dry matter intake study would be necessary to evaluate feed efficiency. Milk samples taken at the time of the weigh-suckle-weigh and at the same stage of milk let down would allow the comparison of total milk fat and protein in lasalocid treated cows. It would be interesting to evaluate condition score changes frequently in further studies. A longer study with an increased number of milk yield measurements would allow a researcher to more accurately evaluate persistency of lactation in lasalocid treated animals.

Another area of lasalocid research with beef cattle may be to feed lasalocid to the calves as well as to the cows. Studies indicate that lasalocid decreases the

incidence of coccidiosis and improves weight gains. Perhaps the feeding of lasalocid would be more advantageous to the producer if one could derive benefits from broader aspects of animal performance.

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