THE EFFECT OF FEEDING WITH HEMP AND CAMELINA CAKES ON THE FATTY ACID PROFILE OF DUCK MUSCLES

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INTRODUCTION

- Duck meat products are very popular for consumption (after chicken and turkey).
- The content of intramuscular fat and the composition of FA in the muscles of ducks: SFA is high (49.4 %); n-3 PUFA is very low; PUFA / SFA ratio varies 0.22 -0.42; n-6 / n-3 ratios 7.08 to 10.07 (Kokoszynski, 2011, Witak, 2008, Nguyen et al., 2003).
- The production of duck meat with higher PUFA compositions requires enrichment of the diet with ingredients containing higher than usual amounts of PUFA.
- Successful studies developed to produce chicken and turkey with higher n-3 PUFA content.
- Fatty acid modification of duck meat still have little attention by researchers.

INTRODUCTION

- Supplementation of duck feeds with rapeseed oil resulted in better intramuscular fat composition of meat (Woloszyn et al., 2005; 2006; 2011).

- Camelina (*Camelina sativa L. Crantz*) oil cake contains from 16.28 to 29 % ALA fatty acid (Sampath, 2009; Cherian, 2012), the n-6 / n-3 PUFA ratio is 0.63 (Ciurescu et al., 2016). Camelina oil due to antioxidants in it remains stable up to 6 months (Abramovic et al., 2007).

- Hemp (*Cannabis sativa L.*) cake is has a high amount of PUFA (Da Porto et al., 2012).

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The composition of fatty acids in the above cakes allows us to think that the use of these cakes for feeding ducks might improve the fatty acid composition of muscles.

OBJECTIVE

The purpose of our study was to modify the composition of intramuscular fat in the breast and leg muscles of Pekin ducks by using different oily plant cakes rich in n-3 PUFA.

MATHERIALS AND METHODS

COMPOSITION OF FATTY ACID CONTENT OF RAPESEED, HEMPSEED AND CAMELINA CAKES (% OF TOTAL FATTY ACIDS)

Fatty acid	Rapeseed cake	Hempseed cake	Camelina cake
SFA	16.30	7.66	11.73
MUFA	48.66	10.00	35.21
Linoleic (C18:2n-6)	21.67	59.52	24.16
Linolelaidic (C18:2n-6trans)	0.00	0.10	0.02
Octadecadienoic (C18:2n-6cis, trans)	0.00	0.00	0.04
γ-linolenic (C18:3n-6)	0.06	4.52	0.11
α-linolenic (C18:3n-3)	13.05	15.85	25.88
Eicosadienoic (C20:2n-6)	0.08	1.38	1.65
Eicosatrienoic (C20:3n-3)	0.00	0.05	0.84
Eicosatrienoic (C20:3n-6)	0.12	0.00	0.00
Arachidonic (C20:4n-6)	0.00	0.00	0.05
Eicosapentaenoic (C20:5n-3)	0.00	0.16	0.00
Docosadienoic (C22:2n-6)	0.00	0.00	0.30
Docosatetranoic (C22:4n-6)	0.03	0.00	0.03
n-6 PUFA	21.96	65.52	26.36
n-3 PUFA	13.05	16.06	26.72
PUFA / SFA	2.15	10.65	4.53
n-6/n-3	1.68	4.08	0.99

EXPERIMENTAL DESIGN

99 Pekin male ducks, 3 dietary treatment groups with 3 replicates of 11 ducks each. Housed in a controlled environment, stocking rate 15 for 1-day-old and 10 for 21 -day-old ducks per square metre. Water and feed were provided *ad libitum*.

Control group (C)	Wheat-soybean meal-barley based diet supplemented with rapeseed cake (15 % from 0 to 23 day and 20 % from 24 to 49 day)
Experimental group 1 (HEM)	Wheat-soybean meal-barley based diet supplemented with hempseed cake at 15–20 % (instead of rapeseed cake)
Experimental group 2 (CAM)	Wheat-soybean meal-barley based diet supplemented with camelina cake at 15–20 % (instead of rapeseed cake)

DIET COMPOSITION, %

Ingredient	Control group (C)		Experimental group 1 (HEM)		Experimental group 2 (CAM)	
	0 - 23 day	over 23 day	0 - 23 day	over 23 day	0 - 23 day	over 23 day
Barley	18	15	18	15	18	15
Wheat	48.2	52.1	49.5	53.8	49	53.1
Soybean oil meal	13.4	7.5	12.1	5.8	12.6	6.5
Rapeseed cakes	15	20	-	-	-	-
Hemp cakes	-	-	15	20	-	-
Camelina cakes	-	-	-	-	15	20
Monocalcium phosphate	1	1	1	1	1	1
Premix	3	3	3	3	3	3
Feed chalk	1.2	1.2	1.2	1.2	1.2	1.2
Mycotoxin binder Mycofix® Plus	0.2	0.2	0.2	0.2	0.2	0.2

Feed analyses

Dry matter content (by ovendrying at 105), crude protein (Kjeldhal method), crude fiber (Fibercap method), calcium (Atomic absorption method), phospforus (photometric method using molibdovanadate reagent). Rapeseed, hempseed and camelina cakes were analyzed for the fatty acid composition.

