EFFECTS OF BEEF FAT, SOYBEAN OIL OR KRABOK OIL IN BROILER DIETS ON BODY COMPOSITION

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ABSTRACT - In broiler chickens we expected that medium-chain triacylglycerols (MCT) would diminish carcass fat deposition as do polyunsaturated fatty acids (PUFA). Broiler chickens were fed on diets containing either tallow, which is rich in saturated fatty acids (SFA), soybean oil, which is rich in PUFA, or krabok oil, which is rich in MCT. Krabok oil was isolated from the seeds of a tree (*Irvingia Malayana*) grown widely in tropical and subtropical areas. In keeping with earlier investigations, dietary soybean oil versus tallow siginificantly lowered whole body fat deposition (P<0.01). The feeding of krabok oil instead of tallow did not affect the percentage of whole body fat, which would lead to rejection of our hypothesis. The amount of whole body fat deposition was reduced significantly when replaced by soybean oil (P<0.01).

Key Words – tallow, whole body composition

I. INTRODUCTION

It has been observed frequently that the addition to the diet of an oil rich in polyunsaturated fatty acids (PUFA) or at the expense of long-chain saturated fatty acids (SFA) reduces the amount of fat deposition in broiler chickens (Sanz et al., 1999, 2000a; Crespo and Esteve-Garcia, 2002a; Newman et al., 2002; Pinchasov and Nir, 1992; Villaverde et al., 2005; Zollitsch et al., 1997, Wongsuthavas et al., 2007). One possible mechanism could be that PUFA versus SFA are preferentially oxidized (Beynen and Katan, 1985) and thereby yield ATP so that carbohydrates are shifted from the oxidative into the lipogenic pathway. This reasoning could explain why the feeding PUFA versus SFA caused the observed decrease in carcass fat deposition in broiler chicken. Consequently, the feeding of PUFA instead of SFA acids may lead to less deposition of carcass fat. Analogous to PUFA, saturated fatty acids with medium-chain length are also preferentially oxidized (Bach and Babayan, 1982). Thus, it could be hypothesized that dietary fats rich in medium-chain triacylglycerols (MCT) would diminish carcass fat deposition and enhances whole body nutrients deposition when compared with the feeding of a high-SFA diet.

Krabok (*Irvingia Malayana*, Oliv. ex. A. Benn.) is a tree grown widely in tropical and subtropical areas. In Thailand, the krabok tree is commonly used for wood and charcoal production, whereas the seeds, after peeling, are consumed by people. Krabok seed oil is rich in lauric (C12:0) and myristic acid (C14:0) (Wongsuthavas, 2007). In the light of the above-mentioned, we hypothesized that the consumption of krabok oil by broiler chickens would lower the deposition of whole body fat.

II. MATERIALS AND METHODS

Krabok seed oil extraction

Krabok seeds were purchased from a local market. The seeds were dehulled and ground through pass a 1-mm screen sieve of a grinding machine. Then, the meal was extracted by the Sohxlet method using hexane (AOAC, 1975).

Broiler Chickens and diets

Forty-five 7-day-old Arbor Acres broiler chicks were used. They were randomly allocated to three groups of 15 birds each and kept in individual cages. Feed was provided *ad libitum* in the form of meal. Birds had free access to water. The experimental diets contained either tallow, soybean oil or krabok oil. The analysed proximate composition of the diets was similar (Table 1). As would be expected, the tallow used was rich in SFA and soybean oil rich in PUFA (Table 2). The krabok oil was high in SFA, but this fraction

consisted mainly of C12:0 and C14:0 which there are MCT.

Table 1 Ingredient and analysed composition of the experimental diets

Ingredients (%)	Fat source		
	BF	SO	KO
Beef Fat	3.00	0.00	-
Soybean oil	-	3.00	-
Krabok oil	-	-	3.00
Constant components	97.00	97.00	97.00
Analysed composition (%)			
Dry matter	92.0	92.0	91.9
Crude protein	18.0	18.0	18.0
Crude fat	3.4	3.3	4.4
Crude fiber	3.2	3.2	3.2
Ash	4.3	4.3	4.3

The constant components consisted of (g/100 g diet): tapioca starch, 46.02; soybean meal, 41.05; rice bran hulls, 4; di-calcium phosphate, 3.87; D,L-methionine, 0.3; L-lysine, 0.25; sodium chloride, 0.51; premix, 1.

