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CHICKEN CARCASS STRUCTURE FED WITH ADDITION OF LINOLEIC ACID

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ABSTRACT

The aim of this work was to determine the impact of linoleic acid added to feed mixtures for broiler chickens in relation to carcass structure. Research was conducted in experiment, which comparing characteristics of two groups of Ross 308 chickens: the experimental group with 5% addition of linoleic acid and the control group without the addition of linoleic acid. There was significantly higher carcass yield (P≤0.05) in experimental group. There were no significant differences in weight of offal in our experiment. Weight of abdominal fat in the experimental group was significantly higher (P≤0.01). The weight of heart was a higher (P≤0.05) in experimental group than in the control group. The analysis of various tissues of the breast and the thigh was found a higher proportion of fat and skin from the breast part (P≤0.01), and a higher proportion of fat and skin from the thigh part (P≤0.01) in the experimental group. Chicken breast part in the experimental group had a significantly lower proportion of muscle (P≤0.01).

Keywords: Broiler ROSS 308, linoleic acid, carcass structure

INTRODUCTION

Linoleic acid is considered the most important fatty acid in terms of nutrition and the impact on physiology. Is one of the n-6 polyunsaturated fatty acids and of it is synthesized in the body of other fatty acids. By elongating the carbon chain and incorporating two double bonds the human body can create for example arachidonic acid from linoleic acid **(Sommer, 1999)**. Insufficiency of linoleic acid in the diet can cause adverse symptoms such as acne, arthritis, behavioral changes, miscarriages, gallbladder dysfunction, growth disorders, wound healing disorders, kidney problems, cardio vascular disease, muscle cramps, inflammation of the prostate, skin disorders, thirst caused by excessive sweating, impotence in men **(Lee, 1997)**. In relation to the excess intake of n-6 polyunsaturated fatty acids (linoleic acid and arachidonic acid) in the diet in the Western world at present, the overriding importance of the n-3 polyunsaturated fatty acid, alpha-linolenic acid. Alpha-linolenic acid is a precursor of prostaglandins and an important part of cell structures. Nowadays normal ratio of n-6 / n-3 polyunsaturated fatty acids is 10: 1 to 25: 1 **(Simopoulos, 1999; Christophersen and Haug, 2011)**. **Lee (1997)** reported that the body needs at least 3-6 g of essential fatty acids per day, or 1-2% of the daily energy intake. Larger quantities are good for maintaining good health. According to more recent findings **(Webb & O'Neill, 2008; Daley *et al.*, 2010; Christophersen & Haug, 2011)** is necessary to distinguish the different groups of essential fatty acids and the emphasis on the intake of n-3 polyunsaturated fatty acids. The requirements for receiving are individual and depend on factors such as genetic predisposition, stress, nutrition and physical activity. Optimally balanced diet, which also contains other important nutrients such as vitamins B3, B6 and C, zinc and vitamin A, helps the body to better utilize the received essential fatty acids **(Lee, 1997)**. Fatty acids in the body come from two sources "de novo" lipogenesis (synthesis) and dietary intake. The fatty acids are absorbed in the small intestine by the enzyme digestion of fats in the human duodenum. Animal organism cannot synthesize essential fatty acids with 18 carbon atoms - linoleic acid and alpha-linolenic acid **(Webb & O'Neill, 2008)**. Organism cannot convert n-6 to n-3 polyunsaturated fatty acids, because it lacks the enzyme n-3 desaturase **(Simopoulos, 2002)**. According **Daniška (1999)** linoleic acid lowers cholesterol by half of it, how much it saturates increase. States that decrease in LDL cholesterol arises when we replace saturated fats linoleic acid. Also, the other n-6 polyunsaturated fatty acids lower the level of cholesterol in plasma, such as gamma-linolenic acid reduces cholesterol 170 times more effectively as linoleic acid **(Csuka, 2001)**. Meat is a source of fat and saturated fat, and is considered to be a problematic component of nutrition. Therefore, nowadays increased attention is given options to change the representation of fat and proportion of fatty acids in the meat of slaughtered animals **(Wood *et al.*, 2004)**. Conjugated linoleic acid (CLA) is a group of geometric and positional isomers of LA (18:2 n−6) with conjugated double bonds. Previous studies have demonstrated that CLA as a dietary supplement has a potent ability to improve some meat quality traits (such as enhancing intramuscular fat content, shear force and CLA incorporation into tissues, and changing fatty acid composition) in pigs (**Wiegand *et al.*, 2001; Sun *et al.*, 2004; Jiang *et al.*, 2010**), chickens (**Szymczyk *et al.*, 2001**) and fish (**Berge *et al.*, 2004; Valente *et al.*, 2007**). Dietary inclusion of CLA can also promote the deposition of CLA isomers in meat (**Szymczyk *et al.*, 2001; Bandarra *et al.*, 2006; Jiang *et al.*, 2010**). CLA has been reported to possess health benefits, such as anti-obesity (**Gaullier *et al.*, 2005**), anti-tumour (**Kim *et al.*, 2005**) and others. Consequently, these CLA-rich products are healthy foods for consumers. There is considerable interest in including CLAs in animal feeds in the expectation that they may improve production efficiency and meat quality, and, because CLAs are incorporated into meat, provide value-added "healthful" meat products for human consumption.
The aim of this work was to analyze the effect of the addition of linoleic acid in compound feed broilers in relation to the structure of the carcass.

