

# Growth and Carcass Composition Response of Different Protein Food Level for Ross 308 Hybrid Reared in Organic System

Simiz Eliza<sup>1\*</sup>, Drincenu Dan<sup>1</sup>, Stef Lavinia<sup>1</sup>, Mic Florica Irina<sup>2</sup>, Julean Călin<sup>1</sup>,  
Nagy Voinea Robert<sup>1</sup>

<sup>1</sup>Banat's University of Agricultural Sciences and Veterinary Medicine,  
"King Michael I of Romania" from Timisoara, 300645, Calea Aradului 119, Romania  
<sup>2</sup>S.C. AVE IMPEX SRL, 440111 Satu Mare, Soimoseni no. 32, Romania

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## Abstract

The purpose of this experiment was to assess the impact of various protein levels and of the administration periods of concentrate mixture (CM) on the growth and carcass composition in Ross 308 hybrid ecologically raised. The experiment was conducted over a period of 84 days on a flock of 108 chickens belonging to Ross 308 commercial hybrid. There were three experimental groups consisting of 36 chickens. The chickens were fed with the tri-phase feeding program in G<sub>1</sub>, and with the bi-phase feeding program in G<sub>2</sub> and G<sub>3</sub>, as follows: G<sub>1</sub> and G<sub>2</sub> with the same period of administration of CM and with close protein levels, but in G<sub>2</sub> the biological value of the protein in CM starter was higher. G<sub>3</sub> chickens were fed with the bi-phase feeding program, respectively 1-28 days and 29-84 days where the protein level was of 20.94 % and 16.98 % CP. Chickens in G<sub>2</sub> and G<sub>3</sub> received the same CM starter structure with a protein level of 20.94 % with an upper VB. Statistical analysis of the received results was performed by the IBM SPSS 19 software using the analysis of the variant and the testing of significance with ANOVA test complemented by Tukey posthoc test. It can be appreciated that the body weight was significantly influenced (G<sub>2</sub> - 3826.33 g, and in G<sub>3</sub> -3669.96 g) by incorporating an animal protein source (boiled egg) in the CM structure, which after a good start allows the application of a two-phase feeding technology (in G<sub>3</sub>), which significantly simplifies the growing process of broilers. This experimental scheme did not cause significant differences in the quality of meat or in the weight of the cut-up parts of the broiler carcasses.

**Keywords:** protein level, organic system, carcass composition, broilers

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## 1. Introduction

In the recent years, the quality attributes of food products, including poultry products, show a special interest. Modern consumers are becoming increasingly aware of the relationship between quality and safety [1, 2] and most of them believe that organic food products are healthier [3], have superior sensory properties associated with a better taste [4-6]. Quality features are determined by a large number of genetic and non-genetic

factors. Among non-genetic factors, broiler nutrition plays an important role together with the growing system applied [7-9].

In the intensive growing system, the food protein level has major effects on the carcass rate and composition [10], but the scientific information on the effect of different protein levels, which are even available in this system, are controversial [11] McInermy quoted by Czyszter, 2010, [12] states that consumers of western European countries search for a maximum nutritional benefit for the money they are willing to pay.

Organic production of poultry faces severe restrictions in providing high protein food, therefore the organic poultry farmers must adapt

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\* Corresponding author: Eliza Simiz, 0256277265, 0256277110, [esimiz@animalsci-tm.ro](mailto:esimiz@animalsci-tm.ro)

to the limited range of protein-rich fodder feed with a high biological value [13]. Hence the need to adjust the protein level of structures of concentrate mixtures so as not to impair the bio-productive rates, and the quality of carcasses obtained in this farming system [14]. As a result of a study performed [15], state that recipes with a low protein level can support proper growth rate when using high digestibility ingredients, but nevertheless a high rate of breast meat requires a diet rich in crude protein (CP).

By using rations with different levels of CP during growth [16] concluded that the reduction of CP in rations had no effect on carcass and wings growth rate, but it reduced the chest growth rate and increased the legs rate.

