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STUDY OF THE PROFILE OF FATTY ACIDS DETERMINED FOR HUBBARD CAPONS

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Abstract

The present study looked at the effect of applying the orchidectomy operation, in Hubbard roosters, on the fatty acids profile. In this regard, two groups of roosters were formed, an experimental group (Exp. B), consisting of castrated birds at the age of 7 weeks, and a control group (C.B.) consisting of uncastrated roosters. The results obtained by reporting the values of saturated fatty acids (SFA) to unsaturated fatty acids (UFA) illustrated that in case of pectoral muscles the experimental group recorded a value of 0.58, while in the case of the whole legs, the result was 0.57. Regarding the ratio between polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA), the value calculated for the chest muscles, resulting from the capons, was 0.60, and for the whole thighs muscles, for the same batch, was 0.61. The Ω6 / Ω3 ratio was calculated to be 5.06 for the breast of the castrated roosters, respectively 4.91 for their whole thighs. Additional research in this area is recommended.

Key words*: capons, fatty acids, Hubbard, Ω6 / Ω3ratio.*

INTRODUCTION

Capon manufacturing is an ancient practice that has endured till now, with records reaching back over 2000 years (Winter and Funk, 1960; Symeon et al., 2010). Capon production is done on a limited scale, with just a small market niche, but it has a lot of room for expansion because capon meat has special sensory properties that customers like (Amorim et al., 2016). Caponization is orhidectomy, leading to androgen deficiency and consequent phenotypic and behavioral changes, such as reduced development of comb and wattles loss of aggressiveness, and reduced activity (Calik, 2014). As a result, energy that would otherwise be spent on fighting and territorial dominance is freed up, allowing for further development and fat deposition.

More variety and high-quality attributes in various poultry meat products are currently being demanded by consumers. One of these products is the capon (a male rooster with his testes surgically removed before installation of the sexual maturity). The testicles are removed, which affects the animal's metabolism, growth, behavior, tissue composition, chemical composition, and meat organoleptic quality. (Miguel et al., 2008; Sirri et al., 2009). The principal metabolic effect of caponization is the increase of fat content abdominal, subcutaneous, and intramuscular. This effect has increased meat quality by improving flavor, texture, and juiciness, as well as making it more appealing to consumers than rooster meat of the same age (Chen et al., 2005; Tor et al., 2005). A decrease in saturated fatty acids (SFA) and increase in unsaturated fatty acids (UFA) content in capon meat would be beneficial for the human diet.

The goal of this study was to compare the fatty acids content of the capons and roosters of the Hubbard hybrid.

MATERIALS AND METHODS

The biological material was thirtieth roosters from the Hubbard hybrid, divided into two: experimental batch (experimental group-Exp. B., consisting of 20 heads; control batch-C.B., consisting of 10 heads). The only difference between the two groups was that the Exp.B. males were medically castrated at the age of seven weeks. Roosters were castrated in the last intercostal area using a bilateral laparatomy

procedure, puncturing the air sacs, pulling the testicles to the fore with a special forceps, and then performing orhidectomy by unlimited torsion. A continuous thread was used to stitch the wound. All of the birds were slain when they reached the age of 20 weeks.

The applied method consisted in extracting the fat, the concentration of fatty acids was expressed in grams FAME/100 g FAME (methyl esters of fatty acids). The working method applied was in accordance with:

1. Preparation of methyl esters SR CEN ISO/ TS 17764-1: 2008;
2. Gas chromatographic method SR CEN ISO/ TS 17764-2: 2008.

The principle of the method was based on the transformation into fatty acids of methyl esters from the fat sample under analysis, followed by separation of the components on the capillary chromatographic column, identification by comparison with standard chromatograms and quantitative determination of fatty acids (g FAME/100 g total FAME).

The interpretation of the obtained data was performed using their processing in the program Microsoft Excel and GraphPad Prism 9.3.1.

