

Transfer of dietary fatty acids from butyric acid fortified canola oil into the meat of broilers

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ABSTRACT - The literature reported positive beneficial effects of butyric acid and canola oil on production performance traits of broiler chickens. Three hundred hybrid Ross 708 (150 males and 150 females) were randomly allotted to 10 pens per treatment with 5 males and 5 females per pen. Ten pens were administered a diet supplemented with soybean oil (control), ten pens the same basal diet but supplemented with a blend of mono-, di-, tri-glyceride of butyric acid added to soybean oil (T1) and ten pens the same basal diet supplemented with a mix of soybean and canola oil containing butyrate (T2). No differences in final body weight, dressing percentage, liver and thigh weight were found between groups. The T2 birds showed the highest feed/gain ratio ($P < 0.05$). The control group showed the highest value for breast weight while the highest quantity of abdominal fat was in T2 carcasses. Fatty acid profile was significantly influenced by the presence of oil supplements, not only quantitatively but also qualitatively.

Key words: Fatty acid, Canola oil, Glycerides, Broilers feeding.

Introduction - Jøsefiak *et al.* (2004) in a recent review paper acknowledge short chain fatty acid (SCFA) as potent factors inhibiting pathogenic bacteria. Van Immerseel *et al.* (2004; 2005) succeeded in controlling *Salmonella enteritidis* in challenged birds using SCFA as a feed additive. Isolauri *et al.* (2004) attributed to SCFA a growth promoting effect on the beneficial intestinal microflora. Amongst SCFA, butyric acid (BA) is considered the prime energy source to enterocytes and it is also necessary for the correct development of the gut associated lymphoid tissue (GALT) (Friedman *et al.*, 2005). Moreover, Leeson *et al.* (2005) and Antongiovanni *et al.* (2007) reported positive beneficial effects of BA on production performance traits of broiler chickens. All these beneficial actions of BA in particular, make it a fatty acid deserving scientific and technical attention as a feed additive. Canola oil (CO) is very high in the monounsaturated oleic acid (OA, 18:1 cis9); it contains considerable amounts of linoleic (LA) and α -linoleic (LNA) acids, the precursors of $\omega 6$ and $\omega 3$ fatty acids and is poor of saturated fatty acid. Together with supplying energy, the addition of fat to animal diets improves the absorption of fat-soluble vitamins, increases diet palatability and the efficiency of utilization of energy. Aim of the present trial was to test the effects of the inclusion of butyric acid (BA) either as mono-, di-, tri-glyceride or as butyric acid enriched canola oil, in the diet of broiler chickens.

Material and methods - Three hundred hybrid Ross 708 (150 males and 150 females) were purchased one-day-old and vaccinated for coccidiosis and Marek's disease. The chicks were randomly allotted to 30 pens with 10 birds per pen. Feed and water were provided *ad libitum*. Lighting program was 24 hours throughout the whole trial, lasting 5 weeks. The scheduled periods are: i) 0-14 days, starter period; ii) 15-28 days, grower period; iii) 29-35 days, finisher period.

The diets were based on maize, soybean meal 48 and soybean oil, adequately supplemented with vitamins and minerals, with decreasing crude protein and increasing metabolizable energy (Table 1).

The experimental protocol was designed in 3 theses: i) the control diet, supplemented with 5.3% soybean oil (SO) all the time; ii) thesis 1 (T1), supplemented with SO and mixture of mono-, di- and tri butyric glycerides (BG) (5.1% SO+0.2% BG in the starter diet and 5.25% SO+0.05 BG later on); iii) thesis 2 (T2), supplemented with SO and CO, enriched with BA (ECO) (5.3% ECO in the starter diet and SO+1.3% ECO later on). ECO was obtained by introducing BA into the Sn1 position of natural glycerides of a blend of SO and CO (1:1). The resulting profile was: (BA 6 g/100 g lipids; OA 50 g/100 g lipids; LA 30 g/100 g lipids; LNA 7 g/100 g lipids).

Fatty acids profile of soybean oil was characterized by the presence of OA (21.7 g/100 g lipids), LA (53.1 g/100 g lipids) and LNA (7.4 g/100 g lipids). During the trial, the following measurements were recorded weekly: weight gain, feed intake, mortality. At the end of the trial, the birds were slaughtered and the following measurements were made: dressing out percentage, breast weight, thigh and drumstick weight, abdominal fat weight, liver weight. Samples of thigh and drumstick from twenty birds per treatments, chosen at random, were analysed by GC.

Results and conclusions - Data related to the whole period (0-35 day) showed that all treatments were characterized by comparable body weights but the feed conversion (FC) of T1 resulted slightly higher, but still good (Table 2).

Table 1. Ingredients and nutrient composition of basal diets (kg/100 kg).

