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Effect of *Garcinia cambogia* Leaf Meal Supplementation Level at Finisher Stage on Productivity and Juiciness of Male Ross 308 Broiler Chickens

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ABSTRACT

Two experiments were conducted to evaluate the effects of *Garcinia cambogia* leaf meal supplementation levels at finisher stage on productivity and juiciness of male Ross 308 broiler chickens. The design of the experiments was a completely randomised design. The first experiment examined the effect of level of *Garcinia cambogia* leaf meal supplementation at finisher stage (29 to 42 days of age) on productivity and carcass characteristics of male Ross 308 broiler chickens. Level of *Garcinia cambogia* leaf supplementation had no effect ($p>0.05$) on feed intake, growth rate, feed conversion ratio, live weight, blood glucose, blood urea and carcass characteristics of male broiler chickens. However, daily supplementation with 300 mg of *Garcinia cambogia* leaf meal per kg DM feed reduced ($p<0.05$) fat pad weight by 18.75% in broiler chickens. This could not be explained in terms of differences in feed intake, digestibility, or growth rate. The second experiment examined the effect of *Garcinia cambogia* leaf meal supplementation interval on juiciness of Ross 308 broiler chickens. *Garcinia cambogia* leaf meal supplementation interval had no effect ($p>0.05$) on meat flavour of male Ross 308 broiler chicken meat. However, daily supplementation with 300 mg of *Garcinia cambogia* leaf meal reduced ($p<0.05$) juiciness of male Ross 308 broiler chicken meat by 40%.

Key words: Hydroxycitric acid, carbohydrates, obesity, meat quality, glycogen stores

INTRODUCTION

Continuous attempts to increase growth rate of meat-type chickens in poultry industry have been accompanied by excessive fatness which is not desired by most of consumers (Aho, 2001; Oyedeji and Atteh, 2005) mainly because coronary heart diseases and arteriosclerosis are strongly related to the dietary intake of cholesterol. Saturated fatty acids and are among the most important causes of human mortalities (Sacks, 2002). Currently, dietary recommendations favour the consumption of less saturated fat (Hrdinka *et al*., 1996). This brings to question the importance of meat quality. According to Wrick (1995), the expectation of the consumer for meat is that it should be healthy, rich in protein, low in fat, tender and have a typical flavour. For this reason, an increase in the production of lean broiler chicken meat as well as reduction in juiciness

would be of direct nutritional benefit to the consumers. Hence, in this regard, appetite control in poultry could be of importance in reducing fat deposition. *Garcinia cambogia* a plant native to Southeast Asia containing hydroxycitric acid (HCA) as the primary acid in the fruit rind has been shown to be active in suppressing appetite and body fat accumulation in experimental animals (Vasselli *et al*., 1998; Ishihara *et al*., 2000; Ohia *et al*., 2002; Shara *et al*., 2003). Therefore, it may be of value to supplement male Ross 308 broiler chickens with HCA-containing *Garcinia cambogia leaf meal* as an appetite suppressing supplement to reduce fatness as well as juiciness of poultry meat thereby leading to improved meat quality. However, the use of *Garcinia cambogia leaf meal* for reducing fatness and improving juiciness of broiler chickens meat is not known. Such information would be very beneficial to poultry farmers in South Africa and elsewhere. The main objective of this study was, therefore, to determine the effect of *Garcinia cambogia* leaf meal supplementation level on productivity and juiciness of male Ross 308 broiler chickens.

MATERIALS AND METHODS

Study location: This study was conducted at the University of Limpopo Experimental farm at Syferkuil. The experiment was conducted during the summer period with temperatures ranging between 20 and 32°C.

