

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Range Beef Cow Symposium

Animal Science Department

12-5-1995

Improving Re-Breeding Through Protein Supplementation

M. K. Petersen

New Mexico State University, Las Cruces, NM, mark.petersen@ars.usda.gov

D. E. Hawkins

New Mexico State University, Las Cruces, NM

I. Tovar

New Mexico State University, Las Cruces, NM

L. A. Appeddu

New Mexico State University, Las Cruces, NM

Follow this and additional works at: <https://digitalcommons.unl.edu/rangebeefcowsymp>



Part of the [Animal Sciences Commons](#)

Petersen, M. K.; Hawkins, D. E.; Tovar, I.; and Appeddu, L. A., "Improving Re-Breeding Through Protein Supplementation" (1995). *Range Beef Cow Symposium*. 193.

<https://digitalcommons.unl.edu/rangebeefcowsymp/193>

This Article is brought to you for free and open access by the Animal Science Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Range Beef Cow Symposium by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

IMPROVING REBREEDING THROUGH PROTEIN SUPPLEMENTATION

M.K. Petersen, D.E. Hawkins¹, I. Tovar² and L.A. Appeddu²

Animal and Range Science Department,
New Mexico State University, Las Cruces, NM 88003-0003

INTRODUCTION

Research conducted at Fort Robinson in 1960 and following studies have demonstrated that good body condition supports successful reproduction in both young and older cows. The recommendations from these studies have emphasized the feeding of energy to assist thin cows back into condition. However, in the extensive range conditions of the West, the ranch is intended to supply dietary energy through the range vegetation. When we look at the costs associated with calf production many ranchers have production costs above the national average. Many of these high cost producers have higher than average purchased feed costs. It would be advantageous for ranchers to have an alternative nutritional strategy, to achieve reproductive management goals. Nutritional schemes that use small, biologically potent, easy to deliver and cost effective supplements would be widely adopted if available.

The question to be asked is "*Can the factors associated with good body condition on reproduction be mimicked by the diet in young thin cows?*" This question has been the basis of our research program at New Mexico State University. The purpose of this paper is to describe how protein may act as a switch to turn on the reproductive system of thin young cows to breed back sooner after calving.

We know that 2 and 3 year old cows ranging on native pastures after calving can lose weight at a rate close to 1 pound per day. This is due to an imbalance of nutrient demand (especially milk production) compared to nutrient intake. Usually late winter and spring forage is not abundant and low in nutritive value. Keeping in mind that our goal is to reduce cost of supplementation, "Is it possible to minimize the negative effects of weight loss on reproduction in young range cows with supplements?"

SUPPLEMENTING PROTEIN TO REDUCE WEIGHT LOSS

Weight loss occurs after calving to supply nutrients for milk production since forage intake is insufficient. If the period of time that weight loss occurs is extended then the

¹Reproductive Physiologist, Assistant Professor.

²Animal and Range Sciences Graduate Student, Range Nutrition
duration of post calving anestrus is probably also going to be extended. Interesting studies have been reported in the last ten years that have investigated weight loss and the composition of lost weight. Brendemuhl et al. (1987) fed lactating first litter sows four diets differing in

concentration of protein and energy. The diets fed were low energy/low protein, low energy/high protein, high energy/low protein and high energy/high protein. After farrowing, the gilts fed the low/low diet lost the most body weight, those fed the high/high lost the least while those fed the low/high and high/low lost an intermediate amount of weight. However, protein and energy interacted such that the sows fed the low energy lost less weight when fed high protein. But, when fed a high protein diet sows lost more body condition than those fed the low protein diet. These results suggest that a greater use of body fat occurred when high protein was fed and that the composition of weight loss was dependant upon diet composition.

Even though the sows fed the high protein diet lost more body condition, a higher percentage of these sows returned to estrus earlier. Surprisingly, the concentration of dietary energy had no influence on days to first estrus even though they possessed a higher body condition. In a follow-up study (Brendemuhl et al., 1989) it was confirmed that sows fed the low protein diets lost a greater amount of protein tissue from both muscle and internal organs, while those fed the energy deficient diet (high protein) lost a greater proportion of body fat. The important point is that the composition of diet may influence the type of tissue lost and length of the post-partum interval.

