



Revista Brasileira de Ciência Avícola

ISSN: 1516-635X

revista@facta.org.br

Fundação APINCO de Ciência e  
Tecnologia Avícolas  
Brasil

Martins, JMS; Carvalho, CMC; Litz, FH; Silveira, MM; Moraes, CA; Silva, MCA; Fagundes, NS; Fernandes, EA

Productive and Economic Performance of Broiler Chickens Subjected to Different  
Nutritional Plans

Revista Brasileira de Ciência Avícola, vol. 18, núm. 2, abril-junio, 2016, pp. 209-215  
Fundação APINCO de Ciência e Tecnologia Avícolas  
Campinas, Brasil

Available in: <http://www.redalyc.org/articulo.oa?id=179746750002>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative



## Productive and Economic Performance of Broiler Chickens Subjected to Different Nutritional Plans

### ■ Author(s)

Martins JMS<sup>I</sup>  
Carvalho CMC<sup>II</sup>  
Litz FH<sup>III</sup>  
Silveira MM<sup>III</sup>  
Moraes CA<sup>II</sup>  
Silva MCA<sup>II</sup>  
Fagundes NS<sup>IV</sup>  
Fernandes EA<sup>II</sup>

- <sup>I</sup> Escola de Veterinária e Zootecnia - Universidade Federal de Goiás  
<sup>II</sup> Faculdade de Medicina Veterinária - Universidade Federal de Uberlândia  
<sup>III</sup> Instituto de Genética e Bioquímica - Universidade Federal de Uberlândia  
<sup>IV</sup> Escola Superior de Agricultura "Luiz de Queiroz" - Universidade de São Paulo

### ■ Mail Address

Corresponding author e-mail address  
Julyana Machado da Silva Martins  
Laboratório de Nutrição Animal – LANRA  
Rua Ceará, s/n, bloco 2 D, sala 36, Bairro Umuarama  
38402-018, Uberlândia, MG, Brasil.  
Phone: (34) 32182371  
E-mail: [julianamachado\\_zoo@hotmail.com](mailto:julianamachado_zoo@hotmail.com)

### ■ Keywords

Nutrient density, performance, carcass yield, economic viability.

### ABSTRACT

The objective of the study was to evaluate the effect of nutritional plans on the productive and economic performance of Hubbard Flex broiler chickens. A completely randomized experimental design was applied, consisting of five treatments. Treatments consisted of five different nutritional plans: a basal diet containing the nutrient and energy levels recommended by literature and designated reference diet; two diets containing 1.5% and 3% lower levels than the reference diet; and two diets containing 1.5% and 3% higher levels than the reference diet (-3%, -1.5%, reference plan, +1.5% and +3%). Feed intake (FI), body weight (BW), feed conversion rate (FCR), livability (L) and productive efficient index (PEI) were determined when broilers were 42 days old. Broilers were processed, and carcass and parts (breast fillet, leg, and wings) yields were determined. The economic viability of the nutritional plans was evaluated as a function of feed cost/kg live and carcass weights, economic efficiency index (EEI), and cost index (CI). Feed intake and the feed conversion rate decreased as dietary nutrient and energy levels increased. Feed cost/kg live weight, economic efficiency index, and cost index cost increased as dietary nutrient and energy levels increased. Feed intake, feed conversion ratio, production efficiency index, and breast yield improved with increasing nutritional and energy levels. However, worse economic results were obtained with higher nutritional and energy levels.

### INTRODUCTION

The improvement of performance parameters requires constant adjustment of the nutritional requirements of the modern broiler strains, in order to allow the expression of their full genetic potential. When adequately fed, broilers are efficient, producing the required carcass yield and quality at the lowest possible cost.

