Two Different Oils in Feeds For Broiler: Effects on Fat Digestion

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Two different oils in feeds for broiler; effects on fat digestion

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Abstract

The objective of present study was to investigate the digestibility of fat in the different segments of the small intestine in broiler chickens fed with two different feed containing either 4% soybean oil or 2% rapeseed oil + 2% linseed oil. The feed containing soybean oil resulted in higher fat digestibility percentage (in jejunum 38.8 vs. 36.3% and the first part of ileum 85.8 vs. 74.6%) compared to the rapeseed plus linseed oil diet. Final body weight and liver weight were significantly different in the diet groups ($p \leq 0.05$). Final body weight in the soya oil group was 2137.6 gram and in the rapeseed plus linseed oil group 2019.6 gram, and liver weight was 64 gram in the soybean oil group and 58 gram in the rapeseed plus linseed oil group. There were no significant differences in the gizzard weight in two diet groups. The increased fat digestibility in jejunum and the first part of ileum might be one factor contributing to increased final body weight.

Keywords: digestibility, ileum, jejunum, fat

Contents

1. Introduction

Chicken meat is popular all over in the world. Due to its large parts of white meat containing low level of saturated fat and high level of long chain polyunsaturated fatty acid (LC PUFAs), the meat is regarded as healthy meat (Haug et al. 2007). Amount of fatty acid in the chicken meat depend on the feed provided to the chicken,

(Christophersen & Haug 2011) Fats and oils are important as high energy source in the poultry diets. Chickens that have been kept on low fat diets have shown poor growth rates, poor feathering, edema and high mortality in few weeks of life. Oil seeds are rich sources of linoleic acid (LA, 18:2 n6), Linseed oil is a valuable source of alpha-linolenic acid (18:3 n3, ALA). Linseed oil is allowing to 10 % up to poultry feed. Both ALA and LA are essential fatty acids that the chicken needs for growth and development. ALA is healthy for the broiler due to increased muscle levels (Olomu & Baracos 1991**,** (Villaverde et al. 2006)**.** Inclusion of linseed oil in broiler feed can be good for enrichment healthy fat n-3 PUFA (Zelenka et al. 2006**)**. Nguyen et al. (2003) also reported that linseed oil is the main alternate source of fish oil, it contain ALA and dietary inclusion of ALA increase the production of long chain omega 3 (in your thesis: use either n3 or omega-3) fatty acid EPA (20:5 n3), DPA (22:5 n3) and DHA (22:6 n3). Fatty acid composition of meat play important role in the human health. Long chain omega 3 PUFA play an important role in the metabolism in the body. LA and ALA can be converted in the cells to important eicosanoids. The western diet contains much more omega-6 than omega-3 fatty acids. The ratio between omega6 to omega3 in the western diets may be as high as 10:1 or even 20:1, Haug et al. (2007). Balance of omega-6 and omega-3 fatty acid in the animal product is affected by omega-6 and omega-3 intake. An increase of omega-3 in the feed will increase omega-3 in the meat and this meat may result in improved human health.

Omega-3 polyunsaturated fatty acid EPA and DHA are beneficial for the protecting and inhibiting the incident and development of different chronic disease cardiovascular, neurodegenerative, immune and inflammatory disorder in the human beings;(Calder 2004)Alessandri et al. 2004**;** Sijben 2007; **(**Calder 2006)

In the present study we wanted to find out the effect the two different fat sources soybean oil and rapeseed plus linseed oil on the fat digestibility in the small intestine in broiler chicken.

2. Literature

(Baião & Lara 2005) reported that composition of fatty acid in the diet may influence fatty acid profile in the breast and thick muscle and diet with fat source contained high amount of long chain polyunsaturated fatty acid showed less fat deposition in the muscles. Rape seed oil content high amount of oleic acid (18:1 n9) Soybean oil content high level of un saturated fatty acid therefore it highly digested by broiler compare to the animal fat like lard and tallow, (Leeson & Atteh 1995).

Digestibility indicates that the quality of food, due to its ability to determine the proportion of nutrient in the food that are available for the absorption into the body. Digestibility of nutrient is important as it gives the information about the amount of nutrient in the diet and digested by the animals (Case et al. 2010). Digestibility used to the measure the quality of fees in the diet and cost of production.

2.1. Digestion processes

- Mechanical part of digestion
- Secretion of enzyme-containing digestive juices
- Enzymatic breakdown of organic nutrients
- absorption

Bird – crop-proventriculus-gizzard-small intestine-large intestine (Sjaastad et al. 2010).

2.2 Feed intake and mechanical digestion:

Birds are evolutionarily adapted to different types of the feed. The beak plays an important role in the crushing and cutting of feed. In the chicken mouth contains no teeth. The tongue helps for the movement of food rapidly to the oral cavity. In the oral cavity tubular salivary gland released mucin and amylase. Feed is transferred by peristaltic movements in the esophagus to the crop. The crop is the pouch like structure of the esophagus. The function of the crop is to store food and sends it to the stomach. The crop has neutral pH so it helps to degradation of starch. Birds combine chemical digestion using HCl and pepsin with mechanical grinding of feed through the gizzard and proventiculus (Sjaastad et al. 2010).

When the feed passes through proventiculus digestive juices are secreted from the gland cells in the mucosa. The wall of gizzard consists of layer of smooth muscle cells .By the alternating contraction of of these muscles layer gizzard content is churned. The transport of food from proventriculus to the gizzard occurs rapidly. The enzymes from the proventriculus continue to the act while the food is being mechanically treated by the gizzard.

2.3 Enzymatic digestion and Absorption of nutrients

Main role of stomach in the fat digestion is transported to the small intestine. There is two enzymes is necessary for the normal digestion these are lipase and bile. In the digestion process lipase break down the fat and enzymes comes to the lipid molecule. From the stomach fat passes to the intestine in the form of large droplets. (Hurwitz et al. 1979) reported that jejunum is main part of lipid digestion and ileum is the important for the linolenic, steric acid and palmitic acid absorption.

The small intestine divided in to the two parts, jejunum and the ileum, 40% and 60% of total small intestine .Main role of the small intestine is to breakdown and absorption of the nutrients in to the intestinal wall. Muscle in the jejunum wall is thicker and wide compare that ileum wall so when feed pass through the jejunum there is very short retention time compare to the ileum it is going fast (Attara & Ramji 2012).

