The Influence of Feed Protein-Energy Level on the Growth and Slaughter Performance for „Arbor Acres" Hybrid

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Abstract
In this paper was studied the influence of feed energy-protein level on the growth performance (average daily gain, feed conversion), slaughtering efficiency and participation of the trenched parts in the whole carcasses structure at „ARBOR ACRES" hybrid slaughtered at 42 days old. The two groups (control group-Lc, experimental group Lexp.) were given feed mixed with different level of energy and protein (Lc-standard hybrid, Lexp.-higher by 10% compared to standard hybrid). In the growth period for each group were made weighings at: 1, 7, 14, 21, 35 and 42 days. After slaughter, from each group were sampled 30 carcasses (15 females and 15 males) for determined the slaughter efficacy on fresh and refrigerated carcasses. At the end of the growing period, at Lexp. group average body weight was 2481.93g, with 3.88% more than average values recorded at control group. For average daily gain, Lexp. group had higher values compared with the control group, the situation is reversed when has been referring to the feed conversion rate. The fresh carcasses at slaughtering efficiency had values for males from 80.27% (Lexp.) to 79.36% (Lc) and for females from 78.57% (Lexp.) to 78.18% (Lc). After 24 hours of refrigeration, these values were reduced by 1.78 up to 1.88%. For participation of the trenched parts in the whole carcass structure (breast, wings, thighs and shanks), at Lexp. group were registered the highest values, and for the control group the lowest values for these parts and the highest values for the other parts (head, neck, back and legs), with differences between females and males. For Lexp. group, which received feed with high protein-energy level, average values for feed conversion rate (FCR) were lower and for other studied indicators were higher as compared with control group.

Key words: average daily gain, feed conversion ratio, hybrid, slaughtering efficacy

1. Introduction

The modern technologies to broiler chicken growth aimed at: valorification genetic potential of hybrid, feed conversion rate and meat production.Poultry meat production and its valorification is under the influence of genetic factors and technological factors (growing technology, microclimate, nutrition, prevention, ensuring the health and welfare, etc.) [1, 2]. Every company producing broiler chicken has elaborated a broiler management guide specifically for each hybrid stating all the necessary technological elements for genetic potential exteriorization in condition of obtaining high economic efficiency [3].

To be a profitable activity in the growth of meat chickens is necessary to know the growth characteristics of hybrids delivered to market. Once with membership of Romania at the European Union appeared the competitive market of chicken meat, which aims obtain the qualitative carcasses at a competitive price.

Feed rations must be balanced so as to ensure a proper energy/protein balance, correlated with the stages of development of offspring. By ensuring

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an adequate feeding program ensures maximum expression the productive potential [3, 4, 5, 6].
Rations deficient in protein, even if not clearly reflected in the growth performance, impacting negatively on the carcass meat percentage [7, 8, 9]. In this paper was studied the influence of feed energy-protein level on the growth performance (average daily gain, feed conversion), slaughtering efficiency and participation of the trenched parts in the whole carcasses structure at „ARBOR ACRES" hybrid slaughtered at 42 days old.

2. Materials and methods

Our research was conducted on broiler chicken belonging hybrids "ARBOR ACRES", sacrificed at the age of 42 days. For this study, comprising two groups of chicks (males and females), of a control group (Lc) and experimental groups (Lexp.), reared in the same microclimate. In the growth period (1-42 days) for microclimate factors of the house (air temperature and air relative humidity), the values have been according to the manual „ARBOR ACRES" hybrid [2]. The growth system was on the permanent litter and a density of 12 chicks/m2. At the two groups of chickens were given feed mixed with protein and energy levels differently as follows: Lc-protein and energy level as recommended company Aviagen for the „ARBOR ACRES" hybrid [2], Lexp.-protein and energy level whit 10% higher than Aviagen recommendations for „ARBOR ACRES" hybrid. Depending on the age of chicks during growth (1-42 days) for each group were given three fodder recipes (starter, growing, finishing) (table 1) [1, 2, 6, 10, 11].

