FATTY ACID COMPOSITION OF BODY BROILER LIPIDS FEED DIFFERENT LEVELS OF DIETARY CHÌA SEEDS (*Salvia hispanica*)

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Introduction

Epidemiological evidence has indicated that increased consumption of long chain n-3 polyunsaturated fatty acids (PUFA n-3) is associated with a reduce risk of cardiovascular disease (CVD) and all-cause of mortality (Din et al., 2004). High blood eicosapentaenoic (EPA) and docosahexanoic (DHA) acids levels was associated with a 70% lower risk of fatal ischemic heart disease (IHD) in older adults (Lemaitre el al. 2003). There is also an increasing evidence that an imbalance between n-6 and n-3 fatty acids is a major risk factor for several diseases. Polyunsaturated fatty acids n-6 and n-3 compete for the same enzymes but have different biological roles, hence a correct balance between them is of considerable importance (FAO, 1994). Considering the very low intakes EPA and DHA in many population there is interest in producing n-3 PUFA poultry meats via altered feeding (flax-seed, fish oils, etc). Chicken lipids are a good source of essential n-6 fatty acids for human but generally have low amounts of PUFA n-3 and a high n-6/n-3 fatty acid ratio (Garcia & Casal 1999). Chia (*Salvia Hispanica*) seeds have 35.6% of oil content and a high percentages of linolenic acid (18:3 n-3) (Ayerza, 1995).

This study was conducted to determine the effects of feeding chia seeds on cholesterol, fat content and fatty acid composition of broiler breast lipids.

Materials and Methods

A completely randomized design of 3 treatments, with 8 repetitions of 10 Ross male broiler chicks of each was used. The three treatments were isocaloric and isoproteic with the following characteristics: T1 Control, without the aggregate of chía seeds; T2 with the 5% of chía seeds and T3 with 10% of chía seeds. The treatments started on the 22[nd] days of age. On the day 50 the trial was ended and aliquot samples of breasts (B) without skin were used for lipid analysis. One breast aliquot sample were dried and extracted with boiling hexane to obtain % of intramuscular fat (IMF). In a second aliquot sample lipids were extracted according to Folch et al. (1957). Aliquot samples of the chloroform extract were used for fatty acids composition analysis and cholesterol determination. The methyl esters from fatty acids were analyzed by GLC with a 50 mm CP-SIL88 capillary column. Total cholesterol, after saponification, was evaluated with a colorimetric and enzymatic method (Biochemical System). The data was analyzed using a Lineal General Procedure (SAS, 1987).

Results & Discussion

The fatty acid composition is shown in Table 1. Saturated fatty acid percentages of C14:0, C16:0 and C18:0 were not affected significantly by the inclusion of chia seeds. Only a small difference in C16:0 in T2 compared with T1 and T3 was detected. MUFA C16:1 and C18:1 were higher in T1 compared with T2 and T3. The decrease could be related to the inhibition of PUFA against delta 9 desaturase activity, preventing the formation of oleic and palmitoleic acids from their precursors. The effects of chia on n-6 PUFA were variable: C18:2 was similar in all the treatments, C20:4 was significantly higher ($p<0.05$) in T1 compared to T2 and T3 and. C22:4 decreased as the amount of chia in the diet increased. The effects on n-3 PUFA were important. C18:3 increased linearly as the amount of chia in the diet increased, C20:5 and C22:6 increased also significantly ($p<0.05$) but within certain limits. These finding are in agreement with other studies that have indicated a limited capacity of broilers to desaturate and elongate linolenic acid from plant origen. The n-3 long chain EPA (20:5 n-3) and DHA (22:6 n-3) are the most effectives compared with C18:3 n-3.

The percentages of intramuscular fat, cholesterol and fatty acid composition of breast lipids are shown in Table 2. % IMF was higher in T2 than in T1 and T3. The cholesterol content seems to be more related to the intramuscular fat content than to the diet composition.

