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CARCASS QUALITY AND ABDOMINAL FAT FATTY ACID COMPOSITION OF CHICKENS FED WITH DIFFERENT VEGETABLE OIL ADDITIONS

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Abstract

The aim of this study was to investigate the effect of soybean, linseed and rapeseed oils on the productive performance, carcass quality and fatty acid composition of abdominal fat of broiler chickens. At the beginning of the experiment, six groups with 40 day old chicks Cobb 500 line, with five replications were formed. Chicken were fed with two diet mixtures. During the first two weeks of the preparatory period, chickens were fed with starter mixture and after that period with grower diet mixture until the end of the experiment. The control group was fed with a mixture of standard composition, based on soybean meal and corn with the addition of 4% and 8% of soybean oil, while in the experimental groups, 4% and 8% of linseed oil and 4% and 8% of rapeseed oil were included. The experiment lasted 35 days. During the experimental period, chicks were fed and watered ad libitum, and microclimate conditions were regularly monitored. Control of body weight gain and feed consumption was performed every seven days. At the end of the experiment, 10 chicks from each group were sacrificed for the purpose of testing the carcass quality and fatty acids composition. Upon completion of the experimental period, the control group achieved body weight of 2122g and 2053g, and the experimental group with linseed oil 2164g and 2094g, while the group with rapeseed oil achieved 2121g and 2081g, respectively. Chickens on treatment with 4% linseed oil in the diet achieved significantly ($P<0.05$) higher body weight at the end of the experiment compared with the groups who were on treatment with 8% of rapeseed and soybean oil. Soybean oil in an amount of 4% had also a statistically significant ($P<0.05$) effect on the final body weight increase, compared with the body weight of chicks in a group with addition of 8% of soybean oil. Feed conversion ratio was lowest in the group with the addition of 4% linseeds and rapeseed oil, and the highest in the group with the addition of 8% linseed oil. The largest amounts of abdominal fat (18.9 g) were recorded in the group with the addition of 4% rapeseed oil and lowest in the group with the addition of 8% soybean oil (12.6 g). The analysis of chicks fatty acid composition of abdominal fat also showed that the introduction of 4 and 8% linseed oil in the diet of chickens had highly significant ($P<0.01$) effect on the increase in the content of linolenic acid (C18:3) compared with the control and experimental treatments. Chickens in the control treatment and treatment with 4 and 8% rapeseed oil have recorded a significantly higher ($P<0.01$) content of linoleic (C18:2) fatty acids in adipose tissue compared with chickens at linseed oil treatment. Based on the obtained results it can be concluded that the addition of 4% oil showed better performance results, did not affect the quality of chicken carcasses, while the significant impact on the improvement of the chicks fatty acid composition of abdominal fat was present.

Key words*: carcass, fatty acids, vegetable oils, nutrition, chickens.*

INTRODUCTION

High genetic potential of hybrids, which are used for the production of chicken meat, meet the needs of the market at the age of 35 days old, and chicken with altered structure of fat and polyunsaturated ω-3 fatty acids, have a significant impact on reducing cardiovascular disease. In recent years, special attention has been focused on the effects of nutritional oils and fats, as health is concerned, which is primarily dependent on the presence of some fatty acids, as well as their relationship. The World Health Organization has recommended to the human diet, fat should provide 15-30% of energy, of which saturated fatty acids were represented less than 10% polyunsaturated fatty acids (PUFA) of 6-10%, n-6 PUFA from 5-8%,

