Pasture intake and cereal-based feed restriction improve the lipid nutritional value of chicken meat

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Introduction

PUFA contents of modern human diets are deficient in n-3 fatty acids (Simopoulos, 2002) which are responsible for the pathogenesis of many diseases, including cancer and inflammatory and autoimmune diseases. Additionally, it has been shown that consumption of eicosapentaenoic (EPA; 20:5n-3) and docosahexaenoic (DHA; 22:6n-3) n-3 fatty acids may reduce the risk of coronary heart disease, while being vital components in the retina and the membrane phospholipids of the brain (Rymer and Givens, 2005). Poultry meat has been considered as one of the main sources of PUFA, in particular n-3 PUFA, for human diets (Sioen et al., 2006; Howe et al., 2006). Interestingly, it has been shown that the content of poultry meat in n-3 fatty acids, particularly in α-linolenic acid (ALA; 18:3n-3), can be readily improved by increasing the levels of n-3 PUFA in poultry diets through the incorporation of vegetable oils (López-Ferrer et al., 1999, 2001a) and/or oily fish by-products (Hulan et al., 1988; López-Ferrer et al., 2001b). Pastures are assumed to be good sources of α-linolenic acid (ALA), although low intake levels of fresh forages in free-range chicken limit changes in meat quality.

Objective

The aim of this work was to investigate the effect of restricting the intake of a cereal-based feed on the consumption of a leguminous-based pasture and on the meat fatty acid profile.

Methods

Two hundred and forty 36-d-old males *RedBro Cou Nu × RedBro M* broilers were fed on a cereal-based feed at different intake restriction levels (100%, 75% or 50% of the *ad libitum* intake), in portable floorless pens located on a *Trifolium subterraneum* pasture. Control birds were maintained in identical conditions but had no access to pasture. At the end of the experimental period, one bird per brooder was sacrificed and the breast meat fatty acid profile was determined by GC-FID, as described by Ponte *et al.* (2008). The fatty acid composition of the high-energy feed and the leguminous based pasture were also determined. Data was subjected to analysis of variance using GLM procedure of SAS at a significant level of 5%.

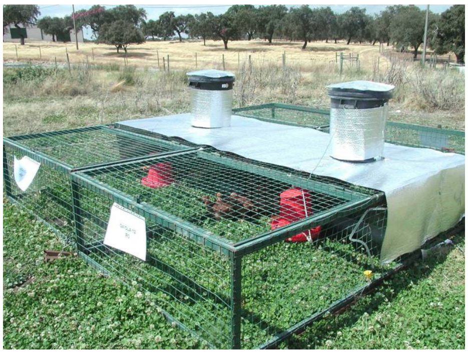


Table 1. Total fatty acids (mg g-1 dry matter), fatty acid composition (% w/w), of the cereal-based feed and of the *T. subterraneum* based pasture.

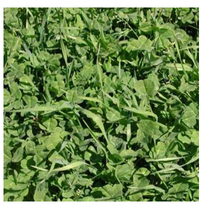
	Cereal-based feed[1]	Pasture
Total fatty acids	19.89	4.51
Fatty acids		
14:0	0.08	0.28
16:0	14.03	13.80
16:1n-7	0.19	0.12
17:0	0.15	0.11
18:0	2.64	1.62
18:1n-9	21.60	1.90
18:2n-6	57.85	10.65
18:3n-3	3.46	71.52

Table 2: Total fatty acids (mg/g), fatty acid composition (% W/W) partial sums of fatty acids(%W/W) and nutritional values of meat from broilers with and without access to dehydrated leguminous-based forage.

