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Metabolizable energy levels for meat quails from 15 to 35 days of age

Níveis de energia metabolizável para codornas de corte de 15 a 35 dias de idade

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ABSTRACT

This trial was carried out to evaluate the effects of dietetic metabolizable energy levels on performance and carcass traits of meat quails from 15 to 35 days old. Five hundred sixty, 15-d old, meat quails were randomly assigned to five treatments (2.850; 2.950; 3.050; 3.150 e 3.250kcal of ME kg^{-1} of diet), with eight replicates and fourteen birds per experimental unit. Feed intake, protein and lysine intake and feed conversion decreased linearly as the metabolizable energy content of diets increased (P<0.01), whereas metabolizable energy intake, body weight, weight gain and viability were not affected (P>0.05) by the treatments. Diets did not influence (P>0.05) carcass traits as dry matter, moisture and protein content in carcass. However a quadratic effect (P<0.04) were observed on carcass fat content. Based on these results, the adequate metabolizable energy level to ensure better meat quails' growth is 3.250kcal of ME kg^{-1} diet, that corresponds to a metabolizable energy: crude protein ratio of 139,24.

Key words: ***Coturnix coturnix*** *sp., energy: protein ratio, performance.*

RESUMO

Com o objetivo de avaliar o efeito dos níveis de energia metabolizável (EM) sobre o desempenho de codornas de corte de 15 a 35 dias de idade, foi conduzido um experimento com 560 aves aos 15 dias de idade, distribuídas em delineamento inteiramente casualizado com cinco tratamentos (2.850; 2.950; 3.050; 3.150 e 3.250kcal de EM kg^{-1} de ração), oito repetições com 14 aves por unidade experimental. Verificou-se redução linear (P<0,01) no consumo de ração, de proteína, de lisina e na conversão alimentar, com o aumento dos níveis de EM da ração. O consumo de energia metabolizável, o peso corporal, o ganho de peso, viabilidade das aves não foram influenciados (P>0,05) pelos níveis de EM utilizados. Os níveis de EM das dietas não influenciaram (P>0,05) a matéria seca, o teor de umidade e a proteína nas carcaças. Foi observado efeito quadrático (P<0,04) dos níveis de EM sobre o teor de gordura nas carcaças. Conclui-se que o nível de EM de 3.250kcal kg^{-1} de ração, correspondendo à relação de energia metabolizável:proteína bruta de 139,24, possibilita melhor desempenho das codornas de corte.

Palavras-chave: ***Coturnix coturnix*** *sp., desempenho, relação energia:proteína.*

INTRODUCTION

In spite of facing several challenges, meat quail industry has been showing positive growth rates of at last decade. In Brazil, meat quail commercialization in industrial scale has started in 1989, after "Perdigão Industrial" company, starts its business with the Avis Raras line, using imported meat-type breeders (PASQUETTI, 2011). Despite the increase in meat quail commercialization, the activity still faces difficulties such as the lack of established genetic meat-type line, and the determination of their nutritional requirements. It's well known that quail performance and carcass traits are influenced by growth phase, genetics, and dietary nutrients intake (KUL et al., 2006); and that birds' growth rate increases with age, until achieving a plateau, when they reach a maximum value with posterior decrease (KESSLER et al., 2000; LONGO, 2000). According to GRIESER et al. (2015), from 14 days of age on, meat-type quail growth rate becomes decreasing,

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which influence negatively on feed conversion rate. Considering such behavior in quail growth, associated to the fact that at 35 days of age quail carcass already presents adequate commercial size, it is recommended to slaughter birds at this age.

The supply of metabolizable energy in quail diet is essential to ensure adequate productive performance, especially after 14 days of age, due to the increased energy requirement resultant from its increased body size (TON, 2007; OLIVEIRA et al., 2007). Dietary energy supply is essential for animal performance, since energetic content of diets regulates feed intake, which consequently reflects on birds' performance (BARRETO et al., 2007). Both excess and reduction on feed intake may result in deleterious effects on animal performance and increase feed costs. Although the effects of dietary energy content on broiler performance are well known, few data involving meat quails metabolizable energy requirements are available in literature.