Mic Florica et al., 2013, [17] in a study on organic Tetra H hybrid, found that protein level and CM administration periods did not significantly influence the carcass or trade rate, but there were registered significant differences in the cut-up chicken carcasses regarding the weight of breast, the weight of chicken offal cutlery and edible giblets determined by the reduction of CM protein level.

## 2. Materials and methods

The purpose of this study was to evaluate the effect of protein level and periods of CM

administration on growth and carcass composition in organic Ross 308 hybrid to establish a technological nutritional conduct for this breeding system.

The experiment was conducted over a period of 12 weeks (84 days) on a number of 108 ROSS 308 commercial hybrids under feeding conditions specific to ecological system. Broilers were divided into three experimental variants, which had a differentially feeding regime in terms of nutritional characteristics of (CM) concentrate mixture and of fodder feeding periods.

-G<sub>1</sub> –consisting of 36 tri-phase fed broilers, as follows: CM starter 1-28 days (20.90% CP and 2965 kcal ME), CM grower, 29-70 days (19.5% CP and 2978 kcal ME) and CM finisher 71-84 days (17% CP and 3000 kcal ME);

- G<sub>2</sub> –consisting of 36 tri-phase fed broilers, as follows: CM starter 1-28 days (20.94% CP and 2851 kcal ME), CM growth 29-70 days (19.61% CP and 2948 kcal ME) and CM finishing 71-84 days (16.98% CP and 2951 kcal ME);

- G<sub>3</sub> –consisting of 36 bi-phase fed broilers, as follows: CM starter 1-28 days (idem G<sub>2</sub>) and CM growing-finishing 29-84 days (16.98% CP and 2951 kcal ME).

**Table 1.** Ingredient and nutritional characteristics of the experimental diets for chicken

Item	G <sub>1</sub>			G <sub>2</sub>			G <sub>3</sub>	
	Starter	Grower	Finisher	Starter	Grower	Finisher	Starter	Grower-Finisher
	1-28 d	29-70 d	71-84 d	1-28 d	29-70 d	71-84 d	1-28 d	29-84 d
<b>Ingredient (%)</b>								
Egg	-	-	-	10	-	-	10	-
Maize	33	37	44	41	52	57	41	57
Barley	30	30	30	10	10	13	10	13
Soybean meal expeler	34	30	22.5	28	20	12	28	12
Sunflower meal expeler	-	-	-	8	15	15	8	15
Mineral premix	3	3	3	3	3	3	3	3
<b>Nutritional characteristics</b>								
ME (kcal/kg)	2965	2978	3000	2851	2948	2951	2851	2951
CP (%)	20.90	19.54	16.99	20.94	19.61	16.98	20.94	16.98

▪ Requirements in vitamins and minerals are provided according to NRC 1994 requests [18], by using a premix according to regulations in force.

▪ ME –metabolized energy, CP –crude protein

Regarding the CM structures in Table 1, there are noticed the following issues:

-during the starter phase, the protein levels are considerably close, but by adding in CM 10% of

boiled egg for G<sub>2</sub> and G<sub>3</sub>, the protein biological value (BV) improved, but ME/Kg is reduced by 114 Kcal.

-during the growing phase, the energy and protein levels were very close, but structures differed in various rates of corn, barley and soy cakes by adding 15% of sun flower in G<sub>2</sub> and G<sub>3</sub>, a more available and cheaper fodder than soy cakes.

-during the finishing phase, there were used mixtures with the same energy and protein characteristics, but with different elements for the structures administered to G<sub>2</sub> and G<sub>3</sub> using 15% of sun flower cakes when reducing soy cakes by 10.5%, barley by 17%, and increasing corn rate by 13%. Actually, by administering CM, G<sub>3</sub> aimed to cover two growing phases (from 29 to 84 days) after using in CM during the starter phase, which contained boiled eggs and animal proteins with a high biological value.

At the end of experimental period, there were carried out determinations of chicken carcass yield, there was set the weight of some anatomic part, after slaughtering 4 chickens (2 females and 2 males) in each experimental group. Chicken slaughter was performed under the law in force.