2.4 Measurement of Digestibility:

Marker method is appropriate for the determination of digestibility in the mono gastric animals such as chicken, dog and pigs. In this method markers are added in to the birds feed. For the determination of nutrient intake in the gastrointestinal tract these marker method is very useful. (Jagger et al. 1992) reported that titanium dioxide ($TiO2_{)}$ is the appropriate marker when it was mixed at concentration of 1 g/kg in pig feed. Short et al. (1996) studied that titanium dioxide quantity, and concluded that 5g/kg in the feed as a good dietary marker in the chicken. (Krawielitzki et al. 1987) studied marker in the rats and concluded that titanium dioxide is easy to analysis and recovery rate is high. (Hafez et al. 1988) studied the titanium dioxide in the cow for the determination of digestibility. (Titgemeyer et al. 2001) studied that titanium dioxide is suitable for the determination of digestibility in the beef stairs. He also reported titanium dioxide ($TiO_{2)}$ is a bright white colored pigment used for the determination of dietary exclusion and intake of nutrient. It is stable for heat, light, oxygen and pH**.**

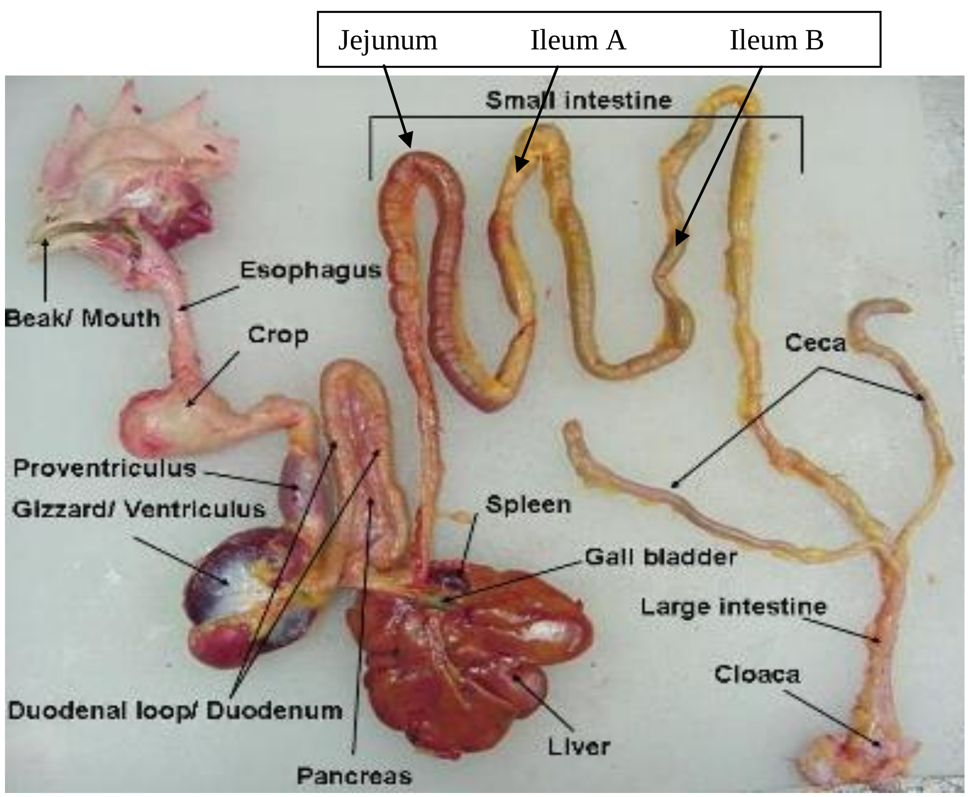

Figure 1 Digestive track in chicken, (Jacob 2012)

2.2.5: Objectives:

To investigate the digestibility of fat in two different feeds containing 4% soybean oil or 2% rapeseed + 2% linseed oil in the small intestine of broiler

3. Materials and methods

3.1 Animal Care

This study was done in the Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences (UMB), Aas Norway. International rules were followed for the care of animals and this experiment was approved by Research Council of Norway.

3.2 Chicken production:

There were 600 male Ross 308 broiler chickens used for the experiments. Day old chickens were sifted into two environmentally controlled rooms. Each room size was 30 meter square, with 300 chickens sifted in each room. Different types of diets were given to the chicken room one and room two; Soybean oil supplemented diet in room 1 and rape seed plus linseed oil supplemented diet were given in room 2. Feed and water was given ad libium through feeder and water trough. The temperature of each room was 33 °C and this temperature and light was continued for the 24 hours and this temperature was maintained 32 °C for the first three days. After first week light was provide for the 23 hour and one hour dark period (no light). Temperature was decreased by the 0.5 °C each day until the slaughtering age week 32.There was two dark period in the room from 17:00 -21:00 and 00:00- 04:00.There was daily and weekly monitored and medically checked by veterinary doctor . Mortality rate also recorded.

3.3. Feeds:

There were two types of feed used in this experiment; the feed ingredients were the same except for fat source, table 1. Wheat, maize gluten soya flour and oat were same in the both diets. One feed supplemented with SO soya oil (4%) and the other feed was supplemented with rapeseed oil (2%) and RLO linseed oil (2%). Titanium oxide marker was mixed at 5 gram per kg in to both feed.

Table 1 Feed composition of broiler chicken diet 1 (SO) and diet 2(RLO)

Commodities	Diet 1 %	Diet 2 %
Wheat	45.00	45.00
maize gluten	10.00	10.00
soy flour	17.00	17.00
oat	15.00	15.00
D-fat	4.00	5.60
soybean oil	4.00	0.00
Rape seed oil	0.00	2.00
linseed oil	0.00	2.00
Choline cholride	0.13	0.13
mono calcium phosphate	1.40	1.40
ground limestone	1.30	1.30
sodium chloride	0.25	0.25
sodium bicarbonate	0.2	0.2
mineral premix*	0.15	0.15
Vitamin A	0.03	0.03
Vitamin E	0.06	0.06
Vitamin ADBK	0.09	0.09
Vitamin D3	0.08	0.08
L-lysine	0.4	0.4
DL-methionine	0.200	0.200
L-threonine	0.200	0.200
Titanium oxide	0.5	0.5
Total	100	100

*Mineral contains –Fe 35 g/kg, Cu 16 g/kg, Mn 55 g/kg, I 0.7 g/kg, Selenium0.3 g/kg from Normin AS Honofoss Norway.

