Beneficial effects of different dietary oils on cholesterol level and fatty acids profile of turkey pectoral muscle

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Paper received January 18, 2007; accepted December 26, 2007

ABSTRACT

Human health depends to a great extent on the quality of consumed food. The relationship between the diet and health is increasingly evident. Therefore, the exact food composition, as well as the possibilities of its improvement, is intensively investigated. Turkey pectoral muscle is often recommended today as the most healthy meat product. The aim of our study was to improve the pectoral fat content of turkeys by adding some extra fat sources to their meals.

The study was performed on 90 female turkeys of the hybrid Nicholas 700, in their final fattening period (from 15th to 19th week of age). Turkeys were divided into three groups, each represented by 30 individuals, and fed with meals differing in fat source, in the amount of 3% of the total meal weight. The added fat in the first group came from the commercial preparation Bergafat. Pronova Biocare Epax 3000 TG was added to the food of second group, while the third group had rapeseed oil added. After the fattening period, the quality of pectoral muscle was determined for the 10 carcasses from each experimental group (water holding capacity - WHC, meat color, protein, fat, ash, water, cholesterol and fatty acids content).

Meat color did not differ between the investigated groups, while WHC statistically differed (P<0.05). Turkey muscles in the first group had the best WHC (7.76 cm²), while the second group had the worst (9.12 cm²). No difference could be shown in the turkey muscle protein, water and ash content between the experimental groups. However, the second experimental group had a lower total lipid content (1.73%, P<0.05) compared to the first (1.97%) and third (1.93%). Turkeys from the first and second groups had lower cholesterol concentration in the pectoral muscle lipids (21.74 and 18.04 mg/100g, respectively, P<0.05) compared to the third group (41.00 mg/100g). The second experimental group had the highest PUFA content (P<0.001) and lowest n-6/n-3 ratio (P<0.001) compared to the other experimental groups.

We concluded that the most favourable effects on the lipid status of turkey pectoral muscle was observed with the Pronova preparation, which lowered its total lipid and cholesterol concentration, raised PUFA content, and lowered the n-6/n-3 ratio. Further investigations, including combinations of added oils to the diet, should be directed to minimize the observed undesirable effects of Pronova preparation on turkey meat quality characteristics.

Key words: Cholesterol, Fatty acids, Turkey, Pectoral muscle, Oils.
RIASSUNTO
EFFETTI FAVOREVOLI DI DIFFERENTI FONTI LIPIDICHE SUL LIVELLO DI COLESTEROLO E SUL PROFILO DEGLI ACIDI GRASSI IN MUSCOLI PETTORALI DI TACCHINO

La salute umana dipende in buona parte dalla qualità del cibo consumato e la relazione tra dieta e salute è sempre più evidente. Perciò l’esatta composizione dell’alimento, quanto le possibilità di un suo miglioramento, sono oggetto di indagini sempre più approfondite. I muscoli pettorali di tacchino sono oggi raccomandati come uno dei più salubri prodotti carnei. Lo scopo di questo studio è stato quello di migliorare il contenuto di grasso nel petto di tacchino attraverso l’integrazione degli alimenti con fonti lipidiche diverse.

La ricerca è stata condotta su novanta femmine di tacchino (Ibridi Nicholas 700) nel periodo finale di ingrassamento (dalla 15ª alla 19ª settimana di vita). Gli animali sono stati divisi in tre gruppi, ciascuno costituito da 30 capi, ed alimentati con mangimi contenenti diverse fonti lipidiche in ragione del 3%. Il grasso addizionato agli alimenti del primo gruppo proveniva dalla preparazione commerciale Bergafat, all’alimento del secondo gruppo è stato addizionato Pronova Biocare Epax 3000 TG, mentre per il terzo gruppo è stato utilizzato olio di colza. Dopo il periodo di ingrassamento, su 10 carcasse per gruppo sperimentale è stata determinata la qualità del muscolo pettorale (capacità di ritenzione idrica- WHC, colore, contenuto proteico e lipidico, ceneri, umidità, colesterolo e contenuto di acidi grassi).

