

The Influence of Nutritive Characteristics and of the Period of Administration of Concentrated Mixture on the Productive Performances of Broilers Raised in Organic System

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Abstract

The objective of this experiment was to assess the nutritional characteristics (metabolisable energy (ME) with values between 2850-3000 kcal, crude protein (CP) from 21 to 17%) and mixture concentrated (MC) administration period (biphasically or triphasically) on the productive performance of broilers raised in organic system. The experiment was conducted on a total of 108 ROSS 308 commercial hybrids for 84 days under specific feeding ecological system. The experimental design consisted of 3 treatments with three replicate cages per treatment. It was found that the higher energy MC₁ caused a lower average daily consumption in offspring of V₁ (43.00 g) compared to broilers of the other two versions, a trend that is maintained in the following phases. Experimental variants V₂ and V₃ which have consumed in the first phase MC₂ with 10% egg in structure obtained a higher average daily gain (23.90 and 23.23 g) in the first phase as well as in the growth and finishing phases. At the age of slaughter (84 days) V₂ stands with 3867.33 g body weight which consumed MC₂ in phase I (with 10% egg in structure), triphasically fed variant, followed by V₃ (3710.96 g) ($p > 0.05$) biphasically fed. Also the introduction in MC₂ of a protein source of high biological value generated in the first phase an feed conversion ratio (FCR) of 1.75, respectively 1.80, higher than recorded in V₁ 2.08. European production index (EPI) shows a high value (161.06) in the version triphasically fed with MC₂, MC₄, MC₆, with values close to the version MC₂ and MC₆ biphasically fed (152.80). The costs of feeding are for V₃ version biphasically fed even if the first phase feeding costs are higher due to the introduction in the MC₂ structure of 10% egg. Given the productive performance and expenses incurred in feeding it should be used in organic farming and growing household a biphasically feeding containing the nutritional requests set.

Keywords: EPI, growth parameters, organic system, poultry

1. Introduction

Organic farming has become an area of interest by the achieved goals and by achieving a balance between soil, plants and animals in a system

which ensures the health, welfare, and production of goods requested by consumers [1-3].

Poultry farming focuses on animal health and welfare, good environmental practices and product quality, in contrast, conventional production focuses on reducing costs and maximizing production through weight gain, feed efficiency and more [4].

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Achieving the bio indicators of poultry is possible only in optimal conditions of feeding, by providing quantitative and qualitative protein, energy requirements, energy-protein ratio.

The challenge for animal nutrition is to adapt the nutrient supply as accurately as possible to the requirements resulting from maintenance and performance need [5-7].

As has been pointed out in the text, organic foods will have to be produced efficiently so that they compete price-wise with conventional foods: there is evidence that the price that the consumer is willing to pay for organic foods is not unlimited. This requires that the diets used in organic poultry production – the major cost in production – be formulated correctly to achieve a satisfactory rate

of gain and efficiency of feed conversion in the market animals, and satisfactory meat [8].

The objective of the experiment was to evaluate the impact of nutritional characteristics and of the period of MC administration on productive performance of broilers raised in organic system.

2. Materials and methods

The experiment was conducted on a total of 108 ROSS 308 commercial hybrids for 84 days under specific feeding ecological system. Data were obtained from May to August. The experimental design consisted of 3 treatment cages with three replicates per treatment. The dietary treatment was as follows (Table 1, Table 2):

Table 1. The general organizing of the experiment

	V ₁	V ₂	V ₃
Phase I 1-28 days	MC ₁ ME 2965 kcal CP 20.90%	Phase I 1-28 days	MC ₂ ME 2851 kcal CP 20.94%
Phase II 29-70 days	MC ₃ ME 2978 kcal CP 19.5%	Phase II 29-70 days	MC ₄ ME 2948 kcal CP 19.61%
Phase III 71-84 days	MC ₅ ME 3000 kcal CP 17%	Phase III 71-84 days	MC ₆ ME 2951 kcal CP 16.98%
Indicators established		- concentrated mixture intake (MC) - metabolisable energy and crude protein intake, - evolution of body weight, - feed conversion ratio (FCR), - livability of poultry (%), - European production index (EPI) - the analysis of fodder-feeding costs	

-V₁ –consisting of 36 chickens triphasically fed with MC₁, MC₃ and MC₅.

-V₂ –made of 36 chickens triphasically fed with MC₂, MC₄ and MC₆ which contains besides the elements inserted in MC structure for V₁ sunflower cakes, and in the structure related to the first phase of growth has been added a quantity of 10% egg.