	No Pasture			Pasture			SEM	Significance level		
	100	75	50	100	75	50		P	R	PxR
14:0	0.43^{ab}	0.40^{bc}	0.41^{bc}	0.48^{ab}	0.51^{a}	0.33^{c}	0.036	ns	*	*
15:0	0.26	0.32	0.33	0.32	0.30	0.34	0.018	ns	ns	ns
16:0	24.6	23.8	23.3	22.1	24.1	22.4	0.912	ns	ns	ns
16:1n-7	2.28	2.16	2.03	2.19	2.25	1.84	0.147	ns	ns	ns
17:0	0.13	0.13	0.15	0.13	0.14	0.14	0.005	ns	***	ns
18:0	12.5	13.0	13.6	12.9	12.7	13.7	0.591	ns	**	ns
18:1n-9	26.1	24.4	22.4	26.8	23.9	20.6	0.735	ns	***	ns
18:2n-6	19.7	20.2	20.2	18.5	19.71	20.6	0.441	ns	*	ns
20:0	0.10^{b}	0.10^{b}	0.12^{a}	0.10^{b}	0.10^{b}	0.10^{b}	0.003	ns	***	*
18:3n-6	0.09	0.08	0.07	0.08	0.08	0.08	0.004	ns	ns	ns
20:1n-9	0.25	0.24	0.22	0.25	0.22	0.20	0.009	ns	***	ns
18:3n-3	0.45^{bc}	0.41^{cd}	0.38^{d}	0.42^{cd}	0.50^{ab}	0.54^{a}	0.024	***	ns	***
20:2n-6	0.34	0.35	0.38	0.41	0.39	0.38	0.023	*	ns	ns
20:3n-6	1.05	1.08	1.09	1.19	1.2	1.22	0.053	**	ns	ns
20:4n-6	7.99	9.27	10.6	9.47	9.15	12.0	0.529	**	***	ns
20:3n-3	0.02	0.02	0.02	0.03	0.04	0.04	0.002	***	ns	ns
20:5n-3	0.19	0.22	0.24	0.25	0.30	0.36	0.017	***	***	ns
22:2n-6	0.06	0.05	0.05	0.09	0.07	0.05	0.008	*	**	ns
22:4n-6	1.60	1.66	1.90	1.85	1.76	2.06	0.089	*	**	ns
22:5n-3	0.81	0.90	0.98	1.03	1.09	1.30	0.052	***	***	ns
22:6n-3	1.09	1.27	1.47	1.52	1.49	1.73	0.093	***	**	ns
Partial sums										
SFA	38.0	37.8	37.9	36.0	37.8	37.0	0.724	ns	ns	ns
MUFA	28.6	26.8	24.7	29.2	26.4	22.7	0.850	ns	***	ns
PUFA	33.4	35.4	37.4	34.8	35.8	40.3	1.009	ns	***	ns
n-3	2.56	2.82	3.08	3.26	3.42	3.97	0.133	***	***	ns
n-6	30.8	32.6	34.3	31.6	32.4	36.3	0.915	ns	***	ns
Ratios										
P/S	0.88	0.94	0.99	1.0	0.95	1.1	0.061	ns	ns	ns
n-6/n-3	12.0	11.6	11.2	9.75	9.57	9.31	0.276	**	ns	ns

Results

Linoleic acid (LA, 18:2n-6) was the predominant fatty acid in the high-energy feed while the pasture was richer in ALA (18:3n-3) (Table 1). Comparing with the high-energy feed, pasture had a higher n-3 FA content (71.5% *vs.* 5.3% of total FA) and a lower n-6/n-3 ratio (0.149 *vs.* 16.72). Restriction of feed intake increased the relative leguminous pasture intake (1.6% to 4.9% of the total DM intake, data not shown). The increased pasture consumption affected significantly the meat fatty acid profile (Table 2). These changes were mainly due to the increase in the n-3 FA content, including the long-chain n-3 FA EPA (20:5n-3), DPA (22:5n-3) and DHA (22:6n-3) acids. Since the pasture is a poor source of EPA, DPA and DHA, the data suggests a high conversion of ALA into its long-chain family derivatives. The content in n-6 FA was affected by cereal feed restriction but no effect of pasture consumption was observed. Free access to the leguminous based pasture decreased n-6/n-3 PUFA ratio, which is favourable attending to the international recommendations of fatty acid composition for human diets.



Conclusions

The results suggest that the imposed restriction on the intake of a cereal-based feed for free-range broilers led to a higher proportion of pasture intake in the overall total intake. The increased consumption of a leguminous-based pasture may contribute to improve meat quality through changes in fatty acid composition.

References

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