Carcasses were refrigerated over 18 hours in temperature of +4°C. Statistical analysis was performed with IBM SPSS software [19], using ANOVA test. The signification of the differences

between the experimental groups was performed with Tukey post hoc test.

### 3. Results and discussion

After the experiment regarding the effect of some protein components in CM and their periods of administration in Ross 308 hybrid in two and three phases of growth, there were recorded the following results: broilers in G<sub>1</sub> showed a body weight of 3419.25 g, significantly lower (p<0.01) compared with experimental variants fed with a starter recipe with a high biological value due to the content of 10% boiled eggs in CM structure (Table 2).

At the end of the experiment, there were performed determinations of the broilers' yield at slaughter, it was set the share of some anatomical parts and of edible giblets of chickens live weight and there were made observations on the sensory quality of meat resulted from these chickens.

The results of the efficiency at slaughter, showed in the two ways: yield of carcass and the commercial yield (which includes the weight of the giblets) are shown in Figure 1.

**Table 2.** Broilers body weight at the end of the experiment and testing the meaning of the difference between the averages

Item	G <sub>1</sub>	G <sub>2</sub>	G <sub>3</sub>			
Body weight (g) at 84 days ( $\bar{x} \pm S \bar{x}$ )	3419.25 ± 55.67 <sup>a</sup>	3867.33 ± 63.58 <sup>b</sup>	3710.97 ± 67.29 <sup>b</sup>			
CV %	9.21	9.44	10.42			
ANOVA						
	Sum of Squares	df	Mean Square	F	Sig.	
Between Groups	3352182.472	2	1676091.236	13.133	<b>0.001***</b>	
Within Groups	12123988.303	95	127620.930			
Total	15476170.776	97				
Multiple Comparisons Tukey HSD						
Experimental groups	Mean Difference	Standard error	Sig.	95% Confidence Interval		
				Lower Bound	Upper Bound	
G <sub>1</sub>	G <sub>2</sub>	-448.0833	88.6310	<b>0.000***</b>	-659.1138	-237.0529
	G <sub>3</sub>	-291.7197	88.6310	<b>0.004**</b>	-502.7501	-80.6893
G <sub>2</sub>	G <sub>3</sub>	156.3636	87.9465	0.183	-53.0372	365.7645

\*\* p<0.01; \*\*\*p<0.001.

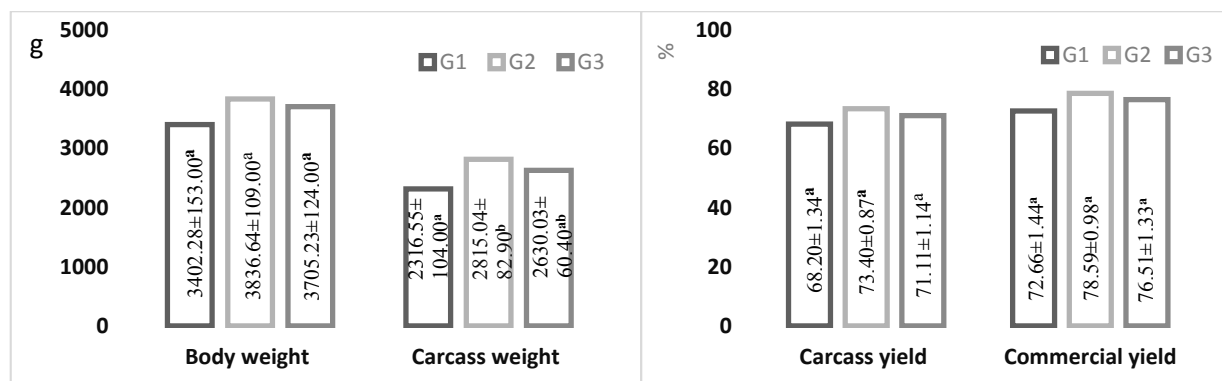


Figure 1. Growth performance of ROSS 308 broilers raised in organic system

Carcass yield, which represents the share of carcass of the total bodyweight, is between 68.20% and 73.40%, thus results in increase yield of about 7% in the experimental variants G<sub>2</sub>, and of 4% in G<sub>3</sub>, variants that have registered the best bio-productive performance.

