EFFECTS OF DIFFERENT FAT SOURCES ON FATTY ACID COMPOSITION AND CLA CONTENT OF EGGS OF LAYING HENS

OZCAN BARIS CITIL, MEHMET SEZGIN*,
ABDURAHMAN AKTUMSEK**, GOKHAN ZENGIN**
Department of Animal Nutrition and Nutritional Disorders, Faculty of Veterinary Medicine,
Selcuk University, 42075, Konya, Turkey
*Department of Chemistry, Faculty of Science, Selcuk University, 42075, Konya, Turkey
**Department of Biology, Faculty of Science, Selcuk University, 42075, Konya, Turkey

In recent years, the poultry sector showed a large development. Increased production has led to large coops and feeding facilities. In terms of increased production people have begun to think about them health and prefer white meat instead of red meat.

China with 23.871 million tons of egg production created 38.2% of the world egg production. United States with 5.34 million tonnes 8.6% and India with 3.1 million tons which is 5.0% of world share.Other major producing countries are Japan, Mexico, Russia, Indonesia and France. Our country with 865.000 tonnes has a share of 1.4% of egg production (www.fao.org).

The nutrient composition of the fatty acid with the desired content aimed at, use can be adjusted in this direction in the ration. That means saturated fatty acids (SFA) can be reduced, in the other way unsaturated fatty acids (UFA) is increased. for this the researchers in them studies, tended to enrichment methods of ratio egg polyunsaturated fatty acids PUFA (Kralik et al., 2008).

Depending on the supply finding in egg linoleic acid and oleic acid is the most of them. There is CLA between conjugated linoleic acid isomers (**Mulvihill,** 2001). **Pariza et al.,** (1979) CLA began with the discovery of anticarcinogenic compounds isolated from beef. Using Lactobacillus species, the isomer of linoleic acid C18: 2 c9 t11 CLA are produced (**Gnädig et al.,** 2003). CLA is located in various regions of the organism. Is a product of adipose tissue (**Kelly,** 2001). On studies In animal, in the fats ruminant CLA 's to reduce the risk of cardio-vascular diseases, in the other hand plasma total cholesterol, triglyceride and LDL levels have been reported to decrease (**Baumgard et al.,** 2001). CLA's anti-carcinogenic body (anti-cancer) the effect of anti-atherogenic effect (hypolipidemic), the effect of anti-diabetic, insulin resistance, anti-obesity effect, effect on the immune system and concluded that the effect of osteoporosis.

Studies of micro-organisms in the intestines of animals and humans bringing ruminate linoleic acid CLA synthesis showed a very limited extent (**Aydın,** 2005). As a result of long research strengthens the immune system of chickens, pursued increases the growth rate of pigs (**Pariza et al.,** 2001).

In the study was found add some of different animal-derived oils to rations increase the amount of CLA in the eggs. In this study, investigate the changes in the amount of fatty acids and CLA in eggs of laying hens when different fat sources added to the ration composition. For this purpose, with the addition of tallow fat, internal fat and tail fat composition of fatty acid of the laying hens and determined whether or not the effect egg of CLA content.

MATERAL AND METHODS

Animals and diets

At 22 weeks of age, 160 Hy-line white egg layers were housed in cages and were assigned (40 laying hens each group) to four experimental diets. The diets of groups were based on control (2.5% canola oil), diet 1 (2.5% canola oil + 2.5% tallow fat), diet 2 (2.5% canola oil + 2.5% internal fat) oil, diet 3 (2.5% canola oil + 2.5% tail fat), respectively. The experiment lasted 90 days. The ingredients and chemical composition of diets are listed in Table 1, and the fatty acid composition of the various oil or fat sources used in the experiment are given in Table 2.

Sample collection

For the determination of fatty acid composition, five eggs from each dietary treatmant were randomly selected and analyzed at 30. days, 60. days and the end of the 90 days of experimental feeding. The yolk from each egg was separeted and held in polyethylene (PE) packing (in N_2 atmosphere) at -18 ^{o}C. At the beginning of each analysis, the samples were allowed to achieve at room temperature and homogenized.

Fatty acid analysis

Collected samples have been boiled. For fatty acid & CLA analysis Folch et al., to use from (1957)'s management 24 thousand rev/min in adjustabled homogenizer in blend of chloroform: methanol (v:v, 2:1) have been homogenized. Homogenized samples have been hold in deep-freeze to become methyl.

