Slovak J. Anim. Sci., 45, 2012 (1): 21-29

ISSN 1337-9984

EFFECT OF USING SATURATED AND UNSATURATED FATS IN BROILER DIET ON CARCASS PERFORMANCE

H. A. MOHAMMED, E. HORNIAKOVÁ*

Slovak University of Agriculture in Nitra, Slovak Republic

ABSTRACT

In this work the effect of three types of fat substances based on the use of saturated fat (SF) and unsaturated fat (USF) and also mixing between them with different level proportions in the diet of broilers (*Ross-308*) chickens was investigated. The effect was observed on carcass yield, share of giblets and abdominal fat chicken part percentages. One-day old 800 chickens were divided to four testing groups C, T1, T2, and T3 and each group had 4 replications. The fattening was 42 days in length, divided to a diet's pre-starter (7 d), starter (9 d), grower (17 d) and finisher (5 d). The testing group C had 5 % of animal fat, T1 2.5 % animal packed fat + 2.5 % sunflower oil, and T3 group 2.5 % packed fat +1.25 % rapeseed and 1.25% sunflower oil. Carcass yield was higher in group C (70.75 % and 70.17 % for female and male, respectively). The differences were not significant ($P>0.05$). The breast muscle percentage was not significantly higher in T3 (28.35 %) for female and also in T3 (29.46 %) for male, but it was with significant difference ($P<0.05$). No significant difference was observed in legs muscle between sex and groups ($P>0.05$). Abdominal fat was significantly lower in group T2 for female (1.036 %), while it was not significant in case of male (T3 - 0.66 %) as compared to C group.

Key words: broiler; SF; USF; carcass performance

INTRODUCTION

The main aim of broiler production is to increase breast yield and to reduce fat deposition and improve feed conversion without decreasing growth rate. Also, the fat inclusion in broiler diets must take into account the effect on carcass fat quality, because dietary fatty acids are incorporated with little change into body fat (Naji and Hamdy, 1989). Dressing percentage of birds is known as the percentage of carcass weight of processed birds slaughtered after the weight of the blood, feathers, and edibles parts, not consumed by humans. Parts are represented on both sides of the winged legs, and head to live body weight (Naji and Hamdy, 1989). The distribution of muscle is concentrated in the chest area, as is the case of strain (Cobb-500) type and it decreases with age (Hassan and Abboud, 2005). Sanz *et al.* (1999) observed that fat concentration will increase accumulation of meat to the chest muscle and thus lead to a high percentage of dressing. Broilers in general are characterized by the rapid growth and accumulation of meat in the main parts of the sacrifice (breast and thigh). These strains differ from each other in the capacity of the chest and firmness of meat influence according to the type of nutrition used (Ibrahim, 2000). A study conducted by Mala *et al.* (2004) using the strain Cobb-500 showed that the content of the mixture of animal fat tallow with Soya bean oil (saturated and unsaturated fatty acids) reflects the inclusion of fatty acids, which are found in parts of the carcass. Kralik *et al.* (2003) when using two types of essential unsaturated fatty acids (α-linoleic and α-linolenic), they observed differences which were highly significant ($P<0.01$) for carcass weight and the weight of the chest and thigh. This means that even the type of fatty acid affects the quality of mass parts. The diet of vegetable oils led to a significant decrease in the

***Correspondence:** E-mail: erika.horniakova@uniag.sk
Erika Horniaková, Department of Animal Nutrition, Slovak University of Agriculture, Tr. A. Hlinku 2, 949 01 Nitra, Slovak Republic
Tel.: +421 6414320

Received: December 2, 2011
Accepted: February 28, 2012

weights of carcass and muscle chest, while the thigh level remained insignificant (P>0.05) with different fat vegetarian diets but they did not affect significantly on the dressing percentage of the offering or the content of carcass fat at the age of 35-49 days (Rosa *et al*.,1999; Sanz *et al*.,1999). Conclusion was that muscles of chest and thigh were influenced by the content of the diet from fatty acids, whether saturated or unsaturated. The content of any food in these acids will be reflected on the content of the main parts of them.

Included minor parts of both are the sacrifice of back, neck and wings, and in some cases, also the head and legs. Despite there are only rare information and studies on the reference to this issue some studies included parts on the ratio of the back and legs and neck. Kralik *et al.* (2003) found that the use of essential unsaturated fatty acids reflected two types, which are highly significant (P<0.01) and indicate the proportion of the back and legs. Ensiminger *et al.* (1990) and Sanz *et al.* (1999) had pointed out that the animal fats will increase the accumulation of grease to the neck area, which will increase the weight and the ratio of weight to the weight of the carcass. In general, the minor parts as part of the carcass weight are dependent on the proportion of fat deposited and the amount and type of fat used.

Abdominal fat is defined as the amount of tissue fat or fat accumulated in the abdomen which is affected by the quantity and quality of the charge doses accumulated and the impact of fat sources used in the poultry diet. Sanz *et al.* (2000) found that the use of (SFO) with fat, especially animal tallow, will increase the amount of filling fat, predominantly over the recent period of breeding broilers with the sources of fat containing unsaturated fatty acids during the first phase of growth and replaced fats within, which is included just a few days before slaughter may cause depositions with flexible fats compared to using sources of saturated fat during the overall growth.