-V₃–consisting of 36 chickens, this time biphasically forage-fed with MC₂ and MC₆ using the structure related to 1st and 2nd phase from V₂. Production period of organic broiler production in this study can be divided into 3 phase:

I. Starting phase: delivery from the hatchery until broilers have access to outdoor area (28 days);

II. Growth phase: transition period from initial move until 70 days;

III. Finishing phase: from d 70 until slaughter (days 84).

On the entire period of experiment, there have been set the following bio-productive indicators:

- MC intake, by a daily weighing of the fodder quantity administered, and of the unconsumed remains, they being reported to intervals of two weeks

- ME and CP intake calculated on the basis of chemical composition of gross integrated concentrate composition intake,

- Registration of the body mass at intervals of two weeks by weighting all broilers in the three experimental versions,

- Setting the weight gain by making bi-monthly weighing through the entire growth,
- Setting the feed conversion ratio (FCR), determined by MC ingesta and by the weight gain calculated in growth phases through the entire experimental period,
- Registering the group, according to register sheets on mortality,
- Determining the European index of production (EIP) using the formula:

$$EIP = [(BW, \text{ kg} \times \text{livability, \%}) / (\text{FCR, kg} \times \text{age, days})] \times 100$$

- the analysis of fodder-feeding costs estimating the real costs with fodder-feeding/kg body weight. Statistical analyses were performed using IBM SPSS software. The data analyzed using One-Way Analysis of Variance (ANOVA) with diet as the factor. The significance of difference between the means was determined by Tukey test and Chi-Square test.

Table 2. Composition of the experimental diets for chicken

Item	Starter		Grower		Finisher	
	V ₁ MC ₁	V ₂ +V ₃ MC ₂	V ₁ MC ₃	V ₂ MC ₄	V ₁ MC ₅	V ₂ +V ₃ MC ₆
Ingredient (%)						
Egg	-	10	-	-	-	-
Maize	33	41	37	52	44	57
Barley	30	10	30	10	30	13
Soybean meal expeler	34	28	30	20	22.5	12
Sunflower meal expeler	-	8	-	15	-	15
Mineral premix	3	3	3	3	3	3
Nutritional characteristics						
Metabolisable energy						
ME kcal/kg	2965	2851	2978	2948	3000	2951
MJ/kg	12.41	11.93	12.46	12.34	12.56	12.35
Crude protein						
CP (%)	20.90	20.94	19.54	19.61	16.99	16.98

3. Results and discussion

As a result of experiment having as purpose the evaluation of impact of nutritional characteristics and of MC period on productive performances of broilers organically raised, there have been obtained the following results:

Mixture of concentrated intake (MC) has been set in periods of two weeks, yet the presentation happens in phases of MC administration, in Table nr. 3.

Table 3. The evolution of feed consumption

Item	Phase			Total	
	I: 1-28 days	II: 29-70 days	III: 71-84 days		
V ₁	-feed consumption MC (g/chicken)	992	4598	3542	9132
	-adi* (g/chicken/day)	43.00	109.47	253	108.7
V ₂	-feed consumption MC (g/chicken)	1172	5172	3668	10012
	-adi* (g/chicken/day)	51.86	123.14	262	119.2
V ₃	-feed consumption MC (g/chicken)	1168		8560	9728
	-adi* (g/chicken/day)	51.71		152.85	115.80

*adi –average daily intake

From the data of Table 3 we can notice that V₁ has registered an MC small total consumption of a consumption of 108.70 g, followed by V₃ with a total consumption higher with 6.53%. V₂ has registered the highest total consumption of MC

daily average of (9132 g) on the entire experimental period, with a daily average (10012 g, with adi -119.20 g) at a 9.65% difference from V₁ and only of 3.95% from V₃.

Regarding the consumption data presented, the following explanations can be formulated:

- in the first phase of growth, the higher energetic level of MC has determined a daily average consumption that has been smaller for the chickens in V₁ comparing with the values recorded by the other two versions, and this stands for the following phases of growth.

-the energetic levels of food almost equal for broilers in V₂ and V₃ have caused small

differences of percent even if broilers in V₃ were administered only two MC structures.

Thus, the dietary energy exerts its effect through variations in feed intake [9]. As energy levels increase, feed intake decreases. A high energy diet effectively limits feed intake, which also limits protein and amino acid intake [10].

➤ **ME and CP intake** has been set in phased of MC administration (Table 4).