Fatty acids and CLA analysis were performed by HP (Hewllett Packard) Agilent HP 6890N model, Flame Ionization Detector and automatic injectory of gas chromatography. The best perform of distinction of conjugated fatty acids in analysis were used 100 meters HP 88 capillary column.

From the fat was made 0,5 ml it putted into conical centrifuge tube. 1 ml 2N solution of KOH methanolic was added above. Then by adding 7 ml n-Heptan, closing tube & was shaken completely .After the shake level it was centrifuged for 10 minute in 5000 revolution. There was two phase on tube. By taking a little of the top phase & filtered by anhydrous Na_2SO_4 transferred to vial & was injected to gas chromatography (ISO-5509, 1978).

For gas chromatographic analysis was performed by modifying the terms of **Ledoux et al.,** (2005). Temperature of injector block of GC was sat to 250 °C & Temperature of detector block was sat to 280 °C. Heat was applied to column. The beginning temperature of column was sat to 60 °C, this temperature was waited for 1 minute, then it was raised 20°C for each minute & reached to 190 °C. It was kept in this temperature for 60 minute. Following this temperature it was raised 1°C for each minute & reached to 220°C then was waited for 10 minute in this temperature. Total analysis duration is 107.5 minute. The gas flow rates of gas chromatography; hydrogen: 45 ml/min, dry air: 400 ml/min & helium: 1 ml/min was used as transporter gas were sat. 1µl of samples of fatty acids that became methyl form for the analysis were injected to GC.

Fatty acids methyl esters standards were obtained from Nu-Check Prep. Inc. USA, Sigma-Aldrich & Accu company. CLA (catalog number 05632) standards were provided from Sigma-Aldrich (st Louis, MO, USA) company. Standards relative retention times were determined by analyzeing gas chromatography instrument. So obtained standards whith the help of relative retention times were determined which of fatty acids corresponding to chromatography's peaks. The triplicate chromatography's peaks that were obtained percent (%) field's arithmetic averages & standard deviations were calculated are given in tables form.

Statistical analysis

The experiment was based on a completely randomised design. The data were analysed by means of one-way ANOVA ($P < 0.05$). When analysis of variance indicated a significant treatment the means were compared by Duncan's multiple range tests. The data were expressed as means ± standard error.

RESULTS AND DISCUSSION

The fatty acid compositions of egg yolks at d 30 and 60 are shown in Tables 3 and 4, respectively. The final fatty acid composition of the egg yolks at the end of the trial are shown in Table 5.

Palmitic acid value in the eggs that collected at the end of 90th day of res-fat group was determined the highest value. The lowest value of this fatty acid was determined from the eggs that was collected from tail-fat group ($P<0.01$). Stearic acid, was determined as secondary saturated fatty acid.

In composition of the fatty acid of the eggs that was collected at the end of 90th day C 18:0, Stearic acid (10.297-21.991%), C 16:0, palmitic acid (15.450-33.596%) major SFA; C 18:1 c9, oleic acid (18.327-33.648%) major MUFA and C 18:2 ω6, linolenic acid (19.381-25.494%) was found as major PUFA (Table 5). **Parlat et al.,** (2010) in the eggs that were obtained from attack-s breed hens that were observed the same results.

The highest value in terms of linoleic acid were determined from tail fat group. The lowest value was determined from the eggs that were collected from internal fatty group. There is no statistical difference between the control & internal fatty group in the terms of linoleic acid. The fatty tail gruop arachidonic acid, statistically is different from other groups. In the eggs that were collected from the fatty tail group, DHA is different from the other groups. In the terms of total PUFA was observed the highest value in fatty tail group; the lowest value in the sol-fat & internal fat group. In the terms of the ratio of the PUFA/MUFA that was obtained the highest results in sol-fat groups and the lowest value in the control group.