Table 1..Features of the mixed feed recipes for chickens

Recipe features	Chicken group	
	Lc	Lexp.
Starter 1-14 days		
Crude protein (%)	24.02	26.23
M. E. (kcal/kg feed)	3041	3270
Energy : Protein ratio	126.60	124.7
Grower 15-35 days		
Crude protein (%)	22.63	24.90
M. E. (kcal/kg feed)	3144	3435
Energy : Protein ratio	133.00	137.95
Finisher 36-42 days		
Crude protein (%)	21.06	23.12
M. E. (kcal/kg feed)	3190	3490
Energy : Protein ratio	151.50	150.00

In the growth period for each group were made individual weighing at: 1, 7, 14, 21, 35 and 42 days, to establish the dynamics of body mass, overall gain for each growth period or overall 42 days period and average daily gain.
The feed intake was determined weekly for each group. Data obtained were used to establish: the feed intake during each period, average individual intake/each feed recipe, daily intake (g/day/chicken) and feed conversion rate (kg feed/kg weight gain).
At the end of the growing period (42-day), chickens were slaughtered, from each group were sampled 30 carcasses (15 females and 15 males), which were weighed before and after refrigeration (24 hours at +4°C) and was determined the carcasses slaughter efficacy for fresh and cold carcasses. Slaughter efficacy is expressed as ratio of fresh or cold carcass weight and live weight [11, 12]. For slaughter efficacy calculated were used carcasses gutted with head, neck and legs.
After cutting carcasses, by gravimetric measurements was determined weight of the trenched parts from carcass and was calculated participation of the trenched portions in whole carcass structure. The trenched parts from the carcass are: breast with bone and skin, thighs, shanks, wings and the remnants consists which of head, neck, back and legs.
Raw data obtained from measurements were processing, using methods of biostatistics with Microsoft Excel spreadsheet application. To test the statistical significance of differences between mean values of the characters studied has been applied analysis of variance using „t"-test and Mann Whitney test of the program MINITAB 14 [13, 14].

3. Results and discussion

The values for body mass dynamics at control lot and experimental group are shown in table 2. Following gravimetric measurements performed it was observed that the values for body weight at 42 days have been of 2481.93±13.30g (Lexp.) and of 2385.51±14.64g (Lc). The coefficient of variation showed a good uniformity of the flock studied (CV=9.28 to 10.63%), and the calculation of variance analysis showed the presence of highly significant statistical differences ($p \leq 0.001$).
The chickens in the experimental group, were given feed with protein and energy levels 10%

higher than of the chickens in the control group. Thus, at the end of growth (42 days) the average body weight for experimental group was higher with 3.88% compared with the control group.

Table 2. The dynamics of weight gain of studied chickens

Specification	Lc (n=300)	Lexp. (n=300)
Weight at one day $\bar{x} \pm s_{\bar{x}}$ (g)	41.49	41.48
	±0.12	±0.14
CV %	5.17	5.85
Weigh at 14 days $\bar{x} \pm s_{\bar{x}}$ (g)	373.97	392.84
	±2.90	±2.95
CV %	13.44	12.99
Weigh at 35 days $\bar{x} \pm s_{\bar{x}}$ (g)	1823.60^{a}	1898.13^{d}
	±14.12	±14.99
CV %	13.41	13.68
Weigh at 42 days $\bar{x} \pm s_{\bar{x}}$ (g)	2385.51^{a}	2481.93^{d}
	±14.64	±13.30
CV %	10.63	9.28

„t"-test: ^{ad} high significant differences p≤0.001

In the table 3 presents the dynamics of body weight in chickens of the control group and experimental group compared with the standard values for „ARBOR ACRES" hybrid [2].

