**52ª Reunião Anual da Sociedade Brasileira de Zootecnia**

*Zootecnia: Otimizando Recursos e Potencialidades*

**Belo Horizonte – MG, 19 a 23 de Julho de 2015**

# Efeito da temperatura ambiente sobre a energia metabolizável para mantença e produção de calor de pintos de corte na primeira semana de vida

Rodrigo Borille[2], Priscila Moraes[2], Marcos Speroni Ceron[2], Rafael Dal Forno Gianluppi[3], Lucas Marques Vilella[4], Andréa Machado Leal Ribeiro[1], Alexandre de Mello Kessler[1]

[1] Professor do Departamento de Zootecnia - UFRGS, Porto Alegre, Brasil.
[2] Doutorando do Programa de Pós-Graduação em Zootecnia – UFRGS, Porto Alegre, Brasil. e-mail: borille.r@hotmail.com
[3]Mestrando do Programa de Pós-Graduação em Zootecnia – UFRGS, Porto Alegre, Brasil.
[4]Aluno de graduação em Zootecnia - UFRGS, Porto Alegre, Brasil.

**Resumo:** A produção de calor de frangos de corte é diretamente afetada pela temperatura, onde, em condições de termoneutralidade, cerca de 30 a 40% da energia ingerida é destinada para a mantença, podendo aumentar se a temperatura ultrapassar os limites críticos. Este experimento teve por objetivo investigar o efeito da temperatura ambiente sobre o desempenho e a eficiência de utilização da energia ingerida de pintos de corte de 1 a 7 dias de idade, machos, de linhagem Cobb 500. Foram utilizados 300 pintos de corte, distribuídos em 30 boxes, onde cada grupo de 10 aves foi submetido a uma temperatura diferente (que foi de 21,85 a 34,96$^{o}$C) durante todo o período experimental. Foi utilizada a técnica de abate comparativo para estimar os índices de retenção dos componentes corporais e a produção de calor. Os dados coletados foram submetidos a análise de regressão em função da temperatura de cada box. Os resultados apresentaram efeito linear decrescente da temperatura sobre a produção de calor por kg de $PV^{0.75}$/dia e energia metabolizável para mantença por ave, e efeito quadrático sobre as variáveis de desempenho, e sobre os resultados de energia retida, percentual de produção de calor da energia ingerida, incremento de calor de produção e energia metabolizável para mantença por kg de $PV^{0.75}$/dia. Desta forma, conclui-se que as exigências de energia para mantença são alteradas em função da temperatura ambiental.

**Palavras–chave:** desempenho, incremento de calor de produção, retenção de energia

## Ambient temperature effect on the metabolizable energy for maintenance and heat production of broiler chicks at the first week of life

**Abstract:** The broiler heat production is directly affected by temperature, where in thermoneutral conditions, about 30-40% of energy intake is used for maintenance, and may increase if the temperature exceeds the critical limits. This experiment aimed to investigate the effect of ambient temperature on the performance and the efficiency of use of energy intake of male Cobb 500 broiler chicks 1-7 days old. It were used 300 broiler chicks, distributed in 30 boxes, each with 10 birds and subjected to a different temperature (that varied from 21.85 to 34.96$^{o}$C) during the experimental period. It was used the comparative slaughter technique to estimate the retention indices of body components and heat production. Data were subjected to regression analysis as a function of the temperature of each box. The results showed a linear decreasing effect of temperature on heat production per kg $PV^{0.75}$/day and metabolizable energy for maintenance per bird, and quadratic effect on the performance variables, on the retained energy results, heat production percentage of energy intake, heat increment and metabolizable energy for maintenance per kg $PV^{0.75}$/day. Thus, it is concluded that the energy requirements for maintenance are changed depending on the ambient temperature.

**Keywords:** energy retention, heat increment of production, performance

## Introduction

Much of the production of Brazilian broilers still uses open sheds, and so has faced problems due to internal temperature variations of the sheds. One of the problems caused by this reason is the change of metabolizable energy requirements of chickens depending on the temperature, and thus, becomes valuable the use of prediction equations for energy requirements (Rostagno et al., 1996). According Sakomura et al., (2014), heat production for broilers is determined by the temperature, where in thermoneutral conditions, about 30 to 40% of energy intake is used for the maintenance and can greatly increase when temperature exceeds the critical limits. The same authors also mentions that, regardless of strain, the energy intake for maintenance usually has a quadratic effect in relation to environment temperature. However, Emmans (1974) mentions that in most models to estimate requirements ME for maintenance is considered a linear effect of temperature.