Even though this paper is for a Range Beef Cow Symposium, it is easier to demonstrate the relationship between diet composition, weight loss and reproduction in nonruminants because the digestive system is less complicated. To conduct a study like this in cows, the source of protein must be carefully selected. To insure that dietary protein available to the cow will increase, she needs to be fed a source of bypass or ruminally undegradable protein. Normally the cow is dependent upon the quantity of microbial protein produced in the rumen which is controlled by dry matter and protein intake. This is where the experimental use of bypass protein sources have become invaluable. By feeding bypass proteins we can maintain similar energy intake and increase the supply of metabolizable protein.

A study was conducted to determine the effect of bypass protein on weight loss with high body condition heifers that were fed a wheat straw diet with or without fishmeal. Heifers not fed fishmeal lost nearly 2 pounds per day while those fed fishmeal did not change in body weight, but did change in body composition. They decreased in fat content and increased in protein tissue. These heifers used the fish meal protein and energy released from fat to supply the nutrients needed to grow more lean tissue. By feeding high levels of protein with an energy deficient diet, it was shown that body weight could be maintained because protein tissue growth was fueled by dietary bypass protein and energy released from body fat. In two similar studies (Vipond et al., 1989) lambs were fed a barley straw at a rate that would cause weight loss. Unsupplemented lambs lost .25 and .4 pounds per day while those supplemented with .2 lb fishmeal per day gained .02 and .1 lbs. per day. The conversion of fishmeal to body weight was better than a 1:1 conversion.

In Montana it was demonstrated that pregnant range beef cows would reduce weight loss when supplemented with bypass protein. The supplements were formulated to add blood meal to a typical 40% crude protein soybean meal supplement. Approximately .3 lbs of blood meal was added to 1 lb. of a 40% supplement. This study was conducted during two consecutive winters.

In the first year cows that received no supplement maintained body weight from December to March 1. The cows that received protein supplement gained weight and no differences were found between cows fed or not fed blood meal. The improvement in body weight was attributed to the protein used in the rumen. In the second year of the study the winter was more normal and the non-supplemented cows lost nearly 80 lbs in 60 days. Cows fed the 1 pound of soybean meal supplement lost only 40 pounds and the cows fed the additional .3 pounds of blood meal lost no weight at all, again showing better than a 1:1 feed conversion for the bypass protein. An extremely important point needs to be emphasized. **The bypass protein appears to only be effective in cow supplements when the cows are losing weight.** In Australia (Lindsey, 1982) when combinations of cottonseed meal and meat meal are fed together to cows during the dry season, weight change was improved by over 1 lb per day. In certain conditions adding bypass protein to a winter range supplements may change body composition and magnitude of weight loss.

PROTEIN SUPPLEMENTATION FROM CALVING TO BREEDING

The interpretation explained above has lead to examinations of the effects of additional supplemental protein on reproduction, milk production, and body weight and condition scores changes in young and mature postpartum cows. A study was conducted (Petersen et al., 1987) with 38 black baldie heifers and their suckling calves. They grazed an improved pasture while receiving a half a ration of alfalfa hay. Cows were individually fed one of two supplements providing 350 g of crude protein daily while differing in the amount of ruminally degradable and bypass protein. The supplements provided either 250 or 39 g of bypass protein. Ingredients of the two supplements included beet pulp, urea, blood meal and corn gluten meal. The cows receiving the high bypass protein supplement produced about 2 lb more milk and weaned calves that were 17 lb heavier. Cows fed high bypass also started cycling 10 days sooner and 13% more cows were pregnant in the fall. The conditions of this study, however, minimized any nutritional stress. All cows had sufficient energy intake and they started the study in a body condition score of 6. Although the results of this study were interesting, the application of the nutritional regimen provided was doubtful under range land conditions.

In the fall of 1988 and 1989, another study (Wiley et al., 1991) was designed with a factorial arrangement of treatments. Two year old heifers (135 total) were fed two levels of nutrition in the fall and winter followed by two protein supplements (differing in bypass protein content) for 65 days after calving. The two prepartum nutrition treatments allowed for one group of heifers to be fed to maintain their body weight and condition while the other group was fed 50% of the amount of feed the first group received. The result of these extreme nutritional treatments was evident by cow body weight on January 15 (five weeks prior to calving). The low nutrition group weighed less than their fall weight and 149 lb less than the moderately fed group. The moderate nutrition group gained 75 lb and .3 condition scores since fall.

After calving, the cows received a 10% crude protein grass hay at 2.5% of their body weight and one of two supplements. Both supplements contained the same quantity of energy and ruminally degradable protein (to supply .5 lb per day). The second supplement supplied an additional .5 lb of crude protein of low ruminal degradability supplied by blood and corn gluten

meals. It is important to note that both post calving diets supplied protein in excess (125 and 180%) of the requirements for 1,000 lb nursing 2 year old cow.