Table 3.The dynamics of weight gain of studied chickens as compared with standard „ARBOR ACRES" hybrid

Specification	Lc	Lexp.
Weight at one day (g)	41.49	41.48
Standard weight (g)	42.00	42.00
Percentage differences (%)	-1.21	-1.48
Weigh at 14 days (g)	373.97	392.84
Standard weight (g)	450.00	450.00
Percentage differences (%)	-16.89	-12.70
Weigh at 35 days (g)	1823.60	1898.13
Standard weight (g)	2013.00	2013.00
Percentage differences (%)	-9.40	-5.70
Weigh at 42 days (g)	2385.51	2481.93
Standard weight (g)	2637.00	2637.00
Percentage differences (%)	-9.53	-5.88

Comparing the medium values of the weights of chickens broiler studied with the standard weights specified in the manual for breeding the „ARBOR ACRES" hybrid [2] , we can notice the fact that have been obtained lower weights with 5.88% at Lexp. group and 9.53% at control group.
Besides this, were calculated the growth average individual gain recorded on each period of growth in part and average daily gain (table 4).

Table 4. Total growth gain for each technological period and average daily gain at the studied chickens

Growth period	Specification	Lc		Lexp.		Difference to Lc (%)
		$\bar{x} \pm s_{\bar{x}}$	CV %	$\bar{x} \pm s_{\bar{x}}$	CV %	
1-14 days	g/chicks/ period	332.48^{a} ±2.18	11.37	351.46^{c}±2.14	10.53	+5.40
	g/chicks/day	23.75±0.16	11.37	25.10±0.15	10.53	+5.40
15-35 days	g/chicks/period	1449.70^{a}±7.63	9.12	1505.29^{c}±7.47	8.59	+3.69
	g/chicks/day	69.03±0.36	9.12	71.68±0.36	8.59	+3.69
36-42 days	g/chicks/period	561.83^{a}±3.25	10.02	583.80^{c}±3.12	9.27	+3.76
	g/chicks/day	80.26±0.46	10.02	83.40±0.45	9.27	+3.76
1-42 days	g/chicks/period	2344.02^{a}±12.45	9.20	2440.55^{d}±12.12	8.60	+3.95
	g/chicks/day	55.81±0.30	9.20	58.11±0.29	8.60	+3.95

„t"-test: ^{ac}distinguished significant differences p≤0..01; ^{ad} high significant differences p≤0.001

The results showed a linear ascendant trend, from 23.75 g/chicks/day (Lc) and 25.10 g/chicks/day (Lexp.) for starter period, at 69.03 g/chicks/day (Lc) and 71,68 g/chicks/day (Lexp.) during grower period, respectively up to 80.26 g/chicks/day (Lc) and 83.40 g/chicks/day (Lexp.) in finishing period. Across the entire growth period (42 days), the average daily gain was calculated at 55.81 g/chicks/day (Lc) and 58.11 g/chicks/day (Lexp.). At the Lexp. group were obtained values higher with 5.40% in starter period, 3.69% in growing period and 3,76 % in finishing period as compared with control group.
In the tabel 5, was compared average daily gain obtained for studied chickens with values standard for „ARBOR ACRES" hybrid.
As compared with the standard „ARBOR ACRES" hybrid, it is found that obtained values for average daily gain were lower for both the control group (with -9.66%) as for Lexp. group (with -5.94%)[2].

Table 5. Average daily gain obtained for studied chickens compared with standard „ARBOR ACRES" hybrid

Growth period	Specification	Lc	Standard values	Difference to standard (%)	Lexp.	Standard values	Difference to standard (%)
1-14 days	g/chicks/day	23.75	29.14	-18.50	25.10	29.14	-13.86
15-35 days	g/chicks/day	69.03	74.42	-7.24	71.68	74.42	-3.68
36-42 days	g/chicks/day	80.26	89.00	-9.82	83.40	89.00	-6.29
1-42 days	g/chicks/day	55.81	61,78	-9.66	58.11	61,78	-5.94

Feed consumption has been determined weekly, for each group average individual intake and the feed conversion rate have been calculated, using those data. Details referring at feed consumption, average individual intake and feed conversion rate is presented in table 6.

