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A BIO-ECONOMIC ANALYSIS MODEL IN TETRA H HYBRID RAISED IN ORGANIC SYSTEM

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ABSTRACT

This paper shows a bio-economic analysis model in Tetra H hybrid, raised in organic system, in line with the protein intake and of the body weight registered during the experimental period. The mathematic model y=a/(1+bx+cx2) allows the assessment of the expenses recorded with chicken feeding depending on crude protein intake. The model also validates the possibility to simplify the chickens' nutrition technology (starting from a triphase fodder feeding to a diphase fodder feeding) and at nutritional (protein) levels adapted to the desired body weight. The indices of correlation between the expenses registered with fodder feeding and crude protein intake show us that between them there is a strongly positive correlation, thus: 0.958 (in T1), 0.980 (in T2) and 0.972 (in T3). The indices of determination (R2) corresponding to the three experimental variants are higher, with values over 0.963, and the error percentage of the mathematical model is reduced (below 6%). Based on the results obtained in Tetra H chickens, it may be recommended a diphase fodder feeding (with starter fodder between 1-21 days and grower-finisher fodder between 22-112 days) with concentrates mixtures (CM) by 22% and 17,5% CP and 2971 and 3160 kcal ME/kg.

Keywords: bio-economic analysis, protein, mathematical model, costs of feeding, organic poultry Tetra H

INTRODUCTION

Ecologic agriculture is thought to be a viable solution, which solves the negative impact of an intensive agriculture, through which are satisfied the requests of some advised consumers, contributing to the protection of the environment, to the welfare of the animals, as well as to the rural development (Regulation CE 889/2008).

The ecological poultry egg and meat production registers a special dynamics through an increase in the number of operators in this sector, but due to the low level of the productive performances, the internal intake needs can still not be provided.

The indices most utilized in assessing the economic efficiency of aviculture and organic system can be: live growth achieved at the sacrifice age (min 81 days), the cost per poultry and per unit of product, the feed/day/bird expenses and per unit of product, the energy intake per bird, the hours-individual activities per unit of product, the profit per bird (simiz et al. 2012).

From the influence factors on the costs of an organic product, are cut off the expenses with fodder feeding, which, according to different authors, (Scahaw, 2000; Weersink et al. 2002) may oscillate 40% and 60%.

Failing some complete control values of feed for poultry youth raised organically, we hereby propose a bio-economic analysis model of the results achieved in Tetra H hybrid depending on the administered crude protein intake and of the body weight registered at the end of the experimental period.

The high degree of correlation of protein level with weight gains and the feed conversion rate (Mendes and Cury, 1986; D'alfonso, 2003; Balevi and Coskun, 2000; Zhan et al. 2007; dairi et al. 2010) as well as the high costs of protein feeds, has stayed at the basis of the elaboration of bio-economic analysis model in Tetra H hybrid, raised in organic system.

MATERIAL AND METHODS

The experiment that led to the elaboration of bio-economic analysis model has been performed on a number of 102 one day old of mixed sex Tetra H. These birds were again randomly divided into three equal treatment groups of 34 birds each. In the experiment, dietary treatments were as follows: chickens in T_1 were triphase fed with starter (1 to 21 d), grower (22 to 56 d) and finisher (57 d to slaughter, 112 d) with 22.00, 19.03 and 17,5% crude protein (CP) and 2971, 3136 and 3160 kcal (metabolizable energy) ME, chickens in T_2 were diphase fed with starter (1 to21 d) and grower-finisher (22 to 112 d) with a nutritional value similar to that of chickens in T_1, and the chickens in T_3 diphase fed with starter and grower-finisher with protein level minimized by approx. 10p% and energetic level by 5.5-8% (19,73, respectively 15,75% CP and 2809, respectively 2910 kcal ME). Feed and water was provided *ad libitum*. Daily mortality was recorded for each group.

Bird and feed were weighed every two weeks to determine body weight and feed intake, and to calculate the protein and energy intake.

Economic traits:

a. Cost of feed (CF) consumed for one kg of weight gain was calculated as follows:

CF=(C1F1+C2F2+C3F3)/(WG1+WG2+WG3), where:

C1, C2, C3: Price of one kg feed at starter, grower and finisher, respectively.

F1, F2, F3: Feed intake at starter, grower and finisher, respectively.

WG1, WG2, WG3: Weight gain at starter, grower and finisher, respectively.

The fodder feed costs analysis has been set during the entire growing period based on the purchase price of the fodders and based on the concentrated mixture (CM) structure in the phases of growth.

b. Estimation of feed costs based on protein intake with the help of a mathematic model using the Data fit 9 softhware.

Data were processed by one-way ANOVA (IBM SPSS Statistics 19). When appropriate, differences among system means were compared with Turkeys multiple-range test and were considered significant at $P<0.05$.

RESULTS AND DISCUSSIONS

Data on body mass, total growth rate, CM and CP intake, and ME as well, set for the entire experimental period in Tetra H hybrid are shown in *Table 1*.

