FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

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FAT IN BEEF CATTLE RATIONS

INTRODUCTION

Dr. Richard A. Zinn at the University of California in El Centro has been studying the utilization of fat in beef cattle feedlot rations for the FATS AND PROTEINS RESEARCH FOUNDATION during the past six years and recently had two papers published in the "Journal of Animal Science".

The Foundation and Dr. Zinn have known for some time that the practical constraints or limits for optimal utilization of supplemental fats in growing-finishing diets for feedlot steers have not been resolved. Of particular concern to feedlot cattle nutritionists is how the level of fat supplementation influences its comparative feeding value. Depression in growth rate have been noted with levels of supplementation as low as 3%, however, the greatest depression have been observed for levels greater than 5% of the diet's dry matter. Because of these erratic responses feedlot nutritionists usually formulate no more than 1 1/2 - 3% fat in feedlot cattle diets. Whether this sometime negative effect is due to diet acceptability or to metabolic regulation is unknown. Little work has been done to study the nature of adaptation by feedlot cattle to fat supplementation. It is recommended that fat be introduced into the diet gradually. With the present trial and that of Zinn's in 1988, steers had been consuming a diet of supplemental fat prior to initiation of these trials.

Several studies have implicated urea supplementation as a negative factor affecting acceptability or consumption of fat-supplemented diets. However, because positive performance responses to fat supplementation were observed for urea-supplemented diets in the present study, as well as our study in California last year, the general applicability of this concept may be questioned.

OBJECTIVES

The objectives of this study were to evaluate the impact of level of supplementation of yellow grease (primarily kitchen grease) and blended animal-vegetable fat on feedlot cattle growth rate and net energy value of the diet at 4, 6 and 8% levels and determine the influence of substituting 25% crude lecithin for animal vegetable fat on its corresponding feeding values.

FEEDING RESULTS

Increasing the level of supplemental fat in the diet resulted in linear improvements in weight gain, feed conversion and Net Energy Value of the diet. Diet Net Energy Values were similar for the two fat sources. Across all supplementation, the estimated NE_m (Net Energy-maintenance) and NE_g (Net Energy-gain) values averaged 6.03 and 4.79 for yellow grease and 5.53 and 4.43 Mcal/kg (Megacalories per kilogram) for blended vegetable fat, repectively. Considering the extropolations used in obtaining these estimates, the derived NE_m and NE_g values for yellow grease were in remarkably close agreement with estimates of 6.20 and 4.53 Mcal/kg respectively, obtained from two previous trials supported by F.P.R.F. with Dr. Zinn. This present study further supports the contention that the current tabular estimates in the 1984 National Research Council's "Nutrient Requirements of Beef Cattle" of NE_m 4.75 Mcal/kg and NE_g 3.51 Mcal/kg considerably underestimates the feeding value of fat for feedlot cattle. Feed Intake Was Not Affected By Fat Supplementation.

Fat supplementation linearly decreased the feed required per unit empty, body gain and linearly increased the estimated NE_m and NE_g content of the diet. Using the replacement technique, the NE_m and NE_g values for supplemental fat were estimated to be 5.84 and 4.63 Mcal/kg for 4% fat and 5.78 and 4.61 Mcal/kg at 8% fat, respectively. Thus, it appears that under the conditions of this trial, increasing level of fat supplementation from 4% to 8% of diet dry matter did not markedly influence the feeding value of supplemental fat. The total fat content of the 8% fat supplemented list was 9.23%.

Differences in main effects of yellow grease and blended vegetable fat with respect to carcass meat were small. There was, however, an interaction between fat source and level of supplementation with respect to percentage of kidney, pelvic and heart fat. Percentage of KPH fat at the 4% and 8% levels of supplementation averaged 3.14 and 3.19 for YG and 3.00 and 3.51 for BVF, respectively.

DIGESTIONS OF THE FATS

Increasing level of fat supplementation from 0 to 8% resulted in linear decreases in ruminal digestion of organic matter (OM) and acid detergent fiber (ADF). The negative effect of supplemental fat on ruminal fiber digestion has been reported previously by Brooks, Brethour and Kowalczyk. The inhibitory effects of fat on fiber digestion may be brought about, in part, by physical coating of feed particles, which presumably would retard the rate of exposure to enzymatic attack, particularly in extreme cases where the melting point of the fat is near or exceeds the temperature of the rumen. Another basis for the depression in ruminal fiber digestion is the negative effect of supplemental fat on growth of protozoa and fatty acids on cellulolytic bacteria. Consistent with previous studies, ruminal digestion of starch and feed N were not affected by fat supplementation.