Beyond few literature data, discrepancies observed among published reports, most probably caused by nutritional requirements used as base for diets formulation, become unclear the birds' energy requirements. Thus this study was performed to determinate the effects of different levels of metabolizable energy on meat quails performance and carcass traits from 15 to 35 days of age.

MATERIALS AND METHODS

A total of 560 one day old quails were housed and fed with a diet formulated based on the nutritional recommendations described by SILVA & COSTA (2009) until 14 days of age.

At the beginning of the trial, at 15 days of age, birds (with average weight of 90.64g) were randomly assigned to experimental treatments, each one replicated eight times with fourteen birds per experimental unit. Experimental diets (Table 1) were formulated according to nutritional requirements described by SILVA & COSTA (2009). To formulated diets it was considered the chemical composition of ingredients described by ROSTAGNO et al. (2011). The treatments consisted of different metabolizable energy levels (2,850, 2,950, 3,050, 3,150, and 3,250kcal kg^{-1}). Birds were housed in 50×50×5cm (width×length×height) metal cages placed on masonry counter tops with approximately 120cm in height. Each cage was equipped with one nipple drinker and one metal feeder placed in front of each cage. Immediately after housing into the cages, the quails were oriented for the presence of water by wetting their beak into the water inside nipples cup. The lighting program consisted of 24h of light (natural + artificial). The environmental temperature inside the experimental facility was recorded by a maximum and minimum thermometer, and the relative humidity of the air was determined by dry and wet bulb thermometers, both of them birds height placed. Quails behavior around the lamps was also considered in temperature control.

At the end of the trial, at 35 days of age, birds and the residual feed in feeders were weighed to calculate the following performance parameters: feed intake (g), metabolizable energy intake (kcal), crude protein intake (g), lysine intake (g), body weight (g), weight gain (g), feed conversion (g g^{-1}). Viability (%) was calculated through the difference between birds alive at the end and the beginning of the trial. After 4 hours of fasting, two birds per experimental unit were weighed to obtain their live weight, and then slaughtered by cervical dislocation between the atlas and the occipital bone. After the slaughter, birds were stored into plastic bags identified per treatment and replicated and immediately frozen. Then, frozen samples were ground in industrial meat grinder to determinate carcass composition. The ground carcasses were weighed, homogenized, and dried in a forced-ventilation oven at 55ºC for 72h for pre-drying. Afterwards, it were ground in a ball mill and transferred to the Animal Nutrition Laboratory of DZO for the analyses of the dry matter (DM), moisture (M), crude protein (CP), and fat (EE) contents in the carcasses, according to the methodology described by SILVA & QUEIRÓZ (2004). Statistical analyses were performed using Sistema para Análises Estatísticas (SAEG, 2007) software package. After analysis of variance, metabolizable energy requirement was estimated using polynomial regression model. Significant effects were considered for P-value $\leq$0,05.

RESULTS AND DISCUSSION

The average maximum and minimum temperatures recorded during the trial (from 15 to 35d of age) were 31.99±2.7°C and 22.70±1.3°C, respectively. Thus, based on the comfort temperatures (between 32 and 22ºC) suggested by MURAKAMI & GARCIA (2010), it can be inferred that the birds were under thermal comfort during the experimental period.

The birds' feed intake decreased linearly (P<0.01) with the increase in the dietary ME levels; however, no effects were observed (P>0.05) on ME intake. According to regression equation presented at table 2, each 100kcal of increase in dietary energy

Table 1 - Chemical and nutritional composition of experimental diets on natural matter.