Experimental procedure, dietary treatments and design

Experiment 1: The first experiment determined the effect of *Garcinia cambogia* leaf meal supplementation level at finisher stage on productivity and carcass characteristics of male Ross 308 broiler chickens. A total of 90 male Ross 308 broiler chickens were used in this experiment. The chickens were raised up to 28 days old before the experiment commenced. The experiment was terminated when the chickens were 42 days old. Feed and water were offered as *ad libitum* throughout the experiment. *Garcinia cambogia* leaf meal was given as a feed supplement each morning by 8.00 hours. At the age of 29 days, the chickens were randomly allocated to 6 dietary treatments with five replications, each having 3 birds. Thus, 30 floor pens (1.5 m^2 per pen) were used in total. The chickens were fed a grower diet supplemented with 0 mg (G_0), 200 mg (G_{200}), 300 mg (G_{300}), 400 mg (G_{400}), 500 mg (G_{500}) or 600 mg (G_{600}) of *Garcinia cambogia* leaf meal /bird/day (Table 1). A completely randomized design was used for the experiment (SAS, 2008).

Experiment 2: The second experiment was done after the first one and it determined the effect of *Garcinia cambogia* leaf meal supplementation interval at finisher stage on juiciness of Ross 308 broiler chickens. A total of 90 Ross 308 male broiler chickens were used in a completely randomized design. Chickens were fed either a grower diet without *Garcinia cambogia* leaf meal supplementation (G_0D_0); grower diet with 300 mg of *Garcinia cambogia* leaf meal/bird supplemented daily for 14 days ($G_{300}D_{18}$). Therefore, the experiment had 2 treatments replicated 5 times, resulting in a total of 10 floor pens of 9 birds each. At 29 days of age, chickens were randomly allocated to the 2 treatments.

Data collection: The initial live weights of the birds were taken at the start of the experiment. Average live weight per bird was measured at weekly intervals by weighing the chickens in each pen and the total live weight was divided by the total number of birds in the pen to get the average live weight of the chickens. These live weights were used to calculate growth rate. Feed conversion ratio per pen was calculated as total feed consumed divided by the weight of live birds plus the

Table 1: Nutrient composition of the grower diet

	Treatment					
Nutrients	G_0	G_{200}	G_{300}	G_{400}	G_{500}	G_{600}
Dry matter (g kg^{-1} feed)	940	940	940	940	940	940
Energy (MJ kg^{-1} DM)	13.78	13.74	13.74	13.74	13.74	13.74
Protein (g kg^{-1} DM)	158.2	158.2	158.2	158.2	158.2	158.2
Garcinia cambogia (mg kg^{-1} DM)	0	200	300	400	500	600
Lysine (g kg^{-1} DM)	11.5	11.5	11.5	11.5	11.5	11.5
Fat (g kg^{-1} DM)	25	25	25	25	25	25
Calcium (g kg^{-1} DM)	10	10	10	10	10	10
Phosphorus (g kg^{-1} DM)	5.5	5.5	5.5	5.5	5.5	5.5

Treatment: The chickens were fed a grower diet supplemented with 0 mg (G_0), 200 mg (G_{200}), 300 mg (G_{300}), 400 mg (G_{400}), 500 mg (G_{500}) or 600 mg (G_{600}) of *Garcinia cambogia* leaf meal /bird/day

weight of birds in the pen at the start of the experiment. Digestibility was done between ages of 36 and 42 days. Digestibility was conducted in specially designed metabolic cages with dimensions of 60×50 cm and a 1×1 cm wire mesh bottom having separated watering and feeding troughs. Two birds were randomly selected from each replicate and transferred to metabolic cages for the measurement of apparent digestibility. A three-day acclimatization period was allowed prior to a three-day collection period. Droppings voided by each bird were collected on a daily basis at 09.00 h. Care was taken to avoid contamination from feathers, scales, debris and feeds. Apparent digestibility was calculated as follows:

$$\text{Apparent digestibility} = \frac{(\text{Amount of nutrient ingested} - \text{amount of nutrient excreted})}{(\text{Amount of nutrient ingested})}$$

At 42 days of age, all remaining birds per pen were slaughtered by cervical dislocation to determine carcass characteristics. Carcass parts and abdominal fat were weighed. Fat surrounding the gizzard and intestines extending to the bursa were considered as abdominal fat (Mendonca and Jenesen, 1989). At the end of each slaughtering, meat samples from each breast meat part of the slaughtered bird were taken and stored in the refrigerator until analyzed for dry matter and nitrogen according to the method described by AOAC (2002).