Small intestinal digestion of OM, ADF and starch was not affected by level of fat supplementation. However, small intestinal digetion of fat decreased linearly with level of fat supplementation. Consistent with F.P.R.F.'s previous work with Zinn,

differences in apparent intestinal digestibility of fat between the 0 to 4% level of supplementation are relatively small (2.4%). However, increasing supplemental fat from 0 to 8% depressed fat digestibility appreciably (11.2%). True digestibility of supplemental fat at the 4 and 8% levels of supplementation averaged 80.1 and 69.3%, respectively. These values are in close agreement with studies of Palmquist and Jenkins, funded by F.P.R.F., who observed that at moderate levels of supplementation (3 to 5%), true digestibility of fat was 80%, whereas fat added above that level was digested less efficiently (56%). Assuming a linearily of response, digestibility of supplemental fat decreased by an average of 3.4% for each percentage increase in level of supplementation above 4%.

Blended fat resulted in a greater depression in percentage ruminal digestion of ADF and starch than did YG. Two characteristics of fat source that may be pertinent to these effects are degree of saturation and free fatty acid concentration. Unsaturated fatty acids have greater effects than saturated fatty acids on growth of cellulolytic bacteria in pure culture. Semi-continuous culture experiments of Jenkins also indicated an association between degree of saturation of fatty acid mixtures and fermentation. Because, in the present study, BVF was more highly saturated than YG, YG should have been more inhibitory than BVF on ruminal digestion. On the other hand, BVF also had a substantially higher proportion of free fatty acids than YG (52.8 vs 9.7%). Chalupa at the University of Pennsylvania observed that free fatty acids were more inhibutory in vitro (test tube) than an equivalent amount of triglyceride. Other studies indicated that a higher free fatty acid content of blended fat has less inhibitory effect on ruminal fermentation. The proposed basis for this synergistic effect between free fatty acids and triglycerides is that higher proportions of free fatty acids have been found to inhibit biohydrogenation, (rumen microorganisms hydrolyze fat than saturate it).

INFORMATION FROM THIS PAPER THAT WILL ASSIST YOU IN SELLING MORE FAT TO YOUR CUSTOMERS

1. The comparative feeding value of YG and BVF, evaluated in this trial, were similar.

2. Estimated NE_m and NE_g for supplemental fats were considerably higher than current feed standards.

3. Even though, increasing level of fat supplementation of a steam-rolled barley-based finishing ration decreased ruminal and total tract digestion of organic matter and acid detergent fiber, decreased ruminal acetate;proportionate ratios and methane production, increasing the level of fat supplementation from 4 to 8% did not appreciably reduce the comparative feeding of fat.

4. Fat supplementation of a barley/milo based finishing diet may improve weight gain and feed conversion at levels of supplementation as high as 8% of diet dry matter.

5. You can recommend, with confidence, that there is usually (based on today's markets) a positive cost benefit ratio with 4% fat supplementation in feedlot cattle diets. Cost of milo/barley and type and quality of forage will influence the cost benefit ratio of fat for levels above 4%.

6. Overall, a 70% iodine value or less lipid with less than 20% free fatty acid content, may be more desirable as a supplemental fat for feedlot cattle than very high unsaturated fats with an extreme free fatty acid content. High free fatty acid products can be used with success and combining 25% crude lecithin with BVF did not increase or decrease the feeding value of the BVF.

7. Whereas the high free fatty acid BVF and the high unsaturated YG performed well in feedlot cattle, do not interpret this as saying the same fats are preferred for dairy cattle. High unsaturated fats with high free fatty acid content may, as in this study, depress ADF digestibility and consequently lower butterfat levels of the milk. Blended fats have been used successfully in dairy rations when mixed well in a total mixed ration and supplemented up to 2 to 2 1/2% of ration dry matter.

8. If you need copies of papers or assistance, please call me at 813-463-4744.

LITERATURE CITED

Brethour, J.R., R. J. Sirry and A. D. Tillman. 1958. Further studies concerning the effects of fats in sheep rations. J. Anim. Sci. 17:171

Brooks, C.C., G. B. Garner, W. C. Gehrke, M. E. Muhrer and W. H. Pfander. 1954. The effect of added fat on digestion of cellulose and protein by the rumen microorganisms. J. Anim. Sci. 13:758.

Chalupa, W., B. Rickabaugh, D. S. Kronfeld and D. Sklan. 1984. Rumen fermentation in vitro as influenced by long chain fatty acids. J. Dairy Sci. 67:1439.

Palmquist, D. L. and T. C. Jenkins. 1980. Fat in lactation rations: Review. J. Dairy Sci. 63:1.

Zinn, R.A. 1989. Influence of level and source of dietary fat on its comparative feeding value in finishing diets for steers: Feedlot cattle growth and performance. J. Anim. Sci. 67:1029.

Zinn, R.A. 1988. Comparative feeding value of supplemental fat in finishing diets for feedlot steers supplemented with and without monensin. J. Anim. Sci. 66:213.

Zinn, R.A. and F. N. Owens, 1986. A rapid procedure for purine measurement and its use for estimating net ruminal protein synthesis. Can. J. Anim. Sci. 66:157.