Il colore della carne non è risultato diverso tra i gruppi esaminati, mentre il valore di WHC ha evidenziato differenze significative (P<0,05). Il valore più favorevole di WHC è stato riscontrato nel primo gruppo (7,76 cm²), il peggiore nel secondo (9,12 cm²). Non si sono rilevate differenze significative tra i muscoli dei tacchini appartenenti ai diversi gruppi sperimentali relativamente al contenuto di proteine, umidità e ceneri. Tuttavia nel secondo gruppo sperimentale è stato registrato un contenuto lipidico totale più basso (1,73%, P<0,05) rispetto al primo (1,97%) e al terzo (1,93%). I tacchini del primo e del secondo gruppo hanno mostrato una concentrazione di colesterolo nei lipidi dei muscoli pettorali più bassa rispettivamente (21,74 e 18,04 mg/100 g) rispetto a quelli del terzo gruppo (41,00 mg/100 g; P<0,05). Il secondo gruppo sperimentale ha evidenziato il più alto contenuto di PUFA (P<0,001) e il più basso rapporto n-6/n-3 (P<0,001).

In conclusione la preparazione Pronova ha apportato gli effetti più favorevoli sullo stato lipidico nei muscoli pettorali di tacchino, abbassando il contenuto lipidico, la concentrazione di colesterolo e il rapporto n-6/n-3 ed aumentando, invece, il contenuto di PUFA. Ulteriori ricerche, che prevedano anche l’uso combinato di diversi oli alimentari, dovrebbero essere rivolte a minimizzare gli effetti indesiderabili osservati con la preparazione Pronova sulle caratteristiche qualitative della carne di tacchino.

Parole chiave: Colesterolo, Acidi grassi, Tacchino, Muscolo pettorale, Oli.

Introduction

Pectoral muscle is a valuable constituent of human food. Owing to its small fat percentage and high content of easily digestible proteins, it is recommended for the diet of sportsmen, children and the elderly. Protein, ash and water content in the pectoral muscle of turkeys cannot be influenced by environmental factors. However, the pectoral muscle content of fat and cholesterol can be changed by variations in the feeding schedule.

Consuming food with low fat and cholesterol content is recommended for a proper human diet. The main parameters determining the meat quality in that context are low saturated fatty acid content (myristic–C18:0, lauric–C12:0 and palmitic–C16:0 considered hypercholesterolemic), low cholesterol content and a favourable n-6/n-3 polyunsaturated fatty acid (PUFA) ratio.

Compared with other poultry meat, skinless white turkey meat contains the lowest fat (1.6%) and the highest protein content (23.5%). With only 115 kcal per 100 g of edible parts, it represents the meat with the smallest caloric value. However, the pectoral muscle content of fat, cholesterol and fatty acids can be changed by variations in the feeding schedule.
In relation to other domestic animals, despite low fat content, chicken and turkey meat has high cholesterol content (Engeseth and Gray, 1989). Fortunately, poultry meat cholesterol content can be manipulated (Ajuyah et al., 1991). Komprda et al. (2003), showed significantly lower cholesterol content in pectoral muscle of turkey males and females as well as in drumstick muscle of females by adding linseed oil in meals. Komprda et al. (2001), measured pectoral and drumstick muscle cholesterol content in turkey aged 20 weeks fed with commercial feed. Fat and cholesterol content were higher in drumsticks than in pectoral muscle. Similarly, Baggio et al. (2002), determined fat and cholesterol content in turkey wings, drumstick, pectoral muscle and skin fat. Komprda et al. (2002), investigated the influence of sex and age on cholesterol and fatty acid content in turkey meat. In ageing male turkeys, cholesterol content in pectoral and drumstick muscle was significantly decreased, while in female turkeys age did not influence cholesterol content in muscles. Zelenka et al. (2003), investigated fat content in drumstick and pectoral muscle of heavy hybrid BUT Big 6 male and female turkeys. Both sexes had significantly higher fat content in drumstick muscle than in pectoral muscle. In turkeys of the same age sex had no influence on pectoral muscle fat deposition.

