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Influence of age on total lipids and phospholipids in turkey meat.

Introduction

Many factors have influence on the amount and quality of fat in meat. Among these factors the plan of nutrition (especially in connection with the modern intensive raising techniques) and the sex of the animals have the greatest importance, even though the role of the age of the animals must not be underestimated.
In fact, extensive investigations have put in evidence that, as animals grow and accumulate fat, the proportion of triglycerides in the muscles increases at the expense of phospholipids; simultaneously there is a variation in the fatty acids composition of the various lipid classes especially for what the degree of unsaturation is concerned.
The fatty acids C16 and C18 are mainly involved in the process, which is of the utmost importance as unsaturated fatty acids play a significant role both in lipid metabolism and in determining the perishability of meat.
The object of the present study was to investigate turkey's meat in order to verify the role of the age of the animals as a determinant of the characteristics of the various classes of muscle lipids.

Materials and Methods

Breast and leg samples from turkeys carcasses were used for the analysis. The large-type turkeys (White Giant) were fed on a standard diet and killed at 18 and 23 weeks of age.
Total lipids were extracted from the muscle samples according to the method of Bligh and Dyer (1959) which consists of an homogenisation with chloroform-methanol-water followed by filtration and separation of the chloroform phase which contains the lipids. Part of the lipid extract was mixed - according to the method of Hornstein et al. (1967) - with activated silicic acid and a mixture of chloroform-hexane-diethylether (2:1:1) and then centrifuged in order to separate the triglycerides and free fatty acids (in the supernatant) from the phospholipids which remain bound to the silicic acid. Phospholipids are then transmethylated directly on the silicic acid by means of sodium methoxide and finally extracted with hexane. The concentrated hexane phase is analysed by GLC. The supernatant containing both triglycerides and free fatty acids (FFA) was treated with a purified anion exchange resin Dowex 1-X8 so as to separate the two components: the resin retains the FFA. The methylation of FFA was accomplished directly on the resin by means of a mixture methanol-HCl 5 - 10%. The methylesters were analysed by GLC. The supernatant containing the triglyceride fraction was saponified with KOH; the fatty acids were then released by means of HCl and finally extracted with hexane. This extract was treated with the anion exchange resin so as to separate the cholesterol, which was not determined, from the fatty acids which are absorbed on the resin. The fatty acids were then methylated as described for the FFA and determined, after extraction with hexane, by means of a chromatograph C.Erba 4200 equipped with a hydrogen flame ionization detector. The percentage of phospholipids was determined on the assumption that Phosphorus represents 4% of total phospholipids (Hornstein et al., 1961). Phosphorus is then determined according the method described by Morrison (1964) based on the destruction of organic matter by wet oxidation, liberating phosphoric acid, formation of a phosphomolybdic acid complex which is quantitatively reduced to a heteropoly blue color and measurement of the color by spectrophotometry.

Results

The analysis carried out on the turkey's breast and leg muscles put in evidence some modifications in the composition of the various lipid classes as regards to the age of the animals.
In particular:

- for what triglyceride are concerned (see table 1) the fatty acids of the breast don't substantially change with age, except C16:1 which increases and C17:1 which decreases ($P \leq 0.05$), while in the leg it is possible to observe a greater variation, with a decrease of C14:0, C16:0, C17:0, C18:0 ($P \leq 0.05$), C20:3, C20:5 ($P \leq 0.01$) and an increase of C18:1 ($P \leq 0.01$), C18:2, C18:3 ($P \leq 0.05$).
- as for the FFA (see table 2) there are not great differences between breast muscles from 18 weeks old turkeys and 23 weeks old ones: there is only an increase of C18:2 ($P \leq 0.05$) and a decrease of C20:3 and C20:5 ($P \leq 0.05$), while also in this case in leg muscles there are more meaningful variations: C16:1, C18:1 and C18:2 decrease ($P \leq 0.05$, $P \leq 0.01$ and $P \leq 0.001$ respectively) and C18:0 increases ($P \leq 0.01$).
- finally for what phospholipids are concerned (see table 3) in breast muscles there is a decrease of C15:0, C17:1 ($P \leq 0.001$) and C22:6 ($P \leq 0.01$) and an increase of C18:0 ($P \leq 0.01$), whereas in leg muscles there is a decrease of C17:0 ($P \leq 0.05$), C18:2 ($P \leq 0.01$) and an increase of C18:1 and C20:4 ($P \leq 0.01$).

The proportion of phospholipids on the overall amount of lipids is different in leg and in breast muscles in relation to the age of animals. In fact in breast such proportion is almost the same in 18 weeks old turkeys and in 23 weeks old, while in leg muscles the phospholipids significantly decrease ($P \leq 0.001$).
These results are closely related to those obtained by other Authors in investigations carried out on different kinds of meat.