MATERIAL AND METHODS

Experimental data

The trial was conducted as a comparison group of four feeding trials in four replications in the biological testing centre ÚKSÚP Vigľaš under the auspices of the Department of Animal Nutrition and Regional Department ÚKSÚP in Zvolen. The experiment was done in one-day, (two genders) of Ross-308 chicken meat; the total number of the animals was 800. The animals were divided into groups by random selection of 50 birds in each flock. The material had to obey certain criteria compatible with STN 46 6410, which was verified by assessing the individual, the weight and exteriors assessed and 200 chicken were included in each experimental group. The feed mixture for the control (C) and trial groups (T1, T2 and T3) were differentiated by the quality of fat. In C group 5 % of animal packed fat was used, in T1 2.5 % packed fat +2.5 % rapeseed oil, in T2 2.5 % packed fat +2.5 % sunflower oil and in T3 2.5 % packet fat +1.25 % rapeseed +1.25 % sunflower oil. Each group had 4 replications.

Collected data included the periods of 7 days for pre-starter, 9 days for starter, 17 days for grower, and 5 days for finisher.

Feeding and management

Birds were housed on the deep litter in the same technological conditions. Microclimate indicators in the range of temperature and humidity were measured and recorded three times a day at 7.00 AM, 12.00 Noon and 5.00 PM. Measurement indicated the zone of animals, the height from the floor and the largest part of the body of animals.

The feed mixtures formulated for each period of feeding are presented in tables 1, 2, 3, and 4.

Experimental procedure

The heart and the liver were immediately removed from hot carcasses for both sexes, packed in plastic bags and stored in liquid nitrogen until the time of analysis. After removal of the heart and liver, carcasses were chilled to 4°C, and the abdominal fat pad (from the proventriculus surrounding the gizzard down to the cloaca) was removed and weighed (Cahaner and Nitsan, 1985). At the end of the experimental period (42 days old), one chicken from each replicate of treatments group (similar body weight) was slaughtered to determine the relative weight of the following parts: the hot carcass weight, breast, legs, thighs, drumstick, half back, wings, abdominal fat, gizzard, heart, liver and feathers.

Statistical analysis

The obtained data were statistically analyzed using complete random design with 4 treatments. Data in all experiments were subjected to ANOVA procedures appropriate for a completely randomized design and the significance of differences between the means were estimated using Duncan test (Duncan's new multiple range test). Probability level of P<0.05 was considered for significance in all comparisons except with blood parameters for which P<0.01 was considered. Values in percentage were subjected to transformation of Arc sin v100. All statistical analyses were performed using the software SPSS 17.5 for Windows® (SPSS Inc., Chicago, IL).

Table 1: Pre-starter feed mixture formula

Components	Groups %			
	C	T1	T2	T3
Maize	44.20	44.20	44.20	44.20
Soybean meal	32.00	32.00	32.00	32.00
Wheat	10.00	10.00	10.00	10.00
Fish meal	5.00	5.00	5.00	5.00
Limestone (Ca Co_3)	1.35	1.35	1.35	1.35
Monocalcium phosphate	1.00	1.00	1.00	1.00
*PX BR Unit	1.00	1.00	1.00	1.00
Methionine 99 %	0.12	0.12	0.12	0.12
Total salt	0.20	0.20	0.20	0.20
Threonine 99 %	0.13	0.13	0.13	0.13
Packed fat	5.00	2.50	2.50	2.50
Sunflower oil	-	2.50	-	1.25
Rapeseed oil	-	-	2.50	1.25
TOTAL	100.00	100.00	100.00	100.00

*vit. A=4,500,000 IU, vit. D=1,660,000 IU, vit. E=20,000 mg.kg^{-1}, vit. K3=1 mg.kg^{-1}, vit. B1=1,800 mg.kg^{-1}, vit. B2=2,500 mg.kg^{-1}, vit. B6=1,600 mg.kg^{-1}, vit. B12=8.75 mg.kg^{-1}, folic acid=600 mg.kg^{-1}, calcium pentonite=5,500 mg.kg^{-1}, niacinmid=18,000 mg.kg^{-1}, biotin=60 mg.kg^{-1}, cholin chloride=30,000 mg.kg^{-1}, betain=65,000 mg.kg^{-1}, Co=150 mg.kg^{-1}, I=380 mg.kg^{-1}, Mn=45,800 mg.kg^{-1}, Cu=6,500 mg.kg^{-1}, Si=110 mg.kg^{-1}, Zn=28,300 mg.kg^{-1}, Fe=27,200 mg.kg^{-1}, Mo=350 mg.kg^{-1}

Table 2: Formula for starter feed mixture

Components	Groups %			
	C	T1	T2	T3
Maize	48.50	48.50	48.50	48.50
Soybean meal	29.00	29.00	29.00	29.00
Wheat	10.00	10.00	10.00	10.00
Fish meal	4.00	4.00	4.00	4.00
Limestone (Ca Co_3)	1.30	1.30	1.30	1.30
Monocalcium phosphate	0.85	0.85	0.85	0.85
PX BR Unit	1.00	1.00	1.00	1.00
Methionine 99 %	0.05	0.05	0.05	0.05
Total salt	0.22	0.22	0.22	0.22
Lysine	0.03	0.03	0.03	0.03
Threonine 99 %	0.05	0.05	0.05	0.05
Packed fat	5.00	2.50	2.50	2.50
Sunflower oil	-	2.50	-	1.25
Rapeseed oil	-	-	2.50	1.25
TOTAL	100.00	100.00	100.00	100.00

