INFLUENCE OF DIETARY ACETYLSALICYLIC ACID ON ABDOMINAL FAT DEPOSITION AND PERFORMANCE OF BROILER CHICKS FED HIGH AND LOW FAT DIETS*

CASSIO XAVIER DE MENDONÇA JUNIOR
Professor Adjunto
Faculdade de Medicina Veterinária e Zootecnia da USP

MARIA AMELIA ZOGNO SILVA
Biologista
Faculdade de Medicina Veterinária e Zootecnia da USP

JULIO CEZAR ALVAREZ
Médico-Veterinário
Anderson Clayton S.A. indústria e Comércio

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SUMMARY: One hundred fifty day-old Hybro male broiler chicks were fed from hatching to 3 weeks of age 2 isonitrogenous and isocaloric experimental diets. 75 birds were fed a high fat diet (HF) and the other half was fed a low fat diet (LF). Sixty birds of each treatment were assigned to 4 pens and fed 4 diets (HF, LF, HFA, LFA) from 21 to 42 days. The HFA and LFA diets were formulated to contain 1 g aspirin per kg of diet. All the diets used were isocaloric and isonitrogenous. Chicks fed HF diets had a body weight greater than those fed LF diets, but the difference was significant only at 3 weeks of age. Percent abdominal fat was significantly lower for the LF diet at 6 but not 3 weeks of age. A significant decrease in percent abdominal fat and increase in plasma glucose were obtained with aspirin. Growth rate, feed efficiency or feed intake were not significantly depressed in birds fed diet containing aspirin from 21 to 42 days of age.

UNITERMS: Acetylsalicylic acid; Abdominal fat; Dietary fat; Broiler chicks performance

INTRODUCTION

The deposition of fat in broiler chicks, especially in the abdominal region, has been responsible for economical and energetic wastes in the processing plant and for the poultry meat consumers.

It has been demonstrated that obesity in birds is influenced by nutritional, genetic, environmental and physiological factors (McLEOD, 12, 1982). This last factor undoubtedly plays a major role in the regulation of lipid metabolism. Several hormones including glucagon, growth hormone, catecholamines, cortisol, and corticotropin have been reported to enhance the release of nonesterified fatty acids from adipose tissue. Besides, glucagon has been considered a glucogenic hormone (SCHADE et alii, 15, 1979). A decrease in blood glucose stimulates glucagon secretion and, conversely, a rise in blood glucose is a potent inhibitor of glucagon secretion (LEFEBVRE, 10, 1975). Avian adipose tissue is extremely sensitive to glucagon, while dog or human adipose tissue responds only under centain experimental conditions (LEFEBVRE, 10, 1975). Glucagon's lipolytic activity has not always been observed in vivo because the insulinogenic effects of glucagon may obscure this activity (SCHADE et alii, 15, 1979). LEFEBVRE, 10 (1975) has pointed out that this lipolytic action is inhibited by insulin in most animal species but not in birds, whose glucacon's effect is particularly potent. However, the glucagon-induced lipolysis is markedly reduced by prostaglandin E as a result of its inhibitory effect on cyclic AMP formation (GRANDE & PRIGGE, 7, 1972; LEFEBVRE, 10, 1975). LIKOFF et alii, 11 (1981) have shown that aspirin acted synergistically with vitamin E inhibiting the prostaglandin synthesis. Aspirin would inhibit the enzime cyclo-oxygenase, which would be essential for prostaglandin E biosynthesis and therefore could release the glucagon to stimulate lipolysis in the adipose tissue, resulting in less deposition of carcass fat.

BRENES & JENSEN, 2 (1982) have found an abdominal fat reduction in the older chickens fed a high level of aspirin (2g/kg) that was associated with a marked growth depression. Also working with high level of aspirin (1.6 g/kg), PROUDFOOT & HULAN, 14 (1983) reported a reduction in body weight.

The present study took place at the Universidade de São Paulo, São Paulo, Brazil and was designed to evaluate the effect of added aspirin (1g/kg) on performance and abdominal fat deposition of male broiler chicks fed high and low fat diets.

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A report of these data was made at the ANNUAL MEETING OF THE POULTRY SCIENCE ASSOCIATION, 1985. Ames, Iowa, USA.