When evaluating the effect of dietary nutritional levels on broiler performance, no performance losses were observed by Aziz *et al.* (2011), when diluting dietary protein and energy, or by Widyaratne & Drew (2011), when reducing protein and digestible amino acid levels. This indicates that reducing dietary nutrient levels may yield significant performance and economic benefits. Leandro *et al.* (2003) observed that the dietary metabolizable energy and crude protein levels applied in different nutritional plans influenced the weight gain and the feed conversion ratio of both male and female Ross 308 broilers, as well as male breast yield, and emphasized the importance of studies to determine the best nutritional plan for each broiler strain.

Feed cost accounts for the greatest proportion of broiler production variable costs (Kamran *et al.*, 2008; Moosavi *et al.*, 2011), having a



direct impact on farm productivity, and therefore, on its profitability. Production efficiency is significantly and negatively affected when feed nutritional levels are lower than the broilers' requirements. On the other hand, supplying diets with nutrient levels above the requirements improves live performance, but may result in economic losses due the higher cost of those diets.

Considering that the genetic line Hubbard Flex was recently introduced in Brazil, where climate, production conditions, and typical feedstuffs are different from those in the country of origin, its nutritional requirements under Brazilian conditions need to be established. According to Araujo *et al.* (2002), the nutritional recommendations established in genetic manuals do not always promote maximum live performance and profitability when applied in the Brazilian broiler production setting.

Therefore, the objective of this study was to evaluate the effects different nutritional plans relative to the recommendations on the live and economic performance of Hubbard Flex broilers reared during the summer in the southeast of Brazil.

## MATERIAL AND METHODS

The experiment was carried out in the experimental broiler facilities of Gloria experimental farm of the Federal University of Uberlândia, state of Minas Gerais, Brazil, between March and April, 2013. The experimental procedures were approved by the Committee of Ethics of that university, under protocol CEUA/UFU 002/13.

In total, 1,700 (850 males and 850 females) one-day-old Hubbard Flex broilers, with 44-g average initial body weight, were housed in pens in a conventional poultry house until 42 days of age. A completely randomized experimental design, consisting of five treatments with 10 replicates of 34 birds per pen (17 males and 17 females) was applied.

Treatments consisted of five different nutritional plans: a basal diet containing the nutrient and energy levels recommended by Rostagno *et al.* (2011), and designated reference diet; two diets containing 1.5% and 3% lower levels than the reference diet; and two diets containing 1.5% and 3% higher levels than the reference diet (Tables 1 and 2).

**Table 1** – Feedstuffs and calculated nutritional composition of the pre-starter and starter diets.

Ingredients (%)	Nutritional plans									
	Pre-starter					Starter				
	3% lower	1.5% lower	Reference	1.5% higher	3% higher	3% lower	1.5% lower	Reference	1.5% higher	3% higher
Sorghum	57.08	55.22	53.43	50.78	48.70	59.00	57.12	55.27	53.14	50.40
Soybean meal	35.58	36.38	37.18	38.77	39.77	32.95	33.75	34.57	35.66	37.27
Soybean oil	3.20	4.16	5.09	6.15	7.13	4.36	5.35	6.31	7.33	8.42
Dicalcium phosphate	1.80	1.80	1.85	1.90	1.90	1.44	1.44	1.50	1.55	1.55
Limestone	0.89	0.93	0.92	0.90	0.96	0.91	0.96	0.94	0.93	0.98
Salt	0.44	0.46	0.46	0.46	0.48	0.44	0.46	0.47	0.46	0.49
Premix starter*	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
L-lysine	0.31	0.32	0.33	0.30	0.30	0.27	0.28	0.28	0.27	0.24
DL-methionine	0.19	0.21	0.22	0.22	0.23	0.14	0.15	0.17	0.17	0.17
L-threonine	0.11	0.12	0.12	0.12	0.13	0.09	0.09	0.09	0.09	0.08
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nutritional levels										
ME (kcal/kg)	2,910	2,955	3,000	3,045	3,090	3,007	3,054	3,100	3,147	3,193
Crude protein (%)	22.06	22.30	22.52	22.86	23.19	20.91	21.13	21.37	21.69	22.00
Calcium (%)	0.89	0.91	0.92	0.93	0.95	0.81	0.83	0.84	0.85	0.86
Available P (%)	0.46	0.46	0.47	0.48	0.48	0.39	0.39	0.40	0.41	0.41
Sodium (%)	0.21	0.22	0.22	0.22	0.23	0.21	0.22	0.22	0.22	0.23
Dig. lysine (%)	1.28	1.30	1.32	1.34	1.36	1.18	1.20	1.22	1.24	1.26
Dig. methionine (%)	0.65	0.66	0.67	0.68	0.69	0.59	0.60	0.61	0.62	0.63
Dig. met+cys (%)	0.92	1.02	1.04	1.06	1.07	0.85	0.87	0.88	0.89	0.91
Dig. threonine (%)	0.83	0.85	0.86	0.87	0.88	0.77	0.78	0.79	0.80	0.81
Dig. tryptophan (%)	0.25	0.25	0.26	0.26	0.27	0.23	0.24	0.24	0.24	0.25
Dig. arginine (%)	1.36	1.38	1.40	1.42	1.44	1.28	1.30	1.32	1.34	1.36