MATERIAL AND METHODS

One day old broiler chicks were divided into two groups, control group (n=100) and experimental group (n=100). Chickens were fed *ad libitum* standard feed mixtures for broilers. From 1 day to 14 day was given feed mixture HYD 01 for both groups. From 15 day to 21 day was given feed mixture HYD 01/HYD 02 (3:2), while for the experimental group was added 5% linoleic acid extraction of lipids to the mixture HYD 02. From 22 day to the end of the fattening period was given feed mixture HYD 02 with a 5% addition of linoleic acid to the experimental group. Linoleic acid was applied by spraying to ensure a homogeneously mixed and do not constitute the lumps. After 42 days of feeding and fasting for 12 hours, the chicks were slaughtered and subsequently were performed detailed carcass dissection. The laboratory scales Kern were weighed (accurate to 0.01 g) weight of the carcass (g), weight of edible offal (g) (liver

weight, heart weight, gizzard weight and neck weight), abdominal fat weight (g). The carcass was divided symmetrically into 2 halves. Analysis of the structure of the carcass, we used the right half of carcass. After dissection of the right carcass were weighed on laboratory scales Kern with an accuracy of 0.01 g: weight of the breast and thigh part (g), weight of the meat from the breast and the thigh part (g), weight of bone from the breast and the thigh part (g), weight of the skin and subcutaneous fat from the breast and the thigh part (g).

The results of carcass structure (arithmetic mean, standard deviation) were processed by the statistic program Statgraphics 5.1. For the determination of significant differences between the tested groups, F-test was used followed by t-test.