3.4 Slaughtering of chicken in Rakkestad

The chickens were slaughtered at Nortura Rakkestad, Herland. A veterinary checked all the birds at arrival, making sure all animals were sound and healthy. They all were. There was a five minute wait between slaughtering each of the two groups to make sure none of the animals were mixed up. The birds were sedated with gas, a mixture of Nitrogen and Carbon dioxide. They were exposed to gas for one minute. Prior to the gas treatment, a person looked at the birds, again checking that none of them are dead.

After this, their feet and wings were checked. There were no animals with damages to either wings or feet. Their throats were cut by machine, making sure they bled out. Also here, there was a person checking that every animal had been killed. If one had not, the person would cut the throat manually. They were scolded in hot water after bleeding out, and then plucked by revolving soft fingers moving at high speed around to axes. Their bowels were then removed by machine and veterinarians checked the bowel of each animal, making sure that none of them had any diseases. They were cooled for two hours, then packed in boxes and frozen. From group 1, there were 272 animals packed. They had an average weight of 1129 grams, total 307 kg. From group 2, 271 animals were packed. The average weight was 1052 gram, a total of 285 kg. So there was quite a large difference between the two groups.

3.5 Slaughtering of chicken and sample collection in UMB

Sixteen broilers from each group of the two dietary treatments were randomly selected for the analysis. Birds were slaughtered by knocking the head and cutting the neck. First there were killed 2 chickens from SO group and another 2 chicken were killed from RLO group until all 32 chickens were killed. Final body weight of chicken was taken at slaughter. Liver and gizzard weight also recorded.

Small intestine was divided into 3 parts; ileum was divided in to two parts Ileum (A) and Ileum (B) and jejunum. Excreta content of Ileum (A), Ileum (B) and jejunum were taken in plastic cups and stored in the refrigerator for the lyophilization and used for the further analysis.

Figure 2: Rearing, Slaughtering and excreta collection of chicken in UMB

Fig: 3 Sample from jejunum, Ileum A and Ileum B

3.6 Chemical Analysis

Gut contents were dried at 50°C for the constant weight then analyzed total fat. Feed was analyzed for the fatty acid contents and excreta were analyzed for total lipid percentage. Sample size of feed for the analysis of dry mater ash, total lipid, Marker) was 1 mili meter and for the marker analysis sample size 0.5 milli meters. TiO_2 was analyzed at Department of animal and aquaculture sciences following the procedure of Short et al. (1996)**)** and total lipid composition analyzed by the procedure as described by (Haug et al. 2012) .

Formula of the determination of total fat digestibility with marker method:

Total collection

$$Digestibility = \frac{Nutrient\ intake - Nutrient output}{Nutrient\ intake}$$

Marker method

$$Digestibility = 1 - \left(\frac{\%marker in feed \times \%nutrient in excreta}{\%marker in excreta \times \%nutrient in feed}\right)$$

3.7 Statistical Method:

Microsoft Excel 2010 was used for the calculation of mean and standard deviation. T test was used for the analysis of significant of data. The level of significance was presented at P<0.05.

4 Results

4.1 Fatty Acid Composition in the feed

Table 2: Fatty Acid Composition in the feed after FAME analysis

Table 2 shows that the composition of fatty acids varied in the two different feeds. Omega - 6 and omega-3 content is higher in the SO add feed compare to the RLO feed. SO feed contained more saturated fat compare to the RLO added feed. Myristic acid (C 14:0) is equal in the both feeds , whereas Palmitic acid (C 16:0) is less and stearic acid (C 18:0) is the higher in the RLO feed compare to the SO feed. Mono unsaturated fatty acid and poly - unsaturated fatty acid content are higher in the SO feed compare to the RLO feed. LA is much higher in the SO feed while ALA is higher in the RLO feed. Omega 6 and omega 3 ratios is significantly higher in the SO feed compare to the RLO feed 9.82:1 and 1.74:1. (About 10:1 and 2:1)

Fatty Acids	Soybean oil (SO)		Linseed + Rapeseed oil(RLO)	
	Mean	SD	Mean	SD
C14:0	0.88	0.05	0.89	0.03
C16:0	17.25	0.24	15.17	0.13
C16:1	1.10	0.02	1.16	0.01
C18:0	7.79	0.27	8.34	0.06
C18:1,c9	27.20	0.13	33.63	0.06
C18:2,n-6(LA)	35.92	0.88	21.58	0.26
C18:3,n-3(ALA)	3.61	0.09	12.37	0.11
n-6,n-3	9.82	0.06	1.74	0.03
2 total amount SFA	25.92	0.21	24.41	0.06
3Total amount MUFA	28.30	O.15	34.79	0.06
4Total amount PUFA	39.65	0.96	34.05	0.25

LA: linoleic acid, ALA: alfa.linolenic acid,.

1LC n-3 PUFA: 2 Sum SFA: amount of C14:0, C16:0 and C18:0. 3 total amount MUFA: total of C16:1 and C18:1, c9. 4 amount of PUFA: Total of LA, ALA, AA, and EPA.

4.2 Fat digestibility in the different parts of small intestine in the birds fed the SO feed

Table 3: Fat digestibility in the different parts of small intestine in the birds fed the SO feed. Mean digestibility of fat in the different intestinal parts of broiler fed with SO diet. In the jejunum there was range between (– 102 to 93.79 %), ileum (A) (31.94 to 95.88) and ileum (B) 34.25 to 99.05 % digestibility. Results clearly indicate that in the jejunum it is very low fat digestibility compare to ileum A and ileum B 38.80, 85.78 and 88.01 % respectively. Figure 4 shows that negative digestibility in some birds.

Comparison table 4 shows there was no significantly different digestibility between the ileum (A) and ileum (B).There was highly significant differences in the ileum (A) compared to the jejunum (P=0.007) and ileum (B) and jejunum (P=0.008).