\*Premix starter (composition per kg product): vitamin A 1,600,000 IU; vitamin B1 600 mg; vitamin B12 20 mcg; vitamin B2 800 mg; vitamin B6 400 mg; vitamin D3 4,000 IU; vitamin E 30 mg; vitamin K 400 mg; zinc 12.60 g; copper 1,260 mg; selenium 80 mg; iron 10.50 g; iodine 252 mg; manganese 12.60 g; folic acid 140 mg; pantothenic acid 1,600 mg; zinc bacitracin 11 g; biotin 12 mg; choline 70 g; methionine 336.60 g; sodium monensin 22 g; niacin 6,000 mg.



**Table 2** – Feedstuffs and calculated nutritional composition of the grower and finisher diets.

Ingredients (%)	Nutritional plans									
	Grower					Finisher				
	3% lower	1.5% lower	Reference	1.5% higher	3% higher	3% lower	1.5% lower	Reference	1.5% higher	3% higher
Sorghum	61.48	59.66	57.67	55.53	52.77	64.08	62.24	60.55	57.82	55.69
Soybean meal	29.64	30.44	31.38	32.45	34.10	27.24	28.04	28.67	30.29	31.31
Soybean oil	5.44	6.44	7.44	8.47	9.59	5.70	6.69	7.67	8.79	9.85
Dicalcium phosphate	1.20	1.26	1.28	1.31	1.30	1.00	1.00	1.05	1.06	1.11
Limestone	0.90	0.89	0.89	0.90	0.91	0.77	0.79	0.79	0.80	0.79
Salt	0.44	0.44	0.44	0.44	0.47	0.42	0.45	0.45	0.45	0.47
Premix grower*	0.40	0.40	0.40	0.40	0.40	-	-	-	-	-
Premix finisher**	-	-	-	-	-	0.30	0.30	0.30	0.30	0.30
L-lysine	0.28	0.26	0.26	0.26	0.22	0.26	0.25	0.26	0.23	0.22
DL-methionine	0.14	0.14	0.16	0.16	0.16	0.17	0.18	0.19	0.20	0.20
L-threonine	0.08	0.07	0.08	0.08	0.08	0.06	0.06	0.07	0.06	0.06
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Composition										
ME (kcal/kg)	3,104	3,152	3,200	3,248	3,296	3,153	3,201	3,250	3,299	3,348
Crude protein (%)	19.59	19.77	20.07	20.37	20.85	18.70	18.90	19.06	19.55	19.83
Calcium (%)	0.74	0.75	0.76	0.77	0.78	0.64	0.65	0.66	0.67	0.68
Avail. phosphorus (%)	0.34	0.34	0.35	0.36	0.36	0.30	0.31	0.31	0.31	0.32
Sodium (%)	0.20	0.210	0.210	0.210	0.220	0.20	0.21	0.21	0.21	0.22
Dig. lysine (%)	1.10	1.11	1.13	1.15	1.16	1.03	1.04	1.06	1.08	1.09
Dig. methionine (%)	0.55	0.56	0.57	0.58	0.59	0.51	0.52	0.53	0.54	0.55
Dig. met+cys (%)	0.80	0.81	0.82	0.83	0.84	0.75	0.76	0.77	0.78	0.79
Dig. threonine (%)	0.72	0.73	0.74	0.75	0.76	0.67	0.68	0.69	0.70	0.71
Dig. tryptophan (%)	0.21	0.22	0.22	0.22	0.23	0.20	0.21	0.21	0.21	0.22
Dig. arginine (%)	1.18	1.20	1.22	1.24	1.26	1.11	1.13	1.14	1.15	1.17

