Efficiency of dietary energy utilisation in hens under thermal stress

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Abstract

A nutritional solution was investigated for alleviating the negative effect of high temperature (30°C) on egg production in Albo hybrid (White Leghorn) layers. The efficiency of dietary energy utilization was determined by comparative slaughtering and the requirement of energy and protein was calculated with the mathematical model for energy and protein metabolism simulation. The evidence showed that the ME_m expressed in kJ/kg$^{0.75}$ was lower in the group fed on a diet supplemented with 15% CP (389 compared to 433 in the standard diet), while ME_{egg} was higher (327 compared to 285 in the standard diet); feed conversion efficiency as ME_c from GE was 78% and 79% respectively.

Keywords: *thermal stress, energy metabolism, hens.*

Introduction

Temperatures exceeding 30°C are not unusual during the summer period in countries with hot climate, associated with high humidity. The usual effect of such conditions is a high mortality, the drastic depression of egg production due to a significantly lower feed intake (Balnave 1996; Jamada et al., 1996; Azmat 2000; Khan 2000; Kreygen 2000; Grossu 1991). The extremely expensive technological solutions stimulated the nutritional research in an attempt to solve the problem, materialized in many papers presented in international meetings.

The purpose of this paper is to monitor the effect of heat (30°C) on the performance and energy-protein balance in Albo hybrid (White Leghorn) layers, under the conditions of using isocaloric diets with varying protein levels.

Material and methods

The experiment was conducted in a room with controlled environmental conditions (30°±1°C and 77±0.8% relative humidity) on 60 White Leghorn layers aged 28 weeks in the beginning of the experiment.

The experiment lasted for 42 days during which the total excreta and eggs were collected and feed intake was measured.
The energy and protein balance was determined by comparative slaughtering (in the beginning and end of the experiment 4 hems were slaughtered from each group).
The requirement of energy expressed in corrected metabolisable energy (ME_c), metabolisable energy for maintenance (ME_m), metabolisable energy for production (ME_p), deaminated energy (deamE) and the requirement of protein expressed as available protein (AP), retained protein (Pr) and protein for maintenance (Pm) were calculated with the mathematical model for energy and protein metabolism simulation in poultry (Burlacu et al., 1996).
The experimental diets based on corn, soybean meal and fish meal were formulated to contain 11.51 kJ GE/kg DM, 15.5% CP, 1.17% lysine, 0.73% methionine +cystine, 0.22% tryptophan (control) and 11.51 kJ GE/kg DM, 17.0% CP, 1.2% lysine, 0.79% methionine +cystine, 0.23% tryptophan (experimental).
The hens had free access to food and water.
The feeds, excreta, body mass and eggs were analyzed chemically and calorimetrically by standard methods, AOAC 1984.
Data were processed with Quatro Pro 6.0 software.

Results and discussion

The high temperature (30^{o}C) affected bird performance, namely the laying percentage, egg mass and egg weight. Differences were observed, however, between the two groups: laying percentage was 80.6% in group C and 86% in group E, compared to 89% at 20^{o}C under feeding with standard diet (Burlacu et al., 1996). Egg weight was significantly different: 49.93 g (C) and 51.37 g (E); both values were significantly different compared to the determinations at 20^{o}C with values of 57 g (Burlacu et al., 1996) and 55.02±0.67g (Grossu 1991).
These results are higher than those obtained by Grossu 1991 at 29.3^{o}C with isocaloric and isoproteic diets on White Leghorn layers aged 28-39 weeks: 49.93 (C) and 51.37 (E) compared to only 47.7±0.59.
Daily feed intake was 94.79 g/hen/day in group C and 96.83 g/hen/day in group E (not significant differences), lower, however, than in hens raised in neutral thermal conditions (117 g/hen).
The energy and protein balance showed that digestibility did not vary significantly, 86.60±2.43% for C and 83.26±1.95% for E, quite similar results being recorded for the crude protein, 88.07±1.80% in C and 84.51±2.13% in E, as also mentioned in the literature.

The corrected metabolisable energy (ME_c) related to the metabolic weight was 776 kJ for C and 765 for E, with an efficiency of 79, respectively 78% towards the ingested gross energy.

The data of comparative slaughtering regarding body mass protein and lipids was used to calculate the metabolisable energy for production (ME_p) with values of 343 $kJ/kg^{0.75}$ in C and 376 $kJ/kg^{0.75}$ in E, with an efficiency of 35, respectively 38% towards the ingested GE.

Within the ME_p, ME_{egg} represented 83% in C and 87% in E.

The metabolisable energy for maintenance (ME_m) was 433 $kj/kg^{0.75}$ in group C and 389 $kJ/kg^{0.75}$ in group E.

The higher laying percentage of group E was due to a lower weight gain and to a lower energy requirement for maintenance, as mentioned in the literature too (Grossu 1991; Burlacu 1996). The low difference between the two groups suggest, however, the effort of hens to accommodate to the heat stress, which was easier to do in group 2.

Conclusions

1. The feed intake improvement in the group supplemented from 94.79 g protein/hen/day to 96.83 g protein/hen/day was not significant, being lower than the intake recorded at neutral temperature.
2. The high temperature (30^0C) and relative humidity (79%) affected the egg production (laying percentage, egg mass, egg weight), however less in the group which received a diet supplemented with 15% CP. The least affected was the laying percentage, 80.6% in group C and 86% in group E.
3. The increased depression of the ME_m in the experimental group supplemented with protein improved significantly hen performance but not enough as to support the complex phenomenon of thermal regulation, this decrease showing a stage towards accommodation.

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