*vit. A=4,500,000 IU, vit. D=1,660,000 IU, vit. E=20,000 mg.kg^{-1}, vit. K3=1 mg.kg^{-1}, vit. B1=1,800 mg.kg^{-1}, vit. B2=2,500 mg.kg^{-1}, vit. B6=1,600 mg.kg^{-1}, vit. B12=8.75 mg.kg^{-1}, folic acid=600 mg.kg^{-1}, calcium pentonite=5,500 mg.kg^{-1}, niacinamid=18,000 mg.kg^{-1}, biotin=60 mg.kg^{-1}, cholin chloride=30,000 mg.kg^{-1}, betain=65,000 mg.kg^{-1}, Co=150 mg.kg^{-1}, I=380 mg.kg^{-1}, Mn=45,800 mg.kg^{-1}, Cu=6,500 mg.kg^{-1}, Si=110 mg.kg^{-1}, Zn=28,300 mg.kg^{-1}, Fe=27,200 mg.kg^{-1}, Mo=350 mg.kg^{-1}.

Table 3: Formula for grower feed mixtures

Components	Groups %			
	C	T1	T2	T3
Maize	42.40	42.40	42.40	42.40
Soybean meal	29.00	29.00	29.00	29.00
Wheat	20.00	20.00	20.00	20.00
Limestone (Ca Co_3)	1.35	1.35	1.35	1.35
Monocalcium phosphate	0.80	0.80	0.80	0.80
*PX BR Unit	1.00	1.00	1.00	1.00
Methionine 99 %	0.05	0.05	0.05	0.05
Total salt	0.33	0.33	0.33	0.33
Lysine	0.02	0.02	0.02	0.02
Threonine 99 %	0.05	0.05	0.05	0.05
Packed fat	5.00	2.50	2.50	2.50
Sunflower oil	-	2.50	-	1.25
Rapeseed oil	-	-	2.50	1.25
TOTAL	100.00	100.00	100.00	100.00

*vit. A=4,500,000 IU, vit. D=1,660,000 IU, vit. E=20,000 $mg.kg^{-1}$, vit. K3=1 $mg.kg^{-1}$, vit. B1=1,800 $mg.kg^{-1}$, vit. B2=2,500 $mg.kg^{-1}$, vit. B6=1,600 $mg.kg^{-1}$, vit. B12=8.75 $mg.kg^{-1}$, folic acid=600 $mg.kg^{-1}$, calcium pentonite=5,500 $mg.kg^{-1}$, niacinamid=18,000 $mg.kg^{-1}$, biotin=60 $mg.kg^{-1}$, cholin chloride=30,000 $mg.kg^{-1}$, betain=65,000 $mg.kg^{-1}$, Co=150 $mg.kg^{-1}$, I=380 $mg.kg^{-1}$, Mn=45,800 $mg.kg^{-1}$, Cu=6,500 $mg.kg^{-1}$, Si=110 $mg.kg^{-1}$, Zn=28,300 $mg.kg^{-1}$, Fe=27,200 $mg.kg^{-1}$, Mo=350 $mg.kg^{-1}$

Table 4: Formula for finisher feed mixtures

Components	Groups %			
	C	T1	T2	T3
Maize	40.50	40.50	40.50	40.50
Soybean meal	22.60	22.60	22.60	22.60
Wheat	28.00	28.00	28.00	28.00
Limestone (Ca Co_3)	1.35	1.35	1.35	1.35
Monocalcium phosphate	0.80	0.80	0.80	0.80
*PX BR Unit	1.00	1.00	1.00	1.00
Methionine 99 %	0.20	0.20	0.20	0.20
Total salt	0.30	0.30	0.30	0.30
Lysine	0.15	0.15	0.15	0.15
Threonine 99 %	0.10	0.10	0.10	0.10
Packed fat	5.00	2.50	2.50	2.50
Sunflower oil	-	2.50	-	1.25
Rapeseed oil	-	-	2.50	1.25
TOTAL	100.00	100.00	100.00	100.00

*vit. A=4,500,000 IU, vit. D=1,660,000 IU, vit. E=20,000 $mg.kg^{-1}$, vit. K3=1 $mg.kg^{-1}$, vit. B1=1,800 $mg.kg^{-1}$, vit. B2=2,500 $mg.kg^{-1}$, vit. B6=1,600 $mg.kg^{-1}$, vit. B12=8.75 $mg.kg^{-1}$, folic acid=600 $mg.kg^{-1}$, calcium pentonite=5,500 $mg.kg^{-1}$, niacinamid=18,000 $mg.kg^{-1}$, biotin=60 $mg.kg^{-1}$, cholin chloride=30,000 $mg.kg^{-1}$, betain=65,000 $mg.kg^{-1}$, Co=150 $mg.kg^{-1}$, I=380 $mg.kg^{-1}$, Mn=45,800 $mg.kg^{-1}$, Cu=6,500 $mg.kg^{-1}$, Si=110 $mg.kg^{-1}$, Zn=28,300 $mg.kg^{-1}$, Fe=27,200 $mg.kg^{-1}$, Mo=350 $mg.kg^{-1}$.