of n-3 PUFA from 1-2%, and less than 1% trans fatty acids. In the feeding of poultry, fats and oils are sources of energy. Their energy value is greater than all other nutrients present in the compositions, of a carbohydrate, and more than twice. The compositions usually contain fats or oils from different sources, which contribute to variations in the chemical composition and nutritional value (Wiseman et al., 1998; Leeson and Summers, 2005). Researchers in recent years, the examination of the impact of the type and amount of oil to increase the intensity, the efficiency of feed utilization, carcass quality and meat quality of chickens. In this way tests are conducted by Nobakht et al. (2011) and found that 4% of pure soybean, rapeseed and sunflower oil, and mixtures thereof, in mixtures for broiler chickens had significant impact on production performance, carcass quality and content of vitamin E in breast meat. The same authors on the basis of the results found that the best feed conversion ratio (1.83) was in the group with a mixture of 2% of the oil from rapeseed and soybean and lowest relative share of the stomach (2.52%), while the highest amount of vitamin E in white meat (22.05 mg / kg) was recorded in the group with a mixture of all three oils. Lopez-Ferrer et al. (2001) have concluded that 2 to 4% of linseed oil in the diets for broilers, with the addition of up to 8% of fat influences the fatty acid composition of tissues, and the production parameters showed slight differences between the treatments. The differences in the carcass yield and quality of meat between groups were not significant. However, the results of Bartos et al. (2004) show a negative effect on the addition of 6% of linseed oil, to a mixture of broiler chickens, the quality of the carcass. With the introduction of 3% of rapeseed oil in the diet of broiler chickens, there was a significant increase in body weight compared with the control group, while the difference in weight of the liver, white and red meat were not significant (Shahyar et al., 2011). Addition of 4% of linseed oil in chicken diet has resulted in a higher concentration of fat in the liver, as compared to treatment with the chicks at 4% of rapeseed oil. Rape seed oil in the feed mixtures broiler leads to a decrease in the lipid content of the edible parts of the carcass, in particular the saturated fatty acids in the white meat and liver, as well as monounsaturated fatty acids, and the red and white pulp, liver, and stomach (Zanini et al., 2006). DeWitt et al. (2009) argue that the introduction of 6% sunflower and fish oil leads to improved feed conversion of broiler chickens, which is consistent with previous research, El Yamany et al. (2008) in terms of production performance of Japanese quail. The research of Stanaćev et al. (2012), which was aimed to investigate the effect of different vegetable oils in the diet of broiler chickens, it was concluded that the use of 4 and 8% oil and linseed seed does not exhibit significant differences in production parameters and carcass quality. In previous studies Stanaćev et al. (2011) have come to the conclusion that the inclusion of extruded rapeseed in quantities of 10, 15 and 20% in chicken feed, significantly affect the final body weight compared with the control group of chickens. Also by the same authors (Stanaćev et al., 2011), we note significant changes when it comes to the fatty acid composition of lipids in chicken meat under the influence of feeding treatment, where he recorded a reduction of linoleic acid by 20% and increase the content of linoleic acid by 50%. Bearing this in mind, the goal of this study was to investigate the production parameters, carcass quality and fatty acid composition of adipose tissue of broilers aged 35 days, fed with different amounts of soybean, linseed and rapeseed oils.

MATERIAL AND METHODS

Tests were conducted in production on the experimental estate »Pustara" in Temerin, the floor system posture. At the beginning of the experiment six groups with 40 one-day old chicks Cobb 500 line were formed, with five replications. Nutrition has used two mixtures. During the first two weeks of the preparatory period, the feeding of starter chickens was mixed with 21% of proteins and then the mixture grower from 20% of protein by the end of the experiment. The control group was fed with a mixture of standard composition, and on the basis of the quality of soybean meal and corn with the addition of 4% and 8% of soybean oil, and the experimental groups were included 4% and 8% of linseed oil and 4% and

8% of rapeseed oil (Table 1). The experiment lasted 35 days. During the experimental period, chicks were fed and watered *ad libitum*, and microclimate conditions regularly monitored. Control of body weight and feed consumption was performed every seven days. At the end of the experiment (35th day) of each group were sacrificed at 10 chicks (5 males and 5 females), of mean body weight, for the purpose of testing the quality of the carcass and fatty acid composition. Then they performed the bleeding, scalding, plucking, evisceration and cooling. Then they were measured classically processed carcasses and cut on the basic anatomical parts and measured (Rule: Sl. Gazette of SFRY, br.1/81 and 51/88). Evaluations were conducted on the basis of yield and weight of certain body parts. For proper interpretation of the results were analysed by appropriate statistical methods ANOVA and Tukey post-hoc test, using the software package STATISTICA 12.