Bird Number	Jejunum	Ileum A	Ileum B
1	67.7	80.49	89.83
2	30.57	95.88	88.20
3	-45.4	82.94	85.59
4	-102	31.93	34.24
5	68.59	84.44	80.80
6	24.52	94.67	90.15
7	53.86	92.97	85.87
8	30.92	83.04	97.30
9	77.04	94.24	99.05
10	69.03	86.51	97.71
11	70.93	93.28	95.86
12	50.93	91.54	94.07
13	46.56	92.82	91.09
14	48.06	91.24	90.97
15	58.08	92.79	94.84
16	71.52	82.80	92.65
Mean	**38.80**	**85.78**	**88.01**

Table 4 Comparisons of different segment of small intestinal digestibility fat in the SO group

Segments	Mean	Comparison	P- value
Jejunum	38.79	Jejunum-Ileum (A)	**0.008**
Ileum (A)	85.78	Jejunum-Ileum (B)	**0.007**
Ileum (B)	88.01	Ileum (A)- Ileum(B)	0.15

Value in the bold mark denote significant different at the 5 % level.

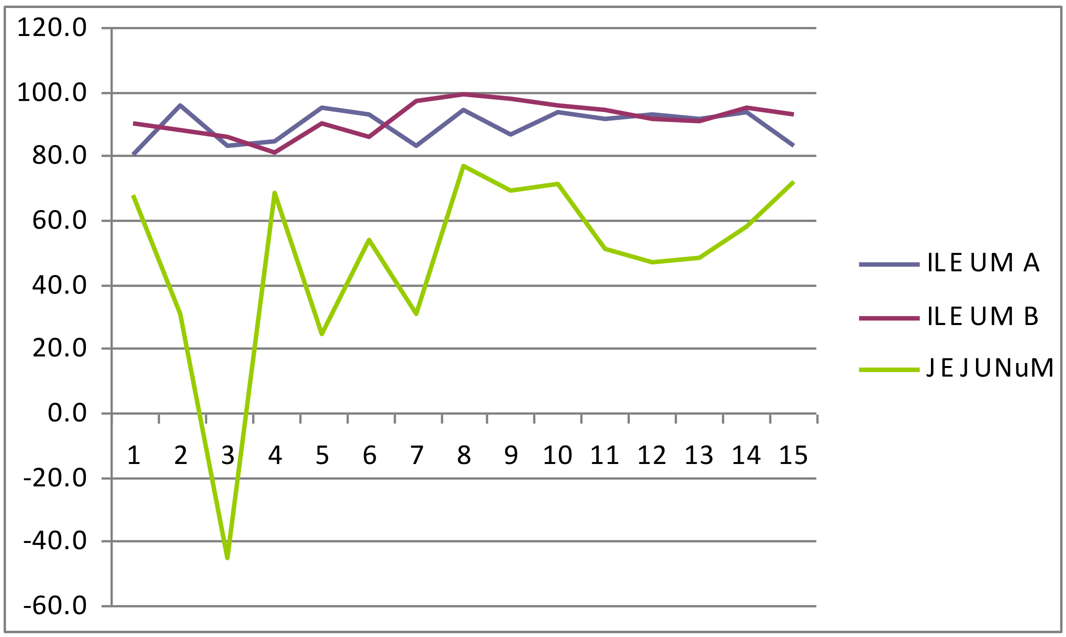

Figure 4: Graphic presentation of fat digestibility in small intestine in 16 individual broiler fed SO diet.

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4.3 Fat digestibility in the different parts of small intestine in the birds fed the RLO feed

Table 5 shows the fat digestibility in the RLO diet group in the broilers intestine. Mean digestibility of fat in the RLO diet is highest in ileum (B) followed by the ileum (A) and the jejunum 89.6, 74.6 and 36.2 respectively.

Comparison table 6 shows that there was significantly different fat digestibility ($p<0.05$) in the all three section of small intestine. There was significantly different fat digestibility in jejunum and ileum (A) (P=0.003), and jejunum and ileum (B) (P= 0.011) and ileum (A) and ileum (B) (P= 0.049). Figure 6 shows that negative digestibility were in some birds .The negative value shows some birds are difficult to explain.

Table 5: Fat digestibility in the broiler chicken fed with RLO feed

Birds number	Jejunum	Ileum A	Ileum B
1	-58.6	76.8	95.5
2	95.8	85.2	89.4
3	10.3	90.5	96.7
4	82.4	94.3	96.4
5	81.0	91.2	90.5
6	15.4	83.5	89.1
7	32.1	7.2	86.0
8	-2.4	85.5	86.4
9	-22.6	31.0	84.4
10	55.5	89.6	84.1
11	51.9	84.6	95.0
12	51.4	89.4	92.1
13	60.0	88.5	89.0
14	55.1	47.0	79.4
mean	**36.2**	**74.6**	**89.6**

Table 6 Comparisons of different segment of small intestinal digestibility fat in the RLO group

Segments	Mean	Comparison	P- value
Jejunum	36.20	Jejunum-Ileum (A)	0.009**
Ileum (A)	74.6	Jejunum-Ileum (B)	0.001*
Ileum (B)	89.6	Ileum (A)- Ileum(B)	0.049*

* significant at 10%, ** significant at 5%

Value in the bold mark denote significant different at the 5 % level

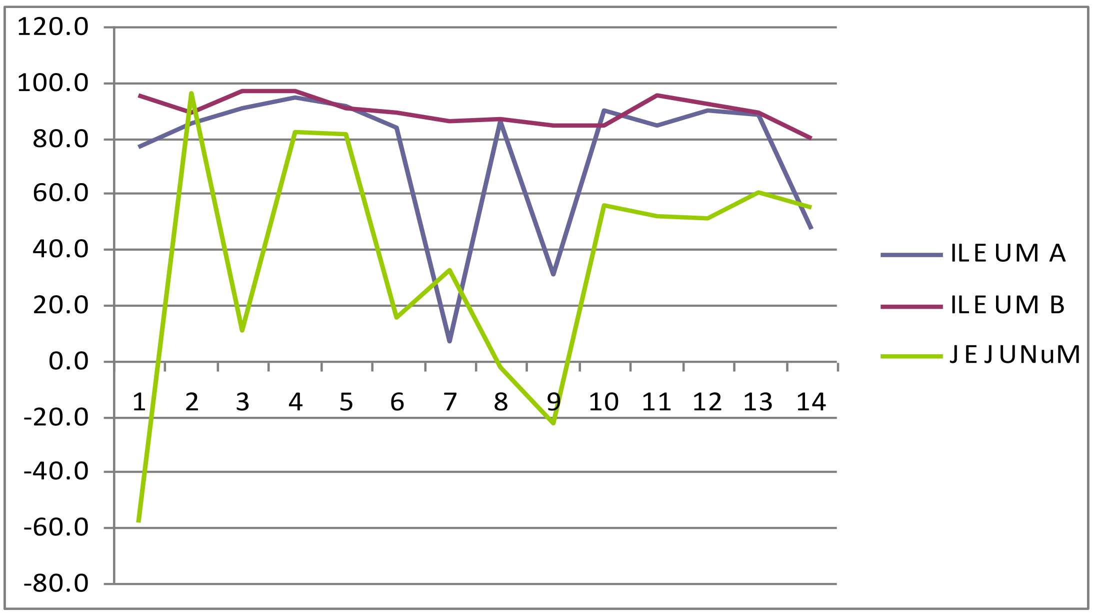

Figure: 5 Graphic presentation of fat digestibility in small intestine in 16 individual broiler fed RLO feed