Table 4. The evolution of daily average intake of metabolizable energy (ME kcal) and of crude protein (CP g)

Item	ME kcal*			CP g*		
	V ₁	V ₂	V ₃	V ₁	V ₂	V ₃
Phase I	105.05	119.33	118.93	7.40	8.76	8.73
Phase II	326.02	363.03	451.08	21.39	24.15	25.96
Phase III	759.00	773.16		42.98	44.49	
Total	324.53	350.15	340.36	20.33	22.41	20.22

*average daily intake

From the data on metabolizable energy intake during growth, is found that it registers values from the three different experimental versions. V₂ is highlighted during both growing phases and during the entire period with energy consumption of 350.15 kcal/day, which is higher by 7.89% than V₁ that used an MC with a higher level of ME in the first phase of growth and by 6.24% than V₃.

Regarding the intake of CP, there can be seen that V₁ recorded an intake of CP by only 0.54% lower than V₃, the version that has benefited during growth of only two prescriptions of MC. The experimental version 2 had a general CP intake with 10.23% higher than V₁. Low-protein diet is used to support a slower rate of growth and improve meat quality [11].

Body weight and growth rate are shown in growth phases in Table 5.

Results on body weight in Table 5 show that the experimental versions consumed in the first phase of growth MC₂, V₂ and V₃ with 10% egg in their structure had a body mass superior to p<0.001 (710.22, respectively 691.38 g) compared with V₁

(518.20 g) which consumed an MC without animal protein, although both MC structures were about 20.90% CP. The daily average growth achieved in the first phase by broilers in V₂ and V₃ is about 23 g of 40.25% compared with V₁.

In the second growth phase V₂ stands with a body mass of 2490.30 g, 4.10% higher than V₃ (p>0.05) and 14.28% higher than V₁ (p<0.001). In this growth phase V₁ stands with a daily mean growth close to the value of V₃, but they do not recover the small increase achieved in the first 28 days.

V₂ distinguishes in the last phase of growth, reaching a final slaughter weight of 3867.33 g maintaining the significant difference (p<0.001) compared to broilers in V₁ (3419.25 g).

As noticed, the version 2 shows experimental values of upper body mass compared to the experimental version 3 (3710.96 g), but these differences are small and uninsured statistically (p>0.05).

It is noteworthy that during the growth of chickens in organic system, there has been registered a coefficient of variation less than 10% which shows a uniform increase.

Table 5. Statistical indices of the body mass and weight gain in growth phases

Item	Body mass			Weight gain	
	Mean ± Std. error	Std. deviation	CV (%)	Weight gain/period	Daily mean growth
Phase I					
V ₁	518.20 ± 8.35 ^A	50.10	9.73	477.20±7.25	17.04±0.99
V ₂	710.22 ± 11.960 ^B	71.765	10.10	669.22±8.10	23.90±1.12
V ₃	691.38 ± 10.236 ^B	61.417	8.80	650.38±7.99	23.23±1.10
Phase II					
V ₁	2179.00 ± 31.577 ^A	178.632	8.20	1693.84±16.22	40.33±1.86
V ₂	2490.30 ± 37.057 ^B	212.876	8.55	1780.08±18.04	43.38±2.30
V ₃	2392.18 ± 34.485 ^B	198.103	8.28	1700.8±18.00	40.49±2.45
Phase III					
V ₁	3419.25 ± 55.667 ^A	314.903	9.21	1240.25±10.15	88.58±4.35
V ₂	3867.33 ± 63.579 ^B	365.236	9.44	1377.03±11.25	98.36±5.42
V ₃	3710.96 ± 67.28 ^B	386.538	10.42	1318.78±11.08	94.20±4.60
Period one day – 84 days					
V ₁	3419.25 ± 55.667 ^A	314.903	9.21	3378.25±38.44	40.21±1.98
V ₂	3867.33 ± 63.579 ^B	365.236	9.44	3826.33±40.22	45.55±2.45
V ₃	3710.96 ± 67.28 ^B	386.538	10.42	3669.96±55.89	43.69±2.28

^{A-B}The mean difference is significant at the 0.001 level, ^{B-B}The mean difference is insignificant at the 0.05 level

Figure 1 graphically represents the evolution of body mass modeled using third degree polynomial regression in chickens of the three experimental versions.