RESULTS AND DISCUSSION

Some factors affecting diet on carcass quality

The composition of the broiler carcass is now receiving considerable attention with the poultry industry's major trust in further processing. Today the trend is towards specialized carcass types and composition of meet specific demands for cut-up, deboning, and subsequent new product manufacture. Carcass composition can, to a large extent, be modified through diet choice (Leeson and Summers, 1997). Obtained data on slaughter outputs are presented in table 5.

Effect of diet on hot or fresh carcass percentage

Hot or fresh carcass percentage values of trial groups are presented in table 5. At 42 days age of females and males, differences were insignificant (P>0.05). For females the difference between group C and T2 (70.75 and 70.35 % respectively) was higher than that between T1 and T3. Values obtained in this study for average carcass are in accordance with results of some trial groups (Moharerry, 2005) in which different levels of soybean oil mixing with tallow was used. These results are in agreement with those of Kermanshahi *et al*. (1998), when they fed diets supplemented with commercial feed additives depending on a blend of essential oils' source, for 42 days old chickens. Same results were found in the experiment performed by Mitchell and Burk (1993) where sunflower oil was used in broiler diets. It was mentioned that at advanced age after grower period till the end of trial at 42 days the growth of digestive system was better and there was increase of secretion of lipase enzyme.

Effect of diet on breast percentage and share of meat in the breast

Breast percentage and share of meat in mass breast values of trial groups are presented in table 5. The data on breast percentage at 42 days of age revealed the lowest average value in T2 group (2.5 % packed

Table 5: The effects of dietary natural feed additives on carcass interior organs of 42 days' old broiler chickens

Attributes (%)	Groups							
	C		T1		T2		T3	
	Female	Male	Female	Male	Female	Male	Female	Male
The Carcass	70.75±1.40	70.17±0.16	69.59±0.85	70.26±0.91	70.35±1.21	68.56±1.70	69.61±0.62	69.14±0.63
The Breast	26.19±1.99	25.34±2.34a	27.05±0.90	26.61±0.92ab	25.42±0.51	23.89±1.73a	28.35±5.16	29.46±3.41b
Breast muscle	21.97±1.80	20.42±0.78	22.50±0.36	21.84±0.33	21.52±0.79	19.98±1.49	21.38±1.32	20.27±0.65
The Legs	20.05±1.16	17.78±1.13	19.37±0.13	15.80±1.10	19.32±0.62	17.31±2.70	19.06±1.08	18.50±3.39
Legs muscle	13.59±0.46	13.27±0.35	13.11±0.11	13.62±0.51	13.05±0.80	12.67±0.91	13.08±0.65	13.36±1.02
Thigh	6.11±0.40	7.123±0.62a	6.02±0.32	7.49±0.30ab	6.51±0.48	8.20±0.54b	6.72±0.50	8.01±0.43b
Drumstick	8.99±0.61	9.06±0.84	8.67±0.8	9.75±0.35	8.60±0.23	8.90±0.65	8.46±0.57	8.98±0.37
Drumstick muscle	5.76±0.26	5.48±0.29	5.54±0.26	5.54±0.20	5.47±0.33	5.24±0.56	5.48±0.36	5.53±0.48
The Wings	6.79±0.09a	7.04±0.20a	7.07±0.18ab	6.94±0.17a	7.24±0.38a	7.54±0.67ab	6.98±0.28ab	7.70±0.23b
The Back	7.16±1.15	7.96±1.63a	6.48±0.75	6.29±0.54a	6.86±1.43	7.04±0.91a	6.79±1.08	12.52±2.43b
Abdominal fat	1.98±0.34b	1.21±0.36	1.19±0.20a	0.77±0.36	1.036±0.27a	0.80±0.38	1.56±0.44ab	0.66±0.41
Total bowel	11.62±0.76	11.18±0.67ab	10.73±0.45	10.80±0.38a	10.64±0.95	11.36±0.27b	11.26±0.46	1.05±0.66ab
Stomach	1.41±0.15	1.42±1.96	1.39±0.13	1.39±0.20	1.48±0.14	1.51±0.21	1.49±0.16	1.31±0.16
Heart	0.55±0.05	0.55±0.03	0.49±0.11	0.47±0.04	0.46±0.09	0.52±1.01	0.52±0.11	0.55±0.02
Liver	1.97±0.17	1.93±0.13	2.00±0.36	1.75±0.17	1.74±0.13	1.87±0.07	1.83±0.41	1.86±0.10
Neck	2.67±0.35	2.51±0.45	2.60±0.07	2.60±0.41	2.35±0.63	2.55±0.13	2.54±0.52	2.65±0.53
Under skin breast fat	0.41±0.11b	0.30±0.11	0.19±0.08a	0.23±0.07	0.26±0.10ab	0.12±0.08	0.20±0.10a	0.31±0.23
Under skin thigh fat	0.68±0.23b	0.32±0.18	0.28±0.07a	0.24±0.10	0.37±0.05a	0.15±0.16	0.26±0.12a	0.31±0.08
Breast skin	0.52±0.08	0.29±0.11	0.51±0.28	0.23±0.07	0.62±0.12	0.12±0.08	0.71±0.10	0.31±0.23
Thigh skin	0.76±0.17	0.32±0.18	0.85±0.05	0.24±0.10	0.71±0.10	0.15±0.16	0.68±0.07	0.31±0.08
Plumage	5.02±0.50	5.03±0.36	5.30±0.99	4.25±0.71	4.80±0.47	5.01±0.38	5.02±0.88	4.62±0.54