The grower diet was bought from a milling company, NTK in Polokwane, South Africa. The nutrient contents were determined as explained in Table 1. Garcinia cambogia, a pumpkin-shaped fruit, grows in the wild in India and Southeast Asia. It has a chemical structure rather similar to citric acid. It is also known as the malabar tamarind and is widely used as a condiment in Indian and Asian curry dishes. The extract of the fruit used for weight loss is known as hydroxycitric acid, or HCA, and is meant to suppress appetite and enhance fat-burning, in a similar way to Hoodia and Guarana.

Nutrient analysis: Dry matter and nitrogen contents of the diets, refusal and faeces were determined. Feeds, feed refusals and excreta samples were also analyzed for ash by placing the samples in the furnace at 300°C for 48 h. Glucose and urea content of the blood were also determined. Analyses of isoberberine alkaloid in *Garcinia cambogia* leaf meal and lysine, fat, calcium and phosphorus diets were determined by (LATS University of Limpopo South Africa). The

gross energy of the diets and excreta samples was determined using an adiabatic bomb calorimeter (LATS University of Limpopo, South Africa). The apparent metabolisable energy (ME) contents of the diets were calculated. Apparent metabolisable energy was equal to energy in the feed consumed minus energy excreted in the faeces and all analyses were done according to the methods described by AOAC (2002). Nitrogen retention was calculated as intake nitrogen multiplied by digestibility nitrogen. Dressing percentage was determined using the following formula:

$$\text{Dressing percentage} = \frac{\text{Carcass}}{\text{Live weight}} \times 100$$

Sensory evaluation: Sensory evaluation compared chickens from treatments G_0 and G_{300}. The meat was cut into 5 cm pieces. These pieces were baked for 30 min in a stove oven set at 105°C. The meat was then evaluated for its flavour and juiciness preference using 32 panellists to rank each part on a 3-point ranking scale. The flavour was divided into: 1- no flavour, 2-some flavour and 3- good flavour. Juiciness was divided into: 1-extremely dry, 2-dry and 3-moist.

Statistical analysis: Data on feed intake, digestibility, growth rate, feed conversion ratio, fat pads and other carcass characteristics of male Ross 308 broiler chickens were analyzed using the General Linear Model (GLM) procedure of the statistical analysis of variance. Where there was a significant F-test ($p<0.05$), Duncan test for multiple comparisons was used to test the significance of differences between treatment means (SAS, 2008). The dose-related responses in feed intake, feed conversion ratio, live weight, growth rate, carcass weight and other carcass characteristics to level of *Garcinia cambogia* leaf meal supplementation were modelled using the following quadratic equation:

$$Y = a + b_1x + b_2x^2$$

where, Y = optimum feed intake, feed conversion ratio, live weight, growth rate, carcass weight, breast meat, heart, liver or abdominal fat; a = intercept; b = coefficients of the quadratic equation; x = *Garcinia cambogia* meal level of supplementation and $-b_1/2b_2$ = x value for optimum response. The quadratic model was fitted to the experimental data by means of the NLIN procedure of SAS (2008).

RESULTS

Level of *Garcinia cambogia* leaf meal supplementation had no effect ($p>0.05$) on production parameters of feed intake, intake as a percentage of live weight, apparent metabolisable energy, nitrogen retention, growth rate, feed conversion ratio and live weight of male Ross 308 broiler chickens between 29 and 42 days of age. Level of *Garcinia cambogia* leaf meal supplementation had no effect ($p>0.05$) on carcass weight, breast meat, heart, liver, dressing percentage, breast meat nitrogen content, blood glucose, blood urea of male Ross 308 broiler chickens at 42 days old except abdominal fat pad weight (Table 2). Daily supplementation with 300 mg of *Garcinia cambogia* leaf meal reduced ($p<0.05$) abdominal fat pad weight by 18.75% in male Ross 308 broiler chickens. A quadratic model was fitted to the data where $Y = 24.274+0.005x -0.00000833x^2$, $r^2 = 0.052$. Minimum abdominal fat pad weight was achieved at an optimum supplementation of 287 mg/bird/day (Fig. 1).

