

## METABOLIZABLE ENERGY REQUIREMENT FOR MAINTENANCE OF FREE-RANGE LAYING HENS

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### ABSTRACT

The main purpose of the egg production in the free-range system is to obtain a more natural and less stressful result for a product that has great market acceptance. However; there is little scientific information on the utilization of food by these birds. The objective of this study was to determine the requirement of metabolized energy (ME) for maintenance and efficiency of energy utilization of the diet of free-range laying hens during their production phase, using the comparative slaughter technique. The linear regression equation of retained energy in the body and eggs for different intake levels of ME (ad libitum, 80%, 60% and 40% of ad libitum intake), provided the requirement for maintenance (MEM) through the intercept X-axis, and the efficiency of utilization of the diet above maintenance (*kgp*) through the regression coefficient, whereas heat production (HP) was calculated as the difference between ME ingested and retention of energy in the body and eggs. The net requirement for maintenance (NEM) was obtained by exponential regression of the HP according to intake of ME, and the efficiency of energy utilization for maintenance (*km*) calculated as the ratio between NEM and MEM. The requirements and efficiency of energy utilization for maintenance were 121.8 kcal of ME/kg<sup>0.75</sup>/day and 0.68, respectively. The ELM requirements were 82.38 kcal EM/kg<sup>0.75</sup>/day, and the efficiency of utilization of ME above maintenance was 0.61.

**KEYWORDS:** comparative slaughter, factorial method, free-range system, layers

### INTRODUCTION

The production of free-range type meat and eggs is a niche in poultry still unexplored. With the recent changes in the concept of animal production in Europe, mainly due to the increased demand for consumers more conscious about food safety and animal welfare, there has been an increased demand for more natural products which were obtained in alternative systems. However; the technical and scientific knowledge about nutritional requirements, feeding management and reproductive performance of free-range chickens is still very scarce in the literature.

The energy requirement for maintenance is the energy needed to keep the animal in a state in which there will be no gain and no loss of bodily substance. This may then be defined as the amount of energy required to maintain the balance between anabolism and catabolism, that is, when there is no retention of energy. The energy requirement for maintenance includes the requirement for the basal metabolic rate, caloric increase, thermoregulation and physical activity, and is always higher than the basal metabolic

rate, but such an increase depends on the habits of the birds and the environment in which they live (Klasing, 1998)

Therefore; the aim of this study was to estimate the metabolized energy requirements and net energy for maintenance, as well as the efficiency of utilization of energy below and above the maintenance of free-range laying hens.

## MATERIALS AND METHODS

The experiment was conducted at the Experimental Station of Small Animal in Carpina, which belongs to the Federal Rural University of Pernambuco, Brazil, were utilized 168 hens of lineage Embrapa 051 between the 34th and 40th weeks of age, randomly assigned to four treatments with four replicates of ten birds each. The birds were housed in four shelters with 16 experimental units for ten birds with access to an outdoor range with an area of 3 m<sup>2</sup> / bird. The treatments consisted of four levels of intake: ad libitum, 80%, 60% and 40% of ad libitum feeding, being supplied to the feed-restricted groups based on the daily intake of ad libitum hens. The experimental diet was formulated according to the nutritional requirements suggested by recommendation guide of Embrapa 051, and 2,800 kcal/kg metabolized energy, 15.5% crude protein, 3.7% calcium and 0.42% available phosphorus. Also was carried out a trial of metabolism cages for the determination of apparent metabolized energy corrected by nitrogen (ME<sub>n</sub>) of diets by the method of total excreta collection with four days of adaptation and four days collection.

In determining the requirement for maintenance was used the method of comparative slaughter, in which eight hens were sacrificed by cervical dislocation at the beginning and all the hens of the plots at the end of the experimental period, and all previously submitted to fasting for 24 hours. And the end of the experiment, total feed intake and metabolizable energy intake were calculated and energy retention in the carcass was estimated by the difference between the energy body at the end and beginning of the experiment. The processing of the carcasses was to autoclaving at 127°C and 1 atm for 5 hours, homogenized in industrial blender for 5 minutes and lyophilization at -54°C for 48 hours. Then the dried samples were weighed again and ground in a ball-type mill for the determination of dry matter and gross energy. The retention of energy in eggs was measured by collecting a sample weekly of six eggs each plot, which was homogenized in a blender for 2 minutes, frozen and lyophilized to determine its composition. The total retention energy corresponding to the sum of retention in the carcass and eggs, and both the retentions and the ingestion of energy were expressed as the weight average daily metabolic (kcal EM/kg<sup>0.75</sup>/day).

The variables metabolizable energy intake (ME<sub>i</sub>), retained energy (RE) and heat production (HP) were related by regression equations to obtain the daily requirement of metabolized energy for maintenance (ME<sub>m</sub>) and utilization efficiency of energy dietary (RE = a + bME<sub>i</sub>), and to determine the heat production during fasting, that is, the net energy requirement for maintenance, NE<sub>m</sub>, (log HP = a + bME<sub>i</sub>). The efficiency of energy utilization for maintenance was estimated by relating ME<sub>m</sub>/NE<sub>m</sub>.