\*Premix grower (composition per kg product): vitamin A 1,280,000 IU; vitamin B1 400 mg; vitamin B12 1,600 mcg; vitamin B2 720 mg; vitamin B6 320 mg; vitamin D3 3,500 IU; vitamin E 2,400 mg; vitamin K 300 mg; copper 1,200 mg; iron 10 g; iodine 240 mg; manganese 12 g; selenium 60 mg; zinc 12 g; folic acid 100 mg; pantothenic acid 1,600 mg; biotin 6 mg; choline 50 g; halquinol 6,000 mg; methionine 267.30 g; niacin 4,800 mg; salinomycin 13.20 g.

\*\*Premix finisher (composition per kg do product): vitamin A 1,300,260 IU; vitamin B1 166 mg; vitamin B12 1,667 mcg; vitamin B2 666.80 mg; vitamin B6 200 mg; vitamin D3 4,000 IU; vitamin E 2,167.10 mg; vitamin K 333.40 mg; copper 2,000 mg; iron 16.60 g; iodine 400 mg; manganese 20 g; selenium 60.68 mg; zinc 20 g; folic acid 100 mg; pantothenic acid 1,333 mg; biotin 6.67 mg; choline 50 g; methyl 230 g; niacin 4,000 mg; virginiamycin 3,666 mg.

Diets were formulated according to a 4-phase feeding schedule: pre-starter (1-7 d), starter (8-21 d), grower (22-35 d), and finisher (36-42 d).

Cumulative performance was evaluated at 42 days of age. Birds and feed offer and residues were weekly weighed, and mortality was daily recorded. The following parameters were evaluated: average feed intake (FI), average body weight (BW), feed conversion ratio (CA), livability, and productive efficiency index (PEI). This index took into account body weight, livability, bird age, and feed conversion ratio, and was calculated according to the following equation:

$$PEI (\%) = \frac{\text{Body weight (kg)} \times \text{livability (\%)} \times 100}{\text{Age (days)} \times \text{feed conversion ratio}}$$

At 42 days of age, 10 birds per treatment (five males and five females), with average live weight equal to the average weight ( $\pm 5\%$ ) of each treatment,

were processed (stunned, bled, scalded, plucked, and eviscerated). Carcass yield (CY, %) was calculated as clean and eviscerated carcass weight relative to body weight at slaughter. Carcasses were then cut up, and parts yields (thigh+drumstick or leg, breast fillet, and wings) were calculated as part weight relative to carcass weight.

The economic viability of the applied nutritional plans was determined as feed cost relative to body weight ( $Y_i$ ) and relative to eviscerated carcass weight ( $Y_i$ ), according to the following equation proposed by Bellaver *et al.* (1985):

$$Y_i = \frac{Q_i \times P_i}{G_i}$$

where  $Y_i$  is the feed cost per kg of body weight or eviscerated carcass weight of the  $i^{\text{th}}$  treatment;  $P_i$  is the price per kg feed fed in the  $i^{\text{th}}$  treatment;  $Q_i$  is the amount of feed intake in the  $i^{\text{th}}$  treatment; and  $G_i$  is



the weight gain or carcass weight obtained in the  $i^{\text{th}}$  treatment.