The same situation is present in the commercial yield, which also contains the offal (heart, gizzard, liver) weight besides the carcass weight relative to live weight. On the average, commercial yield was of 72.66% in G<sub>1</sub>, and of 78.59% in G<sub>2</sub>, respectively of 76.51% in G<sub>3</sub>.

It is noted that the experimental groups that had a very good start record a slaughter yield, meaning a high commercial yield compared with the experimental variant G<sub>1</sub>, which received in the first growth phase in CM structure with a low biological value compared to G<sub>2</sub> and G<sub>3</sub>.

Testing the significance of differences between the experimental variants regarding the yields at slaughter was performed by ANOVA testing complemented by Tukey testing, and the data obtained are presented in Figure 1.

The data presented in Figure 1 show that although there were no significant differences in terms of live weight of the slaughtered poultry, the carcass weight in chicks belonging to variant G<sub>2</sub> registered significant differences (p<0.001) in their favor compared to carcass weight of chicks belonging to G<sub>1</sub>.

The registered differences regarding the carcass yield but also in the case of the commercial yield are statistically insignificant (p>0.05).

After cutting the carcasses into parts (breast with bone and skin, legs, wings and giblets) the obtained results are summarized in Tables 3-7.

Table 3. Testing the significance of differences (ANOVA complemented by Tukey test) in carcass quality (breast with bone and skin)

Item		G <sub>1</sub> X±Sx	G <sub>2</sub> X±Sx	G <sub>3</sub> X±Sx		
Breast with bone and skin	(g)	513.90±10.60	662.10±42.30	634.50±23.40		
	% of carcass	22.28±0.55	23.56±1.05	24.13±0.527		
	Percentage differences	100	105.74	108.30		
Sum of Squares		df	Mean Square	F	Sig.	
<b>Breast weight (Tukey HSD)</b>						
Between Groups		4972.36	2	24862.68	7.620	0.012*
Experimental groups	Mean Difference	Standard error	Sig.	95% Confidence Interval		
				Lower Bound	Upper Bound	
G <sub>1</sub>	G <sub>2</sub>	-148.24	40.39	0.013*	-261.01 -35.48	
	G <sub>3</sub>	-120.65	40.39	0.037*	-233.42 -7.88	
G <sub>2</sub>	G <sub>3</sub>	27.60	40.39	0.779	-85.17 140.37	
<b>Breast percentage (Tukey HSD)</b>						
Between Groups		3.330	2	1.665	0.746	0.502 <sup>ns</sup>

\*p<0.05; <sup>ns</sup>p>0.05.

The data presented in Table 3 shows that the weight of the chest with bone and skin is higher in variants that have benefited from a better start, 662.10 g (G<sub>2</sub>) and 634.50 g (G<sub>3</sub>) and of only 513.90 g in G<sub>1</sub> that consumed in the first growth phase in CM structure with lower biological value.

The share of chest reaches 24.13% in G<sub>3</sub>, by about 8% higher than G<sub>1</sub> and a share of G<sub>2</sub> 23.56% in G<sub>2</sub>, by 5.74% higher than G<sub>1</sub>.

The differences registered in terms of breast weight are statistically significant (p<0.05), but the differences regarding its share of the total carcass are however not significant (p>0.05).