Table 6. Data referring at feed consumption

Growth period	Specification	Lc	Lexp.
	Average flock size (chickens)	300	300
1-14 days	Intake/period/group (kg)	132	124.5
	Average individual intake/period (kg)	0.440	0.415
	Average weight gain/chicken (g)	0.333	0.352
	Feed conversion rate (kg. feed/kg gain)	1.323	1.179
15-35 days	Intake/period/group (kg)	762	723
	Average individual intake/period (kg)	2.54	2.41
	Average weight gain/chicken (g)	1449.70	1505.29
	Feed conversion rate (kg. feed/kg gain)	1.752	1.601
36-42 days	Intake/period/group (kg)	376.5	388.2
	Average individual intake/period (kg)	1.26	1.29
	Average weight gain/chicken (g)	0.562	0.584
	Feed conversion rate (kg. feed/kg gain)	2.242	2.216
1-42 days	Intake/period/group (kg)	1270.50	1235.70
	Average individual intake/period (kg)	4.24	4.12
	Average weight gain/chicken (g)	2344.02	2440.55
	Feed conversion rate (kg. feed/kg gain)	1.774	1.661

The data presented in table 6 show that:

-in starter period (1-14 days) broilers from Lc group consumes 440g feed/chicken while on the chickens for Lexp. group have an average consumption per period of 415g;

-in growing period (15-35 days) the consumption of feed/period was from 2410g Lexp. group at 2540g Lc group;

-during finishing period the feed consumption was high, because the average individual consumption was 1260g at Lc group and 1290g at Lexp. group;

-overall period (1-42 days) was characterised by an average individual consumption of 4240g at Lc group and 4120g at Lexp. group.

Values obtained in this experiment were under limit of 4655g specified by the company Aviagen for „ARBOR ACRES" hybrid in management guide for period 1-42 days and 2637g live weight [2].

Knowing average individual of feed consumption and total weight gain, was calculated the feed conversion rate (FCR) for each growth period and for total growth period 1-42 days. (table 6).

The result presented in table 6 has showed a linear ascendant trend for this indicator. The best performance was obtained for Lexp. group, which have the values from 1.179 kg feed/kg gain in starter period up to 2.216 kg feed/kg gain in finisher period, compared with Lc group for which the values were higher (respective from 1.323 up to 2.242 kg feed/kg gain).

For growing period 1-42 days, FCR was calculated at 1.661 kg feed/kg gain for Lexp. group and 1.774 kg feed/kg gain at Lc group. Thus, as compared with standard values (1.765 kg feeed/kg gain) for "ARBOR ACRES" hybrid [2], values obtained were lower with 5.89% for Lexp.group or slightly higher with 0.51% at Lc group.

After slaughter, the carcasses obtained were chilled 24 hours at temperature +4°C. Following gravimetric measurements it was observed that the values for hot carcass weight (after slaughter) have been from 1760.88g (females-Lc) to

2018.24g (males-Lexp.) (table 7). The coefficient of variation showed a good uniformity of the flock studied (CV=5.03 to 8.05%), and the calculation of variance analysis showed the presence of highly significant statistical differences ($p \leq 0.001$) averages obtained between females and males, both before and after refrigeration.

After applying the formula of calculated, were obtained values of the slaughtering efficacy for both moments of measurement (fresh and refrigerated carcass) (table 7). Thus, it is noted that the average values obtained from measurements taken immediately after slaughter are higher compared to the yield calculated on the carcasses refrigerated [1, 11].