Diet cost and feed intake were separately calculated for each feeding phase, and subsequently summed. The price of each dietary treatment took into account nutrient density. The feedstuff prices considered were those effective in the market of the region of Uberlândia, state of Minas Gerais, in March, 2013.

Subsequently, the economic efficiency index (EEI) and the cost index (CI), proposed by Fialho *et al.* (1992), as follows:

$$EE_i = \frac{LC_a \times 100}{CT_{ai}}$$

and

$$CI = \frac{CT_{ai} \times 100}{LC_a}$$

where  $MC_a$  is the lowest feed cost per kg body weight or eviscerated carcass weight among treatments and  $CT_{ai}$  is the cost of the  $i^{\text{th}}$  treatment.

Data were checked for residue normality, and then submitted to analysis of variance at 5% significance level. Nutritional plan data were submitted to analysis of regression. Statistical analyses were performed using SAS 9.3 (SAS, 2011).

## RESULTS AND DISCUSSION

The performance results obtained from one to 42 days of age are shown in Table 3. Feed intake and feed conversion ratio linearly decreased as dietary nutrient and energy levels increased. Body weight presented a cubic response to nutritional plan, with the lowest body weight obtained at +0.106% nutritional level.

The treatments did not influence ( $p>0.05$ ) livability. Production efficiency index linearly improved as dietary nutrient and energy density increased, which may have been due to the linear reduction in feed conversion ratio.

Reginatto *et al.* (2000), Mendes *et al.* (2004), and Dozier *et al.* (2006), evaluating different nutritional plans, also found a linear reduction in feed intake with increasing dietary energy levels. Waldroup *et al.* (1990) and Dozier *et al.* (2006) stated that dietary energy level controls the feed intake of broilers. Silva *et al.* (2001), Costa *et al.* (2001), and Kamran *et al.* (2008) observed a linear reduction in feed intake and feed conversion ratio with increasing dietary crude protein levels.

The manipulation of dietary nutrient density levels may be an alternative to supply the nutritional requirements of broilers, while minimizing performance losses resulting from reduced feed intake, as typically occurs in hot climates. In the present experiment, dietary energy level was increased with the inclusion of oil, which promotes low heat increment, and therefore, better dietary energy:protein ratio, resulting in high protein deposition and consequent better feed conversion ratio. This result corroborates with Leandro *et al.* (2003), Mendes *et al.* (2004), and Sakomura *et al.* (2004), who reported that feed conversion ratio improved as dietary ME levels increased. On the other hand, Lima *et al.* (2008) did not find any effect of dietary energy and amino acid levels on the feed conversion ratio of either male or female broilers between 1-40 or 1-45 days of age. Relative to dietary amino acid content, Kidd *et al.* (2005) observed better feed conversion ratio when supplying higher amino acid levels.

**Table 3** – Feed intake (FI), body weight (BW), feed conversion (FCR), livability (LIV), and productive efficiency index (PEI) of 42-d-old Hubbard Flex broilers submitted to different nutritional plans.

Treatments	FI (kg)	BW (kg)	FCR (kg/kg)	LIV (%)	PEI (%)
Plan -3%	4.750	2.853	1.670	95.90	391.31
Plan -1.5%	4.670	2.892	1.628	97.39	415.22
Reference plan	4.574	2.860	1.605	97.71	416.54
Plan +1.5%	4.381	2.781	1.589	98.04	412.62
Plan +3%	4.300	2.820	1.551	97.32	428.90
CV (%)	4.64	2.72	3.03	2.98	5.58
p value	Linear	<0.0001 <sup>1</sup>	0.2600	<0.0001 <sup>3</sup>	0.7314
	Quadratic	0.5094	0.5894	0.6664	0.2153
	Cubic	0.3191	0.0139 <sup>2</sup>	0.1713	0.9692