Table 1. Plan experiments with chickens

Group and Tratment	Control, I (T5)	Control, II (T6)	III (T1)	IV (T2)	V (T3)	VI (T4)
Source of oil	Soybean	Soy bean	Lin seed	Linseed	Rape-seed	Rape-seed
In grower	4%	8%	4%	8%	4%	8%

RESULTS AND DISCUSSION

Based on the obtained results it can be concluded that in this experiment set demonstrated significant differences (P<0.05) in body weight between groups of chickens with different types and amounts of vegetable oils. During the preparatory period chicks had very balanced body weight. After the end of the experimental period 35 day was observed in the small increase in the depression of the V group, treatment with a 4 % rapeseed oil compared to the control group, while the III, IV and VI groups were superior. The highest body weight of 2164g obtained in chicks of group III on treatment with 4 % of linseed oil, which was 1.97 % in comparison to the control group with the same amount of soybean oil, while the body weight was lowest in the group V of chickens with 4 % rapeseed oil and 2121g was 0.05% or less as compared to the control group (Table 2). During the third week, there are statistically significant differences (P<0.05) between groups II and IV, while in the fourth week occur significant differences (P<0.01) between the control group by 8 % of soybean oil, and the experimental group III, IV, V and VI, as well as between the groups I and VI, to the weight of the fifth week old chicks almost levelled by the same amount of oil. A statistically significant difference was maintained between the groups II and VI of the level of 8 % of soybean and rapeseed oil.

Table 2. Body weight of chickens 35 days of age, g

Chicken age (weeks)	Group, treatment and oil amount					
	I (T5)	II (T6)	III (T1)	IV (T2)	V (T3)	VI (T4)
	4%-soy	8%-soy	4%-linseed	8%-linseed	4%-rape	8%-rape
Initial weight	42	42	42	42	42	42
1	185	185	183	190	187	190
2	468± 35,3	469± 38,1	468± 28,3	468± 33,2	469± 42,5	469± 33,6
Index, %	*100*	*100*	*100*	*99,78*	*100,21*	*100*
3	986± 57,2	967^{b}± 58,3	989± 52,8	997^{B}± 54,7	995± 64,5	977± 55,4
4	1457^{bD}± 155,3	1422^{ABCD}± 134,1	1523^{A}± 127,3	1532^{B}± 125,6	1515^{C}± 154,1	1575^{D}± 90,8
5	2122^{E}± 231,5	2053^{ac}± 212,0	2164^{A}± 260,2	2094± 231,5	2121± 255,1	2081^{a}± 223,7
Index, %	*100*	*100*	*101,97*	*101,99*	*99,95*	*101,36*

The same upper case letters in the same row = highly significant (P <0.01), and the same capital and small letters in the same row = significantly (P <0.05); same lowercase letters in the same row = not significant (P> 0.05)

Table 3. Feed conversion, kg / kg

Period	Treatment and oil amount					
	I (T5)	II (T6)	III (T1)	IV (T2)	V (T3)	VI (T4)
	4%-soy	8%-soy	4%-linseed	8%-linseed	4%-rape	8%-rape
1	1,13± 0,06	1,16± 0,06	1,14± 0,06	1,12± 0,11	1,14± 0,04	1,08± 0,03
2	1,35± 0,04	1,34± 0,05	1,30± 0,03	1,35± 0,09	1,36± 0,06	1,33± 0,02
Index, %	*100*	*100*	*96,29*	*100,74*	*100,74*	*99,25*
3	1,38± 0,14	1,36± 0,14	1,39± 0,22	1,42± 0,03	1,41± 0,03	1,41± 0,03
4	1,49± 0,03	1,48± 0,04	1,41± 0,06	1,50± 0,02	1,47± 0,03	1,50± 0,09
5	1,62± 0,03	1,61± 0,04	1,60± 0,04	1,68± 0,04	1,60± 0,02	1,63± 0,05
Index, %	*100*	*100*	*98,76*	*104,34*	*98,76*	*101,24*

Using different types and amounts of oil showed different efficiency of food utilization (Table 3). In the preparatory period that saw a balanced food consumption per kilogram of gain (1.30 to 1.36). However, in this experimental period of three to five weeks of age, it can be seen that the utilization of the food be most efficiently in groups III and V with the addition of 4% of linseed oil, and (1.60), while the highest conversion of 1.68, and 1.63 kg/kg weight gain observed in IV and

VI group who were on treatment with 8% linseed oil.

