FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

FRED D. BISPLINGHOFF, D.V.M.
Director Technical Services

7150 ESTERO BLVD. • APT. 906
FT. MYERS BEACH, FL 33931
AREA CODE 813 — 463-4744

March 1990 No. 194

UTILIZATION OF PROTEIN IN ANIMAL BY-PRODUCTS FOR MILK PRODUCTION

Dr. Marshall D. Stern
Department of Animal Science
University of Minnesota
St. Paul, Minnesota 55108

INTRODUCTION

Absorbed amino acids from the small intestine of ruminants are supplied by microbial protein synthesized in the rumen, undegraded dietary protein and endogenous protein. Microbial protein usually accounts for the largest proportion of the total amino acid-nitrogen entering the small intestine of ruminants. Microbial protein synthesis in the rumen is mainly dependent on the nitrogen and energy supply to the rumen microbes, which is determined by quantity and ruminal fermentability of protein and carbohydrates. If the energy supplied by the diet is not sufficient, there may be a corresponding decrease in microbial protein synthesis due to less ammonia uptake by the microbes. Therefore, deficiency of energy may lead to a reduced intestinal protein supply and at the same time may precipitate excessive ammonia levels in the rumen, especially when feeding highly degradable proteins. The use of low degradable or protected proteins in diets fed to ruminants with high protein requirements improves the amino acid supply to the animal and concurrently decreases the surplus of ammonia, thereby reducing stress on liver metabolism.

Even when nutrients are non-limiting in the rumen, the rumen system may not supply sufficient microbial protein to meet the animal's needs for maximum production. Under conditions of high production (fast growth, late pregnancy or early lactation), the animal depends on an additional exogenous supply to the duodenum, e.g. feeding proteins that because of their physical state escape rumen fermentation. It is essential that the protein which passes through the rumen undegraded provides an amino acid profile with a better balance of amino acids for milk production and growth.

In our previous research, supported by the Fats and Proteins Research Foundation, by-products of animal processing such as meat and bone meal, blood meal and feather meal were shown to be highly resistant to microbial degradation in the rumen. In addition, they differed in amino acid profiles and should serve as excellent complementary proteins when fed together. Kopfenstein and Goedeken (Proc. National Renderers Assoc.1:12, 1986) found that performance of steers in a growth experiment indicated that calves consuming blood meal, feather meal and a combination of the two animal proteins gained faster than steers fed urea. The improved protein efficiency for blood meal and feather meal compared to either fed alone may be due to sulfur amino acids supplied by the feather meal and/or other amino acids supplied by blood meal. This observation signifies the potential importance of supplying complementary amino acids to the small intestine. In addition, our research indicated that the carbohydrate:protein interrelationship is also extremely important in affecting protein supply to the small intestine.

OBJECTIVES

1) To determine milk production response in early lactation when a combination of animal by-product proteins (meat and bone meal, blood meal and feather meal) are fed compared to soybean meal, and
2) To examine the effect of carbohydrate:protein interrelationship on milk yield and composition.

EXPERIMENTAL PROTOCOL

A total of 46 lactating Holstein cows in their first, second or greater lactation were used. During the first 21 days of lactation, all cows were fed the same diet. Milk production during days 14-21 were used for covariate analysis. Four diets shown in Table 1 were used in a 2 x 2 factorial arrangement of treatments, with the main effects being protein supplement (soybean meal vs animal by-products) and carbohydrate source (corn vs beet pulp as a replacement for some corn). Diets contained 17% crude protein and a minimum of 18% acid detergent fiber, on a dry matter basis.

Production data: Daily a.m. and p.m. milk yields were recorded for 120 days postpartum; samples from consecutive a.m. and p.m. milkings were obtained once each week for compositional analyses (proteins, fat, lactose).

Feed data: Weights of feed offered and refused were recorded daily; samples of total mixed diets were obtained once each week and composited at four week intervals for chemical composition analysis and for use in the proposed continuous culture experiment.

Body weights: Were obtained weekly.

RESULTS

Mean values for covariate adjusted milk yield and milk composition are presented in Table 2. Average daily milk yield and fat corrected milk yield was 32.2 and 33.5 kg, respectively and was not different among diets. Dry matter intake was depressed with beet pulp in the diet, however efficiency of milk yield appeared to be higher with beet pulp. Milk composition showed no apparent differences between soybean meal and animal by-products. Although data has not been statistically analyzed, it seems clear that animal by-products can replace soybean meal protein without affecting milk yield of cows in early lactation. Therefore, cost per unit of protein and availabiliity are major considerations in use of animal by-products.

Table 1. Ingredient composition of total mixed diets.

Ingredient	Diet 1	Diet 2	Diet 3	Diet 4
	- - - - - - - - % of DM - - - - - - - -			
Corn silage	20.35	20.41	19.82	20.21
Corn-fat mix	29.47	33.10	12.71	19.42
Alfalfa hay	17.13	16.80	17.99	16.34
Alfalfa pellets	17.13	16.80	17.99	16.34
Beet pulp	--	--	15.00	15.00
Molasses	2.80	2.80	2.80	2.80
Soybean meal	8.69	--	8.50	--
Meat and bone meal	--	2.25	--	2.26
Feather meal	--	2.25	--	2.26
Blood meal	--	1.13	--	1.13
Animal fat	1.12	.97	2.09	1.65
Dicalcium phosphate	.92	.40	.85	--
Trace mineralized salt	.65	.65	.65	.65
Urea	.50	.50	.50	.50
Sodium bicarbonate	.50	.50	.50	.50
Limestone	.31	--	--	--
ZMS premix	.20	.13	.18	.20
Dynamate	.15	.15	.15	.15
A, D & E premix	.09	.09	.09	.09
Monosodium phosphate	--	.05	--	--

[a] Dry matter basis.

Table 2. Milk yield and composition.

Item	Diet 1	Diet 2	Diet 3	Diet 4
Milk yield, kg/d	32.1	32.7	31.8	32.3
Fat corrected milk, kg/d[a]	33.0	33.5	33.9	33.5
Dry matter intake, kg/d	21.5	21.4	20.4	19.8
Efficiency[b]	1.56	1.55	1.69	1.72
Milk composition, %				
Fat	3.69	3.62	3.94	3.80
Protein	3.03	2.96	2.95	2.86
Lactose	5.09	5.14	5.08	5.04
Solids-non-fat	8.76	8.77	8.75	8.57
Total solids	12.45	12.37	12.71	12.36

[a] 3.5% fat-corrected milk (FCM).
[b] kg 3.5% FCM/kg dry matter intake.