EVALUATION OF THE FIVE-DAY POSTHATCHING HEAT DISTRESS ACCLIMATION TECHNIQUE

T. Belay[1], K. McDonald[2], M.O. Smith[3] and R.G. Teeter[4]

Story in Brief

In one study birds were exposed to 85, 95, 105 and 110°F for 24 hours at five days posthatching followed by housing at 85°F for 23 days and subsequent heat distress exposure to test a proposed new acclimation procedure. In addition, one group of birds was allowed to self regulate their ambient temperature under brooders. On day 28 posthatching the chicks were placed in two environmental chambers with 16 replicates of 6 chicks each per treatment. One chamber was maintained at 79°F while the other was cycled between 79 and 99°F for 2 weeks. A cubic acclimation effect on survival was detected during the growth phase with heat stressed broilers. Survival (%) and live weight gain (lb) in the cool and (hot) chambers during the growing phase for the 85, 95, 105, 110°F and the self regulated groups averaged 100, 2.23 (84, 1.39); 99, 2.20, (90, 1.45); 98, 2.27, (77, 1.42); 100, 2.29, (93, 1.43); 100, 2.20, (85, 1.37), respectively. In the thermoneutral chamber acclimation reduced gain at 28, but not 37 days posthatching. Further studies are needed to judge the efficacy of the procedure to counter heat distress consequences.

(Key Words: Acclimation, Heat Distress, Broilers, Mortality.)

Introduction

Heat distress in broilers is age dependent with the greatest susceptibility occurring four weeks posthatching and thereafter. Acclimation, the process by which birds adjust to the heat insult, increases broiler heat tolerance, but it depends on breed, age, climate and nutrition (Meltzer, 1987). Reece et al. (1972), reported that acclimating male broiler chicks from four to eight weeks was effective in reducing mortality when exposed to high temperature up to 105°F at eight weeks of age. Arjona et al. (1988) reported that mortality resulting from heat stress at 44 and 45 days of age was significantly

[1]Graduate Assistant [2]Student [3]Research Associate [4]Professor

reduced in broilers exposed to elevated environmental temperatures for 24 hours at just five days of age. They also indicated that under heat stress conditions the acclimatized broilers had a significantly improved feed efficiency compared to the unacclimatized group.

The metabolic basis for short-term acclimation to heat exposure is unknown. May et al. (1986) exposed broilers to moderate, constant and high-cyclic temperature for three days in a long term study and reported that neither acclimation nor constantly severe heat exposure 106°F impacted triiodothyronine (T3) or thyroxine (T4) concentration. Meltzer (1987), reported that the rise of body temperature in an acclimatized fowl is less than in the unacclimatized, and suggested that acclimatization occurs due to either a increased heat loss or decreased heat production. Teeter and Smith (1988) determined that 52% of the hypothermic effect of acclimation could be attributed to reduced feed intake leaving 48% of the response independent of feed consumption.

If the 5-day acclimation procedure is effective at increasing the broiler's heat tolerance then it may offer a means for the consequences of heat distress to be minimized. The objective of this trial was to evaluate the 5-day acclimation procedure on the performance of broilers subsequently exposed to heat distress.

Materials and Methods

Arbor Acre x Vantress broiler chicks were housed on rice hull litter in a partitioned brooder house. At five days posthatching, chicks were divided into five groups of 250 chicks each. Each group was assigned at random to one of five partitioned areas within the broiler house. Four groups of chicks were under controlled temperatures of 85, 95, 105 and 110°F for 24 hours while the other group was left to control their comfort zone by altering their position under the brooder. During days 6 through 28 all chicks were wing banded and placed in a common pen where the temperature was maintained at 85°F initially and gradually reduced to the birds ideal growing temperature of 70°F at 21 days posthatching. On day 28 chicks were identified by acclimation groups and distributed within two environmental chambers with one maintained at 79°F while the other cycled between 79 and 99°F. Relative humidity in both chambers was maintained between 50 to 55%. Feed (Table 1) and water were available for ad libitum consumption throughout the study. Upon completion of the 2-week experimental period body weight gain, survivability and feed efficiency were determined and analyzed by general linear model.

Table 1. Composition of basal diet.

Ingredient	Percent
Ground corn	56.8
Soybean meal	36.0
Fat	3.0
Dical. phosphate	2.35
Calcium carbonate	.90
Salt	.50
Vitamin Mix	.25
Trace Mineral	.10
DL-Methionine	.10
Total	100.00

Results and Discussion

Body weight at 28 days of age was significantly ($P<.05$) decreased by all artificial acclimation treatments (Table 2). The 4 week body weight of broilers acclimated at 95°F was decreased ($P<.05$) compared to those acclimated at 85, 105 or 110°F. However, no significant differences in body weight were detected at 43 days of age, suggesting that compensatory gain occurred. Indeed, body weight gain during the growth phase within the hot environmental chamber tended ($P<.1$) to increase among the acclimated groups. The desirability of this acclimation effect must be questioned as a greater growth rate is also associated with increased heat production.

Broiler survivability was significantly ($P<.05$) impacted in the heat stress environment by the acclimation technique. However, a significant ($P<.05$) cubic effect was detected making interpretation uncertain. Birds acclimated at 105°F had a significantly ($P<.05$) lower survivability compared to controls or those acclimated at 95 or 110°F. Feed efficiency, unadjusted for mortality, was numerically improved (64) in the 95 and 110°F acclimation groups and depressed (74) in the 105°F group. Further studies are needed so that the acclimation response may be adequately defined.

Table 2. The effect of 5-day posthatching heat distress acclimation on body weight, survivability, body weight gain and feed efficiency.

5-Day acclimation temperature (°F)	Body wt (lb) 28 days	Environment (growth phase) Thermoneutral % Survival[2]	Gain (lb)	FE[3]	Heat Distress % Survival	Gain (lb)	FE
Control[1]	1.28[a]	100[a]	2.20[a]	.51[a]	85[b]	1.37[b]	.40[ab]
85	1.23[b]	100[a]	2.23[a]	.52[a]	84[bc]	1.39[b]	.39[ab]
95	1.18[c]	99[a]	2.20[a]	.52[a]	90[bd]	1.45[b]	.43[a]
105	1.24[b]	98[a]	2.27[a]	.52[a]	77[c]	1.42[b]	.37[b]
110	1.23[b]	100[a]	2.29[a]	.53[a]	93[d]	1.43[b]	.43[a]

[a,b,c,d]Means within a column with different superscript differ (P<.05).
[1]Control = broilers allowed to seek comfort zone.
[2]Survivability.
[3]Feed efficiency.

Literature Cited

Arjona, A.A. et al. 1988. Effect of heat stress early in life on mortality of broilers exposed to high environmental temperature just prior to marketing. Poultry Sci. 67:226.

May, J.D. et al. 1986. Effect of acclimation and heat stress on thyroid hormone concentration. Poultry Sci. 65:1211.

Meltzer, A. 1987. Acclimatization to ambient temperature and its nutritional consequences. Worlds' Poultry Sci. 43:33.

Reece, F.N. et al. 1972. Effect of high temperature and humidity on heat prostration of broiler chickens. Poultry Sci. 2021.

Teeter, R.G. and M.O. Smith. 1988. Broiler acclimatization to heat stress: physiological effects of feed intake and water consumption. Poultry Sci. 67(Suppl. 1):38.