Ingredients	starter	grower	finisher
Maize	52.25	55.20	56.44
Soybean meal	37.90	35.55	34.80
Oil supplementation	5.30	5.30	5.30
Vitamin-mineral supplement	4.05	3.65	3.30
Lysine HCl	0.25	0.10	-
DL Methionine	0.25	0.20	0.16
Crude protein %	22.00	21.00	20.00
ME poultry, kcal/kg	2958	2998	3032
Ca %	1	0.88	0.82
P available %	0.42	0.39	0.35

Table 2. Final body weight, FC whole period and mortality.

	Diet C	Diet T1	Diet T2	SE
Final body weight,g	2238.63	2113.46	2170.21	52.1
FC whole period	1.71a	1.79b	1.71a	0.02
Mortality,%	4	2	1	-

a, b: $P < 0.05$.

No differences in dressing percentage, in liver and thigh weight were found between groups; the control group showed the highest value ($P < 0.05$) for breast weight while the highest quantity of abdominal fat was in T2 carcass (Table 3). The fatty acid profile was significantly influenced by the presence of oil supplements (Table 4), not only quantitatively but also qualitatively. In fact, canola oil, rich in OA, induced an increase of this nutraceutical fatty acid in meat. However, the most representative acids in meats, besides the OA, were LA and LNA. The highest percentage of LA was reached with the highest inclusion of SO in the diet (control diet). An increase of saturated fatty acids percentage was showed by T1 treatment. In particular, the harmful C14 decreased significantly with BG and canola oil.

No great differences were found in the performance traits

Table 3. Major carcass traits of slaughtered birds.

Diet	Dressing, %	Breast, g	Thigh, g	Liver, g	Abdominal fat, g
Control	85.21	442.29a	458.40	41.60	26.40a
T1	84.75	370.00b	451.60	40.86	24.28a
T2	84.12	367.43b	451.10	43.43	33.50b
SEM	0.56	6.03	7.78	1.36	2.03

a, b: $P < 0.05$.

Table 4. Fatty acid composition (g/100 g lipids).

Acid	Diet C	Diet T1	Diet T2	SE
C14	0.41A	0.38B	0.35C	0.01
C16	16.44A	18.39B	17.70C	0.02
C16:1	1.85A	2.54B	2.28C	0.01
C17	0.26A	0.22Ba	0.18Bb	0.01
C17:1	0.17A	0.20B	0.15A	0.02
C18	5.64A	5.99B	5.38C	0.05
C18:1 cis9	24.20A	23.08A	28.95B	0.07
C18:2 n-6 cis	32.04A	30.03B	26.80C	0.08
C18:3 n-6	2.89A	2.62Ba	2.59Bb	0.02

A,B $P < 0.01$; a, b $P < 0.05$.

of broiler chickens, only a worse feed/gain ratio for T1 ($P < 0.05$) and lighter breasts ($P < 0.05$) for both T1 and T2. More interesting results concerned the meat fatty acid profile. The incorporation of unsaturated fatty acid in meat lipids was directly related to the presence of these fatty acid in the diet. Since it appears desirable to produce meats for human consumption naturally enriched of nutraceutical fatty acids, the present study confirmed the high performance of canola oil, good provides of oleic acid.

REFERENCES – **Antongiovanni M.**, Buccioni, A., Petacchi, F., Leeson, S., Minieri, S., Martini, A., Cecchi, A., 2007. Butyric acid glycerides in diet of boiler chickens: effects on gut histology and carcass composition. *Ital. J. Anim. Sci.* 6:19-27. **Friedman, A.**, Bar-shira, E., 2005. Effect of nutrition on development of immune competence in chickens gut associated lymphoid system. *Proc. 15th Eur. Symp. on Poultry Nutrition.* Wpsa, Balatonfuured, Hungary, 234-242. **Isolauri, E.**, Salminen, S., Ouwehand, A.C., 2004. Probiotics. *Best pract. Res. Cl. Ga.* 18:299 313. **Jósefiak, D.**, Rutkowski, A., Martin., S.A., 2004. Carbohydrate fermentation in the avian ceca: a review. *Anim. Feed Sci. Technol.* 113:1-15. **Leeson, S.**, Namkung, H., Antongiovanni, M., Lee, E.H., 2005. Effect of butyric acid on the performance and carcass yield of broiler chickens. *Poultry Sci.* 84:1418-1422. **Van Immerseel, F.**, Fievez, V., De Buck, J., Pasmans, F., Martel, A., Haesebrouck, F., Ducatelle, R., 2004. Microencapsulated short-chain fatty acids in fee modify colonization and invasion early after infection with salmonella enteritidis in young chickens. *Poultry Sci.* 83:69-74. **Van Immerseel, F.**, Boyen, F., Gantois, I., Timbermont, L., Bohez, L., Pasmans, F., Haesebrouck, F., Ducatelle, R., 2005. Supplementation of coated butyric acid in the feed reduces colonization and shedding of salmonella in poultry. *Poultry Sci.* 84: 1851- 1856.