The aim of our research was to investigate the influence of various dietary oils (Bergafat preparation, Pronova Biocare Epax 3000 TG and rapeseed oil) in meals on qua-

| Ingredient (%) | Finisher | Calculated composition of diets (%) |
|---------------|----------|-----------------------------------|
| Corn          | 51.44    | Crude protein                     | 19.50 |
| Extruded soybean | 22.41  | Fat                               | 10.00 |
| Soybean cake, 46% | 11.61  | Crude fibre                       | 3.43  |
| Yeast, 52%    | 5.00     | Ash                               | 6.22  |
| Phosphonatal  | 2.62     | Lysine                            | 1.45  |
| Methionine    | 0.21     | Methionine                        | 0.50  |
| Lysine        | 0.04     | Tryptophan                        | 0.26  |
| Salt          | 0.20     | Arginine                          | 1.40  |
| Lignobond (binder) | 1.00  | Ca                                | 1.05  |
| Limestone     | 0.47     | P usable                          | 0.55  |
| Premix a      | 1.00     | Na                                | 0.17  |
| Fat (oil)     | 3.00     | Linoleic acid                     | 3.09  |
| Pigosan       | 1.00     |                                   |       |
| Total         | 100.00   | ME                                | 13.54 |

*Per kg feed: vit. A 1,300,000 U; vit. D3 200,000 U; vit. E 2000 mg; vit. K3 300 mg; vit. B1 400 mg; vit. B2 1000 mg; vit. B6 400 mg; vit. B12 2 mg; niacin 7000 mg; biotin 20 mg; pantotenatic acid 1500 mg; folic acid 100 mg; choline chloride 1300 mg; cobalt 40 mg; iodine 150 mg; selenium 20 mg; copper 750 mg; manganese 10,000 mg; iron 5000 mg; zinc 9000 mg; antioxidant 10,000 mg; plant-mineral carrier up to 1 kg.
lity of pectoral turkey muscle as well as its cholesterol and fatty acids content.

**Material and methods**

**Diet composition**

The investigation was performed on 90 female turkeys of Nicholas 700 origin in their final fattening period (from 15th to 19th week of age). The chemical composition of the diet in the “finisher” (used from 15th to 19th week of age), as well as the calculated composition of diets is presented in Table 1.

Turkeys were divided into three groups, each represented by 30 individuals, and fed with meals differing in fat source in the amount of 3% of the total meal weight. The added fat in the first group came from the commercial preparation Bergafat; Pronova Biocare Epax 3000 TG was added to the food of second group, while the rapeseed oil was added to the meals of the third group. The final chemical composition of the diet of the three experimental groups is given in Table 2. It is evident that the three diets differed only in the oil sources (Bergafat, Pronova and rapeseed oil) and therefore were considered isoenergetic.

According to the declaration of the manufacturer, commercial preparation Bergafat contains 30-44% of saturated fatty acids (SFA), 35-45% monounsaturated fatty acids (MUFA) and less than 4% of arachidonic acid (C20:0), as well as other fatty acids with 20 or more carbon atoms. Pronova Biocare Epax 3000 TG preparation contained 27-29% SFA, 24-26% MUFA, 15.36% eicosapentaenoic acid (EPA, C20:5n-3) and 9.99% docosahexaenoic acid (DHA, C22:6n-3). The rapeseed oil contained 8.39% SFA, 59.45% MUFA and 31.98 PUFA (24.99% n-6 PUFA and 7.17% n-3 PUFA). Fatty acid content in the diets with different fat sources (% of total fatty acids) is given in Table 3.