In this thesis, in hy-line breed hens egg yolks SFA has been identified as a major palmitic acid. Similar results were observed in the eggs of hens that was fed by flax seed (**Sehu et al.,** 2012). Total SFA, 36.382% (control), 52.067% (sol-fat), 47.420% (internal fat) and 26.840% (tail fat), has been determined (Table 5). Similar results were observed in research by **Çelebi et al.,** (2008) about total value of SFA (22.25-34.02%) of collected egg. Total SFA value (29.40-32.48%) in eggs that was collected in the study conducted by the **Parlat et al.,** (2010) was lower than our study. Total MUFA at the end of the 90th day was determinded the control, sol-fat, internal-fat and tail-fat that was collected from the eggs respectively, 36.183%, 21.461%, 37.197%, 26.371% (Table 4). Total MUFA value, **Çelebi et al.,** (2008) was lower that the MUFA value that was obtained from egg yolks. Diffrenence were determinded between the groups in the terms of total MUFA and Oleic acid in the eggs of Hy-Line breed hens. Similarly **Gürbüz et al.,** (2012) there is the difference between the values of oleic and palmitoleic acid in the eggs that was obtained from the hens that was fed frrom different rations containing fat sources. At the end of the 90th day Total PUFA, control, sol-fat, internal-fat were determined respectively 27.434%, 26.471%, 26.210%, & 35.963%. **Çelebi et al.,** (2008) and **Aydin** (2005) value of total PUFA in the eggs that they were obtained in their study, was determined lower than our study results. At the end of the 90th day C 20:4, in arachidonic acid (4.832%) is determined higher than the other feed rations (%2.403-4.832). **Gürbüz et al.,** (2012) detecting a high percentage of lino-

leic and arachidonic acid in hens eggs & were determined a statistically difference between them. At the end of 90th day in terms of ω3 were determined respectively, %2.878 (control), %2.637 (sol-fat), %2.928 (internal-fat) and % 4.801 (tail fat), (Table 5). The highest value of total ω3 that we collected from the eggs was obtained from the hens that fed by tail fat. The detected highest percentage of two CLA isomer from control, sol-fat, internal fat and tail fat groups from collected eggs at the end of the 90th day the highest percentage is one found C 18:2 c9-t11 isomer (Table 5). The highest total CLA in the Hy-line breed hens's eggs were determined from the tail fat fed hens's eggs (%0.093). Total CLA at the end of the 90th day respectively was determined as, %0.027 (control), %0.066 (sol-fat), %0.070 (internal fat) and %0.093 (tail fat). %1.17-2.38 of total CLA was saw in the eggs that was obtained from the Aydın's study (2005). In this thesis study, the CLA of the CLA & C 18:2 c9-t11, that was determined from the addition of sol fat and internal fat to hy-line breed hens's rations, is different from the other groups CLA and C18:2 c9-t11 's CLA.

Rations of this study, hy-line breed hens that fed by canola fat, sol fat, internal fat and tail fat added foods, the fatty acid compositions and change of CLA's levels of eggs that was obtained at the 30th, 60th and 90th days was analyzed by gas chromatographic method.

30 units fatty acid at all was determined in the eggs from the results of the analyzes. Total saturated fatty acids in the eggs that was obtained at the end of 90th day from tail fat fed groups was found as lowest level (Table 5). The reason of this is low level of palmitic and stearic acid of major saturated fatty acids. The highest level of the saturated fatty acids was determined from the eggs that were obtained from sol fat fed hens. The highest value in terms of total MUFA was detected from the eggs that were obtained from tail fat groups. The lowest value in terms of total MUFA was detected from the eggs that were obtained from sol fat groups. The highest fatty acid of MUFAs is belong to C18:1 oleic acid. The highest percentage in terms of total PUFA was determined from the eggs that were obtained from tail fat fed groups. This is because of too C 18:2 linoleic acid. The high rate of arachidonic acid C 22:6 DHA and C 20:4 also has been effective in total PUFA's height. According to the percentage of total UFA (PUFA + MUFA), the highest level from tail fat groups and the lowest level from sol fat groups was determined from the collected eggs. The highest value in the terms of omega-3 was determined from the fat tail eggs groups (table 5). The highest value in terms of total CLA was determined from the eggs that was collected from the tail fat groups (Table 3,4,5). The reason of the high percentage of CLA at the end of the 90th day, the high percentage of c9-t11 rumenik acid is remarkable (table 3, 4, 5).

The eggs that weres collected at the end of 30th, 60th and 90th day from the sol fat and internal fat fed hens's total SFA has been increased and total MUFA and total UFA were showed decreased. Total PUFA in the control groups eggs at the end of the 30th, 60th and 90th day was decreased. (Table 3, 4, 5). In the eggs of tail fat fed hens, this ratio at the 60th and 90th day was inccreased. Total omega-3's value at the 30th, 60th and 90th days was increased in the control and tail fat groups. But the maximum increase was observed in the tail fat fed groups. Increase was observed at the total CLA's value that was collected from the sol fat, internal fat and tail fat's eggs groups (Table 3, 4, 5). But the specified increase at the end of the 60th day is higher than the specified increase at the end of the 90th day.