Control slaughtering

Six ducks from each group (at the age of 49 days) were selected for control slaughtering. The carcasses were anatomically dissected according to the methodological recommendation of anatomic carcass dissection and organoleptic evaluation of poultry. 50 g of breast and leg muscles were taken for the analysis of fatty acid composition.

Fatty acid analyses

The FA were analyzed using a gas liquid chromatography (GC-2010 Shimadzu) fitted with flame ionization detector. The relative proportion of each fatty acid was expressed as the relative percentage of the sum of the total fatty acids using “GC solution” software for Shimadzu gas chromatograph workstations.

Lipid quality indices

Atherogenic index (AI), thrombogenic index (TI), and hypocholesterolemic / hypercholesterolemic (h / H) indices were calculated on the basis of fatty acid analysis data

Statistical Analyses

Statistical analyses were performed using statistical software package STATISTICA (Version 7; Stat Soft Inc. Tulsa, OK, USA).

The differences were considered to be statistically significant at $P \leq 0.05$.

All analytical studies were carried out at the Analytical Laboratory of the LUHS Animal Science Institute.

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RESULTS




FATTY ACID COMPOSITION OF DUCK BREAST MUSCLES, %

Item	Control group (C)	Experimental group 1 (HEM)	Experimental group 2 (CAM)
Lauric (C12:0)	0.02	0.02	0.02
Myristic (C14:0)	0.40	0.44	0.42
Pentadecanoic (C15:0)	0.06^{a}	0.05^{b}	0.06^{ab}
Palmitic (C16:0)	22.65^{b}	23.44^{a}	23.18^{ab}
Margaric (C17:0)	0.12^{a}	0.10^{b}	0.11^{ab}
Stearic (C18:0)	7.32	7.69	7.31
Arachidic (C20:0)	0.08^{B}	0.09^{b}	0.11^{Aa}
Heneicosanoic (C21:0)	0.06	0.06	0.08
Behenic (C22:0)	0.33	0.36	0.27
SFA	31.04^{b}	32.25^{a}	31.55^{ab}
Palmitoleic (C16:1n-7)	2.70	3.01	2.78
Vaccenic (C18:1n-7)	2.40^{A}	1.79^{B}	1.80^{B}
Oleic (C18:1n-9)	45.40	40.50	42.51
MUFA	51.74	46.61	49.49
Linoleic (C18:2n-6)	9.96^{B}	11.67^{A}	10.24^{B}
Linolelaidic (C18:2n-6 trans)	0.03	0.04	0.04
Octadecadienoic (C18:2n-6 cis, trans)	0.06	0.05	0.06
Octadecenoic (C18:2n-6 trans, cis)	0.04	0.04	0.05
γ-linolenic (C18:3n-6)	0.06^{B}	0.14^{A}	0.05^{B}
α-linolenic (C18:3n-3)	1.80^{B}	1.90^{B}	3.29^{A}
Eicosadienoic (C20:2n-6)	0.21^{B}	0.26^{AB}	0.37^{A}
Eicosatrienoic (C20:3n-3)	0.08^{B}	0.13^{AB}	0.16^{A}

FATTY ACID COMPOSITION OF DUCK BREAST MUSCLES, %

continuation

Item	Control group (C)	Experimental group 1 (HEM)	Experimental group 2 (CAM)
Arachidonic (C20:4n-6)	2.00	2.88	1.62
Eicosapentaenoic (C20:5n-3)	0.20	0.25	0.28
Docosadienoic (C22:2n-6)	0.01	0.02	0.03
Docosatetraenoic (C22:4n-6)	0.34	0.45	0.25
Docosapentaenoic (C22:5n-3)	0.32	0.42	0.41
Docosahexaenoic (C22:6n-3)	0.27	0.37	0.40
PUFA	15.50	18.89	17.37
n-6 PUFA	12.83^{b}	15.83^{a}	12.84^{b}
n-3 PUFA	2.67^{B}	3.07^{B}	4.53^{A}
PUFA/SFA	0.50	0.58	0.55
n-6/n-3	5.02^{A}	5.26^{A}	2.86^{B}
Linoleic/α-linolenic	5.83^{A}	6.32^{A}	3.17^{B}
Hypocholesterolemic/hypercholesterolemic ratio	2.62^{A}	2.45^{B}	2.51^{AB}
Atherogenic index	0.36^{B}	0.39^{AB}	0.37^{B}
Thrombogenic index	0.75^{a}	0.78^{ab}	0.69^{b}