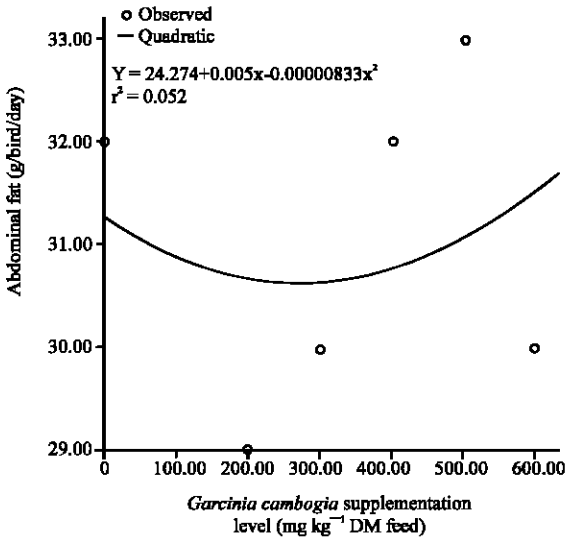

Fig. 1: Effect of *Garcinia cambogia* leaf meal supplementation level on optimal abdominal fat weight of male Ross 308 broiler chickens at days 42 of age

Table 2: Effect of *Garcinia cambogia* leaf meal supplementation level on carcass characteristics, blood glucose and blood urea of male Ross 308 broiler chickens at 42 days of age

	Supplementation level						
Variable	G_0	G_{200}	G_{300}	G_{400}	G_{500}	G_{600}	SE
Carcass weight (g bird^{-1})	1180	1174	1169	1153	1224	1099	75.2
Breast meat (g bird^{-1})	377	367	362	345	398	321	24.1
Heart (g bird^{-1})	11	9	10	9	11	9	0.8
Liver (g bird^{-1})	36	35	34	31	34	31	2.1
Abdominal fat (g bird^{-1})	32^{a}	29^{a}	26^{b}	33^{a}	33^{a}	30^{a}	4.2
Dressing (%)	63	63	63	62	63	63	2.5
Breast meat nitrogen (%)	31	31	29	31	31	31	0.30
Blood glucose (mmol L^{-1})	11.2	12.1	11.5	11.9	12.3	12.3	0.81
Blood urea (mmol L^{-1})	0.23	0.35	0.35	0.42	0.20	0.18	0.09

^{a,b}Means in the same row not sharing a common superscripts are significantly different ($p<0.05$); SE: Standard error

Table 3: Effect of *Garcinia cambogia* leaf meal supplementation level (mg kg^{-1} Dm feed) on male Ross 308 broiler chicken meat flavour and juiciness

	Supplementation level		
Variable	G_0	G_{300}	SE
Flavour	1.8	2.8	0.30
Juiciess	3.0^{a}	1.8^{b}	0.26

^{a,b}Means in the same row not sharing a common superscripts are significantly different ($p<0.05$); SE: Standard error

Garcinia cambogia leaf meal supplementation interval had no effect ($p>0.05$) on meat flavour of male Ross 308 broiler chicken meat. However, daily supplementation with 300 mg of *Garcinia cambogia* leaf meal reduced ($p<0.05$) juiciness of male Ross 308 broiler chicken meat by 40% (Table 3).