The values obtained were interpreted statistically, by calculating the main estimators-descriptors such as the arithmetic mean ($\overline{X}$), the standard error of the mean ($\pm s\overline{x}$), the coefficient of variability (V%), the minimum and maximum values. The mathematical relationships underlying the estimation are:

- ***The arithmetic mean*** represents the ratio between the sum of a number of results (ΣX) and the number of samples taken in the analysis (n):

$$\overline{x} = \frac{\Sigma x}{N};$$

- ***The variance*** is the sum of the squares of the deviations from the mean:

$$\Sigma(x\text{-}\overline{x})^2$$

The sum of the squares of the deviations was not used as such to express the size of the variance, but the average square of the deviations was used, according to the relation:

$$S^2 = \frac{\Sigma(x-\overline{x})^2}{N-1}$$

- **The standard deviation of the mean** ($s\overline{x}$) is the value that shows the deviation or error of the empirical arithmetic mean from the true theoretical mean:

$$s_{\overline{x}} = \sqrt{\frac{S^2}{N}} = \frac{S}{\sqrt{N}}$$

- **The coefficient of variation (V%)** directly indicates the relative variability of the values obtained compared to the average, namely the homogeneity of the studied parameter:

$$V\% = \frac{S}{\overline{x}} \text{ x } 100$$

Depending on the value of the coefficient of variation, the homogeneity of the analyzed parameter was established, as follows:

- V% <10% for a homogeneous population;
- 10% <V% <20% in case of an medium homogeneity;
- V%> 20% a very heterogeneous population.

RESULTS AND DISCUSSIONS

The data obtained on saturated fatty acids origin from the musculature of the chest, revealed, for both batches (C.B., Exp. B.) that the main constituent is palmitic acid C16:0; thus, for C.B. the average was 26.75 ± 0.02 g/ 100 g, with variation of 26.69 g/100 g (minimum) and 26.79 g/100 g (maximum); while for the Exp. B. the average was 26.74 ± 0.01 g/100 g, with variation of 26.71 g/100 g (minimum) and 26.78 g / 100 g (maximum). The constituent with the lowest average, for both batches, was represented by C12:0, lauric acid, with a value of 0.02 g/100 g. The total saturated fatty acids resulting from the chest muscles was 36.83 g/100 g for roosters from C.B., and 36.79 g/100 g for capons (Table 1).

In case of monounsaturated fatty acids, dominant, in both cases, was oleic cis acid, C18:1n9, with an average for C.B. of 34.65 ± 0.01 g/100 g, the minimum being 34.60 g/100 g and the maximum 34.68 g/100 g; while for the Exp. B the average was 34.69 ± 0.01 g/100 g. For both groups the acid with the lowest average was erucic acid C22:1n9 (Table 1). The total of monounsaturated fatty acids was 39.33 g/100 g for C.B. and 39.56 g/100 g for Exp. B. Results on polyunsaturated fatty acids indicated for roosters (C.B.) a total value of 23.40 g/100 g, the lowest value was recorded by C22:4n6, docosatetraenoic acid, with an average of 0.07 g/100 g; on the opposite pole was C18: 2n6,

linoleic acid, with an average of 16.10 ± 0.02 g/100 g.
In case of the experimental group (Exp. B.), the linoleic acid registered a value of 16.14 ± 0.02 g/100 g, with variation of 16.10 g/100 g (minimum) and 16.20 g / 100 g (maximum).
The total of polyunsaturated fatty acids was 23.65 g/100 g for capons (Exp. B.).
Regarding the ratio between fatty acids Ω6 and Ω3 in chest, the values calculated was 5.16 for C.B. and 5.06 for Exp. B.
The SFA/UFA ratio was 0.59 for the control batch and 0.58 for experimental batch; the PUFA/MUFA ratio values was 0.59 for C.B and 0.60 for Exp. B. (Figure 1).