THE FATTY ACID COMPOSITION OF DUCK LEG MUSCLES, %

Item	Control group (C)	Experimental group 1 (HEM)	Experimental group 2 (CAM
Lauric (C12:0)	0.02	0.03	0.03
Myristic (C14:0)	0.42^{b}	0.48^{a}	0.45^{ab}
Pentadecanoic (C15:0)	0.06^{A}	0.05^{B}	0.06^{A}
Palmitic (C16:0)	21.36^{B}	$22.19A^{B}$	22.73^{A}
Margaric (C17:0)	0.11^{Aa}	0.07^{B}	0.09^{Ab}
Stearic (C18:0)	6.34	6.14	6.71
Arachidic (C20:0)	0.06^{B}	0.06^{B}	0.10^{A}
Heneicosanoic (C21:0)	0.06	0.07	0.06
Behenic (C22:0)	0.24	0.22	0.21
SFA	28.62^{B}	29.31^{AB}	30.87^{A}
Palmitoleic (C16:1n-7)	3.48^{ABb}	4.10^{Aa}	3.15^{Bb}
Vaccenic (C18:1n-7)	2.34	2.01	1.88
Oleic (C18:1n-9)	48.93^{A}	45.40^{B}	44.08^{B}
MUFA	55.95^{Aa}	52.69^{ABb}	51.85^{Bb}
Linoleic (C18:2n-6)	10.06^{B}	12.28^{A}	10.35^{BC}
Linolelaidic (C18:2n-6 trans)	0.04^{a}	0.02^{b}	0.03^{ab}
Octadecadienoic (C18:2n-6 cis, trans)	0.06	0.06	0.06
Octadecenoic (C18:2n-6 trans, cis)	0.04	0.04	0.04
γ-linolenic (C18:3n-6)	0.06^{B}	0.17^{A}	0.05^{B}
α-linolenic (C18:3n-3)	1.57^{B}	1.90^{C}	3.80^{A}
Eicosadienoic (C20:2n-6)	0.17^{B}	0.21^{B}	0.35^{A}
Eicosatrienoic (C20:3n-3)	0.03^{B}	0.04^{B}	0.13^{A}
Eicosatrienoic (C20:3n-6)	0.15	0.20	0.18

THE FATTY ACID COMPOSITION OF DUCK LEG MUSCLES, %

continuation

Item	Control group (C)	Experimental group 1 (HEM)	Experimental group 2 (CAM)
Eicosapentaenoic (C20:5n-3)	0.11	0.11	0.17
Docosadienoic (C22:2n-6)	0.00^{a}	0.01^{ab}	0.02^{b}
Docosatetraenoic (C22:4n-6)	0.26^{A}	0.25^{AB}a	0.15^{Bb}
Docosapentaenoic (C22:5n-3)	0.28^{ab}	0.25^{b}	0.32^{a}
Docosahexaenoic (C22:6n-3)	0.19^{ab}	0.18^{b}	0.25^{a}
PUFA	14.17^{B}	16.89^{A}	16.69^{A}
n-6 PUFA	12.00^{B}	14.41^{A}	12.02^{B}
n-3 PUFA	2.17B^{b}	2.48^{Ba}	4.67^{A}
PUFA/SFA	0.49^{b}	0.58^{a}	0.54^{ab}
n-6/n-3	5.54^{A}	5.82^{A}	2.60^{B}
Linoleic/α-linolenic	6.43^{A}	6.48^{A}	2.78^{B}
Hypocholesterolemic/hypercholesterolemic ratio	2.88^{A}	2.73^{AB}	2.60^{B}
Atherogenic index	0.33^{B}	0.35^{AB}	0.36^{A}
Thrombogenic index	0.69	0.70	0.65

CONCLUSIONS

The addition of camelina cake at the level of 15- to 20% in the diet of ducks improved ALA, total n-3 PUFA and the ratio of n-6 / n-3 in their muscles compared with the groups that had diets enriched with rapeseed or hempseed cakes.

Supplementation of the feed with hempseed cake increased n-3 PUFA only in the legs of ducks, while total n-6 PUFA increased in both leg and breast muscles. Hempseed cake also increased the content of GLA in duck meat that is beneficial for human health and allows producing duck meat of exceptional quality

THANK YOU FOR YOUR ATTENTION