MATERIALS AND METHODS

One hundred fifty day-old male broiler chicks were placed at randon in battery brooders and fed ad libitum the experimental diets. Seventy five birds were fed a high fat diet (HF) and the other half was fed a low fat diet (LF) from hatching to 3 weeks of age. Feed and body weight data were recorded at 3 weeks of age. At the end of this period, fifteen birds per treatment were randomly euthanized for removal of the abdominal fat pad. The livers were also removed and weighed. Abdominal fat pad was considered to be that fat surrounding the gizzard and intestines, extending within the ischium and surrounding the bursa of Fabricius and cloaca.

The sixty remained birds of each treatment were then assigned randomly to 4 pens with 15 birds per pen and fed 4 experimental diets (Table 1) from 21 to 42 days. The HFA and the LFA diets were formulated to contain 1g aspirin/kg of diet. All the diets used were isocaloric and isonitrogenous.

At the end of the experiment, feed consumption and body weight were recorded and heparinized blood samples were obtained by cardiac puncture from all the birds for determination of glucose. The birds were killed by cervical dislocation and livers and abdominal fat pads were removed and weighed.

Glucose was analyzed spectrophotometrically by the O-toluidine method (DUBOWSKI, 4, 1962). Results were analyzed statistically using analysis of variance (SNEDECOR & COCHRAN, 17, 1967) and Duncan's multiple range test (DUNCAN, 5, 1955).

Table 1 Diet composition (%)

Diet * / Ingredient	HF	LF	HFA	LFA
Yellow corn	36.72	58.40	36.72	58.40
Soybean meal (45%)	39.98	38.00	39.98	38.00
Corn gluten meal (60%)	1.57	0.28	1.57	0.28
Soybean oil	7.00	-	7.00	-
Kaolin	11.42	0.12	11.42	0.12
Limestone	0.70	0.60	0.70	0.60
Dicalcium phosphate	1.97	1.91	1.97	1.91
Salt	0.25	0.25	0.25	0.25
L-Lysine	-	0.03	-	0.03
Vitamin and mineral mix [a]	0.40	0.40	0.40	0.40
Acetylsalicylic acid	-	-	0.10	0.10
Calculated analysis				
Crude protein (%)	22.3	22.3	22.3	22.3
ME (kcal/kg)	2870	2870	2870	2870
Fat (%)	9.1	2.8	9.1	2.8
Methionine + cystine	0.82	0.82	0.82	0.82

* HF: High fat diet; LF: Low fat diet; HFA: High fat diet plus aspirin; LFA: Low fat diet plus aspirin

[a] Premix provides (per kg diet): 9000 IU vitamin A, 2250 IU vitamin D, 9 IU vitamin E, 4.5 mg menadione sodium bisulfite, 200 mg choline chloride, 4.5 mg riboflavin, 10.5 mg calcium d-pantothenate, 36 mg niacin, 10 ug vitamin B12, 1.25 g DL-methionine, 125 mg ethoxyquin, 65 mg manganese, 40 mg zinc, 60 mg iron, 4 mg copper, 1 mg iodine, 0.2 mg cobalt, 100 ug selenium

RESULTS AND DISCUSSION

Dietary fat

The effect of dietary fat on body weight, feed intake, abdominal fat and liver weight during the first 3 weeks of the experiment is shown in Table 2. Chicks fed the diet containing 7% of fat (HF) had a body weight significantly greater than those fed low fat diet (LF). This is in agreement with the observations of JENSEN et alii, 8 (1970), FULLER & RENDON, 6 (1977) and ATTEH et alii, 1 (1983) who

found that energy from fat is more efficiently utilized for growth than that from carbohydrates. At 3 weeks of age, in the present study, abdominal fat was not significantly affected by addition of fat in the diet. However, high level of fat significantly decreased liver weight (gram and as percent of body weight) of birds.

TABLE 2 - Effect of dietary fat on body weight (BW), feed intake, abdominal fat and liver weight at 3 weeks of age.