According to the datas by adding tail fat to the rations of the laying hens at the end of the 30th day was observed the increased values of ∑SFA, rumenik acid, ∑CLA and ∑ω3 and reduced values of ∑MUFA, ∑PUFA, ∑ω6 ve ∑UFA's fatty acids in the eggs. By adding tail fat to the rations of the laying hens at the end of the 60th day was observed the increased values of ∑SFA, ∑PUFA, rumenik acid, ∑CLA, ∑ω3 ve ∑ω6 and reduce values of ∑MUFA ve ∑UFA's fatty acids. By adding tail fat to the rations of the laying hens at the end of the 90th day was observed the increased values of ∑PUFA, rumenik acid, ∑CLA, ∑ω3, ∑ω6 and ∑UFA's fatty acids and decrease values of ∑SFA, ∑MUFA (Table 4.8).

By adding tail fat to the rations of the laying hens

Table 1. **Compositions of the experimental diets**

Ingredients	Control , %	Tallow fat , %	Internal fat , %	Tail fat , %
Corn	60.55	60.55	60.55	60.55
Soybean meal (% 47 CP)	25.1	25.1	25.1	25.1
Barley	8.74	8.74	8.74	8.74
Canola Oil	2.5	2.5	2.5	2.5
Animal Fat	0	2.5	2.5	2.5
Dicalcium phosphate (DCP 20%)	2.28	0.07	0.07	0.07
Salt (NaCl)	0.39	0.1	0.1	0.1
Min + Vit premix	0.26	0.26	0.26	0.26
DL-Methionine	0.18	0.18	0.18	0.18

Table 2. **Fatty acid composition of diets , %**

Fatty acids	Control (*n*=5)	Added Tallow fat , % (*n*=5)	Added Internal fat , % (*n*=5)	Added Tail fat , % (*n*=5)
C 8:0*	-	-	-	-
C 10:0	-	-	-	-
C 12:0	0.032±0.00a	0.092±0.00c	0.056±0.01b	0.110±0.01c
C 14:0	0.371±0.36c	5.368±0.17a	1.509±0.16b	1.521±0.24b
C 15:0	0.091±0.01c	0.818±0.02a	0.372±0.04b	0.352±0.01b
C 16:0	15.803±0.89c	33.84±0.72a	21.078±1.04b	15.746±0.34c
C 17:0	0.211±0.01b	0.791±0.03a	0.774±0.08a	0.807±0.02a
C 18:0	4.509±0.54d	13.89±0.41b	16.39±0.37a	7.82±0.25c
C 20:0	0.061±0.00c	0.070±0.00ab	0.075±0.01b	0.269±0.01a
C 21:0	0.054±0.01b	0.032±0.00c	0.034±0.01c	0.068±0.00a
C 22:0	0.551±0.03a	0.168±0.01c	0.258±0.04b	0.187±0.01c
∑ **SFA**	**21.683±0.90d**	**55.069±0.66a**	**40.546±0.96b**	**26.880±0.42c**
C 14:1ω5	0.014±0.00b	0.216±0.03b	0.158±0.03b	0.715±0.44a
C 15:1ω5	0.039±0.01c	0.202±0.01a	0.218±0.04a	0.116±0.01b
C 16:1ω7	0.288±0.04b	1.307±0.02a	1.186±0.14a	1.210±0.07a
C 17:1ω8	0.037±0.00c	0.094±0.01b	0.094±0.01b	0.111±0.01a
C 18:1 *c*9	36.355±0.75b	30.721±0.44c	41.718±0.82a	43.139±0.73a
C 18:1 c11	0.887±0.08c	1.274±0.12b	1.475±0.09a	1.555±0.04a
C 20:1ω9	0.355±0.04b	0.352±0.04b	0.414±0.25b	0.805±0.01a
C 22:1ω9	0.081±0.01a	0.089±0.01a	0.016±0.00b	0.014±0.00b
∑ **MUFA**	**38.056±0.62c**	**34.255±0.50d**	**45.279±0.84b**	**47.665±0.28a**
C 18:2ω6	36.765±0.55a	6.978±0.16d	10.597±0.49c	22.297±0.61b
C 18:3ω6	0.598±0.01a	0.430±0.04ab	0.631±0.23a	0.291±0.02b
C 18:3ω3	1.303±0.05b	0.322±0.02d	0.554±0.05c	2.079±0.10a
C 20:4ω6	0.046±0.01c	0.083±0.01c	0.377±0.04b	0.503±0.02a
C 20:5ω3	0.007±0.00d	0.026±0.00c	0.035±0.00b	0.045±0.00a
C 22:4ω6	0.548±0.04c	1.467±0.06a	1.231±0.15b	0.107±0.01d
C 22:5ω6	0.414±0.04b	1.092±0.27a	0.807±0.23a	0.178±0.01b
C 22:5ω3	0.260±0.02a	0.187±0.04b	0.196±0.02b	0.074±0.00c
C 22:6ω3	0.304±0.06a	0.168±0.03b	0.185±0.04b	0.062±0.01c
∑ **PUFA**	**40.245±0.53a**	**10.783±0.26d**	**14.667±0.28c**	**25.689±0.56b**
CLA c9 – t11**	0.000±0.00c	0.026±0.00b	0.040±0.01ab	0.047±0.00a
CLA t10 – c12**	0.000±0.00a	0.004±0.00a	0.014±0.02a	0.006±0.00a
∑ **CLA****	**0.000±0.00c**	**0.030±0.01b**	**0.054±0.01a**	**0.053±0.01a**
∑ UFA	78.301±0.90a	45.038±0.66d	59.946±0.96c	73.354±0.42b
∑ PUFA / MUFA	1.058±0.02a	0.315±0.01c	0.324±0.00c	0.539±0.01b
∑ ω3	1.874±0.06b	0.703±0.09d	0.970±0.10c	2.260±0.10a
∑ ω6	38.371±0.54a	10.049±0.17d	13.643±0.27c	23.375±0.61b
∑ ω3/ω6	0.049±0.00c	0.070±0.01b	0.071±0.01b	0.097±0.01a