The cows receiving the additional bypass protein regained their prepartum body weight five weeks after calving, while the group of cows fed the lower quantity of bypass protein had not recovered their precalving body weight by the beginning of the breeding season. At breeding 59 and 43% of the high bypass and low bypass supplemented cows had cycled while 65 and 43% of high bypass and low bypass fed cows were bred in the first 21 days of the 42 d breeding season. Fall pregnancy was 80% for the two groups.

What are the results of importance from this study? First of all, there were no interactions between the precalving and postcalving nutritional treatments. This can be interpreted to mean that all cows responded to the additional protein (increased postpartum weight gain and earlier breeding) regardless of their prepartum nutrition. Secondly, there appeared to be a slight repartitioning of nutrients to realimentation of the cows. Lastly, there was a considerable savings of feed in cows fed the low nutrition and high bypass supplement (approximately \$55 per head).

This study agreed with an Australian report (Hunter and Magner, 1988) supplementing formaldehyde treated casein to two year old Brahman X Hereford cows. The cows receiving the additional protein gained weight faster after calving and started cycling five weeks sooner. Cows also declined in milk production 8 weeks postpartum.

From the Overton Experiment Station, Texas, Triplett et al. (1993) reported a study with grazing heifers and mature Brahman cows fed three different quantities of fish meal and soybean meal (0:100, 50:50 and 100:0 ratios of fish meal and soybean meal, respectively). They found that milk production was lower in heifers fed the 100% fish meal supplement but no effect was found in the mature cows. Although days to first estrus were similar, cows fed the fishmeal containing supplements had a higher first service conception rate (57 and 54% vs 29%).

Another study (Sklan and Tinsky, 1993) using dairy cows, showed similar reproductive responses when compared to Triplett et al. (1993), by feeding fishmeal and increasing bypass protein while maintaining crude protein percentage constant. In this study number of days open were 84 and 96 and first service conception rates were 70.9 and 58.5% for the fishmeal and control fed cows. Two Irish researchers (Sreeman and Diskin, 1990) investigated embryo survival rate in beef heifers grazing spring pasture. The heifers were fed either no supplement, 2.2 lb of barley or 2.2 lb of 42% crude protein supplement (which was 32% ruminally undegradable protein). Heifers were inseminated at observed estrus and embryos were recovered. They found that embryo survival rate was higher in the protein supplemented (100%) than either the control (57%) or energy supplemented groups (54%). A Kansas State study (Rusche et al., 1993) showed that two year old cows fed a 33% bypass protein supplement were 56% pregnant while those fed a 42% bypass protein supplement were 80% pregnant. Huston et al. (1991), from San Angelo, conducted a two year study with 60 mature cows each year. They investigated the effects of no supplement compared to cottonseed meal based or feather meal based supplements on beef cow performance. The cows in this study lost 11 to 18% of their

body weight from fall to breeding. There appeared to be a trend for the cows fed the feather meal to have a higher pregnancy rate (100%) than either the control (86%) or cottonseed meal (86%) treated cows.

Lastly, Sasser et al. (1988) found significantly lower conception rates in first calf beef cows when fed a protein deficient diet.

To summarize the effects of sufficient dietary protein on performance of young postpartum cows, the following can be suggested. It may be expected that:

1. cows have earlier positive weight change
2. less tissue protein may be catabolized
3. milk production may increase, decrease or remain unchanged depending upon protein source and the nutritional status of the cow
4. calf weights may increase or remain unchanged
5. cows may become pregnant sooner
6. weaning weights may be increased in the following year

HOW CAN DIETARY PROTEIN EFFECT REPRODUCTION IN YOUNG AND OLDER COWS?

We know that body condition can be used to reliably predict reproductive success. We do not know exactly why this is true. Most would agree that the energy status of the animal is communicated to the reproductive system in order to avoid a pregnancy that would not go to term or jeopardize the dam. A puzzle to animal scientists has been how the communication occurs. We do know that fatter heifers have higher blood insulin concentrations. Insulin is the hormone that allows nutrients into tissues after nutrient concentration in the blood increases following eating. As fat accumulates in the body the amount of insulin increases in the blood. A difference of two hundred pounds in similar type yearling heifers can increase insulin 2 to 3 fold. Insulin injections have been shown to increase the ovulation rate in energy deprived heifers (Harrison and Randel 1986). In the laboratory, insulin has increased the release of follicle stimulating hormone (FSH) and progesterone from ovarian and pituitary cells. Insulin is higher in cattle with higher body condition scores and has an influence on important reproductive hormones and functions.