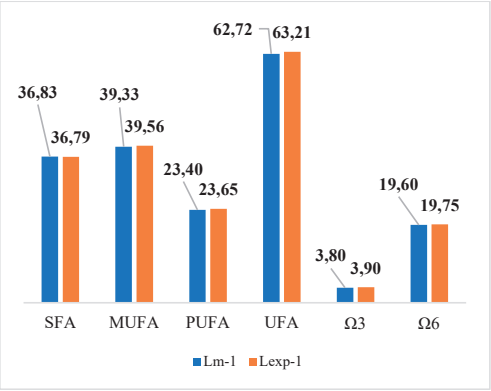

Figure 1. Fatty acids content in the pectoral musculature of Hubbard capons

Table 1. Fatty acids content in the pectoral musculature of Hubbard capons

Specifications	Breast							
	C.B.				Exp.B.			
Fatty acids	Statistics estimators							
	$X \pm s_x$ (g AG/100g)	V%	Min. (g AG/100g)	Max. (g AG/100g)	$X \pm s_x$ (g AG/100g)	V%	Min. (g AG/100g)	Max. (g AG/100g)
C8:0	0.10 ± 0.01	11.40	0.09	0.12	0.10 ± 0.01	1.94	0.08	0.13
C10:0	0.03 ± 0.00	3.65	0.03	0.03	0.04 ± 0.00	4.18	0.04	0.04
C12:0	0.02 ± 0.00	11.29	0.02	0.02	0.02 ± 0.00	10.23	0.02	0.02
C14:0	0.78 ± 0.01	3.68	0.74	0.82	0.68 ± 0.01	3.35	0.64	0.70
C15:0	0.27 ± 0.01	6.83	0.24	0.29	0.27 ± 0.01	9.94	0.23	0.30
C16:0	26.75 ± 0.02	0.17	26.69	26.79	26.74 ± 0.01	0.09	26.71	26.78
C17:0	0.09 ± 0.00	3.97	0.09	0.10	0.09 ± 0.00	2.55	0.09	0.09
C18:0	8.50 ± 0.01	0.27	8.47	8.53	8.54 ± 0.01	0.27	8.51	8.57
C24:0	0.30 ± 0.01	4.94	0.28	0.32	0.31 ± 0.01	4.78	0.29	0.33
SFA	36.83				36.79			
C14:1	0.11 ± 0.02	3.83	0.07	0.16	0.13 ± 0.01	16.42	0.10	0.16
C15:1	0.63 ± 0.01	4.26	0.59	0.66	0.66 ± 0.01	3.71	0.62	0.68
C16:1	3.58 ± 0.02	1.00	3.54	3.63	3.60 ± 0.01	0.57	3.57	3.62
C17:1	0.13 ± 0.01	2.61	0.09	0.16	0.17 ± 0.01	12.75	0.14	0.20
C18:1n9	34.65 ± 0.01	0.09	34.60	34.68	34.69 ± 0.01	0.04	34.68	34.72
C22:1n9	0.01 ± 0.00	8.94	0.01	0.01	0.02 ± 0.00	7.07	0.02	0.02
C24:1n9	0.22 ± 0.01	13.10	0.18	0.25	0.29 ± 0.01	6.26	0.27	0.32
MUFA	39.33				39.56			
C18:2n6	16.10 ± 0.02	0.33	16.04	16.16	16.14 ± 0.02	0.25	16.10	16.20
C18:3n6	0.12 ± 0.01	15.14	0.09	0.14	0.12 ± 0.01	1.87	0.09	0.15
C18:3n3	0.72 ± 0.01	2.60	0.70	0.75	0.73 ± 0.01	1.79	0.71	0.74
C18:4n3	1.92 ± 0.01	1.08	1.90	1.95	1.94 ± 0.01	1.18	1.90	1.96
C20:2n6	1.10 ± 0.01	1.29	1.08	1.12	1.12 ± 0.01	2.06	1.09	1.15
C20:3n6	0.25 ± 0.01	7.48	0.23	0.28	0.26 ± 0,01	5.70	0.24	0.28
C20:3n3	0.30 ± 0.01	4.94	0.28	0.32	0.33 ± 0.01	5.50	0.30	0.35
C20:4n6	1.42 ± 0.01	1.32	1.39	1.44	1.45 ± 0.01	2.15	1.40	1.48
C22:2n6	0.23 ± 0.01	11.55	0.19	0.26	0.25 ± 0.01	10.20	0.21	0.28
C22:3n6	0.30 ± 0.02	12.70	0.26	0.35	0.32 ± 0.01	6.85	0.29	0.35
C20:5n3	0.62 ± 0.01	3.95	0.58	0.64	0.64 ± 0.01	3.60	0.61	0.67
C22:4n6	0.07 ± 0.00	0.17	0.07	0.07	0.09 ± 0.01	0.57	0.04	0.12
C22:5n3	0.09 ± 0.01	0.49	0.06	0.12	0.10 ± 0.01	0.35	0.09	0.12
C22:6n3	0.15 ± 0.01	0.38	0.12	0.18	0.16 ± 0.01	0.30	0.14	0.18
PUFA	23.40				23.65			
UFA	62.72				63.21			
Other acids	0.29 ± 0.01	0.30	0.25	0.32	0.44 ± 0.01	0.26	0.40	0.48
Ω_3	3.80				3.90			
Ω_6	19.60				19.75			
$\Omega_6/\ \Omega_3$	5.16				5.06			
SFA/UFA	0,59				0,58			
PUFA/MUFA	0,59				0,60			