4.4 Comparison of intestinal digestibility of fat in the SO and RLO groups in the broiler chicken

Table 7 shows the intestinal digestibility in the two different oil supplement group SO and RLO. Results clearly shows that there was significant differences of the fat digestibility in the jejunum (38.79 vs 36.20) (p=0.044) in the SO and RLO group. There were also significant differences between the two diet group SO and RLO in the Ileum (A) digestibility (85.78vs74.60) (P=0.009). In ileum (B) (88.01vs 89.60) there were no significant differences between the groups. The highest digestibility percentage was recorded in the ileum B followed by the ileum A and the jejunum 88.01, 85.78 and 38.79 in the SO group similarly, in the RLO group highest digestibility results shown in the ileum (B) followed by the ileum (A) and the jejunum; being 89.60, 74.60 and 36.20 respectively. Figure 6 shows that digestibility of the fat in the SO diet was higher compared to the RLO diet.

Table 7: Comparison of intestinal digestibility of fat in the SO and RLO groups in the broiler chicken

Segments	SO	RLO	P-value
Jejunum	38.80	36.20	**0.044****
Ileum(A)	88.01	74.60	**0.009***
Ileum(B)	85.78	89.60	0.49

* significant at 10%, ** significant at 5%

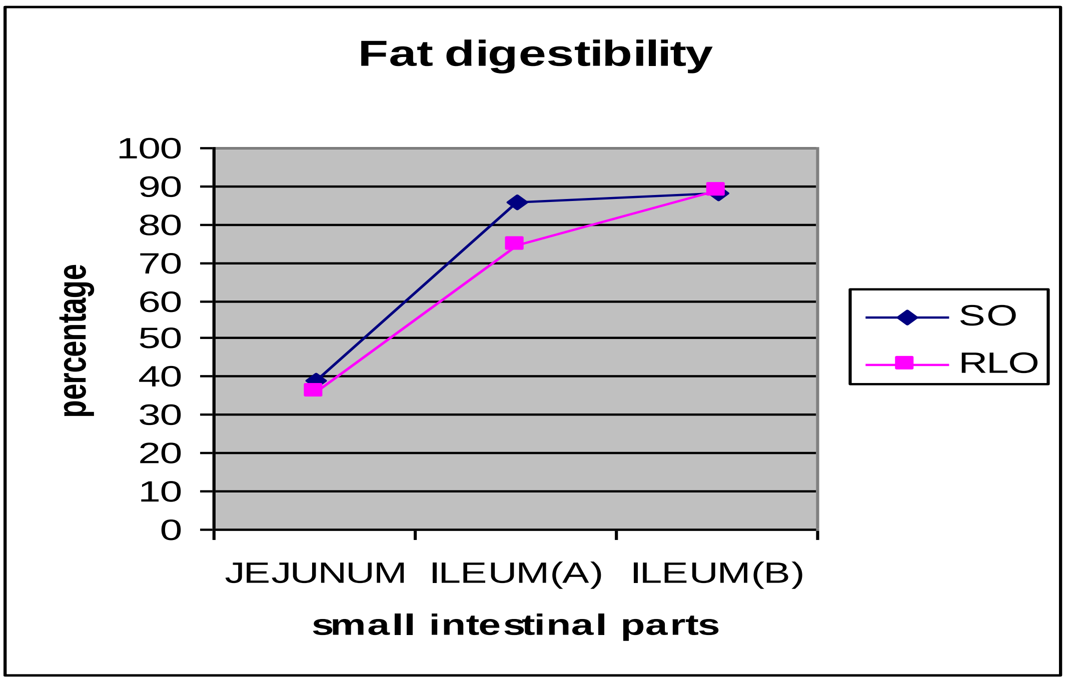

Figure 6: Graphic presentation of intestinal digestibility of fat in the SO and RLO groups in the broiler chicken.

4.5 Liver weight of chicken feed with two different feed SO and RLO

Table 8 results shows that the liver weight of broiler chicken fed with the SO group were slightly higher compared to the broilers fed with the RLO diet. Average liver weight was significantly high (p=0.015) 64.1(±129.8) gram and 58.1(±184.4) gram, respectively. Figure 7 shows that 10% higher liver weight in SO group compare than RLO group.

Table 8 Liver weight of chicken feed with two different feed SO and RLO

Birds Number	Liver weight (Gram)	
	SO	RLO
1	60.0	63.8
2	66.5	63.2
3	65.2	59.1
4	71.0	57.9
5	62.1	67.1
6	63.3	45.0
7	63.8	64.5
8	59.5	56.3
9	59.4	50.2
10	72.7	52.2
11	58.3	54.9
12	59.5	68.2
13	69.1	71.4
14	75.2	53.8
15	60.1	51.0
16	59.7	50.4
Mean (± SE)	64.1(±129.8)	58.1(±184.4)
P value	**0.015**	