Diets (0-3 Wks)	Body weight (g)	Feed intake 0-3 Wks (g/chick)	Abdominal fat (g)	Abdominal fat (%BW)	Liver weight (g)	Liver weight (%BW)
H F	691 a*	909	8.3 a	1.2 a	16.3 a	2.4 a
L F	661 b	877	7.6 a	1.1 a	18.1 b	2.7 b

* Means within a column followed by a different superscript differ significantly ($P \leq 0.05$) by Duncan's test

At 6 weeks of age there was no difference in body weight, body weight gain, and feed efficiency between chicks fed the HF diet and those fed the LF diet (Table 3). In addition, feed intake was insignificantly greater in birds fed HF diet.

Table 3 . Effect of dietary fat on body weight, body weight gain, feed intake and feed efficiency at 6 weeks of age.

Diets (3-6 Wks)	Body weight (g)	BW gain 3-6 Wks (g)	Feed intake 3-6 Wks (g/chick)	Feed efficiency 3-6 Wks
H F	1778 a*	1104 a	2337 a	2.1 a
L F	1758 a	1077 a	2246 b	2.1 a

* Mean values in a column with different superscripts are significantly different ($P \leq 0.05$).

As shown in Table 4, the HF diet determined significantly higher values of abdominal fat pad (expressed either as gram or as percent of body weight) than those in birds fed the LF diet. These observations coincide with those reported by DEATON et alii, 3 (1981) who showed that increasing the level of fat in an isocaloric and isonitrogenous diet resulted in increased abdominal fat deposition. However, LAURIN et alii, 9 (1985) have reported no significant effect of two isocaloric diets differing in dietary fat level (2% or 9%) on carcass ether-extract. Our results also indicated a significant difference between diets in liver weight expressed as gram.

TABLE 4 - Effect of dietary fat on abdominal fat and liver weight at 6 weeks of age.

Diets (3-6 Wks)	Abdominal fat (g)	Abdominal fat (%BW)	Liver weight (g)	Liver weight (%BW)
H F	28.5 a*	1.6 a	33.4 a	1.8 a
L F	22.8 b	1.3 b	31.7 b	1.9 a

* Means within each column followed by a different superscript differ significantly ($P \leq 0.05$).

Dietary aspirin

The data presented in Table 5 indicate that growth rate, feed intake and feed efficiency were not significantly depressed in birds fed the diet containing aspirin level of 1000 mg/kg from 21 to 42 days of age. In contrast, BRENES & JENSEN, 2 (1982) and PROUDFOOT & HULAN, 14 (1983) reported a growth depression in chicks fed higher level of acetylsalicylic acid.

TABLE 5 - Effect of aspirin on body weight, body weight gain, feed intake and efficiency at 6 weeks of age.

Diets (3-6 Wks)	Body weight (g)	BW gain 3-6 Wks (g)	Feed intake 3-6 Wks (g/click)	Feed efficiency 3-6 Wks
Aspirin added	1763 a*	1082 a	2277 a	2.1 a
No Aspirin addes	1773 a	1098 a	2306 a	2.1 a

* Means within each column followed by a different superscript differ significantly ($P \leq 0.05$).

The effect of aspirin on abdominal fat, liver weight and plasma glucose at 6 weeks of age is presented in Table 6. Birds fed diets containing aspirin showed a significant reduction in abdominal fat deposition, expressed either as gram or as percent of body weight.

TABLE 6 - Effect of aspirin on abdominal fat, liver weight and plasma glucose at 6 weeks of age.

Diets (3-6 Wks)	Abdominal fat (g)	Abdominal fat (%BW)	Liver weight (g)	Liver weight (%BW)	Plasma glucose (mg%)
Aspirin added	22.8[a*]	1.3[a]	31.8[a]	1.8[a]	212.7[a]
No Aspirin added	28.5[b]	1.6[b]	33.2[a]	1.9[a]	181.9[b]

* Means within each column followed by a different superscript differ significantly ($P \leq 0.05$).

These results agree in part with those reported by BRENES & JENSEN, 2 (1982) who observed a reduction in abdominal fat deposition in birds fed, from 52 to 66 days of age, a high level (2g/kg) of aspirin. The authors conclude that the acetylsalicylic acid would not be effective in reducing fat deposition since it would be associated with a marked depression in growth rate. This type of effect was not observed in the current research. Our results indicate a reduction in the accumulation of abdominal fat without a concomitant reduction in body weight gain that is extremely advantageous.