Mean ±S.D, a, b means with different superscript within row are significantly different (P< 0.05)
Values are expressed as $\bar{x}$ ± Std. Deviation of 50 birds

fat +2.5 % sunflower oil) for both sexes, further there were significant differences (P<0.05) among all groups for males but there were insignificant differences among all groups for females. The highest yield for males was established in group T3 (29.46 %) followed by T1, C and T2. This can be attributed to two points, first because of mixing type of fat with different levels which results in more concentrated growth of breast muscle, on the other hand the genetics and environment can also affect the concentrated growth of breast muscle in case different levels of unsaturated fats are used. These results are similar to those of Pardio *et al.* (2001) and Mala *et al.* (2004) when they used Cobb 500 strain and fed unsaturated fats to find improvement of breast muscle weight. Their explanation was that due to size of skeleton especially in breast half centimetre more accumulation can take place which is apart from other genetic factors, leading to more accumulation of muscle in that place. Anjum *et al.* (2004) disagreed with the same treatment of soybean oil.

In regard to data on shares of muscle tissue in the breast for females, the lowest average value was obtained in T3 group (21.38 %) in which the highest yield of muscle tissue was established in group C (21.97 %). The net effect of adequate dietary protein on muscle may be enhanced by reducing its accompanying acid load by saturated fat components. Compounds in fat foods, which are SFA-producing, may help preserve bone and muscle mass because of soluble vitamin D which is related with precipitation of calcium ion that has role for building bone (Al-Janabi and Mohammed, 1989). Reducing the acid load that accompanies the typical high protein diet may also be important. USF metabolic environment reducing urinary nitrogen excretion is an indicator of reduced muscle wasting. These results agree with those of Moharrery (2005), when he observed metabolism of Malic acids on carcass performance at beta oxidation of SF.

At 42 days of age, insignificant (P>0.05) differences were observed among all groups for both sex. The highest value for male was obtained in group T1 followed by C, T2 and T3 respectively, and the lowest were found in T2 (19.98 %). In the case of group T1, the higher deposition of protein could be attributed to the synergism of both additive components. This is may be linked to better anabolism related to amino acid digestion. On the other hand pepsinogen secretion, a precursor of pepsin increases due to the action of pungent components provided by mixing equal percentage of SFA and USFA consequence there is an improvement in protein digestion (Popescu and Criste, 2003). Involvement of high level of stearic and oleic acid in C group diet may reduce the utilization of the protein included in the diet. SFA are responsible for the bitterness and unavailability of nutrients to be absorbed by the intestinal tract (Ashild, 2005).

The mechanism of action of SFA is due to the binding of SFA to carbohydrates, fats and peptide molecules by a phenol group, which provides many hydroxyl (OH) groups to produce hydrogen binding reaction, in which reducing availability of these nutrients for catalyst enzymes reduce the absorption from intestine tract wall (Flores *et al*., 1994). Ensminger *et al.* (1990) found that the effect of SFA on older birds is less than young chicks. The net effect of adequate dietary protein on muscle may be enhanced by reducing its accompanying acid load, in which chickens in treatments received emulation of SFA in the diet has lower value of USFA, which is responsible for the acid-production in the blood, thus influencing the reserve of protein in breast muscle indirectly (Ashild, 1985). Values obtained in this study for breast and thigh percentages are in accordance with results of Mohammed *et al*. (2005).

Effect of diet on legs percentage and share of meat in legs

Thigh percentage values of trial groups are presented in table 5. In regard to data on legs percentage, at 42 days of age results showed insignificant (P>0.05) differences between groups. The highest value obtained for male was in group T3 (18.50 %) and the lowest was in the group T1 (15.80 %). At 42 days of age for female groups C and T1 showed high values compared to other groups (20.05 and 19.37 %), respectively. However, the differences between groups were insignificant (P>0.01). In regard to data on shares of muscle tissue in the legs at 42 days of age high yield of muscles was obtained for male in group T1 (13.62 %) and the lowest in group T2 (12.67 %). This could be attributed to the increase of pH in the intestine by fat content of FA which allowed the increase in proteolysis reactions, thus enhancing protein hydrolyses and higher utilization from the diet. Values of group C for female was 13.59 % and of T1 13.11 % higher and were insignificant when compared to other groups' yield (P>0.01). Lowest value was found in group T2 for male and female altogether. These results agree with study of Mohammed *et al.* (2005).

