EFFECTS OF RUMINAL CONTENTS ON B-VITAMIN STATUS IN CHICKS

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Story in Brief

Chick growth and survival were monitored as indices of the B-vitamins supplied by ruminal contents. Ten diets were formulated containing all, none, or all but one of each of the eight B-vitamins. These diets were fed alone or mixed with liquid ruminal contents to test the ability of the ruminal contents to meet the chick's requirement for each B-vitamin. Compared to requirements for chicks, ruminal contents of steers fed concentrate diets contained 37, 500, 160, 244, 309, 207, 15300 and 72% of the chick's total need for thiamin, riboflavin, B_6, niacin, pantothenate, folic acid, B_{12} and choline. This means that based on chick requirements, the supply from ruminal contents was low for thiamin and choline but adequate for all the other B-vitamins. Added ruminal contents increased gain and efficiency for each vitamin deficient diet as expected except for the B_{12} and pantothenate deficient diets. Growth rate of chicks fed the B_{12}-deficient diet was depressed by adding ruminal contents. Based on chick growth, supply of available B_{12} in ruminal contents appears low. Further investigation of the antagonism of B_{12}, of the less than anticipated response to pantothenic acid, and of the low ruminal concentration of thiamin is warranted.

(Key Words: Rumen Contents, B-Vitamins, Cattle.)

Introduction

Ruminal production and degradation of B-vitamins have been studied previously at Oklahoma State (Zinn et al., 1987). Those results indicated that ruminal output of pantothenic acid and folic acid were less than 10% of estimated requirements. In contrast, supply of other B-vitamins (thiamin, riboflavin, niacin, pyridoxine and vitamin B_{12}) exceeded estimated requirements at normal feed intake levels. Whether or not these vitamins were all present in a form available for animals and whether direct

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Table 1. Composition of complete diet.

Ingredient	Amount (grams)
Corn starch	54.35
Vitamin-free casein	26.40
Glista salts[a]	5.37
Solka-Floc (cellulose)	3.00
Citric acid[b]	1.00
Arginine	1.20
DL-Methionine	.40
Glycine	.20
Choline bitartrate	.31
Vitamin ADEK premix[c]	.10
Thiamine hydrochloride premix[d]	.33
Riboflavin premix[d]	.33
Niacinamide premix[d]	.33
Pyridoxine hydrochloride premix[d]	.33
Calcium D-pantothenate premix[d]	.33
Folic acid premix[d]	.33
Vitamin B_{12} premix[d]	.33
Biotin premix[e]	.33
Corn oil	5.00

[a] Glista Salts (TD#88178, Teklad Premier Laboratory Diets) provided 1.16% Ca, .64% P, .404% K, .35% Na, 600 ppm Mg, 212 ppm Mn, .1 ppm Se, 56 ppm Zn, 10 ppm Cu, 5 ppm I, 84 ppm Fe, 5350 ppm Cl, .058% S, and .2 ppm Co.

[b] Citric Acid (Anhydrous) at 1% of diet to prevent microbial growth.

[c] Vitamin ADEK Premix (Teklad) provided 10,000 IU Vitamin A, 2,500 IU Vitamin D_3, 50 IU Vitamin E and 2 mg menadione per kg.

[d] In the complete diet, added B-vitamins were supplied at 2.0 ppm thiamin, 6.6 ppm riboflavin, 33 ppm niacin, 3.96 ppm pyridoxine, 11 ppm pantothenic acid, 1.1 ppm folic acid, and .019 ppm B_{12}, and 1,750 ppm choline. Vitamin deficient diets were made by replacing the vitamin premix(es) with an equivalent amount of corn starch.

[e] Biotin was present in all diets at .35 ppm.

Table 2. Chick average daily gain, dry matter intake, gain/feed and survival.

Vitamin diet[a]	Rumen contents	ADG g/d	Intake g DM/d	Gain/ feed	Survival, % to end
Complete	+	27.0[b]	44.5[b]	.607[b]	100
Complete	-	20.5[c]	31.1[c]	.659[c]	97
Folic Acid	+	25.4[b]	42.2[b]	.601[b]	97
Folic Acid	-	19.1[c]	28.4[c]	.672[c]	97
Niacin	+	24.5[b]	42.3[b]	.578	100
Niacin	-	16.9[c]	27.0[c]	.624	95
Choline	+	15.1	27.6[b]	.549[b]	100
Choline	-	16.7	25.5[c]	.654[c]	97
Riboflavin	+	23.2[b]	39.6[b]	.586[b]	97
Riboflavin	-	7.1[c]	17.5[c]	.407[c]	100
Pyridoxine	+	19.8[b]	34.0[b]	.582[b]	87
Pyridoxine	-	7.2[c]	15.4[c]	.469[c]	93
Thiamin	+	15.1[b]	30.7[b]	.491[b]	97[a]
Thiamin	-	2.9[c]	11.1[c]	.257[c]	20[b]
B_{12}	+	0.1[b]	18.1	.004[b]	100
B_{12}	-	1.4[c]	14.7	.093[c]	100
Pantothenate	+	-1.3[b]	15.2[b]	-.086[b]	96
Pantothenate	-	-2.0[c]	9.7[c]	-.209[c]	94
Devoid	+	10.5[b]	23.4[b]	.448	100[a]
Devoid	-	3.3[c]	9.4[c]	.341	13[b]

[a] The vitamin treatment describes the complete and devoid diets and the diets in which specific B-vitamins were omitted.
[b,c] Means within a vitamin without a common superscript differ ($P < .05$).

Table 3. B-vitamin composition of ruminal contents compared to chick requirements.

Vitamin	Concentration in ruminal contents, ppm	Chick requirements[a] ppm	% Requirement supplied by ruminal contents
Thiamin	0.67	1.8	4.6
Riboflavin	18.0	3.6	62.0
Pyridoxine	4.8	3.0	19.8
Niacin	66.0	27.0	30.3
Pantothenate	30.9	10.0	38.6
Folic Acid	1.14	0.55	25.7
B_{12}	1.38	0.009	1900
Choline	933	1300	8.9

[a] 1984 Poultry NRC requirements for chicks 0-3 weeks old.

microbial B_{12} assay. Depressed ADG and G/F for RC+ compared to RC- suggests that ruminal contents exacerbated the B_{12} deficiency, even though survival was not affected. Survival on both B_{12} diets was high; compared to other B-vitamins B_{12} is retained tenaciously in the body .

Birds fed pantothenate-deficient diets, with or without ruminal contents, had low dry matter intakes and lost weight although survival was not affected. These birds remained alert and lively. Ruminal contents increased dry matter intake and G/F, and decreased weight loss. However, even though ruminal contents contributed 38.6% of pantothenic acid requirements, dry matter intake, ADG and G/F were poorer from both RC+ and RC- diets than from any other diets. The RC+ pantothenate-deficient diet was the only RC+ diet that resulted in weight loss. This poor performance could be related to the effect of rumen fluid on B_{12} status, since B_{12} has a sparing action on pantothenic acid requirements in poultry. Other nutritional interactions may also be important. For example, biotin included in a pantothenate-deficient diet prolongs survival, but precipitates a pantothenate deficiency in only half the time. Our diets all were high in biotin. Pantothenic acid requirements also are influenced by ascorbic acid, folic acid, fat and protein levels.

In conclusion, a 14-day chick bioassay was used in which chicks were fed vitamin deficient diets. The test was insensitive for folic acid, niacin and choline; dry matter intake, ADG or feed efficiency were not depressed. Single deficiencies of thiamin, riboflavin, B_6 and pantothenic acid reduced