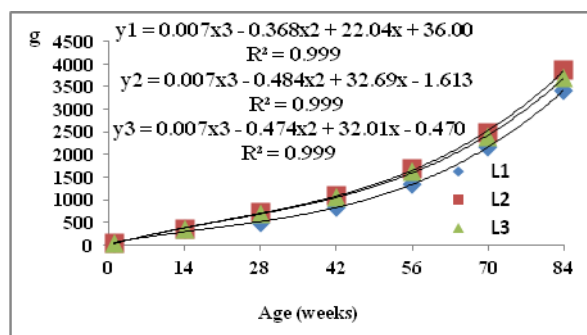


Figure 1. Graphical representation of body mass modeled using the third degree polynomial regression

The chart presented in Figure 1 shows that the experimental version 2 obtains upper weights than the versions V₁ and V₃, during the broilers growth period. There can be noticed a higher difference between V₂ and V₁ (13.10%) and a smaller difference between V₂ and V₃ (4.03%).

Bassler and Ciszuk (2002) [12] achieve similar results in Ross hybrids fed ad libitum with MC with 11.8 MJ ME/kg and 19 %CP at the age of nine weeks having body weights of 3.67 kg, with FCR 2.45.

Feed conversion ratio (FCR), set in phases of administration of concentrated composition is presented in Table 6.

Table 6. Feed conversion ratio (FCR)

Item	Feed conversion ratio			Total
	Phase I: 1-28 days	Phase II: 29-70 days	Phase III: 71-84 days	
V ₁	2.08	2.76	2.85	2.70
V ₂	1.75	2.90	2.66	2.62
V ₃	1.80		2.83	2.65

The results obtained, shown in Table 6 allow the following estimations:

- in the first phase of growth of broilers in V₂ and V₃, the insertion of a protein source with high biological value in MC structure (10% egg)

generated a food conversion index of 1.75-1.80 obviously lower than in V₁ de 2.08.

- in the following growth phases, feed conversion ratio equalizes between the three experimental versions, thus FCR values are not significantly

different, which is a good start, administrating in the first 28 days a balanced MC energo-proteic and with a source of animal protein, and for the rest of growth period (29-84 days) only one

prescription of MC with 2951 and about kcal ME 17% CP.

The group keeping and the European production index were set the stages of growth (Table 7).

Table 7. Statistical analysis on the livability and production index

Item	Livability (%)			EPI ¹		
	V ₁	V ₂	V ₃	V ₁	V ₂	V ₃
Phase I-starter	97.22 ^A	97.22 ^A	100 ^A	86	140.91	137.17
Phase II -grower	88.88 ^A	91.66 ^A	91.66 ^A	100.24	112.44	
Phase III -finisher	88.88 ^A	91.66 ^A	91.66 ^A	133.99	161.06	152.80

¹European production index [(BW,kg x livability, %)/(FCR, kg x age, days] x 100

^{A-A} difference is insignificant at the 0.05 level

The data presented in table 7 show that the experimental version 1 has the lowest group keeping rate of 88.88%, with a mortality rate of 11.12%. Experimental versions 2 and 3 had a lower group keeping rate of 91.66% with a mortality rate of 8.34%.

It is proved that the mortality rate begins to increase after 28 days, when chicks had access to the paddock.

Mortality rate recorded during the course of the experiment is within the limits found in the literature relating to the category of birds bred in organic system [8, 13].

The data on EPI recorded in Table 7 will show that V₂ has in the first phase of growth an EPI of 140.91, at a small difference from V₃ (2.72%), and at a very large difference from V₁ (63.84%), which shows again that this experimental version had an improper layer. At the end of growth period, V₂ stands with the highest value of EPI (161.06) with 20.20% higher than V₁.

Forage feeding cost analysis has been set throughout the period of growth based on purchase price of feed and on the MC structure in growth phases (Table 8).

Table 8. Expenses recorded feeding chicks

Item	Feeding expenses			
	/chicken		/kg weight	
	lei	euro	lei	euro
V ₁	15.070	3.562	4.407	1.042
V ₂	16.491	3.898	4.264	1.008
V ₃	15.010	3.548	4.045	0.956

Data analysis presented in Table 8 show that the experimental version biphasically fed (V₃) recorded the lowest feeding costs per kg live weight 0.956 Euros. This was due as a result of renouncing at the administration of MC prescription, corresponding to the second phase of growth (by about 19.5% CP).

In Figure 2a, b, c we have a graphical image of the leading indicators expressed as percentage difference by comparing their experimental variations for the formulation of a clear

conclusion.

In Figure 2a, the percentage differences of indicators relate to the V₁ experimental version, where chicks were fed with three MC structures and with CP content similar to V₂ and V₃ experimental versions, yet with a lower biological value.