*SFA- Saturated fat acids
*MUFA- Monounsaturated fat acids
*PUFA- Poliunsaturated fat acids
*UFA- Unsaturated fat acids

The data obtained on saturated fatty acids from the musculature of the whole thighs, revealed, for both batches (C.B., Exp. B.) that the main constituent is palmitic acid C16:0; thus, for C.B. the average was 26.50 ± 0.01 g/100 g, with variation of 26.48 g/100 g (minimum) and 26.53 g/100 g (maximum); while for the Exp. B. the average was 26.40 ± 0.01 g/100 g, with variation of 26.36 g/100 g (minimum) and 26.44 g/100 g (maximum). The constituent with the lowest average, for both batches, was represented by C12:0, lauric acid. The total saturated fatty acids resulting from the whole thighs muscles was 36.64 g/100 g for roosters from C.B., and 36.33 g/100 g for capons (Table 2). In case of monounsaturated fatty acids, dominant, in both groups, was oleic acid, C18:1n9, with an average for C.B. of 34.69 ± 0.01 g/100 g, the minimum being 34.67 g/100 g and the maximum 34.72 g/100 g, while for the Exp. B. the average was 34.68 ± 0.01 g / 100 g. The total of monounsaturated fatty acids was 39.50 g/100 g for C.B. and 39.54 g/100 g for Exp. B. Results on polyunsaturated fatty acids indicated for roosters (C.B.) a total value of 23.87 g/100 g, the lowest value was recorded by C22:4n6, docosatetraenoic acid, with an average of 0.09 g/100 g; on the opposite pole was C18: 2n6, linoleic acid, with an average of 16.16 ± 0.01 g/100 g. In case of the experimental group (Exp. B.), the linoleic acid registered a value of 16.17 ± 0.01 g/100 g, with variation of 16.13 g/100 g (minimum) and 16.20 g/100 g (maximum). The total of polyunsaturated fatty acids was 24.13 g/100 g for capons (Exp. B.). Regarding the ratio between fatty acids Ω6 and Ω3 for whole thighs, the values calculated was 5.03 for C.B. and 4.91 for Exp. B. The SFA/UFA ratio was 0.58 for the control batch and 0.57 for experimental batch; the PUFA/MUFA ratio values was 0.60 for C.B and 0.61 for Exp. B. (Figure 2).