Addition of 5% of chia had no significant effects on SFA, decreased MUFA and increased PUFA. Additon of 10% of CHIA decreased SFA and MUFA and increased PUFA (Table 2). The effect of chia seed affected significantly the n-6/n-3 ratio. Current evidence points to a ratio of 5:1 to 4:1 being optimal (British Nutrition Foundation, 1999). As the chia seeds increased from 5 to 10% the n-6/n-3 ratio decreased no significantly ($p<0.05$) . When the ratio n-6:n-3 is above 5:1 the effectiveness of linolenic acid to be converted to EPA and DHA is further reduced (Bivins et al. 1985). Chia seeds improved the P/S on line with the 1:1 ratio recommended (American Heart Association, 1991)

Table 1. Fatty acid composition (%) of broiler breast lipids in the three treatments.

Fatty acid	T1 Control	T2 5% chia	T3 10% chia
C14:0	0.86±0.05 a	0.75±0.08 a	0.76±0.16 a
C14:1+C15:0	0.20±0.01 a	0.23±0.03 a	0.22±0.03 a
C16:0	21.81±0.46 a	23.97±1.12 b	21.32±1.31 a
C16:1	4.82±0.74 a	3.81±0.64 b	3.64±0.26 b
C18:0	6.45±1.08 a	6.79±1.01 a	6.14±0.27 a
C18:1	36.45±0.54 a	35.11±1.06 a	32.94±118 b
C18:2 n-6	20.37±0.96 a	19.16±1.32 a	21.32±1.70 a
C18:3 n-3	1.76±0.35 a	6.73±0.11 b	9.26±1.68 c
C20:3 n-6	0.39±0.04 a	0.37±0.08 a	0.36±0.05 a
C20:4 n-4	2.79±0.95 a	1.88±0.08 b	1.75±0.62 b
C20:5 n-5	0.10±0.02 a	0.65±0.09 b	0.68±0.06 b
C22:4 n-6	0.56±0.02 a	0.31±0.06 b	0.19±0.02 c
C22:5 n-3	Tr	Tr	Tr
C22:6 n-3	Tr	0.86±0.08 a	1.01±0.10 a

a b c : Means in the same row without a common letter differ significantly ($p<0.05$)

Table 2. Intramuscular fat (IMF%), cholesterol (mg/100g) and nutritional ratios of broiler breast lipids in the three treatments.

Item	T1 Control	T2 5% chia	T3 10% chia
IMF%	1.65±0.62 a	2.23±0.62 b	1.26±0.33 a
Cholesterol	44±2.43 a	53±5.13 b	44±0.80 a
SFA %	31.12±1.03 a	30.51±1.68 a	28.21±1.61 b
MUFA %	41.27±1.65 a	38.91±0.88 b	36.57±1.26 c
PUFA %	25.58±1.27 a	28.72±1.04 ab	33.19±3.03 b
P/S	0.82±0.03 a	0.94±0.02 a	1.18±0.14 b
n-6 %	23.72±0.97 a	21.34±1.01 b	23.26±1.36 a
n-3 %	1.86±0.35 a	7.38±0.09 b	9.93±1.68 c
n-6/n-3	13.04±2.19 a	2.89±0.12 b	2.38±0.30 b

SFA (C14:0+C16:0+C18:0). MUFA (C16:1+C18:1). n-6 (C18:2+C20:3+C20:4+C22:4)
n-3 (C18:3+C20:5+C22:5+C22:6). PUFA (n-6+n-3)
a b c : Means in the same row without a common letter differ significantly ($p<0.05$)

Conclusion

Inclusion of chia seeds to poultry diets significantly ($p<0.05$) increased the ALA content and lowered the n-6/n-3 fatty acid ratio in breast broiler lipids. Chia seeds also improved the P/S on line with the 1:1 ratio recommended (American Heart Association, 1991). The moderate effect on EPA and DHA affects the importance of ALA from plant seed as a strategy for increase EPA and DPA in poultry lipids.

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