Table 1. Body weight, feed, protein and energy intake of chickens belonging to different experimental groups

	T_1	T_2	T_3
Body weight at 112 d (g)	2150.00 ± 41.539^{a}	2070.00 ± 40.06^{a}	1700.00 ± 33.485^{b}
Average daily gain (g)	18.84 ± 0.538^{a}	18.13 ± 0.612^{a}	14.82 ± 0.500^{b}
Feed intake (kg)	5.850 ± 0.265^{a}	5.840 ± 0.115^{a}	5.020 ± 0.282^{a}
CP intake (g)	9.57 ± 0.435^{a}	9.31 ± 0.177^{a}	7.22 ± 0.397^{b}
ME kcal	163.91 ± 7.458^{a}	164.00 ± 3.291^{a}	130.03 ± 7.351^{b}

$^{a-a}$ $P>0.05$; $^{a-b}$ $P<0.05$.

The data on body mass at the end of experimental period show that the experimental variant T1 obtains higher weights (2150.00 ± 41.539 g) compared to variants T2 and T3. Chickens in T2 weighing 2070.00 ± 40.06 g at the end of experiment follow closely the body mass of chickens in T1 with an insignificant difference ($p>0.05$). Chickens in T3 registered the most reduced body weight (1700.00 ± 33.485 g) with a significant difference from T1 as well as from T2 ($P<0.05$).

The total rate of growth listed in table 1 reconfirms the findings on body mass evolution of chickens i.e. chickens in T2 fed according to the diphase model, fed with two CM common structures for 85 days from the total of 112 days plus the total of chickens in T1 (fed according to triphase model) registers an decrease of only 3.77% lower, which allows the simplification of fodder feed technology to two phases. The decrease of energetic rate by 5.5-8% and of the protein rate by approx. 10% for CM given to chickens in T3 significantly reduces, by 18.23%, the increases in growth compared to chickens in T2, which shows the necessity to keep a proper nutritional contribution and under the conditions of a slow growth of poultry youth.

It turns out that in T3 it has been registered the lowest total CM intake (5.020 kg/chicken) during the total experimental period, followed by T2 with a higher total intake of 14.20%. In T1 it has been registered the highest total CM intake (5.850 kg/chicken) by 0.17% compared to T_2 and by 16.53% compared to T_3. Although there are differences on CM ingestion, they are statistically insignificant ($P>0.05$).

Regarding the crude protein intake, it turns out that the values are close in T_1 and T_2, 9.57±0.435 g, respectively 9.31±0.177 g, a statistically insignificant difference ($P>0.05$), which could lead to the possibility of applying a diphase fodder feed. CP intake in T_3 registers significantly lower values (7.22±0.397 g) due to the fact that in this variant the CP has been reduced in both CM used structures.

As for the energy metabolized intake in chickens from the three experimental variants, according to data in *Table 1*, it turns out that between T_1 and T_2 the percentage differences are only of 0.06 %. By feeding chickens in T_3 with some CM with energetic levels lower by 162-250 kcal ME/kg, there is not recorded a compensatory energy intake (ZHAN et al. 2007), the ME intake during the entire experimental period being by 20.72% lower than T_2 ($P<0.05$).

The results of the economic analysis become decisive when selecting the feed technique (biphase and triphase) of the duration of these phases as well as on the protein level and the structure of concentrated mixtures.

Table 2. Expenses recorded of feeding chicken

	CF/chicken			CF/kg live weight		
	T_1	T_2	T_3	T_1	T_2	T_3
Euro	3.159	3.088	2.223	1.469	1.492	1.307
%	100	97.75	70.35	100	101.52	87.64

As expected, according to the data in Table 2, the highest expenses are made with feeders for chickens in T_1 with 3.159 euro/chicken, but expressing the costs reported to live weight kg, it turns out that chickens in T_2 (*Figure 1*) these costs are only with 1.52% higher, which allows recommend an application of a diphase diet and with nutritional CM values provided in protocol.