* $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}01$.
** $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}001$.

Table 3. **Fatty acid compositions of yolk of egg at 30. days, %**

Fatty acids	Control (*n*=5)	Tallow fat (n=5)	Internal fat (*n*=5)	Tail fat (*n*=5)
C 8:0*	-	-	-	-
C 10:0	-	-	-	-
C 12:0	-	-	-	-
C 14:0	0.205±0.05a	0.276±0.05a	0.272±0.06a	0.244±0.05a
C 15:0	0.051±0.01b	0.083±0.02ab	0.095±0.02a	0.115±0.03a
C 16:0	22.753±0.69b	26.920±0.35a	22.769±0.55b	22.632±0.33b
C 17:0	0.148±0.01c	0.344±0.03b	0.313±0.05b	0.458±0.02a
C 18:0	7.213±0.13d	12.916±1.35c	16.171±0.66b	20.438±0.27a
C 20:0	0.037±0.05a	0.095±0.08a	0.055±0.03a	0.039±0.02a
C 21:0	0.001±0.00a	0.027±0.04a	0.004±0.01a	0.006±0.01a
C 22:0	0.417±0.11a	0.267±0.05a	0.304±0.09a	0.408±0.06a
∑ SFA	**30.825±0.64c**	**40.928±1.49b**	**39.983±0.65b**	**44.340±0.56a**
C 14:1ω5	0.015±0.01a	0.018±0.01a	0.014±0.01a	0.026±0.03a
C 15:1ω5	0.003±0.00b	0.025±0.01a	0.023±0.01a	0.020±0.01a
C 16:1ω7	1.820±0.51a	1.471±0.36a	1.384±0.36a	2.039±0.22a
C 17:1ω8	0.030±0.03a	0.051±0.01a	0.077±0.03a	0.099±0.06a
C 18:1 *c*9	35.530±0.29a	33.701±0.40b	34.689±0.86a	24.564±0.34c
C 18:1 c11	1.236±0.18a	1.290±0.30a	1.220±0.09a	1.93±0.08a
C 20:1ω9	0.111±0.08a	0.143±0.17a	0.119±0.05a	0.119±0.03a
C 22:1ω9	0.006±0.01a	0.005±0.00a	0.002±0.00a	0.001±0.00a
∑ MUFA	**38.751±0.96a**	**36.704±0.99a**	**37.528±0.62a**	**28.798±0.59b**
C 18:2ω6	23.674±0.08a	16.530±0.35c	15.668±0.28d	19.552±0.38b
C 18:3ω6	0.103±0.06a	0.091±0.01a	0.089±0.01a	0.082±0.02a
C 18:3ω3	0.152±0.03a	0.305±0.14a	0.293±0.09a	0.243±0.02a
C 20:4ω6	2.918±0.18b	3.520±0.51b	3.289±0.24b	4.512±0.32a
C 20:5ω3	0.260±0.40a	0.007±0.01a	0.001±0.00a	0.062±0.12a
C 22:4ω6	0.268±0.08a	0.177±0.06a	0.205±0.06a	0.241±0.03a
C 22:5ω6	1.229±0.29a	0.612±0.22b	0.606±0.18b	0.889±0.25ab
C 22:5ω3	0.100±0.04a	0.102±0.03a	0.114±0.04a	0.134±0.02a
C 22:6ω3	1.700±0.48a	0.989±0.11b	2.184±0.16a	1.921±0.42a
∑ PUFA	**30.425±0.77a**	**22.370±0.64c**	**22.492±0.48c**	**27.699±1.07b**
CLA c9 - t11**	0.018±0.01b	0.033±0.00ab	0.038±0.02ab	0.057±0.01a
CLA t10 - c12**	0.003±0.00a	0.004±0.00a	0.005±0.00a	0.006±0.00a
∑ CLA**	**0.021±0.01b**	**0.037±0.01ab**	**0.043±0.02ab**	**0.063±0.01a**
∑ UFA	69.176±0.64a	59.074±1.49b	60.020±0.65b	56.497±0.56c
∑ PUFA / MUFA	0.785±0.04b	0.609±0.01c	0.599±0.02c	0.962±0.06a
∑ ω3	2.212±0.49a	1.403±0.20b	2.592±0.14a	2.360±0.39a
∑ ω6	28.192±0.22a	20.930±0.40c	19.857±0.34d	25.276±0.74b
∑ ω3/ω6	0.079±0.02c	0.067±0.01d	0.131±0.01a	0.093±0.01b

