THE INFLUENCE OF DIETARY NIACIN, ASCORBIC ACID, AND SODIUM BICARBONATE ON ALLEVIATING HEAT STRESS IN BROILER CHICKS

S.C. Arp[1], F.N. Owens[2] and R.G. Teeter[3]

Story in Brief

The effect of dietary supplemental ascorbic acid, sodium bicarbonate and niacin on performance of heat stressed broilers was studied in a 2 week feeding experiment. Four week old Arbor x Lancet broiler chicks were randomly allotted to two environments (95 F, 73 percent relative humidity; 75 F, 60 percent relative humidity), and further subdivided into the following dietary regimes: ascorbic acid (258 ppm); sodium bicarbonate (5000 ppm) or niacin (100 ppm above a basal level of 27 ppm for all rations). Averaged across all diets, elevating the temperature to 95 F, reduced intake by 23 percent and gain by 33 percent. No benefit was observed for ascorbic acid or niacin supplementation in the hot environment or for all three supplements in the thermoneutral environment. However, at 95 F sodium bicarbonate increased feed intake 12 percent and body weight gain 14 percent.

Introduction

Heat stress in poultry is a serious problem in many parts of the United States. In addition to death losses, feed intake and production can be severely reduced at elevated ambient temperatures.

Niacin, in humans, has been shown to be an effective vasodialator (Spies et al., 1938; Goldsmith and Cardill, 1969) and as a result may increase heat dissipation while abscorbic acid has been shown to aid in maintaining body temperature of chicks in a warm environment (Lyle and Moreng, 1968). Blood bicarbonate levels are depressed during heat stress (Teeter, Unpublished) and could thereby create a physiological need for this ion.

The objective of this study was to examine the effect of ascorbic acid, niacin, and sodium bicarbonate on feed intake and gain of broilers subjected to thermal heat stress.

Materials and Methods

Ninety-six 4 week old broiler chicks with a mean initial weight of 2.1 lb. were randomly allotted to two environmental chambers (95 F, 73 percent relative humidity; 75 F, 60 percent relative humidity). The 95 F constituted the hot environment while the 75 F, the more ideal growing temperature hereafter referred to as thermoneutral.

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[1]Graduate Student [2]Professor [3]Assistant Professor

Birds in each environment were randomly allotted to four dietary regimes with 2 replicates of 6 chicks per replicate. Diets consisted of a commercial chick grower mash (22 percent crude protein) without or with supplemental ascorbic acid (258 ppm), sodium bicarbonate (5000 ppm) or niacin (100 ppm above a base supplementation of 27 ppm for all rations).

The trial lasted three weeks with the first week allowed as an adjustment period for the temperature in the environmental chamber to be gradually increased to 95 F. Chicks were weighed individually on days 7, 14, and 21 of the trial. Period one corresponds to the time between days 7 and 14 while period 2 represents the period between days 14 and 21.

Results and Discussion

Averaged across dietary treatments, chicks subjected to heat stress consumed 23 percent less feed (P<.01) and gained 33 percent less weight (P<.01) than chicks in the thermoneutral environment (Table 1). Effects of ascorbic acid and niacin on performance of the chicks were not apparent at either environmental temperature (Tables 2 and 3). However, feeding sodium bicarbonate to chicks tended to increase feed intake and weight gain of chicks at 95 F (Table 3). Bicarbonate supplementation increased feed consumption by 12 percent and gain by 15 percent for the total trial, and by 14 percent (P<.05) and 20 percent (P<.05), respectively over the last week of the trial as compared to the thermoneutral controls at 95 F. The increased gain for heat stressed chicks receiving sodium bicarbonate therapy is apparently due to the increased feed intake. Further studies are needed to explain the sodium bicarbonate effect and define the specific environmental conditions required to elicit a response.

Table 1. Gains, feed intakes and efficiencies of chicks at different temperatures[a].

Period	Feed intake, g		Daily gain, g		Feed/gain	
	1	2	1	2	1	2
Temperature						
75 F	143.0	142.7	60.0	51.9	2.38	2.75
95 F	103.2	116.9	38.5	36.0	2.69	3.27

[a] Means in all columns differ (P<.01).

Table 2. Gains, feed intakes and efficiencies of chicks at thermoneutral temperature.

Period	Feed intake, g		Daily gain, g		Feed/gain	
	1	2	1	2	1	2
Supplement						
Control	141.6	144.5	59.1	53.5	2.40	2.70
Ascorbic acid	139.1	139.5	58.0	50.8	2.40	2.75
Bicarbonate	145.3	147.0	62.6	52.5	2.32	2.80
Niacin	145.9	139.8	60.4	51.0	2.42	2.75

Table 3. Gains, feed intakes and efficiencies of chicks at 35 C.

Period	Feed intake, g		Daily gain, g		Feed/gain	
	1	2	1	2	1	2
Supplement						
Control	100.8	112.0^{b}	39.2	32.7^{b}	2.59	3.45
Ascorbic acid	100.2	111.4^{b}	37.5	34.6^{b}	2.69	3.24
Bicarbonate	111.8	127.4^{a}	42.0	40.7^{a}	2.67	3.13
Niacin	99.9	116.8^{b}	35.3	36.0^{ab}	2.82	3.25

^{a,b} Means in a column with different superscripts differ ($P<.05$).