	Metabolizable energy level (kcal/kg)				
Ingredient	2,850	2,950	3,050	3,150	3,250
Corn (7.88%)	40.560	40.560	40.560	40.560	40.560
Soybean meal (48%)	31.831	31.831	31.831	31.831	31.831
Inert (sand)	5.000	3.853	2.715	1.577	0.440
Sorghum	12.000	12.000	12.000	12.000	12.000
Corn gluten (60%)	6.154	6.154	6.154	6.154	6.154
Soybean oil	1.589	2.727	3.865	5.002	6.140
Limestone	1.018	1.018	1.018	1.018	1.018
Dicalcium phosphate	0.878	0.878	0.878	0.878	0.878
Salt	0.334	0.334	0.334	0.334	0.334
DL-methionine (99%)	0.145	0.145	0.145	0.145	0.145
L-arginine (99%)	0.151	0.151	0.151	0.151	0.151
Choline chloride (60%)	0.100	0.100	0.100	0.100	0.100
Mineral premix[1]	0.070	0.070	0.070	0.070	0.070
Vitamin premix[2]	0.100	0.100	0.100	0.100	0.100
Antioxidant[3]	0.010	0.010	0.010	0.010	0.010
Growth promoter[4]	0.010	0.010	0.010	0.010	0.010
Coccidiostatic[5]	0.060	0.060	0.060	0.060	0.060
Total	100.000	100.000	100.000	100.000	100.000
Calculated composition					
Metabolizable energy (kcal kg^{-1})	2,850	2,950	3,050	3,150	3,250
Crude protein (%)	23.34	23.34	23.34	23.34	23.34
Digestible lysine (%)	1.016	1.016	1.016	1.016	1.016
Digestible met + cys (%)	0.822	0.822	0.822	0.822	0.822
Digestible threonine (%)	0.783	0.783	0.783	0.783	0.783
Digestible tryptophan (%)	0.243	0.243	0.243	0.243	0.243
Calcium (%)	0.702	0.702	0.702	0.702	0.702
Available phosphorous (%)	0.274	0.274	0.274	0.274	0.274

[1]Composition kg^{-1} of product: Manganese: 160g, Iron: 100g, Zinc: 100g, Copper: 20g, Cobalt: 2g, Iodine: 2g, Inert: 1,000g. [2]Composition/kg of product: Vit. A:12,000,000UI., Vit D3:3,600,000UI., Vit. E: 3,500UI., VitB1:2,500mg, Vit B2: 8,000mg, Vit B6:5,000mg, Pantothenic acid: 12,000mg, Biotin: 200mg, Vit. K: 3,000mg, Folic acid: 1,500mg, Nicotinic acid: 40,000mg, Vit. B12: 20,000mg, Selenium: 150mg, Inert: 1,000g.[3]Butil-hidroxy-tolueno. [4]Avilamicin. [5]Coxistac 12%.

level decreased by approximately 15g in birds' feed intake. Animals regulate feed intake in an attempt to ingest a constant amount of energy, changing intake according to the level of energy (LEESON et al., 1996). According to FREITAS et al. (2006), this occurs because meat quails feed primarily to meet their energy requirements, which is a similar behavior to that of broiler hens. These results are in agreement in those reported by VELOSO et al. (2012), SCHERER (2011), and TON et al. (2011), who observed a decrease in feed intake with the increase on ME level of in diets for meat quails at 35 days of age.

The increase in the ME levels resulted in linear reduction (P<0.01) in protein and lysine intake. However, ME levels did not affect (P>0.05) birds' body weight or weight gain. These results may be related to the increased birds' capacity of digestion and absorption with age advancing and the increasing inclusion of oil in experimental diets. According to SAKOMURA et al. (2004), the oil exert an effect known as extra caloric, that increases digesta retention time in the gastrointestinal tract (GAT), what consequently increases the nutrients availability in GAT lumen. Similar results were observed by TON et al. (2011), who did not observe effect of the ME levels (2,800 to 3,100kcal kg^{-1}) on body weight or weight gain of meat quails from 4 to 35 days of age. CORRÊA et al. (2007b) also did not observe any effects of the dietary ME levels (2,900 and 3,100kcal kg^{-1}) on these same parameters on meat quails aged from 22 to 42 days. Conversely, TEIXEIRA et al. (2013) observed a linear increase in meat-type quails weight gain from 1 to 35d age after ranging metabolizable energy levels from 2,700 a 3,100kcal kg^{-1}.