Protein has been shown to be a potent stimulator of insulin release. When additional bypass protein is fed it can stimulate insulin concentration to be as high as a found in a cows with good body condition. This has been demonstrated in a number of studies (Hunter and Magner, 1988; Wiley et al., 1991; Petersen et al., 1992; Bays et al., 1994). In older cows (Dhuyvetter et al., 1992 and Triplett et al., 1993) the influence of insulin seem to be less important for reproduction than with younger cows, in fact their appears to be little or no advantage for improving days to first estrus in older cows.

In two year old cows it has also been shown (Bays et al., 1994) that after 10 days of eating a supplement with blood and feather meal added, FSH was elevated. This shows that the

reproductive process maybe initiated sooner and we may expect more young cows bred earlier in the breeding season. When insulin is increased more of the nutrients flow into the tissues and away from milk production in younger cows (Triplett et al., 1992, Dhuyvetter et al., 1993, Tovar et al., 1994 and Appeddu et al., 1996 unpublished) thus weight gain may occur in as little as 3 week after calving. The higher insulin levels also seem to change how fat tissue responds to a signal to release fat. Insulin reduces the sensitivity of fat tissue and decreases the rate of mobilization (Gambill et al., 1995) and cows lose less weight or gain weight sooner. Finally, an Australian study with rams compared how different protein sources influenced the release of insulin and subsequent release of luteinizing hormone (LH). Luteinizing hormone is the hormone that stimulates the ovary to ovulate. They found that the protein source that caused the greatest release of insulin also caused the greatest release of LH. Thus showing potential connection between protein intake, insulin stimulation and reproduction.

RECOMMENDATIONS AND CONCLUSIONS

Application of the research discussed may or may not have extensive utilization. It is not recommended to feed these types of supplements to cows that have high body condition scores. In these conditions the bypass protein may stimulate increased milk production and have a negative effect on fertility. This type of supplement probably will not show strong improvements in fertility when fed to typical commercial older range cows. It will most likely be effective with younger range cows. ***The situation that has the greatest promise is with two and three year old range cows after calving.*** A few studies showed a decrease in the number of days from calving to breeding. Beginning supplementation soon after calving and continuing until they stop eating supplement may be a good strategy to follow.

In our formulas we have tried to supply .4 lb of ruminally degradable protein from a natural source. The bypass protein has been added from .33 to .66 lb per day. The supplements are usually close to 50% crude protein. The sources that we have used most often are feather meal and blood meal in a ratio close to 4:1. The feeding rate will range from 1.4 to 2 lbs of supplement per day. The cost of adding the bypass protein maybe \$50 to \$80/ton. Every other day feeding is as effective as every day feeding. Due to the lack of palatability of some of the ingredients it should be expected that two weeks may be required to get 90% of the heifers consuming the supplement.

Experimental evidence shows protein nutrition can improve fertility under certain conditions. Most likely it improves the date of breeding. It also has a potent effect on reducing and reversing weight loss by stimulating insulin and slightly reducing milk production.

The idea is to target specific processes with biologically active nutrients to regulate their operation to achieve a short calving interval and older heavier calves at weaning.

LITERATURE CITED

Bays, T.R., D.E. Hawkins, M.K. Petersen, I. Tovar and D.M. Hallford. 1994. Protein and exogenous insulin in post partum beef cows: 1. Effect on metabolic hormones and pituitary