* $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}01$.
** $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}001$.

Table 4. **Fatty acid compositions of yolk of egg at 60. days , %**

Fatty acids	Control (*n*=5)	Tallow fat (*n*=5)	Internal fat (*n*=5)	Tail fat (*n*=5)
C 8:0*	-	-	0.001±0.00a	-
C 10:0	-	0.000±0.00a	-	0.001±0.00ab
C 12:0	-	0.003±0.00a	0.002±0.00a	0.003±0.00ab
C 14:0	0.227±0.06a	0.258±0.03a	0.244±0.05a	0.279±0.04a
C 15:0	0.026±0.01a	0.019±0.01a	0.017±0.01a	0.026±0.01a
C 16:0	23.960±0.19b	30.972±0.26a	23.365±0.22c	19.348±0.26d
C 17:0	0.158±0.03c	0.386±0.05b	0.382±0.03b	0.466±0.03a
C 18:0	8.243±0.35c	15.241±0.44b	20.066±0.36a	15.515±0.33b
C 20:0	0.013±0.01b	0.027±0.01ab	0.019±0.01b	0.033±0.00a
C 21:0	0.002±0.00a	0.006±0.00a	0.007±0.01a	0.009±0.01a
C 22:0	0.315±0.10a	0.356±0.05a	0.310±0.10a	0.303±0.07a
∑ SFA	**32.944±0.29d**	**47.268±0.48a**	**44.413±0.55b**	**35.983±0.44c**
C 14:1ω5	0.002±0.00b	0.007±0.00ab	0.011±0.00a	0.008±0.00a
C 15:1ω5	0.003±0.00b	0.015±0.00a	0.016±0.01a	0.012±0.01ab
C 16:1ω7	1.694±0.48b	1.293±0.20b	1.186±0.25b	2.312±0.27a
C 17:1ω8	0.019±0.01a	0.053±0.05a	0.042±0.01a	0.047±0.01a
C 18:1 *c*9	33.883±0.89a	26.604±0.41c	29.507±0.35b	27.455±0.33c
C 18:1 c11	1.291±0.22a	1.219±0.14a	1.144±0.12a	1.258±0.13a
C 20:1ω9	0.142±0.01a	0.065±0.02b	0.094±0.02b	0.054±0.01b
C 22:1ω9	0.002±0.00a	0.009±0.00a	0.005±0.00a	0.010±0.01a
∑ MUFA	**37.036±0.85a**	**29.265±0.47d**	**32.005±0.48b**	**31.156±0.62c**
C 18:2ω6	23.203±0.55a	18.380±0.24c	17.251±0.15d	22.476±0.23b
C 18:3ω6	0.132±0.04a	0.035±0.03b	0.059±0.04b	0.026±0.02b
C 18:3ω3	0.263±0.05b	0.357±0.08ab	0.362±0.08ab	0.420±0.08a
C 20:4ω6	2.931±0.32b	2.114±0.09c	3.019±0.35b	6.605±0.48a
C 20:5ω3	0.529±0.87a	0.015±0.01b	0.012±0.01b	0.019±0.01b
C 22:4ω6	0.187±0.07a	0.194±0.05a	0.162±0.03a	0.149±0.04a
C 22:5ω6	0.723±0.29a	0.717±0.21a	0.574±0.17a	0.498±0.14a
C 22:5ω3	0.098±0.04a	0.177±0.06a	0.136±0.04a	0.146±0.02a
C 22:6ω3	1.931±0.66ab	1.424±0.17b	1.978±0.46ab	2.452±0.53a
∑ PUFA	**30.020±0.64b**	**23.465±0.42c**	**23.611±0.24c**	**32.868±0.80a**
CLA c9 - t11**	0.019±0.00c	0.046±0.01b	0.050±0.01b	0.069±0.02a
CLA t10 - c12**	0.004±0.00a	0.006±0.01a	0.008±0.01a	0.008±0.00a
∑ CLA**	**0.023±0.00c**	**0.052±0.01b**	**0.058±0.01b**	**0.077±0.02a**
∑ UFA	67.056±0.29a	52.730±0.48d	55.616±0.55c	64.024±0.44b
∑ PUFA / MUFA	0.811±0.04b	0.802±0.02b	0.738±0.02c	1.055±0.05a
∑ ω3	2.821±0.38a	1.973±0.19b	2.488±0.51ab	3.037±0.49a
∑ ω6	27.176±0.44b	21.440±0.26c	21.065±0.30c	29.754±0.64a
∑ ω3/ω6	0.104±0.01a	0.092±0.01a	0.118±0.03a	0.102±0.02a

* $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}01$.