Effect of diet on thigh percentage and share of meat in thigh

Thigh percentage values of trial groups are presented in table 5. In regard to data on shares of muscle tissue in thigh at 42 days of age for male groups T2, T3 and T1 were insignificant (P>0.05), but significant (P<0.05) with group C while insignificant differences (P>0.05) differences were found among trial groups for female . Higher muscle yield were obtained in group T2 for male and female (8.20 and 6.51, respectively). This could be attributed to that type of mixing of fat promoted the bone building during the starter period.

Effect of diet on drumstick percentage and share of meat in the drumstick

Thigh percentage values for trial groups are presented in table 5. In regard to data on shares of muscle tissue in the drumstick at 42 days of age differed insignificantly (P>0.05). Higher values were obtained in group C for female and male (8.99 and 9.06, respectively) for drumstick, compared to other groups. Group C showed high yield of muscle in comparison to other groups, while differences among groups were insignificant (P>0.05).

Effect of diet on the back and wings portions percentages

The back and wings percentage values of trial groups are presented in table 5. In regard to data on the back portion of the female chicken an insignificant difference (P>0.05) was observed, but significant differences (P<0.05) were registered at 42 days of age. Values did not differ except between C, T1 and T2. At 42 days of age treatments containing natural additives had higher values in back portion than in both T1 and T2. This could be attributed to the influence of these additives on bone formation by affecting hormones responsible for the mineral or type of vitamin soluble involved in fat metabolism.

In regard to data on wings percentage, there was a slight insignificant (P>0.05) difference between groups at 42 days of age except group T3. During the overall rearing period values of wings percentage in trial groups tended to be lower than group T2, even though the differences were statistically insignificant (P>0.05) with T1 and C groups. Wings percentage of birds consumed diets containing mixing of sunflower oil and packed fat equally showed slight decrease as compared to the T3 and C groups. Mala *et al*. (2004) found that wing percentage (on the base of dressed carcass) was insignificantly higher (P>0.01) than the control in groups, which consumed diet containing a group of essential oils. This finding is in agreement with Popescu and Criste (2003).

Effect of diet on abdominal fat percentage

Body fat deposition depends on the net balance among absorbed fat, endogenous fat synthesis and fat catabolism. Abdominal fat percentage values of trial groups are presented in table 5. An insignificant (P>0.05) difference was found among males among groups for abdominal fat. Lowest values were found in groupT3 containing mixing of different types of fat with different proportion as showed in material and methods. This means that the fat metabolism was shifted by the phytochemical included in the beta metabolism of fat cycle (Kamel, 1993) to be more available for the energy supply than precipitating in the abdomen. Also, male sex had no effect on fat accumulation in the abdomen. These results agree with the results of Collins *et al.* (1999) and Sanz *et al.* (1999), while they used mixing of USFA with SFA, and found significant differences (P<0.05) on abdominal fat. Results obtained in present study are also in agreement with those obtained by Vila and Esteve Garcia (1996) who found that abdominal fat deposition increased with increasing fat inclusion level in birds fed tallow, whereas it remained constant in birds fed sunflower. Sanz *et al.* (1999) suggested that dietary fatty acid profile could affect abdominal fat deposition. Crespo and Esteve, (2001) reported that in males abdominal fat increased with increased fat concentration. Similar results were also obtained by Deaton *et al.* (1981), but these results are in contrast with the results of Fuller and Rendon (1977) and Sizemore and Siegel (1993) who did not find any effect of dietary fat concentration when the energy to protein ratio remained constant.

Effect of diet on total bowel and stomach percentage

Total bowel percentage values of trial groups are presented in table 5. At 42 days of age insignificant differences (P>0.05) were observed among trial groups for female. Bowel percentages were higher in group C (11.62 %), while the lowest value was noted in group T2 (10.64 %). On the other hand, for male sex there were significant differences (P<0.05) among groups. Bowel percentages for the male were higher in group T2 (11.36 %) and lowest in group T1 (10.80 % and 10.73 % for male and female, respectively) as compared to other groups. This could be attributed to the growth promoter effects of the type fat when fed to the birds during pre-starter and starter periods as indicated by higher feed consumption during starter and later in finisher phase of feeding. Increasing the digestion system volume is important to increase the capacity of consumption of more diet further that affects type of sex.

Effect of diet on heart percentage

Heart percentage values of trial groups are presented in table 5. During starter phase the heart weight was affected by including saturated fat in the diet, which decreased insignificantly (P>0.05), comparing to both sex of control group and among all groups. A similar result was registered for group C and T1. These results confirm the previous results from Mohammed et al. (2005). There were differences among groups and high percentage for male and female was noted in group C (0.55 %) which can be attributed to accumulation of saturated fat around heart.

Effect of diet on liver percentage

The liver is closely associated with digestive tract, as the organ responsible for metabolism and synthesis from absorbed nutrients (Shane, 2006). Liver percentage values of trial groups are presented in table 5. Percentages of liver were higher in groups consumed diets containing packed fat in C and also in group T1 for female even though there were insignificant differences (P>0.05) among all groups a low value was noted in groupT2 for female and for male it was in group T1. Saleh *et al.* (2003) explained this state due to tri-carboxied cycle in liver for SFA which produce more ATP leading to increase of fat deposition in liver.