Table 7. The values for slaughtering efficacy

Specification	Lc				Lexp.			
	Males (n=15)		Females (n=15)		Males (n=15)		Females (n=15)	
	$\bar{x} \pm s\bar{x}$	CV%	$\bar{x} \pm s\bar{x}$	CV%	$\bar{x} \pm s\bar{x}$	CV%	$\bar{x} \pm s\bar{x}$	CV%
Live weight (g)	2473.4^{a} ±44.31	6.94	2251.6^{d} ±26.07	4.76	2512.2^{a} ±39.96	6.16	2295.2^{d} ±28.16	4.75
Fresh carcass weight (g)	1964.21^{a} ±40.80	8.05	1760.88^{d} ±22.88	5.03	2018.24^{a} ±40.47	7.77	1803.79^{d} ±24.87	5.34
Slaughtering efficacy (fresh carcasses) (%)	79.36^{a} ±0.46	2.25	78.18^{b} ±0.38	1.87	80.27^{a} ±0.57	2.74	78.57^{b} ±0.38	1.86
Refrigerated carcass weight (g)	1936.44^{a} ±40.05	8.01	1735.19^{d} ±22.29	4.97	1988.34^{a} ±39.37	7.67	1777.10^{d} ±24.05	5.24
Slaughtering efficacy (refrigerated carcasses) (%)	77.95^{a} ±0.46	2.27	76.73^{b} ±0.37	1.84	78.80^{a} ±0.55	2.72	77.09^{b} ±0.35	1.75

Mann Whitney-test: ^{ab} significant differences $p \leq 0.05$; ^{ac} distinguished significant differences $p \leq 0.01$; ^{ad} high significant differences $p \leq 0.001$

From the data presented in table 7, follows that at Lexp. group have achieved the highest values for slaughtering efficacy (from 78.57% at females up to 80.27% at males on fresh carcass and from 77.09% at females up to 78.80% at males on refrigerated carcass), while at Lc group have recorded the lowest values for both moments of measurement (from 78.18% at females up to 79.36% at males after slaughter and after chilling from 76.73% at females up to 77.95% at males). This reducing trend the carcass weight, was determined by dehydration which occurs normally during refrigeration period.

Values obtained in this experiment were at the upper limit of the range specified by the company Aviagen for hybrid „ARBOR ACRES", which ensures the achievement of values up to 72% at females and 73.44% at males for the slaughtering efficiency at completely drawn carcasses [2].

Values related to the weight of trenched parts and of their participation in carcass structure was presented in table 8.

Table 8. Weight and proportion of trenched parts in whole carcass structure

Specification	Males-Lc		Females-Lc		Males-Lexp		Females-Lexp.	
	$\bar{x} \pm s\bar{x}$	CV%	$\bar{x} \pm s\bar{x}$	CV%	$\bar{x} \pm s\bar{x}$	CV%	$\bar{x} \pm s\bar{x}$	CV%
Breast with bone and skin (g)	552.85^{a} ±10.52	7.37	487.87^{c} ±13.59	10.79	572.24^{a} ±11.78	7.98	506.27^{c} ±12.78	9.77
% of carcass	28.56±0.17	2.34	28.06±0.48	6.69	28.80±0.20	2.63	28.44±0.43	5.81
Thighs and shanks (g)	575,69±7.62	9.37	530,10±7.20	9.45	596,92±7.69	9.02	545,88±6.56	8.37
% of carcass	29,84±0.11	2.51	30,58±0.21	4.79	30,21±0.10	2.40	30,76±0.16	3.59
Wings (g)	186.67^{a}±5.56	11.53	150.61^{c}±4.67	12.00	194.86^{a}±5.19	10.31	154.79^{d}±4.69	11.73
% of carcass	9.61^{a}±0.18	7.18	8.65^{d}±0.16	7.21	9.78^{a}±0.17	6.75	8.68^{d}±0.15	6.78
Back, heat, neck and legs (g)	621.24^{a} ±10.71	6.68	566.62^{d} ±9.95	6.80	624.33^{a} ±10.57	6.56	570.17^{d} ±8.53	5.80
% of carcass	32.03±0.34	4.08	32.70±0.59	6.96	31.26±.40	4.94	32.11±0.38	4.64

Mann Whitney-test: ^{ac} distinguished significant differences $p \leq 0.01$; ^{ad} high significant differences $p \leq 0.001$

The data presented in table 8 show that:

-weight of the breast with bone and skin was from 487.87g (females-Lc group) up to 572.24g (males-

Lexp. group), the variance analysis, revealed the presence of statistical differences between average females. Participation in the whole carcass structure was values from 28.06% (females-Lc) up to 28.80% (males-Lexp.), but no were statistical differences between average values obtained at females and males or between the studied groups.