**Meat quality analysis**

The quality of pectoral muscle has been determined for the 10 carcasses from each experimental group. Water holding capacity (WHC) and meat colour in pectoral turkey muscle were measured. Compression of a muscle tissue by Grau-Hamm was used to determine WHC. A tissue sample was compressed with compression glasses for trichinelloscopy on filter paper. WHC (cm²) was evaluated as a surface moistened by squeezed out juice with a digital planimeter “HAFF” 350 E. Meat colour was determined with a “Minolta” CR-300, and expressed by L*, a* and b* values.
| Fatty acid                          | Experimental group |
|------------------------------------|--------------------|
|                                    | 1      | 2      | 3      |
| Lauric C12:0                       | 1.89   | 0.27   | 0.26   |
| Tridecanoic C13:0                  | 0.13   |        |        |
| Myristic C14:0                     | 2.96   | 2.51   | 0.28   |
| Palmitadecanoic C15:0              | 0.06   | 0.21   | 0.03   |
| Palmitic C16:0                     | 28.14  | 16.24  | 12.64  |
| Heptadecanoic C17:0                | 0.12   | 0.31   | 0.10   |
| Steric C18:0                       | 6.81   | 4.49   | 3.74   |
| Behenic C22:0                      | *      | 0.70   | *      |
| Lignoceric C24:0                   | *      | 0.21   | *      |
| Σ SFA                              | 40.11  | 24.94  | 17.15  |
| Palmitoleic C16:1                  | 0.12   | 2.34   | 0.18   |
| Heptadecenoic C17:1                | 0.05   | 0.14   | 0.05   |
| Elaidic C18:19t                    | 0.11   | 0.18   | 0.14   |
| Oleic C18:1n9c                     | 17.65  | 20.64  | 30.26  |
| Eicosenoic C20:1                   | 0.18   | 0.85   | 0.49   |
| Nervonic C24:1                     | 0.08   | *      | 0.13   |
| Σ MUFA                             | 18.19  | 24.15  | 31.25  |
| Linoleic C18:2n6                   | 37.43  | 38.22  | 45.32  |
| Eicosadienoic C20:2n6              | 0.52   | 0.34   | 0.44   |
| Docosadienoic C22:2n6              | 0.13   | 0.13   | 0.13   |
| cis-8,11,14-Eicosatrienoic C20:3n6 | *      | 0.33   | *      |
| Arachidonic C20:4n6                | *      | 0.35   | *      |
| Σ n-6 PUFA                         | 38.08  | 39.37  | 45.89  |
| α-linolenic C18:3n3                | 3.62   | 3.86   | 5.71   |
| cis-11,14,17-Eicosatrienoic C20:3n6| *      | 0.29   | *      |
| Eicosapentaenoic C20:5n3           | *      | 4.67   | *      |
| Docosahexaenoic C22:6n3            | *      | 2.72   | *      |
| Σ n-3 PUFA                         | 3.62   | 11.54  | 5.71   |
| Σ PUFA                             | 41.70  | 50.91  | 51.60  |
| SFA/MUFA                           | 2.21   | 1.03   | 0.55   |
| SFA/PUFA                           | 0.96   | 0.49   | 0.33   |
| n-6/ n-3 PUFA                      | 10.52  | 3.41   | 8.04   |

*SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.

* under detection limit.
Chemical analysis

All chemical analyses were performed on 10 carcasses from each experimental group.

Total fat content. Fat content was determined by the Stoldt method (Hungarian Standard No 6830-66). 2.5 g of the sample was boiled gently over a hot plate in 3M HCl for one hour. After cooling, the material was filtered, and the residue was washed in cold water until a neutral filtrate was obtained. The residue was placed on a watch glass and dried for 1.5 h in an oven at 100±3 °C. The filter paper containing the dry residue was placed in an extractor and the total fat content was determined by the Soxhlet method.

Cholesterol analysis. Fats extracted by the Soxhlet method were fractionated using KOH and the methanol and cholesterol component was extracted in hexane. Concentration determination was performed using Chrompack CP-9000 chromatograph with flame ionisation detector, using quartz capillary colon (10 x 0.25 mm) and CP-Sil-5 as a stationary phase. Injector temperature was 270 °C and we used helium as gas phase at 40 kPa.