Effect of diet on neck percentage

Data from table 5 showed that there were insignificant defences (P>0.05) on neck percentage but the higher value for female was in group C (2.67 %) and for male it was in group T3 (2.65 %).

Effect of diet on under skin fat for breast and thigh percentage

Table 5 indicates that values for accumulated fat under skin in breast and thigh for both sex had insignificant differences (P>0.05). On the other hand for female there were significant differences (P<0.05). The high value observed in group C for breast and thigh under skin fat were 0.41 % and 0.68 %, respectively. This is due to using just SF and percentage of deposited fat in the thigh more than in breast which can be attributed to physiological properties of carcass and the ability of thigh to deposit more fat through tissue than breast muscles.

Effect of diet on skin of breast and thigh muscles percentage

Insignificant differences (P>0.05) were observed for both muscles and both sex on skin. Higher values were highlighted in group T3 for female breast skin (0.68 %) and in group T1 (0.85 %) for female thigh skin. For male it was in group C for both breast skin (0.29 %) and thigh skin (0.32 %). This is due to weight and area of tissue muscles in these groups.

Effect of diet on plumage percentage

Feather percentage values of trial groups are presented in table 5. For both sex insignificant (P>0.05) values were recorded. Values in groups containing high level of mixing packed fat and rapeseed tends to decrease the feather formation in male. This could be attributed to the influence of these additives on the pituitary hormone prolactin which is responsible indirectly for the feather formation. Prolactin appears to influence reproductive function by a direct action on the central nervous system (Buntin, 1993), or might be due the effect on availability of sulphuric amino acids by decreasing the feed consumption in groups which consumed diets supplied by mixing two high level SFA and USFA (table 5).

CONCLUSION

From these results, it could be concluded that the best carcass percentage can be obtained by inclusion of the blend of 5 % packed fat in broilers diet. The higher yield of breast meat was obtained with inclusion of packed fat with rapeseed and sunflower oil into the diet in the group T3 for both sexes. The higher meat yield of the legs was obtained by inclusion of 5 % packed fat. Lower abdominal fat deposition was obtained by mixing 2.5 % packed fat with 2.5 % sunflower oil.

ACKNOWLEDGEMENT

This work was financially supported by the Grant Agency of the Slovak Ministry of Education and the Slovak Academy of Sciences under VEGA commission for agricultural, veterinary and wood science (Project n. 1/0662/11). The title of the project is expanding nutrient transformation to suitable production standards of safety of animal food by effective utilization of organic natural resources. Thanks to the poultry farm VÍGLAŠ workers, especially to Ing. Dušan Jančik, for help and support throughout this study. Many thanks for the team of the department who are helpful and are really doing good job.

REFFERENCES

ABDEL-SAMEI, A. H. 1983. Effect of dietary oil fat sources and levels on production performance of layers hen. M.Sc., Thesis, 241 Pages Fac. Agric., Cairo University.

AL-JANABI, A. – MOUHAMED, A. 1989. The principle of poultry feeding. High Ministry education press, Baghdad, Iraq, 235. p. ISBN. 02-4654962-17.

ANJUM, M. I. – MIRZA, I. – KHAN, A. G. – AZIM, A. 2004. Effect of fresh versus oxidized soybean oil on growth performance, organs weights and meat quality of broiler chicks, Animal Sciences Institute, National Agricultural Research. *Pakistan Veterinary J.*, vol. 24, 2004, no. 4, p. 173-178.

ASHILD, K. 1985. Digestion and Absorption of Lipids in Poultry. *J. Nutrition*, vol. 115, 1985, p. 675-685.

BUNTIN, J. D. 1993. Prolactin-brain interactions and reproductive function. *J. American Zoologist*, vol. 33, 1993, no. 2, p. 229-243. (Abstract). http://icb.oxfordjournals.org/cgi/reprint/33/2/229.

CAHANER, A. – NITSAN, Z. 1985. Evaluation of simultaneous selection for live body weight and against abdominal fat in broilers. *J. Poultry Sci.*, vol. 54, 1985, p. 1257–1263.

COLLINS, N. – MORAN, E. – STILLBORN, H. 1999. Effect of feeding optimum high oil corn on pellet quality broiler performance and carcass traits. *J. Poultry Sci.*, vol. 78, 1999, p. 129-133.

CRESPO, N. – ESTEVE, G. E. 2001. Dietary fatty acid profile modifies abdominal fat deposition in broiler chickens. *J. Poultry Sci*., vol. 80, 2001, p. 71-78.

DEATON, J. – MCNAUGHTON, J. – REECE, F. – LOTT, B. 1981. Abdominal fat of broilers as influenced by dietary level of animal fat. *J. Poultry Sci*., vol. 60, 1981, p. 1250-1253.

ENSMINGER, M. – OLD FIELD, J. – HENEMANN, W. 1990. Feeds and nutrition. 2nd Ed. The Ensminger Publishing Company. USA ,1990, p. 250-400. ISBN. 97-809412180-85.