** $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}001$.

Table 5. **Fatty acid compositions of yolk of egg at 90. days , %**

Fatty acids	Control (*n*=5)	Tallow fat (*n*=5)	Internal fat (*n*=5)	Tail fat (*n*=5)
C 8:0*	-	-	-	-
C 10:0	-	0.000±0.00a	0.001±0.01a	0.001±0.01a
C 12:0	0.002±0.00a	0.004±0.00a	0.003±0.00a	0.005±0.00a
C 14:0	0.220±0.04b	0.319±0.09ab	0.275±0.06ab	0.377±0.03a
C 15:0	0.025±0.01a	0.042±0.03a	0.034±0.04a	0.045±0.01a
C 16:0	23.880±0.33b	33.596±0.68a	24.397±1.91b	15.450±0.22c
C 17:0	0.170±0.02c	0.424±0.07ab	0.381±0.05b	0.483±0.05a
C 18:0	11.695±0.36c	17.377±0.24b	21.991±0.47a	10.297±1.06d
C 20:0	0.020±0.01a	0.023±0.01a	0.019±0.01a	0.028±0.01a
C 21:0	0.002±0.00a	0.004±0.000a	0.003±0.00a	0.004±0.00a
C 22:0	0.368±0.05a	0.278±0.08ab	0.316±0.09a	0.150±0.09b
∑ SFA	**36.382±0.71c**	**52.067±0.63a**	**47.420±2.15b**	**26.840±1.13d**
C 14:1ω5	0.002±0.00a	0.015±0.02a	0.017±0.01a	0.013±0.00a
C 15:1ω5	0.003±0.00b	0.017±0.01a	0.015±0.01ab	0.019±0.00a
C 16:1ω7	1.488±024a	1.433±0.23a	1.305±0.33a	1.652±0.11a
C 17:1ω8	0.010±0.00b	0.086±0.11b	0.045±0.07b	0.288±0.03a
C 18:1 *c*9	33.210±0.87a	18.327±0.31c	23.847±0.77b	33.648±0.26a
C 18:1 c11	1.259±0.08a	1.308±0.08a	1.115±0.17a	1.273±0.12a
C 20:1ω9	0.200±0.01a	0.270±0.22a	0.021±0.01a	0.301±0.25a
C 22:1ω9	0.011±0.00a	0.005±0.01a	0.006±0.01a	0.003±0.00a
∑ MUFA	**36.183±1.19a**	**21.461±0.77c**	**26.371±0.96b**	**37.197±0.41a**
C 18:2ω6	20.023±0.54b	20.438±0.34b	19.381±0.88b	25.494±0.42a
C 18:3ω6	0.013±0.00b	0.099±0.01a	0.096±0.03a	0.096±0.02a
C 18:3ω3	0.259±0.05c	0.444±0.14b	0.360±0.09bc	0.729±0.08a
C 20:4ω6	3.078±0.79b	2.403±0.51b	2.913±0.35b	4.832±0.88a
C 20:5ω3	0.034±0.04a	0.014±0.01a	0.020±0.02a	0.025±0.02a
C 22:4ω6	0.286±0.09a	0.196±0.05a	0.206±0.13a	0.220±0.11a
C 22:5ω6	1.129±0.36a	0.632±0.32ab	0.616±0.27ab	0.427±0.17b
C 22:5ω3	0.141±0.05a	0.171±0.02a	0.158±0.10a	0.160±0.06a
C 22:6ω3	2.444±0.26b	2.008±0.81b	2.390±0.73b	3.887±0.83a
∑ PUFA	**27.434±1.33b**	**26.471±0.90b**	**26.210±1.50b**	**35.963±0.97a**
CLA c9 – t11**	0.022±0.00c	0.058±0.01b	0.061±0.01b	0.084±0.12a
CLA t10 – c12**	0.005±0.00a	0.008±0.00a	0.009±0.00a	0.009±0.00a