Fatty acids analysis. From the homogenized sample, 2-4 g was taken for fatty acid analysis. Fatty acids were extracted with n-heptane, and dry sodium sulphate was added to eliminate water content. To the heptane solution containing fat, sodium methylate was added and the mixture was heated at 60 °C for 60 min. with intermittent shaking. After the addition of n-heptane and water, the mixture was homogenized and the heptane phase was dried by sodium sulphate. An amount of 0.5-2.0 µg of the sample was injected into the column of the Chrompack CP-9000 chromatograph with flame ionisation detector, using quartz capillary colon (300 x 25 mm) and Cp-Sil-88 as humid phase. Injector temperature was 220 °C and carrier gas was helium at 235 kPa.

Data elaboration

Statistical analysis was performed using Statistica for Windows v. 7.1. Results are expressed as mean values (x̄), standard deviation (s), mean value standard error (sx̄) and coefficient of variability (Cv). Significant differences between experimental groups were determined by one-way ANOVA. Experimental F value was compared with critical theoretical F value on three levels of significance (5%, 1% and 0.1%). P-value less than 0.05 (P<0.05) was considered statistically significant and the data were tested by Fisher’s LSD-test.

Results and discussion

The results of water holding capacity (WHC) and pectoral muscle L*, a* and b* values are presented in Table 4.

Turkey muscles in the first group had the best WHC (7.76 cm²), while the second group had the worst (9.12 cm²). The difference among the experimental groups was significant (P=0.008).

The palest pectoral muscles were in the second experimental group (L*=53.11) and therefore considered as “pale” meat, while the third group had the darkest meat (L*=49.70). Nevertheless, no evidence of treatment influence either on L* (P=0.161) or on a* and b* values (P=0.632 and 0.556) could be proven. L* values observed are in agreement with the results of investigations performed by Barbut (1996), McCurdy et al. (1996), McKee and Sams (1997) and Owens et al. (2000).

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Pectoral muscle chemical characteristics are shown in Table 5. No difference between the experimental groups could be shown in the turkey muscle protein, water and ash content (P=0.670, 0.139 and 0.539). Water content in the range from 73.59% to 73.67%, protein content from 23.23% to 23.65% and ash content from 1.05% to 1.07% was deter-
mined. However, the second experimental group had a lower total lipid content (1.73%, P<0.05) compared to the first (1.97%) and third (1.93%). Riegel et al. (2004) found similar ash (1.07% to 1.09%) and dry matter content (25.8%) in the pectoral muscle of two investigated turkey hybrids. On the contrary, protein content of their samples was higher (24.8% to 24.9%), while fat content was lower (0.79% to 0.94%) compared to all our experimental groups.

Cholesterol content in turkey pectoral muscle lipids varied depending on added oil source in meals (Table 6). Added dietary fat significantly influenced (P<0.001) cholesterol content of the turkey white meat fat. Turkeys from the first (3% Bergafat) and second (3% Pronova) group had lower cholesterol concentration in the pectoral muscle lipids (21.74 and 18.04 mg/100g, respectively) compared to the third (3% rapeseed oil) group (41.00 mg/100g).

According to Wong et al. (1993), average cholesterol content sums up to 81 mg of cholesterol per 100g of turkey meat. Komprda et al. (2001) found higher cholesterol content compared to the results of our research (58.2 mg/100g). Also, Komprda et al. (2002) concluded that cholesterol deposition is reduced with age in male turkeys, while in female turkeys, ageing had no influence on cholesterol deposition. Pectoral cholesterol content according to Baggio et al. (2002) was 27±3 mg/100g. Komprda et al., (2003), found lower cholesterol content when linseed oil was added to the turkey's diet (57.3:51.9 mg/100g).