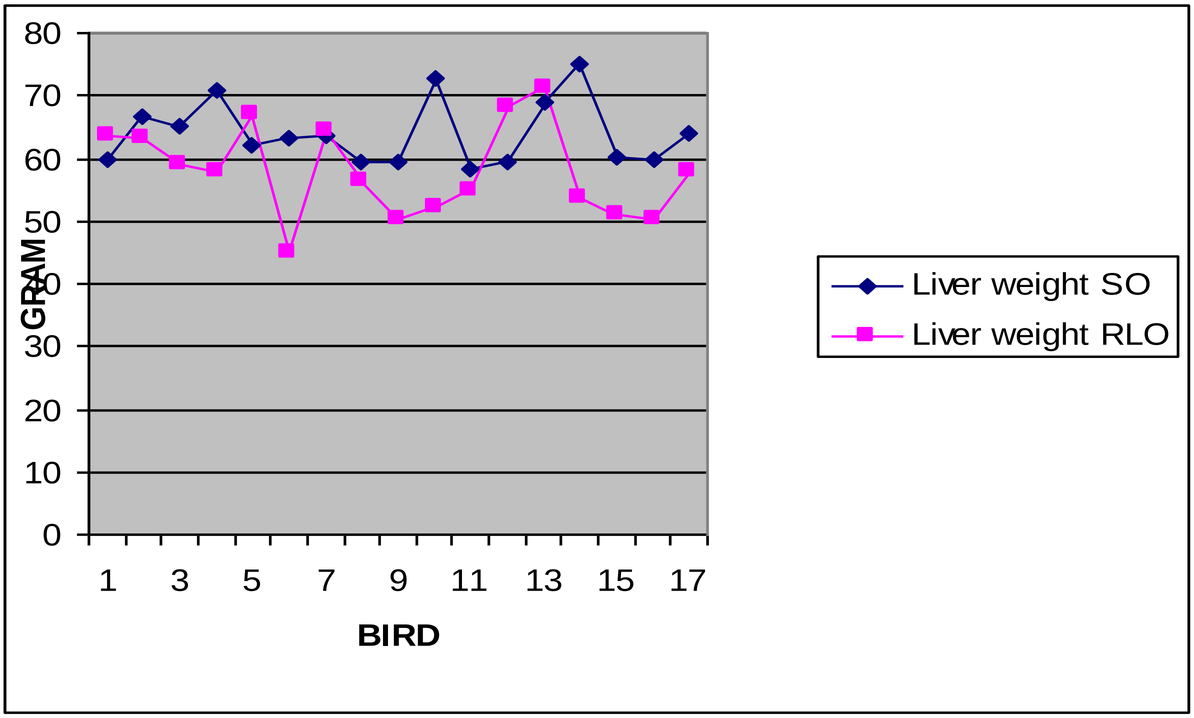

Figure 7 Graphic presentation of liver weight feed with two different feed SO and RLO

4.6 Body weight of the broiler chicken fed with two different feed SO and RLO

Table 9 results shows that the final body weight of broiler chicken fed with the SO and the RLO diet group were 2138 and 2020gram, respectively. The SO feed group had slightly higher body weight compared to RLO feed group. There was significantly (p=0.029) differences in final body weight the two groups.

Table: 9 final body weight of the broiler chicken fed with two different feed SO and RLO at the time of slaughter.

Birds	Final body weight (Gram)	
Number	SO	RLO
1	2102.0	2262.5
2	2092.5	2207.3
3	2121.2	2157.2
4	2137.2	1995.4
5	2240.3	2145.2
6	2098.0	1893.6
7	2002.8	2215.8
8	1964.5	1891.6
9	2065.5	1907.5
10	2358.3	1977.5
11	2013.3	2075.4
12	2053.5	1973.2
13	2252.4	2214.8
14	2323.9	1817.2
15	2103.8	1860.6
16	2236.5	1718.6
Mean	**2137.6**	**2019.6**
P value	**0.029**	

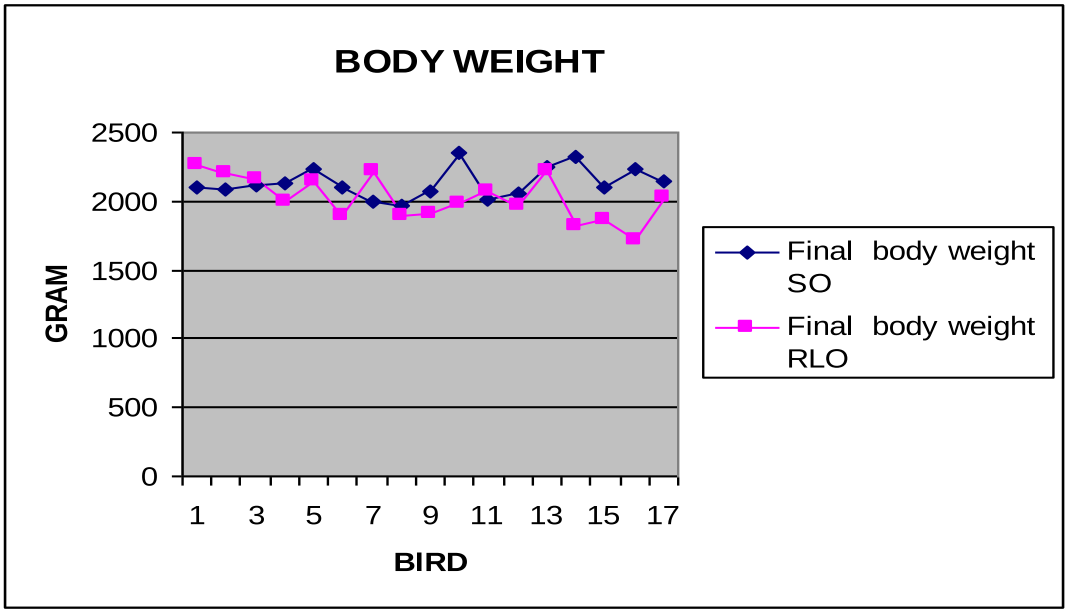

Figure 8: Graphic presentation of Final body weight of the broiler chicken fed with two different feed SO and RLO at the time of slaughter

4.7 Gizzard weight of the broiler chicken fed with the two different Feed SO and RLO

Results in the table10 shows that average gizzard weight of the broiler chicken fed with SO diet and RLO diet. There was no significant difference in the gizzard weight in the two chicken groups 61.9 and 61.9 gram, respectively. Figure 9 shows that similar gizzard weight in both diet groups.