<sup>1</sup>y = 4.5346-0.07891x (R<sup>2</sup> = 0.9756)

<sup>2</sup>y = 2.87499-0.04729x-0.00147x<sup>2</sup>+0.00464x<sup>3</sup> (R<sup>2</sup>=0.9603)

<sup>3</sup>y = 1.60859-0.01859x (R<sup>2</sup>=0.976)

<sup>4</sup>y = 412.79935+4.95579x (R<sup>2</sup>=0.7111)

CV = coefficient of variation



Similarly to the results of the present study, Silva *et al.* (2001) did not find any influence of different dietary energy levels and ME:CP ratios on broiler mortality.

There was no interaction between sex and nutritional plans for carcass yield or breast and wing yields. However, a significant interaction between these factors was observed for leg yield (Table 4). The regression equation for females showed that the lowest leg yield was obtained at a -0.278% nutritional plan, whereas the regression equation for males indicated the highest leg yield at a nutritional plan of +0.233%.

Nutritional plans did not affect carcass, breast meat, or wing yields.

The obtained results are consistent with the reports of Leandro *et al.* (2003) and Kamran *et al.* (2008), who did not find any carcass yield differences in broilers submitted to different nutritional plans, i.e., fed diets with different energy and protein levels. On the other hand, Sabino *et al.* (2004) found a linear effect of increasing CP levels on carcass yield. Such divergent results may be attributed to differences among broiler strains, dietary nutritional levels and nutrient balances applied in the experiments.

Higher protein intake results in higher breast yield, as shown by Costa *et al.* (2001), who observed a linear increase in breast yield in broilers fed diets containing 17.50 to 19.50% CP. However, this effect was not observed in the present experiment, possibly due to the physiology of the evaluated broiler strain.

Antunes *et al.* (2012), evaluating the effects of three dietary energy levels on the carcass yield of two broiler strains, did not find wing yield or breast yield (with or without the skin and bones) differences; however, lower leg yield was obtained when broilers were fed the intermediate energy level.

Table 4 also shows the effect of sex ( $p < 0.05$ ) on carcass yield, with males presenting better results, independently of energy levels, whereas parts yields were not different between sexes. Female broilers accumulate more body fat, which compromises their weight gain and therefore, their carcass yield.

Table 5 shows the results of feed cost/kg body weight, economic efficiency index, and cost index, which were used for the analysis of the economic viability of the different nutritional plans. Feed cost/kg body weight was linearly affected by the nutritional plans, and is represented by the equation  $y = 0.0065x + 1.1069$  ( $R^2 = 0.8765$ ), showing that feed cost increased as dietary nutrient levels increased.

The best economic efficiency and cost indexes were obtained with the -3% and -1.5% plans. Therefore, it does not seem to be economically viable to increase nutrient and energy levels in the diet of Hubbard Flex broilers. However, this depends on the market price of soybean meal and soybean oil at the time of feed formulation, as these were the feedstuffs which levels were most increased in the diets and that most affected the economic indices.

**Table 4** – Carcass yield (CY), leg yield (LY), breast fillet yield (BFY), and wing yield (WY) of 42-d-old male and female broilers submitted to different nutritional plans.

			CY	LY	BFY	WY
	-3%		84.01	22.34	20.48	8.29
	-1.5%		83.85	22.55	19.42	8.28
Nutritional plan	0		83.83	22.02	20.50	8.17
	1.5%		83.28	22.39	18.92	8.07
	3%		84.16	22.30	19.98	8.58
Sex	Female		83.50	21.78	19.80	8.35
	Male		84.16	22.86	19.92	8.21
	CV (%)		1.23	4.69	7.87	6.32
p-value	Nutritional plan	Linear	0.7846	0.9478	0.2948	0.4552
		Quadratic	0.2182	0.8911	0.3523	0.0759
		Cubic	0.2008	0.9750	0.7274	0.1501
	Sex		0.0231	<0.0001	0.7789	0.3153
	Interaction		0.6055	0.0179	0.0924	0.0891
	Female		-	Cubic <sup>1</sup>	-	-
	Male		-	Cubic <sup>2</sup>	-	-