Fatty acid content of turkey pectoral muscle, expressed as $\bar{x} \pm s$ (% of total fatty

| Meat quality indicators | Statistical parameter | Experimental groups | P value (ANOVA) |
|-------------------------|-----------------------|---------------------|----------------|
|                         | $\bar{x}$             | $s$                 | $s_\bar{x}$    | $Cv$         |
| WHC                     | 7.76$^b$              | 1.41                | 0.45           | 18.17        |
|                         | 9.12$^a$              | 0.94                | 0.30           | 10.31        |
|                         | 8.78$^a$              | 1.59                | 0.50           | 18.11        |
|                         | 0.008                 |                     |                |              |
| L*                      | 50.87                 | 4.75                | 1.50           | 9.34         |
|                         | 53.11                 | 3.65                | 1.15           | 6.87         |
|                         | 49.70                 | 3.20                | 0.89           | 5.62         |
|                         | 0.161                 |                     |                |              |
| a*                      | 3.96                  | 0.98                | 0.31           | 24.78        |
|                         | 3.91                  | 1.02                | 0.32           | 26.17        |
|                         | 4.33                  | 1.18                | 0.37           | 27.24        |
|                         | 0.632                 |                     |                |              |
| b*                      | 2.15                  | 1.35                | 0.43           | 63.02        |
|                         | 1.87                  | 1.22                | 0.39           | 65.30        |
|                         | 1.59                  | 0.97                | 0.31           | 61.25        |
|                         | 0.556                 |                     |                |              |

$a, b: P<0.05; \bar{x} = \text{mean; } s = \text{standard deviation; } s_\bar{x} = \text{standard error; } Cv = \text{coefficient of variability.}$
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Table 5. Chemical composition of pectoral muscle (%).

| Composition | Statistical parameter | Experimental groups | P value (ANOVA) |
|-------------|-----------------------|---------------------|-----------------|
|             | \( \bar{x} \)        | 1                   | 2               | 3               |             |
| Water       | s                     | 0.52                | 0.36            | 0.61            | 0.670        |
|             | \( s_{\bar{x}} \)     | 0.17                | 0.11            | 0.19            |              |
|             | Cv                    | 0.71                | 0.49            | 0.83            |              |
| Proteins    | \( \bar{x} \)        | 23.23               | 23.65           | 23.33           | 0.139        |
|             | s                     | 0.51                | 0.34            | 0.55            |              |
|             | \( s_{\bar{x}} \)     | 0.16                | 0.11            | 0.17            |              |
|             | Cv                    | 2.19                | 1.45            | 2.35            |              |
| Fat         | \( \bar{x} \)        | 1.97\(^a\)          | 1.73\(^b\)      | 1.93\(^a\)      | < 0.001      |
|             | s                     | 0.06                | 0.10            | 0.11            |              |
|             | \( s_{\bar{x}} \)     | 0.02                | 0.03            | 0.04            |              |
|             | Cv                    | 3.22                | 5.55            | 5.76            |              |
| Ash         | \( \bar{x} \)        | 1.07                | 1.05            | 1.07            | 0.539        |
|             | s                     | 0.03                | 0.08            | 0.08            |              |
|             | \( s_{\bar{x}} \)     | 0.01                | 0.03            | 0.02            |              |
|             | Cv                    | 2.78                | 7.64            | 7.15            |              |

\( a, b: P<0.05; \bar{x} = \text{mean}; s = \text{standard deviation}; s_{\bar{x}} = \text{standard error}; Cv = \text{coefficient of variability}. \)

Table 6. Cholesterol content of pectoral muscle (mg/100 g).

| Statistical parameter | Experimental groups | P value (ANOVA) |
|-----------------------|---------------------|-----------------|
|                       | \( \bar{x} \)       | 1               | 2               | 3               |             |
|                       | s                   | 21.74\(^b\)     | 18.04\(^b\)     | 41.00\(^a\)     | < 0.001     |
|                       | \( s_{\bar{x}} \)   | 6.29            | 12.14           | 6.78            |              |
|                       | Cv                  | 1.99            | 3.84            | 2.14            |              |
|                       |                     | 28.94           | 67.27           | 16.53           |              |