Table 10: Gizzard weight of the broiler chicken fed with the two different Feed SO and RLO

Birds	Gizzard (Gram)	
Number	SO	RLO
1	69.7	61.6
2	65.4	76.1
3	60.4	57.7
4	67.5	64.4
5	70.0	75.8
6	55.2	55.6
7	63.3	73.1
8	54.9	60.8
9	64.9	59.5
10	56.2	55.5
11	59.7	66.0
12	48.8	58.8
13	59.0	64.4
14	66.0	52.6
15	68.9	46.0
16	60.3	61.8
Mean	**61.88**	**61.85**
P Value	**0.99**	

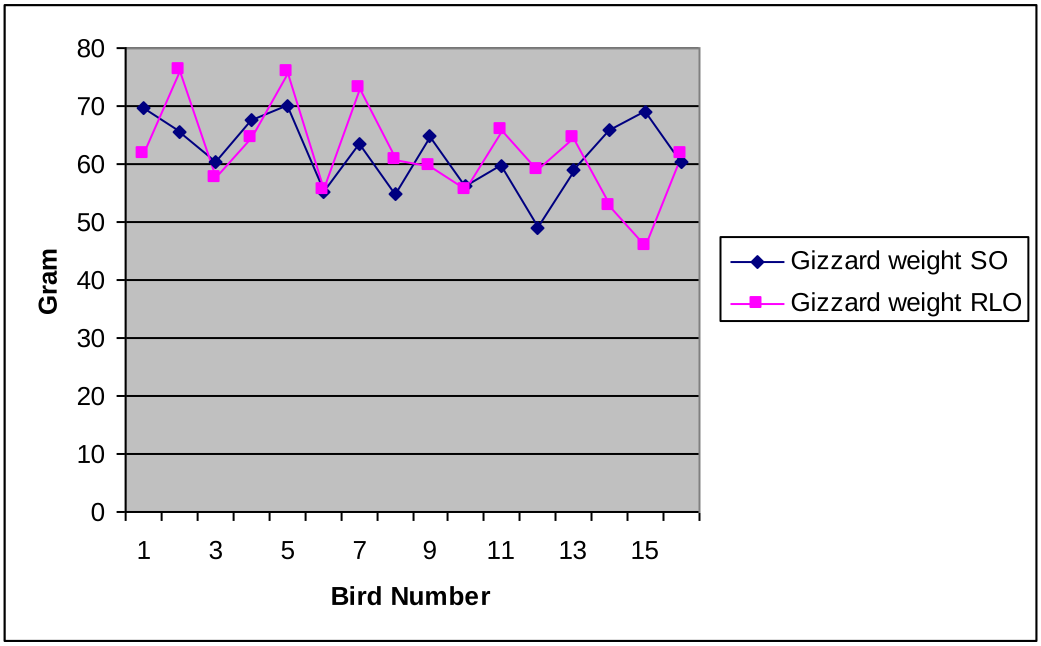

Figure: 9 Graphic presentation of Gizzard weight of the broiler chicken fed with the two different Feed SO and RLO

5. Discussion:

5.1. Feed composition

In this study, one diet was added 4 % soybean oil, and the other feed contained 2% rapeseed oil and 2% linseed oil. The diet added soybean oil contained significantly more of the saturated fatty acids myristic acid (C14: 0), palmitic (C16: 0) and stearic acid (C18: 0) than rapeseed/ linseed oil. So, the SO diet contained17 % palmitic acid, while RLO contained 15% palmitic acid. In our study there was a higher percentage of linoleic acid (n-6) in SO diet than in the RLO diet, 36% and 22%, respectively, while the amount of α-linolenic acid (n-3) was lowest in the SO feed compared to the RLO feed, 3.6% and 12.4 %, respectively . Therefore the SO contains more linoleic acid and less α-linolenic acid than RLO and SO. SO feed contained more n-6 than RLO due to more linoleic acid in SO, and this leads to a less favorable ratio n-6/n-3 in SO diet, being 9.8 in the SO diet and 1.7 in the RLO diet. The ratio of n-6/n-3 is important since there is a high intake of n-6 in Western diet, and changing the way to use of oils in livestock feed, may reduce this ratio. This study resulted in meat that contributed to a shift to a more favorable ratio between these polyunsaturated fatty acids.

5.2. Digestibility of vegetables oils:

The study showed that the digestibility of fat from feed with two different fat supplements either supplemented with SO or RLO in the broiler chicken. Intestinal content of two different diets showed low digestibility of the fat in the jejunum compare to the ileum (A) and ileum (B).(Krogdahl 1985) showed in her report that transit time is the short in the jejunum for the digestion. Saturated fat decreased the digestibility in the small intestine. In the present study SO diet contained more saturated fat compare to the RLO diet so this could result in lower digestibility. (Langhout et al. 1997) describe that when the saturated fat with wheat and rye based diet it may decreased the digestibility of fat. Our results are in line with these findings that it is a low digestibility in the jejunum.

(Sklan & Noy 2003) reported that fat digestibility in the duodenum and upper ileum in the Small intestine is 85%. Our studies agree with this result that digestibility percentage of crude fat is in the ileum (A) 85% and ileum (B) 88.1% in SO diet group and ileum (A) 74.6% and 89.6% in RLO diet groups. If the volume and the viscosity of the small intestine content is increase then the digestion in the small intestine become less efficient. Therefore figure 2 clearly showed that excreta contained from jejunum is much liquid, and this might be a reason of low digestion.(Svihus et al. 2002) showed that intestinal viscosity may affect to the fat digestibility.(Dei et al. 2006) reported that soya bean oil contained high energy and digestibility compare to other vegetable oils. Negative total fat digestibility value were observed in this study , this might be several factor influencing the including anti peristaltic movements, contaminating microbial material, mixing saw dust and separations of marker and digesta studied by (Ayoade et al. 2012). Liver weight of chicken was significantly higher body weight resulting in higher organ weight, (Haug et al. 2007).

In accordance to our results, (Scaife et al. 1994) showed that a diet containing SO resulted in increased feed intake and high liver weight of broiler chicken compared to a diet containing RLO. Final body weight of chicken was significantly different in to the groups (p=0.029). Body weight was affected by the feed intake and fat sources. SO group was higher body weight than RLO groups. There was no significant different in the gizzard weight in both groups. In SO group feed intake was higher than RLO group, Similar, a study by (Sharifi et al. 2013) showed that soya oil in the feed resulted increased body weight in broiler chicken. Chickens that ate RLO had a lower weight than SO. This might be caused by lower digestibility of the RLO diet.

6. Conclusions:

The fat digestibility in the first part of ileum and in jejunum in chickens given a diet containing 4% soybean oil was higher compared to digestibility in the first part of ileum and jejunum in chickens given a diet containing 2 % rapeseed oil plus 2% of linseed oil.

