MINERAL BALANCE OF HEAT DISTRESSED BROILERS

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Story in Brief

A study was conducted using eight colostomized and fourteen intact eight week posthatching Arbor Acre x Vantress broilers to investigate the impact of heat distress on mineral balance. Birds were housed in environmental chambers maintained at either a cycling 74-95°F heat distress or constant 74°F thermoneutral environment. Feed consumption was equalized between environments by force feeding at 6% of body weight daily. Feces and urine were analyzed for Ca, K, Cu, Fe, Mg, Mn, Mo, P, S, Se, Zn and Na by an Inductively Coupled Argon Plasma Emission Spectrophotometer. Urinary excretion was increased for K, Mg, P and S when birds were exposed to heat distress. Fecal excretion was increased by heat distress for Se, Cu and Mg. Mineral balance expressed as intake less excretion was reduced for Cu, K, Mg, Mo, P, S, Se, Zn, and Na in the HD birds. This study suggests that heat distress may increase the mineral requirements of broilers.

(Key Words: Heat Distress, Mineral Balance, Colostomy, Broiler.)

Introduction

Reduced broiler feed intake during heat distress is considered to be a major factor limiting productivity. Such a reduction lowers consumption of all nutrients. Husseiny and Creger (1981), reported that broilers subjected to 90°F for 42 days had reduced retention efficiency for calcium (Ca), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), phosphorus (P), and zinc (Zn). Young turkeys housed at 95°F for four days exhibited reduced absorption of K, P and Ca than the birds held at 75°F (Wolfenson et al, 1987). Research conducted by Smith and Teeter (1987) indicated that broilers subjected to 95°F excreted over 600% more K than those held at 75°F. Supplementing drinking water with up to .15% K increased live weight gain, feed efficiency and survival (Smith and Teeter, 1986). The objective of the study described herein was to evaluate the route of mineral loss in broilers during heat distress.

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Materials and Methods

Arbor Acre x Vantress broiler chicks were colostomized at four weeks posthatching and subsequently individually caged. Feed and water were available for ad libitum consumption until the pretest period was initiated. Eight colostomized and 14 intact birds were allocated at eight weeks of age to environmental chambers maintained at either a cycling 74 to 95°F heat-distress (HD) or a constant 74°F thermoneutral (TN) temperature. Birds were force fed 6% of their body weight per day according to the methodology of Teeter et al. (1984). Feces and urine or total excrement for the colostomized and intact broilers respectively, were collected at 12 h intervals during the 48-h experimental period. Excrement and experimental diet (Table 1) were analyzed by an Inductively Coupled Argon Plasma Emission Spectrophotometer for Ca,

Table 1. Composition of diet.

Ingredient	Percent
Ground corn	56.8
Soybean meal	36.0
Fat	3.0
Dicalcium phosphate	2.35
Calcium carbonate	.90
Salt	.50
Vitamin mix	.25
Trace mineral	.10
DL-Methionine	.10
Total	100
Analyzed mineral composition:	
Ca, %	1.25
K, %	1.08
P, %	1.02
S, %	3.60
Na, %	.21
Mg, %	.19
Cu, ppm	11.13
Fe, ppm	481.40
Mn, ppm	360.40
Mo, ppm	4.94
Se, ppm	32.35
Zn, ppm	148.25

Table 2. The effect of heat distress on major mineral balance, urinary and fecal excretion of broilers.

Parameter	Treatment[a]	Mineral					
		Ca	P	K	Na	Mg	S
Mineral balance[1]	TN	268[b]	271[b]	299[b]	10.3[b]	43.5[b]	1976[b]
	HD	163[b]	59[c]	57[c]	-52.3[c]	19.3[c]	1751[c]
Urinary excretion[1]	TN	7.69[b]	46[c]	57[c]	20[b]	9.4[c]	73[c]
	HD	7.67[b]	93[b]	287[b]	34[b]	17.4[b]	140[b]
Fecal excretion[1]	TN	337[b]	214[b]	213[b]	78[b]	60.2[c]	53[b]
	HD	377[b]	239[b]	206[b]	75[b]	77.7[b]	68[b]

[a] TN is thermoneutral, HD is heat distress.
[b,c] Means within a column in a parameter with different superscripts differ ($P < .05$).
[1] Expressed as parts per million.

Table 3. The effect of heat distress on minor mineral balance, urinary and fecal excretion of broilers.

Parameter	Treatment[a]	Mineral					
		Mn	Se	Fe	Zn	Mo	Cu
Mineral balance[1]	TN	15.3[b]	1.4[b]	9.5[b]	3.1[b]	.04[b]	-.04[b]
	HD	12.9[c]	1.1[c]	5.4[b]	1.7[c]	-.05[c]	-.26[c]
Urinary excretion[1]	TN	.02[b]	.28[b]	.13[b]	.58[b]	.06[b]	.023[b]
	HD	.02[b]	.26[b]	.13[b]	1.1[b]	.11[b]	.023[b]
Fecal excretion[1]	TN	5[b]	.26[c]	17[b]	4.7[b]	.12[b]	.67[c]
	HD	5.3[b]	.35[b]	16.1[b]	4.8[b]	.14[b]	.87[b]

[a] TN is thermoneutral, HD is heat distress.
[a,b] Means within a column in a parameter with different superscripts differ ($P < .05$).
[1] Expressed as parts per million.

K, Cu, Fe, Mg, Mn, Mo, P, S, Se, Zn, and Na using the method of Trudeau and Freier (1967) and DeRuig (1986). Upon completion of the two consecutive switch-back experimental periods, mineral balance, urinary and fecal excretion were determined.

Results and Discussion

The heat distressed colostomized broilers had significantly reduced balance for K, P, S, Na, Zn, Se, Mo, Mn, Mg, and Cu (Tables 2 and 3). The lower mineral balance of these broilers was reflected by a higher urinary excretion for K, P, S (Table 2) and by a higher fecal excretion for Cu and Se, (Table 3). Magnesium loss was elevated for both urine and feces. However, the reduced balance for Na, Zn, Mo and Mn was not attributable to either route of excretion. The balance for Ca and Fe had a tendency to be reduced ($P<.1$). Intact HD broilers displayed a similar trend in that their balance for K, P, Na, Zn, Se, Mo, Mn, Mg and Cu was significantly lowered. Results of this study are in agreement with Husseiny and Creger (1981). Studies are underway to evaluate the potential of mineral supplementation to offset the deleterious effects of heat distress.

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