Table 2 Fatty acid profile of dietary fat source in broiler ration (%)

Fatty acid	Beef fat	Soybean oil	Krabok oil
10:0	0.0	0.0	1.8
12:0	0.00	0.0	44.4
14:0	2.0	0.2	43.7
16:0	19.8	12.9	4.5
16:1	0.9	0.1	0.6
18:0	38.1	4.6	0.4
18:1 n-9c	22.0	22.7	3.6
18:2 n-6c	0.8	53.1	0.5
18:3 n-6	0.4	0.0	0.0
18:3 n-3	0.3	3.6	0.0
20:0	0.4	1.4	0.0
20:1 n-9	0.4	1.1	0.0
MCT	0.0	0.2	89.9
SFA	63.0	19.3	95.0
MUFA	23.7	24.0	4.2
PUFA	1.6	56.7	0.5

ΣSFA = 8:0 + C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0 + C24:0; ΣMUFA = C14:1 + C15:1 + C16:1 + C18:1n-9 + C18:1n-7 + C20:1n-9; ΣPUFA = C18:2 n-6 + 18:3 n-6 + 18:3 n-3

Data collection and chemical analysis

At the end of trial (28 days of age), the birds were stunned and slaughtered at a local slaughterhouse. Five birds per treatment were randomly chosen for measurement of whole carcass composition (DM, CP, EE, ash and fatty acid composition) The experimental diets were analyzed for dry matter, ash, crude fat, crude fiber and crude protein (AOAC, 1975). The dietary fat sources were saponified and methylated according to the procedure of Metcalfe et al. (1966) followed by gas chromatography to determine fatty acid composition (Javadi et al., 2004).

Statistical analysis

Data were subjected to analysis of variance in completely randomized design (Steel and Torrie, 1980) by using the Microsoft Excel program (Windows xp®). Whole carcass composition of the broilers (10 replicates per treatment) were statistically analysed for group differences (Steel and Torrie, 1980). Statistical significance of differences between diets and feeding regimens were assessed using Duncan's multiple range test (Steel and Torrie, 1980).

III. RESULTS AND DISCUSSION

In keeping with earlier investigations (Keren-Zvi et al., 1990; Mossab et al., 2000; Wongsuthavas et al., 2007), dietary soybean oil versus tallow was found to significantly lower fat deposition, the lowering being 25 %.

Abdominal fat only is a small portion of total body fat in broiler chickens, whereas the effect of intake of PUFA instead of SFA had consistent effect on whole body fat was decreased (Crespo and Esteve-Garcia, 2002bc, 2003; Newman et al., 2002; Sanz et al., 2000b; Villaverde et al., 2006; Wongsuthavas et al., 2007).

Table 3 Dietary fat type on body composition

Items, %	Fat sources			Root-MSE	P-values
	BT	SBO	KO		
Water	73.89	72.38	74.27	1.3543	ns
Fat	15.01^{a}	13.07^{b}	15.07^{a}	1.9613	**
Protein[1]	51.81^{b}	62.09^{a}	52.24^{b}	2.9449	**
Ash	9.72^{b}	11.04^{a}	9.40^{b}	0.9461	**

^{abc}Values in the same row with the different superscripts differ; [1]by dry weight

Alternatively, another mechanism, such as inhibition of *de-novo* fatty acid synthesis induced by high intakes of PUFA (Zheng et al., 2006; Ide et al., 1996; Clarke et al., 1976), is responsible for the observed reduction of carcass fat in the chickens fed the diets rich in soybean oil.

Table 4 Fatty acid composition in whole carcass

Fatty acids (%)	Fat sources			Root-MSE	P-values
	BT	SBO	KO		
MCT	1.15[b]	1.01[b]	16.98[a]	0.43372	**
SFA	38.11[a]	30.74[b]	39.27[a]	5.03736	**
MUFA	44.74[a]	41.18[b]	31.67[c]	5.67979	**
PUFA	16.00[b]	27.07[a]	12.08[c]	2.17854	**

[abc]Values in the same row with the different superscripts differ; MCT = medium chain triacylglycerol; SFA = saturated fatty acid; MUFA = monounsaturated fatty acid; PUFA = polyunsaturated fatty acid

Body water content was not significantly changed by diet ($P<0.05$) (Table 3). However, the fat content of whole carcass was decreased in birds fed the diet rich in PUFA instead of SFA and MCT ($P<0.01$). Moreover, protein, and ash content were enhanced in PUFA diet when compared with SFA and MCT diets ($P<0.01$).
As would be expected, the chickens fed the diets rich in soybean oil deposited more PUFA or those fed on diets rich in beef tallow and karbok oil had deposited more SFA and MCT, respectively ($P<0.01$). Similar data have been shown for mice (Javadi et al., 2004) (Table 4). So that, carcass fatty acid deposition went hand in hand with fatty acid in diets.

IV. CONCLUSION

This experiment could be concluded that dietary soybean oil versus tallow lowered whole body fat deposition. The krabok oil instead of tallow in diet did not affect the percentage of whole body fat, which would lead to rejection of our hypothesis. The amount of whole body fat deposition was reduced significantly when replaced by soybean oil. So that PUFA from soybean oil could beneficially for consumer and farmers to improve life and carcass qualities, respectively.

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