7. References:

Attara, G. & Ramji, Z. (2012). *Short Bowel Syndrome*: Badgut.org. Available at: http://www.badgut.org/information-centre/short-bowel-syndrome-1.html/ (accessed: 12/29/2012).

Ayoade, D., Kiarie, E., Woyengo, T., Slominski, B. & Nyachoti, C. (2012). Effect of a carbohydrase mixture on ileal amino acid digestibility in extruded full-fat soybeans fed to finishing pigs. *Journal of Animal Science*, 90 (11): 3842-3847.

Baião, N. C. & Lara, L. (2005). Oil and fat in broiler nutrition. *Revista Brasileira de Ciência Avícola*, 7 (3): 129-141.

Calder, P. C. (2004). n-3 Fatty acids and cardiovascular disease: evidence explained and mechanisms explored. *CLINICAL SCIENCE.*, 107 (1): 1-11.

Calder, P. C. (2006). n− 3 polyunsaturated fatty acids, inflammation, and inflammatory diseases. *The American journal of clinical nutrition*, 83 (6): S1505-1519S.

Case, L. P., Daristotle, L., Hayek, M. G. & Raasch, M. F. (2010). *Canine and feline nutrition: a resource for companion animal professionals*: Mosby.

Christophersen, O. A. & Haug, A. (2011). Animal products, diseases and drugs: a plea for better integration between agricultural sciences, human nutrition and human pharmacology. *Lipids Health Dis*, 10 (1): 16.

Dei, H. K., Rose, S. & Mackenzie, A. (2006). Apparent metabolisable energy and digestibility of shea (Vitellaria paradoxa) fat, cocoa (Theobroma cacao) fat and soybean oil in broiler chicks. *British poultry science*, 47 (5): 607-612.

Hafez, S., Junge, W. & Kalm, E. (1988). [Estimate of digestibility in dairy cows using an indicator method in comparison to the Hohenheimer feed value test]. *Archiv für Tierernährung*, 38 (10): 929.

Haug, A., Eich-Greatorex, S., Bernhoft, A., Wold, J. P., Hetland, H., Christophersen, O. A. & Sogn, T. (2007). Effect of dietary selenium and omega-3 fatty acids on muscle composition and quality in broilers. *Lipids Health Dis*, 6 (29).

Haug, A., Nyquist, N. F., Mosti, T. J., Andersen, M. & Høstmark, A. T. (2012). Increased EPA levels in serum phospholipids of humans after four weeks daily ingestion of one portion chicken fed linseed and rapeseed oil. *Lipids in health and disease*, 11 (1): 1-11.

Hurwitz, S., Eisner, U., Dubrov, D., Sklan, D., Risenfeld, G. & Bar, A. (1979). Protein, fatty acids, calcium and phosphate absorption along the gastrointestinal tract of the young turkey. *Comparative Biochemistry and Physiology Part A: Physiology*, 62 (4): 847-850.

Jacob, J. (2012). *Urban Poultry*: Small and Backyard Flocks community. Available at: http://www.extension.org/pages/65729/ileum (accessed: 12/29/2012).

Jagger, S., Wiseman, J., Cole, D. & Craigon, J. (1992). Evaluation of inert markers for the determination of ileal and faecal apparent digestibility values in the pig. *British Journal of Nutrition*, 68 (03): 729-739.

Krawielitzki, K., Schadereit, R., Borgmann, E. & Evers, B. (1987). Use of 51-Cr2O3 and TiO2 as markers for the determination of passage rate and protein digestibility in rats]. *Archiv für Tierernährung*, 37 (12): 1085.

Krogdahl, A. (1985). Digestion and absorption of lipids in poultry. *The Journal of nutrition*, 115 (5): 675.

Langhout, D., Schutte, J., Geerse, C., Kies, A., De Jong, J. & Verstegen, M. (1997). Effects on chick performance and nutrient digestibility of an endo-xylanase added to a wheat-and rye-based diet in relation to fat source. *British poultry science*, 38 (5): 557-563.

Leeson, S. & Atteh, J. (1995). Utilization of fats and fatty acids by turkey poults. *Poultry science*, 74 (12): 2003-2010.

Nguyen, L., Nuijens, M., Everts, H., Salden, N. & Beynen, A. (2003). Mathematical relationships between the intake of n-6 and n-3 polyunsaturated fatty acids and their contents in adipose tissue of growing pigs. *Meat science*, 65 (4): 1399-1406.

Olomu, J. & Baracos, V. (1991). Influence of dietary flaxseed oil on the performance, muscle protein deposition, and fatty acid composition of broiler chicks. *Poultry science*, 70 (6): 1403-1411.

Scaife, J., Moyo, J., Galbraith, H., Michie, W. & Campbell, V. (1994). Effect of different dietary supplemental fats and oils on the tissue fatty acid composition and growth of female broilers. *British poultry science*, 35 (1): 107-118.

Sharifi, S. D., Khorsandi, S. H., Khadem, A. A., Salehi, A. & Moslehi, H. (2013). The effect of four medicinal plants on the performance, blood biochemical traits and ileal microflora of broiler chicks. *Veterinarski arhiv*, 83 (1): 69-80.

Sjaastad, Ø. V., Sand, O. & Hove, K. (2010). Physiology of domestic animals. *Physiology of domestic animals* (Ed. 2).

Sklan, D. & Noy, Y. (2003). Functional development and intestinal absorption in the young poult. *British poultry science*, 44 (4): 651-658.

Svihus, B., Hetland, H., Choct, M. & Sundby, F. (2002). Passage rate through the anterior digestive tract of broiler chickens fed on diets with ground and whole wheat. *British poultry science*, 43 (5): 662-668.

Titgemeyer, E., Armendariz, C., Bindel, D., Greenwood, R. & Löest, C. (2001). Evaluation of titanium dioxide as a digestibility marker for cattle. *Journal of Animal Science*, 79 (4): 1059-1063.

Villaverde, C., Baucells, M., Cortinas, L. & Barroeta, A. (2006). Effects of dietary concentration and degree of polyunsaturation of dietary fat on endogenous synthesis and deposition of fatty acids in chickens. *British poultry science*, 47 (02): 173-179.

Zelenka, J., Schneiderová, D. & Mrkvicová, E. (2006). Linseed oils with different fatty acid patterns in the diet of broiler chickens. *Czech Journal of Animal Science*, 51 (3): 117.