Tab. 1 - Effect of age on fatty acid composition of triglycerides of turkey's meat. (°)

FATTY ACIDS	B R E A S T 18 weeks	23 weeks	F	L E G 18 weeks	23 weeks	F
14:0	2.70 (0.65)	2.52 (0.83)	n.s.	2.71 (0.83)	1.81 (0.22)	*
15:0	0.61 (0.34)	0.33 (0.16)	n.s.	0.26 (0.03)	0.35 (0.18)	n.s.
16:0	24.81 (1.68)	26.28 (2.01)	n.s.	27.74 (3.44)	24.21 (0.61)	*
16:1	3.67 (0.70)	5.34 (1.19)	*	3.94 (0.45)	4.62 (1.55)	n.s.
17:0	-	-		0.31 (0.08)	0.20 (0.06)	*
17:1	0.57 (0.21)	0.34 (0.11)	*	-	-	
18:0	9.55 (1.67)	7.87 (1.29)	n.s.	10.82 (1.82)	8.12 (1.34)	*
18:1	25.26 (6.64)	25.90 (4.58)	n.s.	22.45 (3.84)	29.35 (2.17)	* *
18:2	19.01 (5.25)	21.25 (3.14)	n.s.	20.56 (3.32)	24.97 (1.70)	*
18:3	-	-		0.94 (0.37)	1.49 (0.17)	*
20:3	5.22 (4.18)	4.21 (2.33)	n.s.	2.71 (1.10)	0.92 (0.47)	* *
20:4	1.99 (1.05)	1.72 (0.80)	n.s.	3.09 (1.39)	2.35 (1.11)	n.s.
20:5	2.96 (2.44)	2.45 (1.38)	n.s.	2.68 (1.20)	0.80 (0.32)	* *

(°) Mean and standard deviation in brackets (percent).

* significant differences $P \leq 0.05$; * * significant differences $P \leq 0.01$.

Tab. 2 - Effect of age on free fatty acid composition of turkey's meat. (°)

FATTY ACIDS	B R E A S T 18 weeks	23 weeks	F	L E G 18 weeks	23 weeks	F
14:0	2.93 (1.08)	2.84 (1.14)	n.s.	2.06 (0.61)	2.18 (0.59)	n.s.
15:0	3.73 (1.52)	2.31 (1.39)	n.s.	2.65 (1.26)	3.85 (1.87)	n.s.
16:0	20.39 (2.25)	21.70 (2.81)	n.s.	18.94 (1.66)	18.53 (3.30)	n.s.
16:1	2.36 (0.36)	2.65 (0.89)	n.s.	2.89 (0.31)	2.11 (0.60)	*
17:1	-	-		0.77 (0.23)	1.68 (1.18)	n.s.
18:0	13.09 (1.19)	12.23 (3.21)	n.s.	9.09 (1.25)	13.56 (2.37)	* *
18:1	13.96 (2.08)	17.08 (2.82)	n.s.	17.86 (0.95)	14.11 (2.39)	* *
18:2	17.97 (3.57)	24.74 (5.46)	*	28.58 (1.81)	22.97 (2.36)	* * *
18:3	-	-		0.80 (0.24)	0.91 (0.53)	n.s.
20:3	7.88 (4.24)	3.52 (1.45)	*	2.11 (0.61)	4.14 (2.78)	n.s.
20:4	11.04 (1.23)	9.43 (5.06)	n.s.	10.39 (1.50)	11.87 (3.53)	n.s.
20:5	3.06 (1.15)	1.39 (0.55)	*	2.30 (1.09)	2.30 (1.21)	n.s.

(°) Mean and standard deviation in brackets (percent).

* significant differences $P \leq 0.05$; * * significant differences $P \leq 0.01$; * * * significant differences $P \leq 0.001$.

Tab. 3 - Effect of age on fatty acid composition of phospholipids of turkey's meat. (°)

FATTY ACIDS	B R E A S T					L E G				
	18 weeks		23 weeks		F	18 weeks		23 weeks		F
14:0	0.28	(0.04)	0.32	(0.09)	n.s.	0.21	(0.05)	0.20	(0.02)	n.s.
15:0	7.56	(0.41)	4.08	(0.67)	***	4.44	(0.53)	4.15	(0.63)	n.s.
16:0	19.57	(0.47)	20.44	(2.15)	n.s.	15.10	(1.37)	14.66	(1.00)	n.s.
16:1	0.48	(0.24)	0.73	(0.40)	n.s.	0.58	(0.06)	0.68	(0.24)	n.s.
17:0	0.19	(0.06)	0.23	(0.10)	n.s.	0.27	(0.04)	0.21	(0.04)	*
17:1	1.84	(0.41)	0.84	(0.32)	***	0.95	(0.22)	0.86	(0.17)	n.s.
18:0	16.52	(1.26)	19.71	(1.91)	**	21.84	(0.77)	21.30	(1.52)	n.s.
18:1	16.02	(1.53)	19.67	(3.79)	n.s.	11.56	(0.67)	14.28	(1.59)	**
18:2	18.56	(2.00)	18.90	(2.54)	n.s.	24.88	(1.06)	21.70	(1.85)	**
18:3	-		-			0.22	(0.12)	0.32	(0.06)	n.s.
20:4	10.90	(0.51)	8.94	(2.24)	n.s.	11.99	(0.50)	13.76	(0.86)	**
22:6	2.95	(0.57)	1.79	(0.23)	**	2.12	(0.63)	2.34	(0.30)	n.s.

(°) Mean and standard deviation in brackets. (percent).

* significant differences $P \leq 0.05$; ** significant differences $P \leq 0.01$; *** significant differences $P \leq 0.001$.

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