$$^1y = 0.0696x^3 + 0.058x^2 - 0.6499x + 21.523 \quad (R^2 = 0.924)$$

$$^2y = -0.0556x^3 - 0.0389x^2 + 0.5101x + 23.036 \quad (R^2 = 0.8426)$$

CV = coefficient of variation





**Table 5** – Feed cost per kg body weight (FC/kg BW), economic efficiency index (EEI), and cost index (CI) obtained for 42-d-old Hubbard Flex broilers submitted to different nutritional plans.

Treatments	FC/kg BW	EEI	CI
Plan -3%	1.09	100.00	100.00
Plan -1.5%	1.09	100.00	100.00
Reference plan	1.10	99.09	100.91
Plan +1.5%	1.12	97.32	102.75
Plan +3%	1.12	97.32	102.75
CV (%)	2.45		
p-value	Linear	0.0047 <sup>1</sup>	
	Quadratic	0.6187	
	Cubic	0.1729	

<sup>1</sup>y = 0.0065x + 1.1069 (R<sup>2</sup> = 0.8765)

CV = coefficient of variation

Table 6 shows the results of the economic viability analysis relative to eviscerated carcass. Feed cost/kg eviscerated carcass was not influenced by the nutritional plans. The best economic efficiency and cost indexes were obtained with the -3% plan, followed by +1.5 and + 3% plans. Therefore, the nutritional plan to be applied depends on the market price of feedstuffs, as mentioned above.

**Table 6** – Feed cost per kg eviscerated carcass (FC/kg eviscerated carcass), economic efficiency index (EEI), and cost index (CI) obtained for 42-d-old Hubbard Flex broilers submitted to different nutritional plans.

Treatments	FC/kg carcass	EEI	CI
Plan -3%	1.32	100.00	100.00
Plan -1.5%	1.35	97.78	102.27
Reference plan	1.35	97.78	102.27
Plan +1.5%	1.33	99.25	100.76
Plan +3%	1.33	99.25	100.76
CV (%)	2.76		
p-value	Linear	0.2704	
	Quadratic	0.0889	
	Cubic	0.2355	

CV = coefficient of variation

## CONCLUSIONS

Feed intake, feed conversion ratio, production efficiency index, and breast yield improved with increasing nutritional and energy levels. However, worse economic results were obtained with higher nutritional and energy levels. Therefore, the choice of the nutritional plan to be applied depends on the market price of feedstuffs at the time of feed formulation.