Plasma glucose was significantly increased by including aspirin in the diets (Table 6). Since glucagon is a glucogenic hormone and its release is increased by the inhibitory effect of aspirin on prostaglandin E synthesis, an enhance of the plasma glucose level must be expected. These data are consistent with studies reported by SMITH 16 (1955) demonstrating that salicylates cause a hyperglycemic effect in rats. According to this author, hyperglycaemia would be a secondary phenomenon. The administration of salicylate would cause an increased secretion of adrenaline which would cause an increased liver glycogenolysis (SMITH, 16, 1955). Our results are in contrast to BRENES & JENSEN, 2 (1982) who showed that plasma glucose was not affected by the addition of aspirin into the diet. In humans, MICOSSI et alii, 13 (1978) observed that moderates doses of aspirin lowered serun glucose in normal subjects.

The analysis of variance presented in Table 7 indicates that no significant effects of dietary level of fat at the first age period (0-3 wks) on abdominal fat were observed. There was a significant ($P < .005$) effect of fat level in the diet during the second age period (3-6 wks) and added aspirin on fat deposition at 6 weeks of age. On the other hand, the level of fat during the 0-3 week age period significantly ($P < .005$) affected the liver weight at 6 weeks of age. Also a significant ($P < .005$) interaction was observed for level of fat during the 0-3 week age period (I) and aspirin (A) in terms of liver weight.

Table 7 - Analysis of variance of abdominal fat and liver weight at 6 weeks of age.

Source of Variation	Abdominal fat (g)	Abdominal fat (%BW)	Liver weight (g)	Liver weight (%BW)
Level of fat 0-3wks(I)	NS	NS	P< .005	P< .005
Level of fat 3-6wks(II)	P< .005	P< .005	P< .05	NS
Aspirin (A)	P< .005	P< .005	NS	NS
I x II	NS	NS	NS	NS
I x A	NS	NS	P< .005	P< .005
II x A	NS	NS	NS	NS
I x II x A	NS	NS	NS	NS

NS - Not Significant

Data obtained in this study suggest that glucagon has been released by an indirect effect of aspirin on prostaglandin E biosynthesis, showing a marked influence on abdominal fat reduction that is in agreement with LEFEBVRE, 10 (1975) who has reported a potent lipolytic effect of glucagon for avian species.

The results of this study indicate that aspirin may be used in the diet at the level of 1000 mg/kg to reduce abdominal fat deposition in chicks from 21 to 42 days of age, without depressing growth rate, feed efficiency or feed intake. However, further studies need to be done using a larger number of birds to confirm the results found in the present research.

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MENDONÇA JUNIOR, C.X.; SILVA, M.A.Z.; ALVAREZ, J.C. Influência do ácido acetilsalicílico dietético sobre a deposição de gordura abdominal e desempenho de frangos de corte alimentados com dietas de alta e baixa gordura. Rev.Fac.Med.Vet. Zootec.Univ.S.Paulo, 24(1):75-81, 1987.

RESUMO: 150 pintos de um dia, machos, da linhagem comercial Hybro, foram submetidos, do nascimento até 3 semanas de idade, a 2 dietas experimentais. 75 aves receberam ração contendo elevado nível de gordura (HF) e as demais foram alimentadas com dietas sem suplementação de gordura (LF). De 3 a 6 semanas de idade, as aves foram alimentadas com as mesmas rações, adicionadas ou não de 0,1% de ácido acetilsalicílico (HF, LF, HFA e LFA). Todas as dietas utilizadas eram isocalóricas e isoproteicas. Os pintos submetidos às rações de alto teor lipídico (HF) apresentaram peso corporal mais elevado, tanto às 3 como às 6 semanas de idade, porém as diferenças mostraram-se significativas apenas na 3a. semana. A porcentagem de gordura abdominal foi significativamente maior para as aves dos lotes de alta gordura, apenas às 6 semanas de idade. A inclusão de aspirina (1 g/kg) às rações propiciou diminuição significativa nos níveis de gordura abdominal e aumento do percentual de glicose sanguínea. A taxa de crescimento, a conversão e o consumo alimentares não foram significantemente reduzidos nas aves alimentadas com dieta contendo ácido acetilsalicílico, de 21 a 42 dias de idade.

UNITERMOS: Ácido acetilsalicílico; Gordura abdominal; Gordura alimentar; Frangos de corte, desempenho

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