RESULTS AND DISCUSSION

Carcass weight and also live body weight was higher before slaughter in the experimental group, on average, 1315.25 g for all chickens regardless of gender group. In the control group, the average carcass weight of 1215.7 g for the whole experimental group. Statistically significant were higher values in the experimental group, regardless of gender ($P \leq 0.01$). Significantly higher carcass yield ($P \leq 0.05$) in the experimental group (77.45%) compared to the control group (76.45%) (Tab. 1). **Crespo and Esteve-Garcia (2001)** were not found significant differences in carcass yield on addition of 6% and 10% sunflower oil. **Haščík *et al*. (2010)** found higher carcass yield of chickens ROSS 308 (78.69%) in the feeding standard compound feed intended for chickens for fattening. Significant difference was not found in the total weight of offal between experimental (133.41 g) and control group (133.74 g). Of the internal organs was a higher average weight ($P \leq 0.05$) of the heart of chicken in experimental group (10.10 g) than in the control group (9.17 g). Higher average heart weight in the experimental group could be related to its higher load at higher intake of lipids. The average weight of the liver in experimental group was 31.22 g and 32.04 g in control group. The average weight of chicken gizzard in experimental group was 22.73 g and 22.95 g in control group. The average weight of the neck chickens in experimental group was 69.36 g and 70.19 g in the control group. There were not found statistically significant differences in the amount (34.31 g in experimental group, 30.16 g in control group) (Tab. 2) and also internal fat (2.62% in experimental group, 2.48% in control group). But was found significant difference ($P \leq 0.01$) in abdominal fat weight, average weight in the experimental group was 24.52g and in control group 18.22 g (Tab. 3). **Crespo and Esteve-Garcia (2002)** report that the proportion and weight of abdominal fat were lower with the addition of sunflower oil compared with the addition of lipids with a higher proportion of saturated fatty and monounsaturated fatty acids. Chest part was 33.49% of the carcass body in the experimental group and 32.64% in the control group. Proportion of breast and thigh tissues of chickens in experimental and control groups is shown in Table 4. Fat with skin formed in the breast of chicken on average 11.12% in the experimental group and 10.0% in the control group ($P \leq 0.01$). Proportion of meat from the breast of the chicken in experimental group was an average of 74.85% and chicken in control group 78.61% ($P \leq 0.01$). The proportion of bone from the breast was 13.3% in the experimental group and 11.39% in the control group. Overall, part of thigh was in the experimental group on average 35.30% of the carcass and the control group, 33.31% of the carcass. Fat with skin accounted for 12.69% in the experimental group and 11.17% in the control group ($P \leq 0.01$). Proportion of meat from thigh was 66.23% in experimental group and 67.08% in the control group. The proportion of bone from the breast was 21.9% in the experimental group and 21.75% in the control group.

Table1 Indicators of carcass quality of chickens fed with the addition of linoleic acid (experimental group) and without addition (control group) linoleic acid in compound.

Parameters		Experimental group (mean±SD)	Control group (mean±SD)	Significance
Carcass weight (g)	♂+♀	1315.25±98.35	1215.70±118.64	**
	♂	1303.64±106.28	1218.36±141.93	NS
	♀	1329.44±91.87	1212.44±90.69	*
Carcass yield (%)	♂+♀	77.45±1.30	76.45±2.07	*
	♂	76.81±1.16	75.90±1.15	*
	♀	78.22±1.07	77.13±2.75	NS
Breast part (%)	♂+♀	33.49±3.79	32.64±2.47	NS
	♂	31.62±3.59	31.71±2.22	NS
	♀	35.77±2.71	33.77±2.4	NS
Thigh part (%)	♂+♀	35.30±3.87	33.31±1.9	*
	♂	37.38±2.33	34.36±1.2	**
	♀	32.77±3.96	32.03±1.84	NS

Legend: P>0.05 NS, P≤0.05 *, P≤0.01 **

Table 2 Weight offal of chickens fed with the addition of linoleic acid (experimental group) and without addition (control group) linoleic acid in compound.

Parameters		Experimental group (mean±SD)	Control group (mean±SD)	Significance
Offal (g)	♂+♀	133.41±9.16	133.74±9.30	NS
	♂	133.49±11.17	135.52±11.23	NS
	♀	133.30±6.59	131.29±5.53	NS
Heart (g)	♂+♀	10.10±1.18	9.17±1.63	*
	♂	10.48±1.23	9.85±1.76	NS
	♀	9.63±0.98	8.33±0.99	*
Liver (g)	♂+♀	31.22±2.54	32.04±3.76	NS
	♂	30.50±2.16	32.93±4.44	NS
	♀	32.09±2.81	30.94±2.57	NS
Gizzard (g)	♂+♀	22.73±1.88	22.95±2.90	NS
	♂	22.60±1.81	22.27±2.78	NS
	♀	22.89±2.07	23.78±2.98	NS
Neck (g)	♂+♀	69.36±9.40	70.19±7.44	NS
	♂	69.91±11.49	70.46±9.47	NS
	♀	68.69±6.62	69.86±4.40	NS