\( a, b: P<0.05; \bar{x} = \text{mean}; s = \text{standard deviation}; s_{\bar{x}} = \text{standard error}; Cv = \text{coefficient of variability}. \)

acids), is presented in Table 7. Different oils in the diet of turkeys added from the 15\(^{th}\) to 19\(^{th}\) week of fattening, significantly influenced (P<0.05) the content of SFA, MUFA and n-3 PUFA in the fat of breast muscle. The lowest content of palmitic acid and total SFA is found in the fat of breast muscle from the third experimental group, compared to the first and second (P<0.05). The second experimental group also displayed lower content of palmitic acid and total SFA compared to the first one. Komprda et al. (2001) found lower SFA content in the turkey breast and drumstick muscles (35.3% and 35.9%), while Serdaroglu et al. (2004) detected in turkeys a higher SFA content. In our experiment, diets containing rape-seed oil and Bergafat significantly increased MUFA content in the breast muscle fat (P<0.05), compared to the diet with Pronova.
preparation. Serdaroglu et al., 2004, found a slightly higher MUFA portion in the turkey meat (24.2%), as well as Fereira et al., 1999, (32.8%) and Komprda et al., 2001, (34.9%). The portion of MUFA in the turkey breast muscle fat, with 4.72% of fish oil added to

Table 7. Fatty acid content of turkey pectoral muscle expressed as $\bar{x} \pm s$ (% of total fatty acids) in experimental groups (1 – Bergafat 3%, 2 – Pronova 3%, 3 – rapeseed oil 3%).

| Fatty acid            | Experimental group | P value |
|-----------------------|--------------------|---------|
|                       | 1  | 2       | 3       |
| Lauric C12:20         | 0.46 ± 0.06a       | 0.35 ± 0.11b | 0.28 ± 0.05c | < 0.001 |
| Myristic C14:0        | 1.48 ± 0.10a       | 1.42 ± 0.10a | 1.01 ± 0.08b | < 0.001 |
| Pentadecanoic C15:0   | 0.09 ± 0.02b       | 0.12 ± 0.01a | 0.09 ± 0.01b | < 0.001 |
| Palmitic C16:0        | 25.39 ± 0.79a      | 23.96 ± 0.63a | 23.05 ± 0.71c | < 0.001 |
| Heptadecanoic C17:0   | 0.34 ± 0.06b       | 0.42 ± 0.05a | 0.36 ± 0.07b | = 0.019 |
| Stearic C18:0         | 10.47 ± 0.98       | 11.58 ± 0.68 | 11.06 ± 1.18 | = 0.054 |
| Σ SFA                 | 38.25 ± 0.94a      | 37.86 ± 0.10a | 35.86 ± 1.23b | < 0.001 |
| Palmitoleic C16:1     | 2.15 ± 0.61        | 1.72 ± 0.26 | 1.69 ± 0.56 | = 0.090 |
| Heptadecenoic C17:1   | 0.16 ± 0.02        | 0.18 ± 0.02 | 0.18 ± 0.07 | = 0.466 |
| Elaidic C18:1n9t      | 0.18 ± 0.03        | 0.17 ± 0.04 | 0.20 ± 0.04 | = 0.109 |
| Oleic C18:1n9c        | 19.77 ± 1.51b      | 17.86 ± 0.56c | 21.32 ± 1.28a | < 0.001 |
| Eicosenoic C20:1      | 0.25 ± 0.04b       | 0.32 ± 0.02a | 0.29 ± 0.03a | < 0.001 |
| Σ MUFA                | 22.51 ± 2.00a      | 20.25 ± 0.78b | 23.68 ± 1.76a | < 0.001 |
| Linoleic C18:2n6      | 30.48 ± 1.43       | 29.85 ± 1.40 | 29.71 ± 1.34 | = 0.434 |
| Eicosaenoic C20:2n6   | 0.38 ± 0.03        | 0.45 ± 0.10 | 0.45 ± 0.07 | = 0.070 |
| Eicosatrienoic C20:3n6| 0.39 ± 0.11        | 0.41 ± 0.08 | 0.45 ± 0.09 | = 0.408 |
| Arachidonic 20:4n6    | 3.65 ± 0.85b       | 3.84 ± 0.60ab | 4.65 ± 1.15a | = 0.042 |
| Σ n-6 PUFA            | 34.90 ± 1.52       | 34.55 ± 0.96 | 35.27 ± 0.98 | = 0.651 |
| A-linolenic C18:3n3   | 2.71 ± 0.23        | 2.56 ± 0.19 | 2.78 ± 0.30 | = 0.146 |
| Eicosatrienoic 20:5n3 | 0.24 ± 0.06c       | 1.40 ± 0.08a | 0.36 ± 0.14b | < 0.001 |
| Docosapentaenoic C22:5n3| 0.54 ± 0.14b      | 0.82 ± 0.14a | 0.75 ± 0.20a | = 0.002 |
| Docosahexaenoic C22:6n3| 0.86 ± 0.21c      | 2.56 ± 0.67a | 1.30 ± 0.31b | < 0.001 |
| Σ n-3 PUFA            | 4.34 ± 0.29c       | 7.34 ± 0.72a | 5.19 ± 0.41b | < 0.001 |
| Σ PUFA                | 39.24 ± 1.69c      | 41.89 ± 0.79a | 40.46 ± 1.16b | < 0.001 |
| SFA/MUFA              | 1.71 ± 0.18b       | 1.87 ± 0.11a | 1.52 ± 0.16c | < 0.001 |
| SFA/PUFA              | 0.98 ± 0.05b       | 0.90 ± 0.04b | 0.89 ± 0.04b | < 0.001 |
| n-6/n-3 PUFA          | 8.05 ± 0.46a       | 4.77 ± 0.66c | 6.82 ± 0.49b | < 0.001 |