The analysis of these data show that V₂ and V₃ recorded a higher performance, with a feeding cost of 3.26%, lower than V₂, and of 8.25% lower than V₃.

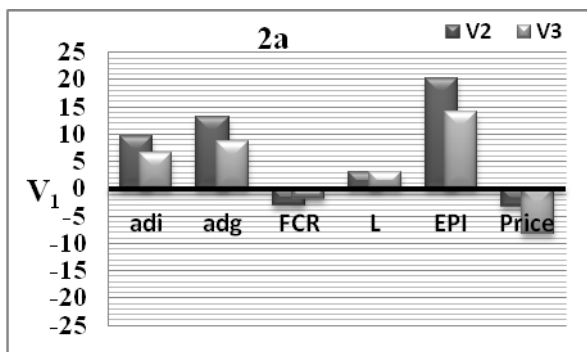


Figure 2a. Graphical representation of percentage differences between the main productive indicators

In Figure 2b, the indicators are reported to the experimental version 2, which registered the best performance, versions V₁ and V₃ showing values below it.

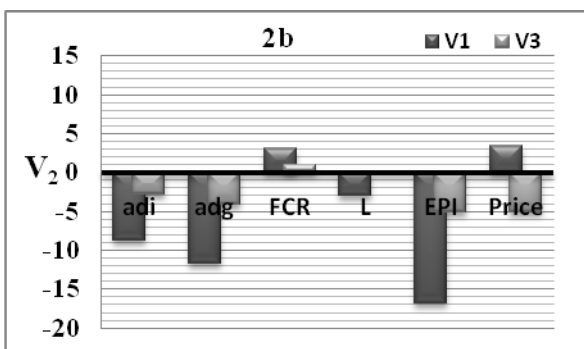


Figure 2b. Graphical representation of percentage differences between the main productive indicators

In Figure 2c the consumption and production performance are reported in version V₃. It is found that this version presents performances that are higher than V₁ and lower than V₃, and the lowest recorded feeding costs.

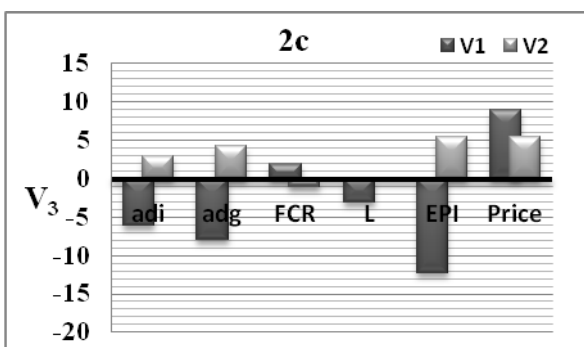


Figure 2c. Graphical representation of percentage differences between the main productive indicators

4. Conclusions

After the experiment on hybrid ROSS 308 broilers under feeding conditions specific to organic system, here are the following conclusions:

- V₂ chickens triphasically fed with MC with 2851, 2948, 2951 kcal ME / kg and 20.94, 19.61 and 16.98% CP have recorded the best growth performance weighing 3867.3 g, significantly higher (p<0.001) than version 1 (which had no egg in MC structure), the best feed conversion rate of 2.62 kg MC/kg gain, but with feed costs recorded lower than V₁ and slightly higher than V₃ (version biphasically fed).

- Chicks of the experimental V₃ fed biphasically with 2851 and 2951 kcal ME in combination with 20.94 and 16.98% CP recorded during the growth performance slightly lower than V₂, but significantly higher than V₁ on body mass (p<0.001) in the end, FCR 2.65 at insignificant difference compared to V₂, EPI with the highest value of 152.80, with the lowest costs of feeding, only 0.956 Euros / kg body weight

- V₁ broilers fed with three structures of MC with 2965, 2978 and 3000 kcal ME in combination with 20.90, 19.5 and 17% CP, but containing no egg in the structure of prescription given in the first phase of growth, recorded the lowest growth performance: 3419.25g body weight, FCR 2.70 kg /MC kg gain, viability of 88.88%, EPI only of 133.99, accompanied by the high feeding costs (1.042 Euros / kg live weight).

Given the productive performances and the expenses incurred with feeding recommend the using of biphasic feeding with the set nutritional conditions, in organic farming and husbandry.

Acknowledgements

This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/89/1.5/S/63258 "Postdoctoral school for zootechnical biodiversity and food biotechnology based on the eco-economy and the bio-economy required by eco-san-genesis"

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