- stores of LH and FSH. *Proc. West. Sec. Amer. Soc. Anim. Sci.* 45:263.
- Brendemuhl, J.H., A.J. Lewis and E.R. Peo, Jr. 1987. Effect of protein and energy intake by primiparous sow during lactation on sow and litter performance and sow serum thyroxine and urea concentrations. *J. Anim. Sci.* 64:1060.
- Brendemuhl, J.H., A.J. Lewis and E.R. Peo, Jr. 1989. Influence of energy and protein intake during lactation on body composition of primiparous sows. *J. Anim. Sci.* 67:1478.
- Chestnutt, D.M.B. 1987. Effect of high protein supplements on the utilization of body reserves by single suckling cows. *Anim. Prod.* 45:15.
- Cox, N.M., M.J. Stuart, T.G. Althen, W.A. Bennett and H.W. Miller. 1987. Enhancement of ovulation rate in gilts by increasing dietary energy and administering insulin during follicular growth. *J. Anim. Sci.* 64:507.
- Dhuyvetter, D.V., M.K. Petersen, M.D. Gambill, M.A. Ward, D.M. Hallford and J.D. Wallace. 1993. Post partum reproduction in young beef cows treated with insulin. *Proc. West. Sec. Amer. Soc. Anim. Sci.* 44:48.
- Gambill, M.D., M.K. Petersen, D.V. Dhuyvetter, M. Ward, D.M. Hallford and J.D. Wallace. 1993. Effect of source and quantity of protein on metabolic hormone regulation and tissue sensitivity in the young postpartum beef cow. *Proc. West. Sec. Amer. Soc. Anim. Sci.* 44:40.
- Harrison, L.M. and R.A. Randel. 1986. Influence of insulin and energy intake on ovulation rate, luteinizing hormone and progesterone in beef heifers. *J. Anim. Sci.* 63:1228.
- Hunter, R.A., and T. Magner. 1988. The effect of supplements of formaldehyde treated casein on partitioning of nutrients between cow and calf in lactating BOS indicus X BOS taurus heifers fed a roughage diet. *Aust. J. Agric. Res.* 39:1151.
- Huston, J.E., K.W. Bales and D.W. Spiller. 1991. A comparison of supplemental feeds for adult beef cows grazing native rangeland in the Edwards plateau region of Texas. *Tex. Agri. Exp. Sta. Prog. Rep.* PR-4851.
- Lindsay, J.A., G.W. Mason and M.A. Toleman. 1982. *Proc. Aust. Soc. Anim. Prod.* 14:67.
- Miner, J.L., M.K. Petersen, K.M. Havstad, M.J. McInerney, and R.A. Bellow. 1990. The effects of ruminal escape protein or fat on nutritional status of pregnant winter grazing beef cows. *J. Anim. Sci.* 68:1743.
- Petersen, M.K., P.J. Halfpop, J.J. McInerney and D.W. Lodman. 1987. Protein supplementation of lactating beef heifers. *J. Anim. Sci.* 65(Supp 1):502.
- Petersen, M.K., D.M. Hallford, D.V. Dhuyvetter, M.D. Gambill, M. Ward, J. Campbell, E. Perez-Eguia, J. Rubio and J.D. Wallace. 1992. The effects of supplemental feather, blood and/or cottonseed meal on metabolic hormones and serum metabolites in ewes fed blue grama hay. *Proc. West. Soc. Amer. Soc. Anim. Sci.* 43:560.
- Rusche, W.C., R. Cochran, L.R. Corah, J.S. Stevenson, D.L. Harmon, R.T. Brandt and J.E. Minton. 1993. Influence of source and amount of dietary protein on performance, blood metabolites, and reproductive function of primiparous beef cows.
- Sasser, R.G., R.J. Williams, R. Bull, C.A. Ruder and D.G. Falk. 1988. Postpartum reproductive performance in crude protein restricted beef cows: Return to estrus and conception. *J. Anim. Sci.* 66:3033.
- Sklan, D., and M. Tinsky. 1993. Production and reproduction responses by dairy cows fed varying undegradable protein coated with rumen bypass fat. *J. Dairy Sci.* 76:216.
- Sreenam, J.M., and M.G. Diskin. 1990. Nutrition and embryo survival rate studies. *Research Report 1190. West. Res. entre. Belclare, Tuan, CO. Galway.* pg 156.

- Tovar, I., M.K. Petersen, D.E. Hawkins T. Bays, S.H. Cox, J.K. Blanton, Jr., M.D. Gambill and D.V. Dhuyvetter. 1994. Protein supplementation and exogenous insulin in postpartum beef cows. 2. Nutrient partitioning. Proc. West. Sec. Amer. Soc. Anim. Sci. 45:266.
- Triplett, B.L., D.A. Nevendoff and R.D. Randell. 1992. Effects of by-pass protein supplementation on milk production, calf weight gain and reproductive performance in Brahman Cows. So. Sec. Amer. Soc. Anim. Sci. pg 24.
- Vipond, J.E., Margaret E. King, E.R. Ørskou and G.Z. Wetherill. 1989. Effects of fishmeal supplementation on performance of overfat lambs fed on barley straw to reduce carcass fatness. Anim. Prod. 46:131.
- Wiley, J.S., M.K. Petersen, R.P. Ansotegui and R.A. Bellows. 1991. Production form first calf beef heifers fed a maintenance or low level of prepartum nutrition and ruminally undegradable or degradable protein post partum. J. Anim. Sci. 69:4279.