## REFERENCES

- Antunes MM, Bueno JPR, Silva MCA, Soares DB, Santos IL, Carvalho CMC, Oliveira MV, Fernandes EA. Rendimento de carcaça e cortes em frangos de corte fêmeas de duas linhagens submetidas a diferentes níveis nutricionais. *Veterinária Notícias* 2012; 18(2):100-104. (Suplemento).
- Azizi B, Sadeghi G, Karimi A, Abed F. Effects of dietary energy and protein dilution and time of feed replacement from starter to grower on broiler chickens performance. *Journal of Central European Agriculture* 2011; 12(1):44-52.
- Bellaver C, Fialho ET, Protas JFS, Gomes PC. Radícula de malte na alimentação de suínos em crescimento e terminação. *Pesquisa Agropecuária Brasileira* 1985; 20(8):969-974.
- Costa FGP, Rostagno HS, Albino LFT, Gomes PC, Toledo RS, Vargas Junior JG. Níveis dietéticos de proteína bruta para frangos de corte de 1 a 21 e 22 a 42 dias de idade. *Revista Brasileira de Zootecnia* 2001; 30(5):1498-1505.
- Dozier WA, Price CJ, Kidd MT, Corzo A, Anderson J, Branton SL. Growth performance, meat yield, and economic responses of broilers fed diets varying in metabolizable energy from thirty to fifty-nine days of age. *Journal of Applied Poultry Research* 2006; 15:367-382.
- Fialho ET, Barbosa HP, Ferreira AS, Gomes PC, Girotto AF. Utilização da cevada suplementada com óleo de soja para suínos em crescimento e terminação. *Pesquisa Agropecuária Brasileira* 1992; 27(10):1467-1475.
- Kamran Z, Sarwar M, Nisa M, Nadeem MA, Mahmood S, Babar ME, Ahmed S. Effect of low-protein diets having constant energy-to-protein ratio on performance and carcass characteristics of broiler chickens from one to thirty-five days of age. *Poultry Science* 2008; 87:468-474.
- Kidd MT, Corzo A, Hoehler D, Miller ER, Dozier WA. Broiler responsiveness (Ross x 708) to diets varying in amino acid density. *Poultry Science* 2005; 84(4):1389-1396.
- Leandro NSM, Café MB, Stringhini JH, Moraes Filho R, Moura KA, Silva Júnior RP. Plano nutricional com diferentes níveis de proteína bruta e energia metabolizável na ração para frangos de corte. *Revista Brasileira de Zootecnia* 2003; 32(3):620-631.
- Lima LMB, Lara LJC, Baião NC, Cançado SV, Michell BC, Ferreira FCR. Efeitos dos níveis de energia, lisina e metionina+cistina sobre o desempenho e o rendimento de carcaça de frangos de corte. *Revista Brasileira de Zootecnia* 2008; 37(8):1424-1432.
- Mendes AA, Moreira J, Oliveira EG, Garcia EA, Almeida MEM, Garcia RG. Efeitos da energia da dieta sobre desempenho, rendimento de carcaça e gordura abdominal de frangos de corte. *Revista Brasileira de Zootecnia* 2004; 33(6):2300-2307. (Suplemento 4).
- Moosavi M, Eslami M, Chaji M, Boujarpour M. Economic value of diets with different levels of energy and protein with constant ratio on broiler chickens. *Journal of Animal and Veterinary Advances* 2011; 10:709-711.
- Reginato MF, Ribeiro AM, Penz Junior AM, Kessler AM, Krabbe EL. Suplementação de treonina em dietas de frango de corte, variando a energia e as relações energia:proteína. *Revista Brasileira de Ciências Avícolas* 2000; 2(3):239-247.
- Rostagno HS, Albino LFT, Donzele JL, Gomes PC, Oliveira RF, Lopes DC, Ferreira AS, Barreto SLT, Euclides RF. Tabelas brasileiras para aves e suínos: composição de alimentos e exigências nutricionais. 3 ed. Viçosa; UFV; 2011.
- Sabino HFN, Sakomura NK, Neme R, Freitas ER. Níveis proteicos na ração de frangos de corte na fase de crescimento. *Pesquisa Agropecuária Brasileira* 2004; 39(5):407-412.



Sakomura NK, Longo FA, Rabello CB, Watanabe K, Pelícia K, Freitas ER. Efeito do nível de energia metabolizável da dieta no desempenho e metabolismo energético de frangos de corte. Revista Brasileira de Zootecnia 2004; 33(6):1758-1767. (Suplemento 1).

SAS - Statistical Analysis System. Statistical analysis system: user's guide: statistics. Version 9.3. Cary: SAS Institute Inc.; 2011.

Silva JHV, Albino LFT, Nascimento AH. Níveis de energia e relações energia: proteína para frangos de corte de 22 a 42 dias de idade. Revista Brasileira de Zootecnia 2001; 30(6):1791-1800.

Waldroup PW, Tidwell NM, Izat AL. The effects of energy and amino acid levels on performance and carcass quality of male and female broilers grown separately. Poultry Science 1990; 69(9):1513-1521.

Widaratne GP, Drew MD. Effects of protein level and digestibility on the growth and carcass characteristics of broiler chickens. Poultry Science 2011; 90:595-603.