FLORES, M. P. – CASTANON, J. I. R. – Mc NAB, J. M. 1994. Effect of tannin on starch digestibility and TMEn of triticale and semi purified starches from triticale and field beans. *British Poultry Sci*., vol. 35, 1994, p. 281-286.

FULLER, H. – RENDON, M. 1977. Energetic efficiency of different dietary fats for growth of young chicks. *J. Poultry Sci*., vol. 56, 1977, p. 549-559.

HASAN, E. – ABOUD, M. 2005. Poultry Theory practical E1. Damascus, Syria, 2005, p. 251. ISBN 01-56423871-12

IBRAHIM, E. 2000. Poultry Feeding, Ed2. Ministry of High Education, Mousel press, Iraq. 2000, p. 192. ISBN 014654962-13

KAMEL, B. A. 1993. Principle of Biochemistry, Ed1. Chapter, 3. Metabolism of lipids Ministry of High Education, Iraq. Mousel University, 1993, p. 184-225. ISBN 02-058496-12.

KERMANSHAHI, H. 1998. The potential of dietary lipases to improve fat utilization in young birds [PhD]. Saskatoon (CA): University of Saskatchewan.

KRALIK, G. – SKTIC, Z. – KUSEC, G. – KADLEC, J. 2003. The influence of rape seed / oil on the quality of chicken carcasses. *Czech J. Anim. Sci*., vol.48, 2003, no 2, p. 77-84.

LEESON, S. – SUMMERS, J. D. 1997. Commercial poultry nutrition. 2nd ed. University books, p. 214. Guelph, Ontario, Canada. ISBN 0-9695600-2-8.

MALA, S. – SLEZAČKOVA, I. – STRAKOVA, E. – SUCHY, P. – VECEREK, V. 2004. Plant–Based containing Ca – Salts of Fatty Acids and their Influence on performance, carcass characteristics and Heath status of broiler. *J. Acta of Veterinary*, vol. 73 2004, p. 321-328.

MIELCHE, M. – BERTELSEN, G. 1994. Approaches to the prevention of warmed over flavour. *J. of Trends in Food Sci. and Technol.*, vol. 5, 1994, p. 322-327.

MOHAMMED, H. – SARDARY, S. – MIRAN, D. 2005. The effect of utilization vegetable fat and oil of sunflower seeds and marketing age on production performance and chemical composition of broiler's carcass. Thesis, Salahaldeen University, Erbil, Iraq.

MOHARRERY, A. 2005. Effect of Malic Acid on Growth Performance, Carcass Characteristics, and Feed Efficiency in the Broiler Chickens. *Int. J. Poultry Sci.*, vol. 4, 2005, no. 10, p. 781-786.

NAJI, S. – HAMDY, A. 1989. Technologic of poultry production. High Education Press, Baghdad, Iraq. 1989, p. 360 ISBN 02-21569874-14

PARDIO, V. – LANDIN, L. – WALISZEWSKI, K. – BADILLO, C. – PEREZ, F. 2001. The effect of Acidified soapstocks on feed conversion and broiler skin pigmentation. *J. Poultry Sci*., vol. 80. 2001, p. 1236-1239.

POPESCU, A. – CRISTE, R. 2003. Using full fat soybean in broiler Diets and its effect on the production and economic efficiency of fattening. *J. Europe Agricult.*, vol. 4, 2001, no 1, p. 120-124.

ROSA, F. C. 1999. Teor de ácidos graxos poliinsaturados ômega-3 no peito e coxa de frangos de corte alimentados com rações contendo três fontes de óleo Lavras, MG, 94p. Dissertação (Mestrado em Zootecnia), Universidad Federal de Lavras, 1999.

SALEH, E. – WATKINS, S. – WALDROUP, A. – WALDROUP, P. 2003. Effects of Dietary Nutrient Density on Performance and Carcass Quality of Male Broilers Grown for Further Processing. *Int. J. Poultry Sci.*, vol. 3, 2003, no. 1, p.1-10.

SANZ, M. – FLORES, P. – PEREZ, D. – AYALA, E. – LOPEZ- BOTE, C. 1999. Higher lipid accumulation in broilers fed on saturated fats than in those fed on unsaturated fats. *British J. Poultry Sci*., vol. 40, 1999, p. 95-101.

SANZ, M. – LOPEZ-BOTE, C. – FLORES, C. – CARMONE, J. 2000. Effect of the inclusion time of dietary saturated and unsaturated fats before slaughter on the accumulation and composition of abdominal fat in female broiler chickens. *J. Poultry Sci.*, vol.79. 2000, p. 1320-1325.

SHANE, S. M. 2006. Nutritional and digestive disorders of poultry. Nottingham university press. Nottingham. UK. ISBN 1-904761-35-6.

SIZEMORE, F. G. – SIEGEL, H. S. 1993. Growth, feed conversion and carcass composition in females of four broiler crosses fed starter diets with different energy levels and energy to protein ratios. *J. Poultry Sci*., vol. 72, 1993, p. 2216-2228.

VILA, B. – ESTEVEGARCIA, A. 1996. Studies on acid oils and fatty acids for chickens. Influence of age. Rate of inclusion and degree of saturation on fat digestibility and metabolisable energy of acid oils. *British J. Poultry Sci*., vol. 37, 1996, p. 105-117.