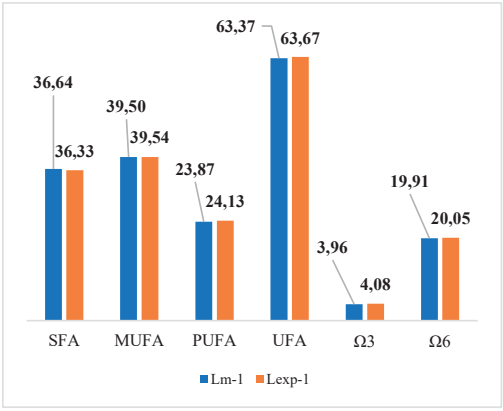

Figure 2. Fatty acids content in the whole thighs` musculature of Hubbard capons

Table 2. Fatty acids content in the whole thighs musculature of Hubbard capons

Specifications	Whole thighs							
	C.B.				Exp. B.			
Fatty acids	Statistics estimators							
	X±s_x (g AG/100 g)	V%	Min. (g AG/ 100 g)	Max. (g AG/ 100 g)	X±s_x (g AG/100 g)	V%	Min. (g AG/ 100 g)	Max. (g AG/ 100 g)
C8:0	0.11 ± 0.01	1.97	0.08	0.14	0.12 ± 0.01	2.54	0.09	0.16
C10:0	0.04 ± 0.00	2.73	0.03	0.06	0.05 ± 0.00	1.40	0.04	0.06
C12:0	0.02 ± 0.00	4.72	0.00	0.02	0.03 ± 0.01	1.94	0.01	0.05
C14:0	0.72 ± 0.01	4.28	0.68	0.75	0.61 ± 0.01	2.98	0.58	0.63
C15:0	0.27 ± 0.01	5.49	0.25	0.29	0.27 ± 0.01	5.49	0.25	0.29
C16:0	26.50 ± 0.01	0.07	26.48	26.53	26.40 ± 0.01	0.11	26.36	26.44
C17:0	0.11 ± 0.01	2.34	0.08	0.13	0.11 ± 0.01	1.86	0.08	0.13
C18:0	8.50 ± 0.01	0.17	8.48	8.52	8.38 ± 0.01	0.34	8.35	8.42
C24:0	0.37 ± 0.01	6.89	0.33	0.40	0.36 ± 0.02	10.03	0.31	0.40
SFA	36.64				36.33			
C14:1	0.11 ± 0.00	6.89	0.10	0.12	0.15 ± 0.01	1.70	0.11	0.18
C15:1	0.65 ± 0.01	2.75	0.63	0.68	0.66 ± 0.01	3.46	0.62	0.68
C16:1	3.64 ± 0.01	0.78	3.60	3.68	3.54 ± 0.01	0.64	3.50	3.56
C17:1	0.15 ± 0.01	1.45	0.12	0.18	0.20 ± 0.01	1.25	0.17	0.24
C18:1n9	34.69 ± 0.01	0.05	34.67	34.72	34.68 ± 0.01	0.06	34.65	34.70
C22:1n9	0.02 ± 0.00	0.44	0.00	0.02	0.02 ± 0.00	0.90	0.01	0.02
C24:1n9	0.24 ± 0.01	10.21	0.22	0.27	0.29 ± 0.01	1.48	0.26	0.3
MUFA	39.50				39.54			
C18:2n6	16.16 ± 0.01	0.17	16.12	16.19	16.17 ± 0.01	0.19	16.13	16.20
C18:3n6	0.14 ± 0.01	1.05	0.12	0.16	0.15 ± 0.01	1.66	0.11	0.18
C18:3n3	0.74 ± 0.01	3.87	0.70	0.78	0.76 ± 0.01	3.56	0.73	0.80
C18:4n3	1.94 ± 0.01	1.19	1.91	1.97	1.96 ± 0.01	1.11	1.93	1.99
C20:2n6	1.12 ± 0.01	2.04	1.10	1.16	1.14 ± 0.01	2.56	1.10	1.18
C20:3n6	0.28 ± 0.01	6.20	0.25	0.30	0.30 ± 0.01	7.45	0.27	0.33

C20:3n3	0.37 ± 0.01	3.08	0.35	0.38	0.40 ± 0.01	5.76	0.37	0.43
C20:4n6	1.47 ± 0.01	1.08	1.45	1.49	1.50 ± 0.01	0.99	1.48	1.52
C22:2n6	0.30 ± 0.01	9.01	0.27	0.34	0.32 ± 0.01	8.44	0.29	0.36
C22:3n6	0.35 ± 0.02	10.22	0.30	0.38	0.37 ± 0.01	6.22	0.34	0.40
C20:5n3	0.64 ± 0.01	4.94	0.60	0.68	0.66 ± 0.01	3.46	0.64	0.69
C22:4n6	0.09 ± 0.01	1.36	0.07	0.10	0.10 ± 0.01	1.65	0.08	0.12
C22:5n3	0.11 ± 0,01	1.70	0.09	0.14	0.12 ± 0.01	1.87	0.09	0.15
C22:6n3	0.16 ± 0.01	1.35	0.13	0.18	0.18 ± 0.01	1.50	0.14	0.21
PUFA	23.87				24.13			
UFA	63.37				63.67			
Other acids	0.29 ± 0.01	0.34	0.24	0.33	0.11 ± 0.01	0.36	0.09	0.12
Ω_3	3.96				4.08			
Ω_6	19.91				20.05			
Ω_6/Ω_3	5.03				4.91			
SFA/UFA	0.58				0.57			
PUFA/MUFA	0.60				0.61			

*SFA- Saturated fat acids
*MUFA- Monounsaturated fat acids
*PUFA- Poliunsaturated fat acids
*UFA- Unsaturated fat acids

CONCLUSIONS

Several factors can affect the quality of meat, some of which act during the life of the birds and others which act during the slaughter of birds (e.g. stunning, bleeding, scratching, or refrigerating the carcases). Capon meat has a number of biological features that are highly valuable, which is why their use in intensive systems has a lot of potential. As far as research is concerned, capons meat obtained from Hubbard hybrid can be considered as high quality, due it's high proportion of polyunsaturated fatty acids. One aspect reflecting the high quality of the capon meat is the Ω6/Ω3 ratio, which recorded values lower than 5,00. We recommend continuing research in this direction.

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