Table 2 - Feed intake (FI), metabolizable energy intake (MEI), crude protein intake (CPI), lysine intake (LYSI), body weight (BW), weight gain (WG), feed conversion (FC) and viability (VIAB) of meat-type quails from 15 to 35 days old fed different metabolizable energy levels.

Variables	-----Metabolizable energy level (kcal/kg)-----										CV (%)[1]
	2,850	SE[2]	2,950	SE[2]	3,050	SE[2]	3,150	SE[2]	3,250	SE[2]	
FI (g bird^{-1})[3]	483.79	5.36	468.85	4.55	453.56	4.47	437.59	4.62	423.96	4.07	2.89
MEI (kcal)[4]	1,378.80	15.28	1,383.12	13.43	1,383.35	13.64	1,378.40	14.57	1,377.87	13.22	2.87
CPI (g)[3]	112.91	1.25	109.43	1.06	105.86	1.04	102.13	1.08	98.95	0.95	2.89
LYSI (g)[3]	4.97	0.06	4.82	0.05	4.66	0.05	4.50	0.05	4.36	0.04	2.89
BW (g)[4]	250.51	2.63	250.93	2.01	249.74	3.13	248.17	2.87	248.62	2.00	2.09
WG (g)[4]	159.60	2.44	160.36	2.28	159.44	3..26	157.87	2.96	157.75	2.09	4.70
FC (g g^{-1})[3]	3.03	0.03	2.93	0.03	2.85	0.04	2.78	0.03	2.69	0.02	3.07
VIAB (%)[4]	99.04	0.96	99.04	0.96	100	0.00	99.04	0.96	100	0.00	2.12

-----Regression equations-----

FI = 913.860 – 0.150921ME	NE[5] $\geq$ 3,250	R^2 = 0.75
CPI = 213.297 – 0.0352256ME	NE[5] $\geq$ 3,250	R^2 = 0.75
LYSI = 9.39456 – 0.0015515ME	NE[5] $\geq$ 3,250	R^2 = 0.75
FC = 5.41591 – 0.000839750ME	NE[5] $\geq$ 3,250	R^2 = 0.67

[1]Coefficient of variation; [2]Standard error; [3]Linear effect; [4]Not significant; [5]Estimated level; R^2= Total sum of squares/Sum of squares of treatment.

Feed conversion decreased linearly (P<0.01) as the dietary ME level was increased. According to the equation presented in table 2, for every increase in 100 kcal of dietary ME, feed conversion was improved by approximately 0.1 point. A similar response was observed by SCHERER (2009), who obtained a reduction of 0.1 point in feed conversion as a result of an increase from 2,800 to 3,300kcal kg^{-1} in the ME level of diets for broilers from 15 to 35 days of age. Similar effects were verified by CORRÊA et al. (2007a), who reported that the increase in ME from 2,900 to 3,100kcal kg^{-1} provided better quails' feed conversion in the phases of 15 to 21, 22 to 28, 29 to 35, and 46 to 42 days of age. The feed conversion values depends on feed intake and weight gain. As mentioned previously, the increase in the ME levels reduced feed intake, but did not influence the weight gain, which explains the behavior observed in feed conversion values from the increase in the dietary ME.

Birds' viability was not affected by dietary ME levels (P>0.05). During experimental phase only three animals died, corresponding to a mortality rate of 0.54%. Higher values were described by FREITAS et al. (2006) and OLIVEIRA (2001), who observed mortality rates of 2.08 and 3.3%, respectively for meat quails.