In this context, the aim of this study was to investigate what the effect of environment temperature on the metabolizable energy requirement for maintenance (ME maintenance) as well as heat production (HP), heat

increment (HI), body energy retention (ER) using the comparative slaughter technique, and performance (body weight, feed intake, and feed conversion of broiler chicks reared between 21.85 to 34.96°C during the first week post-hatch.

## Material e Methods

Three hundred male, one-day-old chicks of the Cobb strain were used in this study. The chicks were kept in thirty boxes, where each of the boxes had the different temperature average from (10 chicks per temperature). The variation of environmental temperature among all the boxes were 21.85 to 34.96°C. Each box (1.0 X 1.0 m) was equipped with tubular feeder and drinker nipple type, and wood shavings litter. The experimental room was equipped with the gas heater positioned at one end (the end that with hot atmosphere) and air conditioner set to a temperature of 21°C at the other end (end with cold weather environment), in order to cause different temperatures in each of the boxes. The collection of temperatures of each box was performed every hour during the 7 days of the experiment. The diet was formulated according to the nutritional requirements for broilers suggested by Rostagno et al. (2005) and provided ad libitum. Feed intake of each box was estimated by the method of weighing the leftovers at the end of seven days. The chicks were weighed at the beginning and at the end of 7 days, and the average weight were used to obtain the evaluated parameters. The comparative slaughter technique was used for energy retention estimates (gross energy, energy retained as protein and energy retained as fat). Five chicks were slaughtered at the beginning of the study and frozen, and at the end of seven days, five other chicks from each box were slaughtered. These birds were milled for laboratory analysis. These results allowed to calculate the retention of total energy, energy retention as protein and energy retention as fat, heat increment ($HI_{production}$) was calculated as the sum of $HI_{protein}$ = (Protein retention*5.66 kcal/g)/0.65*0.35, and $HI_{fat}$ = (fat retention *9.35 kcal/g)/0.85*0.15, considering the energetic efficiency of protein and fat as 0.65 and 0.85, respectively. The heat production was estimated using the equation HP = $ME_{intake}$ - $ER_{body,}$ and the metabolizable energy for maintenance was estimated using the equation: $ME_{maintenance}$ = HP - $HI_{production}$. The results obtained were subjected to regression analysis as a function of environmental temperature average measured for each box, utilizing software Statgraphics 4.1.

## Results and Discussion

Regression analyses (Table 1) showed a quadratic effect (P <0.001) for body weight gain, feed intake and feed conversion of chicks from 1 to 7 days old as affected by ambient temperature. This fact is directly related to changes in the energy adjustment made by the body when it is outside of their optimal range of environment temperature. With increasing environment temperature birds decrease feed intake (Leeson & Summers, 1997), causing the animal to gain less weight. On the otherhand, if the environment temperature is very low, much of the energy intake is directed for heat production, in an attempt to maintain body temperature within the limits supported, and thus the process becomes inefficient deposition of body components. The environment temperature produced quadratic effect (P<0.001) on the bird for energy retention (ER/broiler), energy retention per kg metabolic body weight (ER/kg $BW^{0.75}$/day), energy retention percentage (ER%) and heat production percentage (HP%). Based on the observed, it is clear that the chicks had better efficiency to retain body energy within a great range of ambient temperature (approximately from 25 to 31C). The same quadratic effect (P <0.001) from temperature is also observed on chicks heat production (HIp), that was lower for chicks exposed to extreme temperatures considered, both cold and heat. The lower heat increment in extreme temperatures indicates that, when suffering thermal stress, the bird will decrease the tissue deposition.

Heat production per kg of metabolic body weight (HP/kg $BW^{0.75}$) showed a linear decrease (P<0.05). The estimated heat production ranged from 233 to 206 kcal/kg $BW^{0.75}$/day in relation to the minimum and maximum temperatures measured. The ME maintenance/broiler was influenced by the ambient temperature, and showed a linear effect (P <0.05). Emmans, (1974) had previously shown the same effect of temperature on the ME maintenance. On the other hand, it is observed that the ME maintenance/kg $BW^{0.75}$/day was affected by temperature in a quadratic effect (P <0.05), as would have been predicted by Hurwitz et al. (1980). The environmental temperature has a direct influence on the requirements of metabolizable energy for maintenance, according to Sakomura et al. (2014), in environments where the temperature reaches a critical limit considered, the energy for maintenance can use up to about 60% of total energy intake. This higher requirement is related to physiological regulation to maintain homeothermy. Because of the cold, the body reduces the movement, but increases feed intake in an attempt to produce heat to regulate temperature and, in the hot situation, the bird presents a tendency to eat less feed, and also uses part of the energy ingested in an attempt to dissipate the body heat. Both are energetically inefficient, and this is proved by observing the results of performance, where the feed conversion and weight gain were better when ME for maintenance was lower, whereas it can also be observed when the HI for production is higher.