Legend: P>0.05 NS, P≤0.05 *, P≤0.01 **

Table 3 Weight of internal fat of chickens fed with the addition of linoleic acid (experimental group) and without addition (control group) linoleic acid in compound.

Parameters		Experimental group (mean±SD)	Control group (mean±SD)	Significance
Abdominal fat (g)	♂+♀	24.52±5.50	18.22±8.20	**
	♂	24.11±3.92	19.08±6.64	*
	♀	25.02±7.22	17.17±10.11	NS
Total internal fat (g)	♂+♀	34.31±6.50	30.16±7.07	NS
	♂	32.55±4.60	28.88±5.56	NS
	♀	36.46±8.03	31.71±8.67	NS
Total internal fat (%)	♂+♀	2.62±0.50	2.48±0.54	NS
	♂	2.51±0.37	2.38±0.44	NS
	♀	2.75±0.62	2.61±0.65	NS

Legend: P>0.05 NS, P≤0.05 *, P≤0.01 **

Table 4 Proportion of tissue of breast part and thigh part of chickens fed with the addition of linoleic acid (experimental group) and without addition (control group) linoleic acid in compound.

Parameters		Experimental group (mean±SD)	Control group (mean±SD)	Significance
		Breast part		
Fat and skin (%)	♂+♀	11.20±2.08	10.00±1.95	**
	♂	11.37±2.19	10.07±2.19	NS
	♀	13.03±1.60	9.90±1.73	**
Muscle (%)	♂+♀	74.85±4.14	78.61±2.84	**
	♂	74.06±3.96	77.70±3.16	*
	♀	75.82±4.39	79.72±2.04	*
Bone (%)	♂+♀	13.03±3.60	11.39±2.03	NS
	♂	14.58±3.05	12.23±2.20	NS
	♀	11.15±3.44	10.37±1.28	NS
		Thigh part		
Fat and skin (%)	♂+♀	12.69±1.63	11.17±1.91	**
	♂	12.25±1.37	10.29±1.85	*
	♀	13.22±1.82	12.24±1.45	NS
Muscle (%)	♂+♀	66.23±2.32	67.08±2.15	NS
	♂	65.83±2.69	67.10±2.50	NS
	♀	66.72±1.81	67.06±1.80	NS
Bone (%)	♂+♀	21.09±1.90	21.75±2.06	NS
	♂	21.92±1.89	22.61±1.84	NS
	♀	20.07±1.41	20.70±1.91	NS

Legend: P>0.05 NS, P≤0.05 *, P≤0.01 **

CONCLUSION

In this work we evaluate the structure of the carcass of chickens fed with 5% addition of linoleic acid in compound feed compared with the control group without the addition of linoleic acid. In chickens fed with the addition of linoleic acid was found the carcase weight (1315.25 g), higher carcass yield (77.45%) and a greater proportion of the thigh of the carcase (35.30%). The weight of edible offal, we did not find significant differences. We found higher weight of internal fat (excluding stomach). Weight of abdominal fat was in the experimental group (24.52 g) was significantly higher (P≤0.01). The analysis of various tissues in the breast and the thigh part, we found a higher proportion of fat and skin from the breast (12.11%) and fat and skin from the thigh part (12.69%) in the experimental group, breast part in experimental group was also significantly lower (P≤0.01) proportion of meat (74.85%). In conclusion it can be stated that the addition of linoleic acid in compound feed for broilers was reflected in our experiment by increasing the intensity of growth, a higher proportion of internal fat, subcutaneous and intramuscular fat.

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