∑ CLA**	**0.027±0.00c**	**0.066±0.01b**	**0.070±0.01ab**	**0.093±0.01a**
∑ UFA	63.617±0.71b	47.932±0.63d	52.581±2.15c	73.160±1.13a
∑ PUFA / MUFA	0.758±0.06c	1.233±0.07a	0.994±0.05b	0.967±0.03b
∑ ω3	2.878±0.28b	2.637±0.77b	2.928±0.78b	4.801±0.74a
∑ ω6	24.529±1.29b	23.768±0.36b	23.212±1.06b	31.069±0.57a
∑ ω3/ω6	0.117±0.01a	0.111±0.03a	0.126±0.03a	0.155±0.02a

* $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}01$.
** $^{a-d}$ Mean values within the same row sharing a common superscripts are not significantly different at $P < 0{\cdot}001$.

∑CLA's values at the end of the 30th, 60th and 90th day was observed the increase in the eggs.

Adding the animal fat, especially tail fat to the laying hens's feeds is reason of the CLA isomers that have an important place in terms of health increase, it's advised to laying hens growers to add tail fat to their feeds.

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EFFECTS OF DIFFERENT FAT SOURCES ON FATTY ACID COMPOSITION AND CLA CONTENT OF EGGS OF LAYING HENS

O. B. Citil+, M. Sezgin, A. Aktumsek**, G. Zengin***
Department of Animal Nutrition and Nutritional Disorders, Faculty of Veterinary Medicine, Selcuk University, 42075, Konya, Turkey
**Department of Chemistry, Faculty of Science, Selcuk University, 42075, Konya, Turkey*
***Department of Biology, Faculty of Science, Selcuk University, 42075, Konya, Turkey*

SUMMARY

Effects of different fat sources on fatty acid composition and conjugated linoleic acid (CLA) contents of eggs of laying hens were investigated by gas chromatographic method. Total 30 different fatty acids were determined in fatty acid compositions of eggs. These fatty acids were varied between C 8 to C 22. When animal fats especially tallow fat added to ratios of laying hens, toplam CLA contents of eggs were significantly increased. CLA content of eggs analysed were found to be higher percentages in 90th day than those of 30th nd 60th day.

Key words: *fatty acid composition, CLA, egg, hy-line*

+Corresponding author. Tel.: +90 332 223 26 98; Fax: +90 332 241 00 63
e-mail: ozcancitil@selcuk.edu.tr