Table 4. Carcass quality of chickens aged 35 days

Groups and treatments	I (T5)	II (T6)	III (T1)	IV (T2)	V (T3)	VI (T4)
Source and oil amount	4%-soy	8%-soy	4%-linseed	8%-linseed	4%-rape	8%-rape
Chicken weight, g						
Before slaughter, g	2157	2075	2170	2118	2097	2121
Carcass weight, g	1755	1706	1827	1756	1792	1781
Yield, %	68,42	68,72	70,61	69,61	71,67	70,18
Weight of more valuable body parts, g						
Wings	160,6± 10,8	163,3± 20,7	169,0± 14,3	165,8± 13,2	168,4± 24,3	170,4± 13,9
Thighs	189,6± 17,9	189,1± 17,3	201,5± 22,8	195,5± 22,4	194,9± 25,5	204,1± 23,2
Drumstick	239,2± 17,3	222,2± 23,9	232,9± 51,9	231,3± 24,0	231,5± 36,1	234,4± 25,9
Breasts	566,1± 73,7	528,8± 74,3	591,6± 46,9	562,7± 57,5	578,2± 77,1	527,0± 45,7
Back	320,5± 17,1	322,7± 29,7	337,3± 59,5	319,1± 47,9	330,0± 43,3	352,7± 30,3
Total	1476,0	1426,1	1532,3	1474,4	1503,0	1488,6
Index, %	*100*	*100*	*103,81*	*103,38*	*101,82*	*104,38*
Weight of less valuable body parts, g						
Abdominal fat	18,6± 6,1	12,6± 4,0	17,4± 4,7	15,4± 5,3	18,9± 5,7	17,5± 5,3
Liver	36,3± 4,3	36,1± 4,1	35,8± 4,9	37,1± 4,6	37,0± 5,5	37,6± 8,0
Heart	10,0± 1,7	10,2± 2,0	10,4± 1,7	10,5± 1,2	10,1± 1,1	9,9± 1,1
Gizzard	29,3± 5,2	27,2± 4,8	30,1± 4,2	27,9± 5,5	27,4± 3,8	29,2± 6,8
Head	44,5± 4,6	48,8± 5,0	50,3± 4,9	46,1± 4,8	49,2± 5,4	46,8± 6,3
Neck	75,2± 13,2	76,6± 11,6	77,3± 9,7	75,1±8,1	78,5± 13,0	77,9± 12,4
Legs	64,8± 9,4	68,6± 7,8	73,0± 13,5	69,7± 11,4	67,5± 11,2	73,8± 14,1
Total	278,7	280,2	294,4	281,9	288,7	292,8
Index, %	*100*	*100*	*105,60*	*100,60*	*103,55*	*104,50*
Relative share of more valuable body parts, %						
Wings	9,15	9,42	9,26	9,44	9,39	9,58
Thighs	10,79	11,08	11,03	11,11	10,86	11,43
Drumsticks	13,65	12,99	12,69	13,16	12,88	13,13
Breasts	32,25	30,98	32,41	32,09	32,29	29,57
Beck	18,27	18,93	18,47	18,11	18,39	19,82

Table 5. Fatty acid compositions of abdominal fat chicks, 35 days

Fatty acids	Treatments and fatty acid composition of abdominal fat, %					
	Control, I (T5)	Control, II (T6)	III (T1)	IV (T2)	V (T3)	VI (T4)
	4%-Soy	8%-Soy	4%-Linseed	8%-Linseed	4%-Rape	8%-Rape
C14:0	0,09± 0,11	0,20± 0,20	0,02± 0,007	0,07± 0,03	0,04± 0,008	0,03± 0,02
C16:0	16,70± 1,04DE	13,90± 0,37AbCE	16,66± 0,66A	15,50± 0,85B	16,92± 0,77C	12,57± 0,86ABCD
C16:1	3,66± 0,62dE	2,41± 0,05ABcE	3,95± 0,70A	3,78± 0,80B	3,63± 0,30C	2,62± 0,25AbD
C18:0	4,69± 0,30	4,40± 0,24	4,63± 0,36	4,72± 0,66	4,75± 0,42	3,95± 0,38
C18:1	34,07± 1,55abCD	32,70± 0,45ACD	36,60± 1,04A	31,59± 0,89AB	38,08± 1,76BC	40,50± 0,46ABcD
C18:2	30,24± 2,87ABE	39,16±1,06 ABCDE	24,92± 1,55A	24,83± 0,96B	30,10± 1,53ABC	28,00± 1,01D
C18:3	6,58± 2,36ABcD	5,02± 0,08ABD	10,49± 0,56A	17,21± 1,68AB	3,97± 0,86ABC	9,85± 0,82BCD
C20:0	0,08± 0,01	0,10± 0,01	0,08± 0,01	0,07± 0,03	0,09± 0,01	0,09± 0,01
C20:1	0,41± 0,02BCD	0,42± 0,01BCD	0,44± 0,02A	0,31± 0,02AB	0,71± 0,07aBC	0,71± 0,04ABCD
C22:0	0,08± 0,03	0,15± 0,24	0,13± 0,04	0,16± 0,10	0,06± 0,03	0,06± 0,06
C24:0	0,00± 0,00D	0,00± 0,00D	0,03± 0,03A	0,00± 0,00B	0,12± 0,05	0,12± 0,07aBD