-for thighs and shanks, were obtained high values, at males from 575,69g in Lc group to 596,92g at Lexp. group and for females from 530,10g at Lc group to 545,88g at Lexp. group. If we refer to participation in whole carcass structure, values obtained for thighs and shanks were slightly higher in case the females compared with males and for Lexp. group compared with Lc group;

-wings have weight from 150.61g at female-Lc group up to 194.86g at males-Lexp. group, with statistical differences between average values obtained of females and males. Participation in the whole carcass structure was values from 8.65% (Lc) to 8.68% (Lexp.) for females and from 9.61% (Lc) to 9.68% (Lexp.) for males, the variance analysis, revealed high significant differences ($p \leq 0.001$) between average values obtained in males and females;

-for other components of the carcasses (head, neck, back and legs) participation in the whole carcasses structure was from 31.26% (Lexp.-males) to 32.70% (Lc-females).

4. Conclusionss

At Lexp. group, administration of feed combined with high protein and energy levels has determined good growing performances (+3.88% for live weight, +3.95% for average daily gain and -6.37% for feed conversion rate) as compared with Lc. group.

For Lexp. group, which received rations with high protein and energy level, average values for the slaughtering efficiency (fresh and refrigerated carcasses) and participation of the trenched parts from the whole carcass structure (breast, thighs, shanks and wings) have been higher as compare with Lc group.

References

1. Vacaru-Opriş, I. şi col., Tratat de avicultură, Vol. I, Editura Ceres Bucureşti, 2005, 17-121, 436-458

2.***Broiler Management Guide „ARBOR ACRES", 2009, 13-55

3. Kenny, M., Kemp, C., What protein level will maximize your profits, Asian Poultry Magazine, 2006, 4, 22-25

4. Nikolova, N., Pavlovski, Z., Major carcass parts of broiler chicken from different genotype, sex, age and nutrition system, Biotech & Animal Husbandry, 2009, 25 (5-6), 1045-1054

5. Solangi, A.A., Balocn, G.M., Wogan, P.K., Effect of different levels of dietary protein on the growth of broiler, Journal Anim.Vet.Adv., 2003, 5, 301-304

6. Leeson, S., Summers, J. D., Commercial poultry nutrition, Nottingham Univ. Press., England, 2005, 230-295

7. Al-Taleb, S.S., Effect of an early feed restriction on broilers on productive performance and carcass quality. Journal Anim. Vet. Adv., 2003, 2(5), 289-292

8. Garcia, A.R., Botol, A.B., Baker, D.H., Variations in the digestible lysine requirement of broiler chickens due to sex, performance parameters, rearing environment and processing yield characteristics, World's Poultry Science Journal, 2006, 85(3), 498-504

9. Kamran, Z., Sarwar, M., Nisa, M., Effect of two-protein diets having constant energy to protein ratio on performance and carcass characteristics of broiler chickens from one to thirty days of age. World's Poultry Science Journal, 2008, 87, 468-474

10. Larbier, M., Leclercq, B., Nutriţia şi alimentaţia păsărilor. Editura Altius, Bucureşti, 1994, pp. 163-189

11. Vacaru-Opriş, I. şi col., Sisteme de tehnologii de creştere a puilor de carne, Editura Ceres Bucureşti, 2005, pp. 8-18, pp. 52-54, pp. 71-102

13. Brudiu Ileana, Biostatistică în abordarea practică, Ed.Eurobit, Timişoara, 2010, pp. 23-151

12. Duran-Melensez, L.A., Poultry carcass evaluation and cutting, in Guerrero-Legarreta I., (edit) –Handbook of poultry science and technology, vol.II–Primary processing, Wiley&Sons Inc, London, 2010, pp. 101-106

14. Stone, H., Bleibaum, R., Statistical analysis, in: Platt, C.G. (Edit) – Food science and technology, Blackell Publish Ltd, London, 2009, pp. 341-360