Dietary ME didnot affect (P>0.05) dry matter, moisture, or protein contents of the quails' carcasses at 35 days of age (Table 3). This result is in agreement with the reports of CORRÊA (2006), who did not find effects of the ME levels (2,900 and 3,100) on dry matter or crude protein content of quails' carcasses at 42 days of age. According to SILVA et al. (2007), meat quails has a fast growth until 21 days of age, with greater deposition of protein and water in the carcass, quickly reaching 200g, which is around 25 times their initial weight. After this age, their weight gain declined, due to the greater deposition of fat and retention of nutrients in the reproductive tract.

LEESON (1995) stated that the efficiency in body's protein utilization is reduced because the muscle synthesis is genetically controlled, and thus there is a limit to the daily deposition of this nutrient, irrespective of its intake. However, the extra caloric effect caused by oil in the diets with the higher ME level should be taken into account, as it increases the digestibility of the dietary nutrients, off setting the reduction in the intake of protein and lysine by the birds.

A quadratic effect (P<0.04) of ME levels was observed on the fat content (EE) of the birds' carcasses, which, according to the equation, indicates that the level of 2,926kcal kg^{-1} showed the lowest estimate, of 11.31% EE. These results are in agreement with those reported by MEZA et al. (2015), who verified a linear decrease in broilers carcass fat content after ranging dietary metabolizable energy from 3,660 to 3,000kcal kg^{-1}.

Table 3 - Dry matter (DM), Moisture (MO), ether extract (EE) and crude protein (CP) content on meat-type quails carcass at 35 days old fed different metabolizable energy levels idem 1.

Variables[1]	Metabolizable energy level (kcal kg^{-1})										CV (%)[2]
	2,850	SE[3]	2,950	SE[3]	3,050	SE[3]	3,150	SE[3]	3,250	SE[3]	
DM (%)[4]	32.11	0.88	32.28	0.51	31.96	0.31	32.74	0.49	32.46	0.34	3.36
MO (%)[4]	67.89	0.88	67.72	0.51	68.04	0.31	67.26	0.49	67.54	0.34	1.60
EE (%)[5]	11.32	0.13	11.40	0.14	11.30	0.10	11.67	0.06	11.94	0.05	2.51
CP (%)[4]	15.87	0.16	16.11	0.12	16.55	0.25	16.28	0.15	16.21	0.23	3.32
Regression equations											
$EE = 63.9249 - 0.0359552ME + 0.00000614286ME^2$						EL[6]= 2,926			$R^2 = 0.73$		

[1]Values based on dry matter; [2]Coefficient of variation; [3]Standard error; [4]Not significant; [5]Quadratic effect; [6]Estimated level; R^2=Total sum of squares/Sum of squares of treatment.

Opposite results were reported by SAKOMURA et al. (2004), who evaluated the effect of the dietary ME level on the performance and energy metabolism of broiler hens from 22 to 42 days of age and observed that the birds fed with the diet containing 3,200kcal kg^{-1} showed a lower fat content as compared with those that received a low-energy diet, with 3,050kcal kg^{-1}. TON et al. (2011) observed a linear increase in 35d meat quails' carcasses' fat content as the dietary ME levels increased. These results may be related to the greater or lower intake of nutrients by the birds, what promote differences in the lipogenesis rates and consequently changes in carcass composition towards gains in both protein and fat (KESSLER et al., 2000).

According to WALDROUP (1996), the energy: protein ratio also exert an influence on the EE content of carcasses, given that, as this ratio is increased, the amount of deposited fat also increases, especially abdominal fat. According to MENDONÇA et al. (2007), the amount of deposited fat is directly proportional to the quantity of energy available for the synthesis; therefore, surplus dietary energy is well correlated with the deposition of lipids in most animals.

CONCLUSION

The metabolizable energy level of 3,250kcal kg^{-1}, which corresponds to the metabolizable energy:crude protein ratio of 139.24, provides better performance to meat quails from 15 to 35 days of age.

BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

The experimental procedure is registered under protocol no. 37/2012, approved by the Ethics Committee on the Use of Animals of the Department of Animal Science of Universidade Federal de Viçosa (UFV), Minas Gerais, Brazil.

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