The same upper case letters in the same row = highly significant (P <0.01), and the same capital and small letters in the same row = significantly (P <0.05); same lowercase letters in the same row = not significant (P> 0.05)

Average values of carcass weight, dressing percentage and weight of certain body parts, as well as their relative share of the weight of dressed carcass, shown in Table 4, indicate that there is very little difference in all tested parameters and effect of feeding treatment on carcass yield was not statistically significant (P>0.05). The relative proportion of valuable body parts in weight of dressed carcass shows that breast, as one of the most valuable parts, had the largest representation in the hull, which ranged from 29.57 to 32.41%, then back to 18.11 to 19.82 %, then the thigh from 12.69 to 13.65% and leg with 10.79 to 11.43%. The wings have the least representation from 9.15 to 9.58%. The amount of abdominal fat was relatively low and ranged between 12.6 and 18.9 g. Since abdominal fat is a good indicator of the total fat content, it can be concluded that the carcasses were not greasy.

Results of fatty acid composition of abdominal fat lipids of chicks, show that the introduction of rapeseed and linseed oil in the diet resulted in changes in fatty acid composition of adipose tissue. With the introduction of linseed oil in the chicken feed in an amount of 4 %, the content of stearic C18:0 (r = -0.75), linoleic acid C18:2 (r = -0.77), oleic acid C18:1 (r = -0.11), and linolenic acid C18:3 (r = -0.90) fatty acids is reduced, while the content of palmitoleic C16:1 (r = 0.65) increased. With the introduction of 8 % of linseed oil in the diet of chickens, was observed decrease of oleic content (r = -0.54) and linolenic (r = -0.98) fatty acid, while linoleic (r = 0.58) and palmitoleic C16:1 (r = 0.74) increased.

Speaking of rapeseed oil in diets supplemented with 4 % of the oil, there was a decrease of stearic (r = -0.20), oleic acid (r = -0.15), linoleic (r = -0.28) and linolenic (r = -0.51) with fatty acids. A similar trend is observed when it comes to supplement and 8 % of rapeseed oil in the chicken feed.

It can therefore be concluded that the combination of these types of oils in various quantities contributing substantially and significantly higher (P<0.05, P<0.01) the change in the composition of fatty acid composition of abdominal fat in chickens compared to the control group, as can be seen from the data shown in Table 5.

CONCLUSIONS

Based on the obtained results it can be concluded that the chickens on treatment with 4% linseed oil in the diet achieved higher body weight at the end of the experiment compared with the group who were on treatment with 8% vegetable oil. The differences were statistically significant ($P<0.05$). The highest body weight (2164g) showed the chickens of group III with 4% linseed oil, and the smallest chickens V group (2121g) with 4% rapeseed oil in feed. The greatest amount of abdominal fat (18.9 g) was in the fifth group of 4% with the addition of rapeseed oil, and the smallest in the control group (II) containing 8% of soybean oil (12.6 g). Based on the obtained results it can be concluded that the addition of 4% oil showed better productive results, but had no effect on carcass quality of chickens. Results of fatty acid composition of chicks abdominal fat lipids, shows that the introduction of rapeseed and linseed oil in quantities of 4 and 8% in the diet, resulted in changes in fatty acid composition of adipose tissue.

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