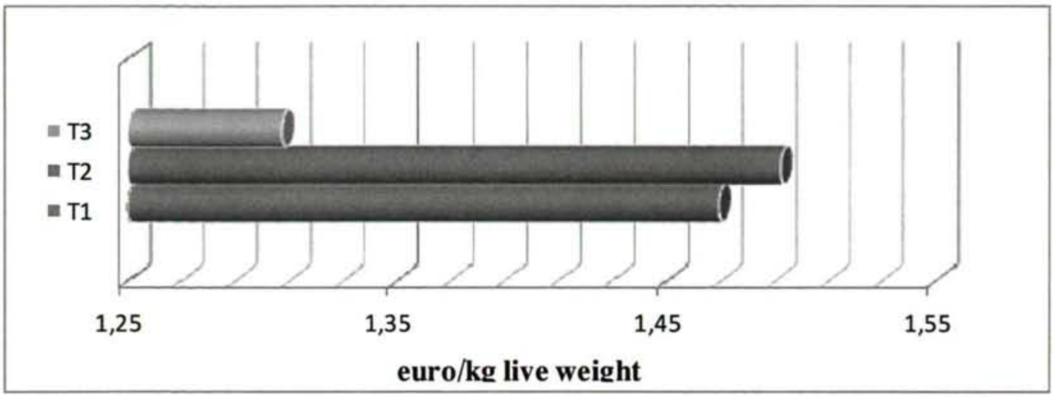

Figure 1. Representation of fodder intake of chickens from the experiment

Although for chickens in T_3 the costs of feed reported to live weight kg are the lowest (1.307 euro/kg live weight), the technological solution can be taken into consideration only under the conditions of accepting some modest productive indicators for Tetra H hybrid.
The indices of correlation between the expenses registered with fodder feeding (y) and crude protein intake (x), presented in Table 3, show us that between them there is a strongly positive correlation, thus: 0.958 (in T_1), 0.980 (in T_2) and 0.972 (in T_3). Starting from this premise, it has been set a mathematic model valid for the three experimental variants which can assess the expenses recorded with chickens fodder feed according to crude protein intake. The model: $y = a/(1+bx+cx^2)$, is shown in *Table 3*.

Tablel 3. Feeding cost estimates according CP intake (g)

Model Definition: $y = a/(1+bx+cx^2)$,
were: y=CF, x= CP intake (g)

Variance Analysis

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob(F)
Regression	2	8.1768856	4.08844	87.2748	**0.0001**
Error	5	0.2342281	0.06845		
Total	7	8.4111138			

Regression Variable Results

Variable		Value	Standard Error	t-ratio	Prob(t)
T_1	*a*	0.097655	2.924868	3.33880	**0.020**
R^2=0.972	*b*	-0.195656	9.068764	-21.5747	**0.000**
r=0.958	*c*	9.894671	8.512789	11.62330	**0.000**
T_2	*a*	0.115788	0.028855	4.0126923	**0.010**
R^2=0.976	*b*	-0.198663	0.008142	-24.399118	**0.000**
r=0.980	*c*	0.010273	0.000766	13.403427	**0.000**
T_3	*a*	0.075582	0.025637	2.9481113	**0.031**
R^2=0.963	*b*	-0.252680	0.015126	-16.704766	**0.000**
r=0.972	*c*	0.016559	0.001858	8.9108727	**0.0003**

Following the application of this mathematic equation, there can be assessed the expenses for fodder feeding in Tetra H hybrid, performed organically under conditions similar to the development of this experiment, based on the determination of crude protein intake.

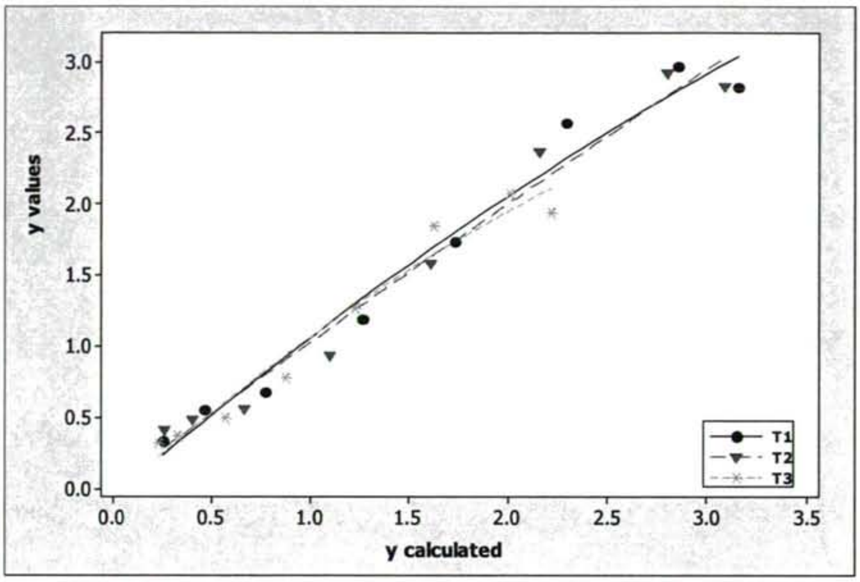

Figure 2. Fodder feeding cost for chickens in experimental variants

The analysis of data shown in *Table 3* results that the values calculated (the predicted price) is close to the analysis experimentally obtained during the 12 weeks of growth. The indices of determination (R^2) corresponding to the three experimental variants are higher, with values over 0.963, and the error percentage of the mathematic model is reduced (below 6%).

CONCLUSIONS

The chickens in T_2 fed by the diphase model record growth performance similar to variant T_1, with insignificant differences, but the costs recorded with fodder feeding are lower by renouncing the CM intermediary structure.

As for the crude protein intake, but also metabolized energy, it turns out that the values are closed in T_1 and T_2, which might lead to the possibility of applying a diphase fodder feeding. The intake CP to T_3 registers significantly lower values.

Costs registered with fodder feeding of Tetra H hybrid maintained in organic system, according to the gross protein intake, can be estimated with the help of the following mathematic model $y=a/(1+bx+cx^2)$ with an error below 6%. The mathematic model selected has registered a high determination index, over 0.958.

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