**Table 4.** Testing the significance of differences (ANOVA complemented by Tukey test) in carcass quality (legs)

Item		G <sub>1</sub> X±Sx	G <sub>2</sub> X±Sx	G <sub>3</sub> X±Sx		
Legs	(g)	733.9±43.6	915.6±41.7	834.30±26.30		
	% of carcass	31.63±0.310	32.50±0.485	31.72±0.359		
	<b>Percentage differences</b>	<b>100</b>	<b>102.76</b>	<b>100.28</b>		
Sum of Squares		df	Mean Square	F	Sig.	
<b>Legs weight (Tukey HSD)</b>						
Between Groups		66303.98	2	33151.99	5.74	<b>0.025*</b>
Experimental groups	Mean Difference	Standard error	Sig.	95% Confidence Interval		
				Lower Bound	Upper Bound	
G <sub>1</sub>	G <sub>2</sub>	-181.74	53.76	<b>0.020*</b>	-331.83	-31.65
	G <sub>3</sub>	-100.46	53.76	0.203	-250.54	49.63
G <sub>2</sub>	G <sub>3</sub>	81.28	53.76	0.331	-68.80	23.33
<b>Legs percentage (Tukey HSD)</b>						
Between groups		0.690	2	0.345	0.563	0.589 <sup>is</sup>

\*p<0.05<<sup>is</sup>p>0.05.

Regarding the weight of the legs obtained after slaughter, it is found that the experimental groups G<sub>2</sub> and G<sub>3</sub> have recorded their highest weights: G<sub>2</sub> -915.6 g, holding a share of 32.50% of the whole carcass; G<sub>3</sub> -834.30 g with a share of 31.72% of the whole carcass. Weight of the legs to G<sub>1</sub> was only 733.90 g; their share is 31.63%.

Only significant differences are obtained with regard to their weight compared to G<sub>1</sub> to G<sub>2</sub> (p<0.05). In terms of total carcass weight of legs the differences are statistically insignificant (p>0.05).

**Table 5.** Testing the significance of differences (ANOVA complemented by Tukey test) in carcass quality (wings)

Item		G <sub>1</sub> X±Sx	G <sub>2</sub> X±Sx	G <sub>3</sub> X±Sx		
Wings	(g)	277.07±5.46	346.30±10.60	318.05±6.66		
	% of carcass	12.04±0.574	12.30±0.127	12.11±0.309		
	<b>Percentage differences</b>	<b>100</b>	<b>102.16</b>	<b>100.56</b>		
Sum of Squares		df	Mean Square	F	Sig.	
<b>Wings weight (Tukey HSD)</b>						
Between groups		9685.01	2	4842.50	19.52	<b>0.001**</b>
Experimental groups	Mean Difference	Standard error	Sig.	95% Confidence Interval		
				Lower Bound	Upper Bound	
G <sub>1</sub>	G <sub>2</sub>	-69.19	11.14	<b>0.001**</b>	-100.29	-38.10
	G <sub>3</sub>	-40.97	11.14	<b>0.013*</b>	-72.07	-9.88
G <sub>2</sub>	G <sub>3</sub>	28.22	11.14	0.075	-2.87	59.31
<b>Wings percentage (Tukey HSD)</b>						
Between groups		0.129	2	0.064	0.110	0.897 <sup>is</sup>

\*\*p<0.001; <sup>is</sup>p>0.05

The wing weight was also higher in the experimental variants with a better start (protein with high biological value) of 346.30 g in G<sub>2</sub>, their

share is of 12.30% of the whole carcass, by about 2% higher compared to G<sub>1</sub> and by 318.05 g in G<sub>3</sub>,

with a share of 12.11% from the whole carcass by only 0.58% higher than G<sub>1</sub>. Differences registered in the weight of the wings between G<sub>2</sub>-G<sub>3</sub> and G<sub>1</sub> are statistically significant

(p<0.01), but significant differences are recorded in terms of their share of the whole carcass.

**Table 6.** Testing the significance of differences (ANOVA complemented by Tukey test) in carcass quality (cutlery)

Specificare	G <sub>1</sub>	G <sub>2</sub>	G <sub>3</sub>	
	X±Sx	X±Sx	X±Sx	
(g)	791.70±61.30	891.10±39.80	843.20±30.80	
<b>Cutlery</b>				
% of carcass	34.06±0.753	31.64±0.531	32.04±0.405	
<b>Percentage difference</b>	<b>100</b>	<b>92.90</b>	<b>94.08</b>	
	Sum of Squares	df	Mean Square	F
<b>Cutlery weight (Tukey HSD)</b>				
Between groups	19765.68	2	9882.84	1.179
<b>Cutlery percentage (Tukey HSD)</b>				
Between groups	4.967	2	2.484	1.841

<sup>is</sup> p>0.05.