*a,b,c: P<0.05.*
the diet, was 24.5% (Komprda et al., 2003). In the same study, no difference was found between the investigated groups according to the content of linoleic acid as well as the total n-6 PUFA.

Furthermore, in our study arachidonic acid content was higher in the breast muscle fat of the third, compared to the first group (P<0.05). The content of EPA, docosapentaenic (DPA, C22:5n3), DHA and total n-3 PUFA was highest in the breast muscle fat of the second experimental group.

Added preparations of rapeseed oil, differing in the myristic, palmitic and oleic acid content and total MUFA content (Table 3) influenced the ratio of SFA/MUFA in the turkey’s breast muscle fat. The addition of the rapeseed oil to the diet resulted in a more favourable ratio of SFA/MUFA, compared to the other diets. Pronova preparation added to the diet of the second group raised the level of the favourable n-3 PUFA (EPA, DPA and DHA) and improved the n-6/n-3 PUFA ratio, compared to the other experimental groups.

The summary of observed changes on the investigated parameters in turkey breast muscle, with calculated differences among groups (expressed in %), is presented in Table 8. It is evident that, despite some undesirable effects on the meat quality parameters (pale colour and worst WHC value), the addition of Pronova preparation (3%) to the diet most favourably improved the fat composition of turkey breast muscle by lowering its total lipid content from 10.4% to 12.2% compared to added Bergafat and rapeseed oil. It lowered cholesterol concentration by 56.0% compared to added rapeseed oil, raised PUFA content from 41.4% to 69.1% and lowered the n-6/n-3 ratio from 30.0% to 40.8%, compared to added Bergafat and rapeseed oil. Further research, including combinations of added oil to the diet, should be directed to minimize the observed undesirable effects on turkey meat quality characteristics.

**Conclusions**

Dietary fat sources (preparations Bergafat and Pronova, as well as rapeseed oil) ad-
ded to the meals, significantly influenced the investigated quality attributes and fat composition of the turkey’s pectoral muscle.

Pronova preparation improved the fat composition of turkey breast muscle most favourably by:

- lowering its total lipid content from 10.4% to 12.2%
- lowering cholesterol concentration by 56.0%
- raising PUFA content from 41.4% to 69.1% and lowering n-6/ n3 PUFA ratio from 30.0% to 40.8%

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