DISCUSSION

This study showed that *Garcinia cambogia* leaf meal supplementation had no effect on feed intake. These findings suggest that feed intake of the birds is, first and foremost, independent of the *Garcinia cambogia* leaf meal supplementary levels used in the present study and hence birds attempt, as a priority, to adjust their feed intakes according to their nutrient requirements. Although, it has been shown that HCA- containing *Garcinia cambogia* is active in suppressing appetite in experimental animals (Vasselli *et al*., 1998; Ishihara *et al*., 2000; Ohia *et al*., 2002; Shara *et al*., 2003), male Ross 308 broiler chickens however, tended to behave differently in this respect. Thus, one possible consequence of the limitations of the birds might be the loss of sensitivity to regulate feed intake according to *Garcinia cambogia* leaf meal supplementary levels as observed in the present study. The physiological explanation for the present observation is not clear and merits further investigation. However, as suggested by Shara *et al*. (2003) hydroxycitric acid reduces the amount of carbohydrates being converted to fat, and as such more carbohydrates will be stored as glycogen within the muscles which results in more glycogen storage. Hence, it is possible that such transient changes in glycogen storage level do not appear to alter feed intake in chickens. The present finding is different from the findings of Saito *et al*. (2004) who observed that *Garcinia cambogia* leaf meal supplementation reduced feed intake in rats. In the present study, *Garcinia cambogia* had no effect on intake as a percentage of live weight, apparent metabolisable energy, nitrogen retention, growth rate, feed conversion ratio and live weight of male Ross 308 broiler chickens between 29 and 42 days of age. These results may be explained in terms of similarities in feed intakes, irrespective of the treatment. However, results of the present study are different from the findings of Saito *et al*. (2004) who observed that supplementation with *Garcinia cambogia* leaf meal reduced weight gains and lives weight of rats.

Daily supplementation with 300 mg of *Garcinia cambogia* leaf meal in the first and second experiment reduced fat pad weight by 18.75% and juiciness by 40% in male Ross 308 broiler chickens, respectively. However, quadratic regression analysis indicated that the lowest amount of fat pad would be achieved at a *Garcinia cambogia* supplementation level of 287 mg/bird/day. The reduction in fat pad was achieved without any significant reduction in feed intake because similar feed intakes were observed in all of the treatment groups. The physiological explanation for this effect is not clear and merits further investigation. However, it is known that *Garcinia cambogia* meal supplementation reduces the amount of carbohydrates that are converted to body fat (Shara *et al*., 2003) and blocks the enzyme ATP-citrate lyase which acts as a key building block for fat synthesis. Thus, because hydroxycitric acid reduces the amount of carbohydrates being converted to fat, more carbohydrates will be stored as glycogen within the muscles which results in more glycogen storage (Shara *et al*., 2003). Such transient changes in glycogen storage level do not appear to alter feed intake in chickens. As such, fad pad deposition in the present study may have been reduced irrespective of feed intake. Therefore, it appears from the result obtained herein that birds would likely benefit practically from HCA derived from *Garcinia cambogia* in terms of suppression of body fat accumulation and as such help to increase demand by consumers. Daily supplementation with 300 mg of *Garcinia cambogia* meal per kg DM feed reduced juiciness of male Ross 308 broiler chicken meat by 40%. This value is higher than the 18.75% reduction in fat pad weight. Thus, this might suggest that HCA derived from *Garcinia cambogia* might be more effective in promoting reduction in juiciness of poultry meat than fatness. However, since this is

the first published report of reduction of juiciness in male Ross 308 broiler chicken meat of HCA-containing *Garcinia cambogia*, we do not currently know which of the constituents of this preparation is responsible for the reduction. The present findings is different from the findings of Wasker *et al.* (2009) who observed no differences in juiciness of microwave cooked boiler chicken fillets supplemented with herbal toxin binder product. No similar study in chickens was found in the study.

CONCLUSION

Garcinia cambogia meal supplementation had no effect on productive parameters of feed intake and growth rate of male Ross 308 broiler chickens. However, chickens given a daily supplement of 300 mg of *Garcinia cambogia* meal had a lower fat pad weight than un-supplemented ones. This could not be explained in terms of differences in feed intake or growth rates. In addition, daily supplementation with 300 mg of *Garcinia cambogia* meal per kg DM feed reduced juiciness of male Ross 308 broiler chicken meat by 40%. More research is required to explore the biochemical reasons for a reduction in chicken fat pad weights and juiciness following HCA-containing *Garcinia cambogia* leaf meal supplementation.

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