The cutlery weight is significantly higher by 891.10 g in G<sub>2</sub> compared to G<sub>1</sub> and by 843.20 g in G<sub>3</sub> compared to G<sub>1</sub> (791.70 g), but as share, the

cutlery weight is 34.06% in G<sub>1</sub> and only 31.64% in G<sub>2</sub> and 32.04% in G<sub>3</sub>.

**Table 7.** Testing the significance of differences (ANOVA complemented by Tukey test) in carcass quality (edible giblets)

Item	G <sub>1</sub>	G <sub>2</sub>	G <sub>3</sub>		
	X±Sx	X±Sx	X±Sx		
(g)	152.40±13.70	198.73±4.87	199.38±7.99		
<b>Edible giblets</b>					
% of body weight	4.46±0.36	5.19±0.19	5.40±0.39		
<b>Percentage differences</b>	<b>100</b>	<b>116.25</b>	<b>121.06</b>		
	Sum of Squares	df	Mean Square	F	
<b>Edible giblets weight (Tukey HSD)</b>					
Between groups	5812.19	2	2906.10	7.890	
<b>Edible giblets percentage (Tukey HSD)</b>					
Experimental groups	Mean Difference	Standard error	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
G <sub>1</sub>	G <sub>2</sub>	-46.36	13.57	<b>0.019*</b>	-84.25
	G <sub>3</sub>	-47.01	13.57	<b>0.018*</b>	-84.90
G <sub>2</sub>	G <sub>3</sub>	-0.65	13.57	0.999	-38.54
<b>Edible giblets percentage (Tukey HSD)</b>					
Between Groups	3.431	2	1.715	4.045	0.056 <sup>is</sup>

\*p<0.05; <sup>is</sup> p>0.05

Edible giblets weight is 152.40 g in G<sub>1</sub>, less than in G<sub>2</sub> (198.73 g), and also compared with G<sub>3</sub> (199.38 g), and have a smaller share of the body weight in G<sub>1</sub> (4.46%) compared to groups 2 and 3 (5.19% and 5.40% of body weight).

The difference between edible giblets weight is statistically significant (p<0.05) between G<sub>1</sub> and G<sub>2</sub>, but also between G<sub>1</sub> and G<sub>3</sub>. Regarding their share of the body weight, the differences are not statistically significant (p>0.05).

#### 4. Conclusions

After the experiment performed on Ross 308 hybrid broilers fed under specific conditions of organic system, are drawn the following findings:  
-Broilers belonging to the experimental group 1, which were fed with three structures of CM 2965; 2978 and 3000 kcal ME in combination with 20.90; 19.5 and 17 % CP, but boiled egg free in the structure of the recipe given in the first growth phase, showed the weakest growth rate: 3419.25 g body weight;

-Broilers belonging to the experimental group 2, tri-phase fed with CM 2851; 2948; 2951 kcal ME /kg and 20.94; 19.61 and 16.98 % CP had the best growth performance weighing 3867.3 g, significantly higher ( $p < 0.001$ ) compared to group 1 (boiled egg free in the CM structure);

-Broilers belonging to the experimental group 3, which were bi-phase fed with 2851 and 2951 kcal ME in combination with 20.94 and 16.98 % CP registered, during the growth, slightly lower rates compared to  $G_2$ , but with body weight at the end of the period significantly higher ( $p < 0.001$ ) than the experimental group 1;

-Under the conditions of this experiment, the feeding performed for the three experimental variants did not cause significant differences in meat quality, namely in the carcass cut yields of broilers;

Finally, we can state that, although the weight of the cut parts show significant differences between variants  $G_2$  and  $G_3$  compared to  $G_1$ , their share in the carcass weight is not significantly different, which recertifies the possibility of applying a bi-phase growth of Ross 308 chickens by ensuring during the starter phase an CM structure containing a protein source in its structure, with high animal biological values (10% boiled eggs).

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