B-VITAMIN ADEQUACY OF RUMEN CONTENTS

T. L. Strause[1], F. N. Owens[2], S. G. Price[1] and K. L. Weidman[1]

Story in Brief

Dried ruminal contents from steers fed high concentrate diets were fed to chicks to check adequacy of thiamin, pantothenic acid, and vitamin B-12. Growth and survival were monitored for chicks fed diets supplemented with 25% dried ruminal contents which without this addition presumably were deficient in either 1) thiamin, 2) pantothenic acid, or 3) vitamin B-12. No significant depressions in feed intake, weight gain, or feed efficiency were noted. Results indicate that amounts of available thiamin, pantothenic acid, and vitamin B-12 in dried ruminal contents were adequate for rapidly growing chicks and thereby, presumably, for ruminants fed concentrate diets.

(Key Words: B-vitamins, Rumen fluid, Thiamin, Pantothenic acid, B-12.)

Introduction

Dietary supplementation of B-vitamins typically has failed to improve performance of ruminants. Consequently, nutritionists have concluded that extensive production of B-vitamins by microbes in the rumen exceeds ruminant requirements. Consequently, the factors affecting ruminal synthesis of the B-vitamins has not been well characterized. Extent of ruminal escape and synthesis vary among the vitamins (Zinn et al., 1987). Further, the availability of B-vitamins in rumen contents has not been investigated, particularly for cattle fed high-concentrate diets. In a previous study at Oklahoma State University (Dubeski et al., 1991), chicks were fed wet ruminal contents to check B-vitamin adequacy. Chicks, due to their rapid rate of growth, are used to bioassay many nutrients. Weight losses or abnormally slow and inefficient growth were noted when thiamin, pantothenic acid, and vitamin B12 were not supplemented together with ruminal fluid. This study was designed to reexamine adequacy of these three vitamins using dried ruminal contents from steers fed high concentrate diets.

Materials and Methods

One hundred and thirty-nine white Cornish rock (broiler) cockerels were purchased and raised in batteries on a standard commercial chick starter diet until they were 9 days of age. Each chick was wing banded for identification.

[1] Wisconsin State University, Platteville [2] Regents Professor

Of these, 120 chicks were allocated randomly to 12 pens in one battery. Each of the four diets was fed to three pens in one battery. The chicks were fed their test diets for 14 days from age 10 to 25 days.

Four semipurified diets were formulated from corn starch, vitamin-free casein, minerals, vitamins, and provided all B-vitamins except thiamin, pantothenic acid, and vitamin B12 by Harlan Teklad, Inc., Madison, WI. Thiamin, pantothenic acid, and vitamin B12 were added to specific diets to provide the four following diets: thiamin deficient; pantothenic acid deficient; vitamin B12 deficient; and a complete diet. These diets were mixed with dried ruminal contents so that ruminal contents comprised 13.2% of each of these final mixtures.

Dried ruminal contents were obtained from Oklahoma State University rumen cannulated beef steers adapted to a high concentrate diet. The contents were dried and ground through a 2 mm screen in a mill before it was mixed into the diet. Fresh diet and water were supplied twice each day. The chicks were weighed on days 0, 4, 7, 11, 14 and a second time on day 14 after fasting for 6 hours. Intakes, rates and efficiencies of gain for the first and second half of the feeding study (fasted final weights) were calculated. Data were statistically analyzed based on pen means. A diet without added B-vitamins was not included for comparison because of the high cost of the purified diet and the fact that Dubeski et al. (1991) found that performance of chicks fed a purified diet without these vitamins added soon depleted their vitamin reserves and lost weight.

Results and Discussion

Results are presented in Table 1. Weight gains, feed intakes, and feed efficiencies were similar for chicks fed purified diets with ruminal contents added whether all vitamins were included or when thiamin, pantothenic acid, or vitamin B-12 were deleted from the diet. These results indicate that the quantity of available thiamin, pantothenic acid and vitamin B-12 supplied from a diet containing only 13% ruminal contents was adequate for optimal rates and efficiencies of gain.

These results do not match results of a previous study (Dubeski et al., 1991) in which chicks fed diets of which 12.4% dry matter consisted of ruminal contents grew slowly or lost weight. In that study, wet ruminal contents were used compared to dried ruminal contents in this study. Whether the differences might relate to presence of antivitamins in wet ruminal contents that are inactivated by drying, to presence of volatile fatty acids and other materials in wet ruminal contents that alter chick metabolism or other factors is not known. Nevertheless, the concern about inadequacy or low availability of pantothenic acid and vitamin B-12 has been alleviated by results of this study.

Concentrations of thiamin in ruminal contents are quite low (under 1 ppm in the final diet) compared to estimated requirements for growing chicks (1.8 ppm), so the rapid growth of chicks fed the thiamin deficient diet was surprising. Further studies with both positive and negative controls are needed to assess B-vitamin adequacy more fully considering the low plasma levels of vitamin B-12 in finishing steers and of pantothenic acid and pyridoxine in transport-stressed calves.

Implications

A 14-day chick bioassay was used in which chicks were fed four separate diets that were devoid of supplemental thiamin, pantothenic acid or vitamin B-12 except for that supplied by 13% of the diet which was dried ruminal contents. Dry matter intake, average daily gain, and feed efficiency were not depressed in the vitamin deficient diets compared to the complete diet. This suggests that the quantity of available thiamin, pantothenic acid and vitamin B-12 were adequate to meet the chicks' requirement and potentially should meet requirements for growing ruminants.

Literature Cited

Dubeski, P. L. et al. 1991. Okla. Agr. Exp. Sta. Res. Rep. MP-134:207.
Zinn, R. A. et al. 1987. J. Anim. Sci. 65:267.

Table 1. Weight gain, feed intakes and gain/feed ratios for chicks fed purified diets plus dried ruminal contents but devoid of specific vitamins.

Measurement	Complete diet	Thiamin deficient	Pantothenate deficient	B-12 deficient	SEm
Gain, g/day					
Day 0-7	33.7	34.6	34.4	34.7	0.93
Day 7-14	47.6	43.8	45.6	45.8	2.25
Day 0-14	40.6	39.2	40.0	40.3	1.44
Feed, g/day					
Day 0-7	42.2	45.0	44.9	43.7	1.51
Day 7-14	74.9	73.2	74.7	74.1	3.03
Day 0-14	58.5	59.1	59.8	58.9	2.25
Gain/feed					
Day 0-7	.80	.77	.77	.80	.02
Day 7-14	.64	.60	.61	.62	.01
Day 0-14	.69	.66	.67	.68	.01