## RESULTS AND DISCUSSION

Through linear regression of retained energy as a function of ME<sub>n</sub> intake was determined the requirement for maintenance of 121.8 kcal/kg<sup>0.75</sup>/day and efficiency of energy utilization above maintenance (*k<sub>gp</sub>*) of 0.61 (Figure 1). The net energy requirement for maintenance (NE<sub>m</sub> = 82.38 kcal/kg<sup>0.75</sup>/day) was obtained by exponential regression of heat production due to the ingestion of ME<sub>n</sub> (Figure 2), and

the efficiency of energy utilization for maintenance ( $km$ ) of 0.68 calculated as the ratio between the NEM and MEM.

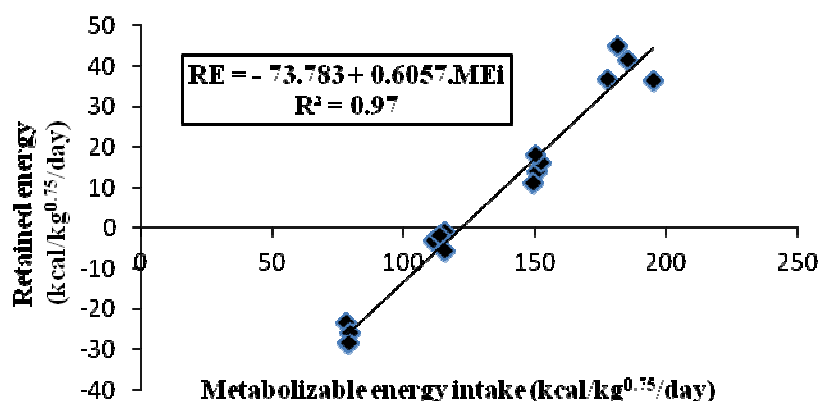


Figure 1: Relationship between the metabolizable energy intake and retained energy in the carcass and eggs.

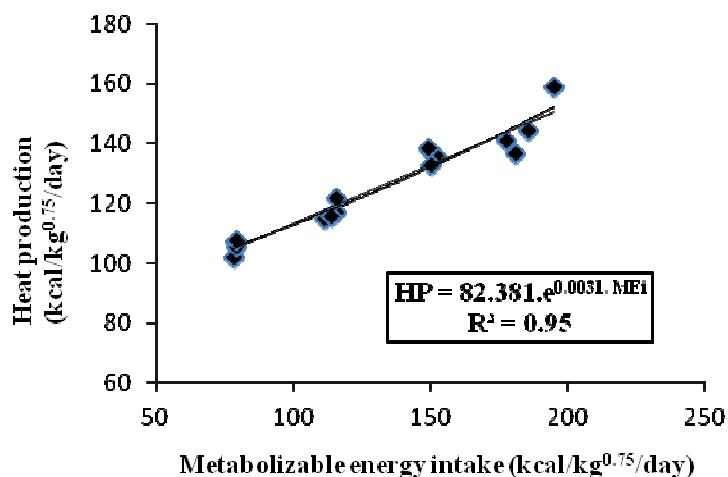


Figure 2: Relationship between the metabolizable energy intake and heat production.

The value of the requirement for maintenance of 121.8 kcal/kg<sup>0.75</sup>/day determined in this study was similar to those reported by Burlacu and Baltac (1971) of 125.8 kcal/kg<sup>0.75</sup>/day for laying hens and Jadhao et al. (1999) of 119.8 kcal/kg<sup>0.75</sup>/day for Rhode Island Red chickens. However; several values in the literature for laying hens kept in cages are lower than those found in this work, as estimated by Rising et al. (1989) of 112.8 kcal/kg<sup>0.75</sup>/day and Sakomura et al. (2005) of 111.98 kcal/kg<sup>0.75</sup>/day.

The variation in the values of MEM requirement is due to several factors inherent to the animal and the environment, and among them stand out temperature, feathering, body composition, genetics and physical activity. In a study conducted with laying hens of 62 weeks of age, Boshouwers and Nicaise (1985) found that 25% of the total heat production was due to physical activity. The highest value for maintenance determined in this experiment is associated mainly to the farming system. As the chickens were kept in shelters with access to outdoor range for a period of 10 hours a day, there was then a higher heat production and energy expenditure due to physical activity more intense with the manifestation of the natural behavior of birds.

The efficiency of utilization of ME above maintenance ( $k_{gp} = 0.61$ ) estimated in this study is consistent with values reported by Sakomura (2004), ranging between 0.59 for broilers to 0.69 for hens in cages. The efficiency of energy use for maintenance ( $k_m = 0.68$ ) estimated in this study was lower than the value of 0.78 found by Burlacu and Baltac (1971) for light laying hens, but was similar to the efficiencies of 0.67 for Rhode Island Red chickens (Jadhao et al., 1999) and 0.71 for broiler breeders and laying hens (Rabello et al., 2004; Sakomura et al., 2005).

The NEm requirement estimated in this study of 82.38 kcal/kg<sup>0.75</sup>/day was similar to that determined by Jadhao et al. (1999) for laying hens Rhode Island Red of 80.7 kcal/kg<sup>0.75</sup>/day. However; lower values were estimated for laying hens as 69.28 kcal/kg<sup>0.75</sup>/day (Reid et al., 1978) and 69.15 kcal/kg<sup>0.75</sup>/day (Sakomura et al., 2005). According to Johnson (1983) several factors may influence the NEm requirement for poultry, among which are the reproductive state, sex, plumage, genotype, climate, age and physical activity.

## CONCLUSION

The metabolizable energy requirement for maintenance of free-range laying hens estimated by the method of comparative slaughter is 121.8 kcal/kg<sup>0.75</sup>/day, and the efficiency of energy utilization for maintenance of 0.68.

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