Table 1. Effect of environment temperature on weight gain, feed intake, feed conversion, heat production per metabolic body wight (HP/kg $BW^{0.75}$), energy retention per broiler (ER/broiler), energy retention per metabolic body weight (ER/kg $BW^{0.75}$), energy retention percentage (ER %), heat production percentage (HP %), heat increment of production (HIp), metabolizable energy of maintenance per broiler (MEm/broiler), and metabolizable energy of maintenance per metabolical body weight (ME maintenance/kg $BW^{0.75}$) of boiler chicks during the 1 st wk post-hatch.

| Parameter | Equation | Effect | P | $R^2$ |
|---|---|---|---|---|
| Weight gain (kg) | $WG = -282.193 + 28.0016T - 0.495411T^2$ | Quadratic | 0.0000 | 0.52 |
| Feed intake (kg) | $FI = -116.794 + 18.2498T - 0.328086T^2$ | Quadratic | 0.0474 | 0.20 |
| Feed conversion | $FC = 3.31739 - 0.143869T + 0.00246064T^2$ | Quadratic | 0.0054 | 0.34 |
| HP/kg $BW^{0.75}$/ (kcal) | $HP/BW^{0.75} = 279.538 - 2.10041T$ | Linear | 0.0109 | 0.22 |
| ER/broiler (kcal) | $ER/broiler = -671.112 + 59.2677T - 1.03775T^2$ | Quadratic | 0.0001 | 0.51 |
| ER/kg $BW^{0.75}$/day (kcal) | $ER/kg\ BW^{0.75} = -378.44 + 36.3414T - 0.632805T^2$ | Quadratic | 0.0001 | 0.48 |
| ER (%) | $ER(\%) = -81.3853 + 8.28758T - 0.141407T^2$ | Quadratic | 0.0002 | 0.48 |
| HP (%) | $HP\ (\%) = 181.385-8.28758T + 0.141407T^2$ | Quadratic | 0.0002 | 0.48 |
| HIp (kcal) | $HI_p = -227.746 + 20.4844T -0.360225T^2$ | Quadratic | 0.0000 | 0.52 |
| MEm/broiler (kcal) | $ME_m/broiler = 271.079-2.37751T$ | Linear | 0.0192 | 0.19 |
| MEm/kg $BW^{0.75}$/day (kcal) | $ME_m/kg\ BW^{0.75} = 622.275-30.5155T + 0.506165T^2$ | Quadratic | 0.0037 | 0.36 |

T = Environmetal temperature

## Conclusions

The results showed that the metabolizable energy requirements for maintenance of broiler chicks of first week post-hatch suffer interference from ambient temperature, and therefore, the body energy retention and heat production are affected.

## References

Emmans, G.C. 1974. The effect of temperature on performance of laying hens. In: Energy Requirements of Poultry, p. 79-90. Edingburgh: British Poutlry Science Ltd.

Hurwitz, S.; Weiselberg, M.; Eisner, U.; Bartov, I.; Riesenfeld, G.; Shavit, M.; Niv, A.; Bornstein, S. 1980. The energy requirements and performance of growing chickens and turkeys as affected by environmental temperature. Poutry Science, Savoy, v. 59, n. 10, p. 2290-2299.

Leeson, S.; Summers, J.D. 1997. Commercial poultry nutrition. 2. ed. Ontario:University Books.

Rostagno, H.S.; Barbarino, P.; Barboza, W.A. 1996. Exigências nutricionais das aves determinadas no Brasil. p. 361-388. In: Anais do Simpósio Internacional sobre Exigências Nutricionais de Aves e Suínos, Viçosa: Universidade Federal de Viçosa.

Rostagno, H. S.; L. F. T. Albino.; Donzele, J. L.; Gomes, P. C.; Oliveira, R. F.; Lopes, D. C.; Ferreira, A. S.; Barreto, S. L. T. 2005. Tabelas Brasileiras para Suínos e Aves: Composição de Alimentos e Exigências Nutricionais. 2nd ed. Universidade Federal de Viçosa, Departamento de Zootecnia, Viçosa, Brazil.

Sakomura, N. K.; Hauschild, L.; Bonato, M. A. 2014. Modelagem da utilização da energia nas aves. p. 314-327. In: Nutrição de não ruminantes. Sakomura, N. K.; da Silva, J. H. V.; Costa, F. G. P. ; Fernandes, J. B. K.; Hauschild, L. Ed. Funep, Jaboticabal, SP, 678 p.