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# EFFECT OF USING CINNAMON POWDER AS NATURAL FEED ADDITIVE ON PERFORMANCE AND CARCASS QUALITY OF BROILER CHICKS

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## ABSTRACT

The effect of feeding broiler chicks on diets containing different levels of cinnamon powder as natural feed additive on productive performance, carcass characteristics and economical efficiency were studied. A total of two hundred one-day old, unsexed (Habbard) broiler chicks were randomly divided into four experimental groups. Each group was further subdivided into five replicates at the rate of ten chicks per pen in complete randomized design. The birds were fed on two basal diets (starter and finisher diets). The cinnamon powder (*Cinnamomumverum*) was added to the basal diets at level (0.0, 3.0, 5.0 and 7.0%) resulting in four formulae respectively to group A, B, C and D with group A serving as control group. The experimental diets were fed for 6-weeks duration. Health of the stock and performance parameters were recorded. At the end of the experiment, the birds were slaughtered, dressed then used for different parameters and economical evaluation were calculated. The results showed that, the diet with 5.0% cinnamon powder had significantly ($P<0.05$) heaviest body weight gain, highest feed intake, best feed conversion ratio, highest dressing percentage with the highest percentage of commercial cuts (breast, drumstick and thigh). In addition to, the inclusion of cinnamon powder in broiler diets showed significantly ($P<0.05$) the higher flavour scores for breast and thigh meat and higher liver and gizzard percentages as compared to control diet. The birds feed with the control diet produced significantly ($P<0.05$) highest abdominal fat percentage. The mortality rate was not significantly ($P>0.05$) affected by the addition of cinnamon powder to broiler diets. The highest profitability ratio (1.28) was obtained by the diet with 5.0% cinnamon powder in broiler diet.

**Keywords:** broiler chicks, Cinnamon powder, broiler diets, carcass quality, natural feed additive

## INTRODUCTION

Aromatic plants have been used worldwide for centuries as food and for medical purposes. Various biological activities, such as antioxidative (Botsoglou *et al*., 2002; Giannenas *et al*., 2005; Florou-Paneri *et al*., 2006), anticoccidial (Christaki *et al*., 2004; Florou-Paneri *et al*., 2006) or antimicrobial (Govaris *et al*., 2007; Botsoglou *et al*., 2010) properties have been identified in these plants. Consequently, an increasing interest in the use of these products in poultry nutrition has been experienced especially since the complete ban by the European Union countries in 2006 (Eu, 2005) on the use of antibiotics as growth promoters in animals.

Cinnamon (*Cinnamomumverum*) is herb commonly used as spice in human food and has received considerable attention as additive in poultry nutrition. Cinnamon is obtained from several trees from the genus cinnamomum that is used in both sweet and savory human foods. In addition to giving flavour to foods, cinnamaldehyde which is the predominant compound of cinnamon, and it presents antimicrobial and antioxidant activity (Lee *et al*., 2004; Faix *et al*., 2009). According to Al-Kassie (2009), the use of cinnamon extract improves feed efficiency and performance of broilers due to substances such as cinnamaldehyde and eugenol. Cinnamon extract inhibits *Helicobacter pylori* at the concentration range of common antibiotics, its antimicrobial properties are mainly related to its cinnamaldehyde content, followed by eugenol and carvacrol contents (Taback e*t al*., 1999). Cinnamon oil and its constituents (cinnamaldehyde

and eugenol) have antibacterial activity against *E. coli*, *Salmonella* sp. And *Parahemolyticus* (Change *et al*., 2001).

The aim of this study was to gain more information about the effect of using cinnamon powder as natural feed additive on productive performance and carcass quality of broiler chicks.

## MATERIALS AND METHODS

A total of two hundred one-day old unsexed (Habbard) broiler chicks were randomly distributed into 4 groups of 50 chicks. Each group was further subdivided into 5 replicates with 10 chicks per each. The chicks of each replicate were housed in a pen (1 square meter) in an open-sided deep litter house. The cinnamon (*Cinnamomumverum*) was purchased from local market and grounded to fine powder then added to basal diets at the levels (0.0, 3.0, 5.0 and 7.0%) resulting in four formulae respectively to group A, B, C and D with group A serving as control group. All the experimental diets were formulated to meet the nutrient requirements of broiler chicks according to NRC (1994) which was formulated from the local feed ingredients commonly used for poultry feeding in the Sudan. The experimental diets were fed for 6-weeks duration with two phases of feeding program involved in supplying starter (1-21 days of age) and finisher (22-42 days of age). Calculated analysis of the experimental basal diets was done according to feedstuff analysis outlined by Ellis (1981), while determined chemical analysis was conducted by the method of AOAC (1995). Formulation and proximate analysis and calculated analysis for the experimental basal diets are shown in Tables 1 and 2 respectively, while chemical composition of the super concentrate used in the basal diets is shown in Table 3. Feed and water were offered ad-libitum. The light was continuous throughout the experimental period. The performance of the experimental birds in term of feed intake, live weight gain and feed conversion ratio were recorded weekly. Health of the experimental stock and mortality rate were closely observed and recorded daily. At the end of the 6$^{th}$ week, the experimental birds were individually weighed after overnight fast (except for water) then slaughtered without stunning. They were then scalded, manually plucked, washed and allowed to drain on wooden tables. Evisceration was performed by a ventral cut and visceral as well as thoracic organs were removed. After evisceration, internal organs (heart, liver and gizzard) were removed, weighed individually and expressed as percentage of slaughtered weight. Eviscerated carcasses were weighed and then chilled in a refrigerator for 24 hours at 4$^{o}$C. Cold carcasses were recorded.

**Table (1): Formulation and proximate analysis of the experimental basal diets (percent as fed)**

| Ingredients (%) | Diet | |
|---|---|---|
| | Starter | Finisher |
| **A: Formulation:** | | |
| Grain sorghum | 53.00 | 65.00 |
| Wheat bran | 7.00 | 5.00 |
| Groundnut meal | 12.00 | 11.00 |
| Sesame meal | 18.00 | 9.00 |
| Super concentrate | 5.00 | 5.00 |
| Oyster shell | 2.75 | 2.75 |
| Common salt | 0.25 | 0.25 |
| Vegetable oil (corn) | 2.00 | 2.00 |
| Total | 100 | 100 |
| **B: Determined analysis** | | |
| Dry matter | 97.00 | 95.00 |
| Crude protein (N% x 6.25) | 23.28 | 20.00 |
| Ether extract | 5.59 | 6.78 |
| Crude fibre | 6.46 | 5.40 |
| Ash | 10.49 | 8.74 |
| Nitrogen free-extract | 50.18 | 53.71 |

**Table (2): Calculated analysis of the experimental diets on dry matter basis (DM)**

| Item | Diet | |
|---|---|---|
| | Starter | Finisher |
| Metabolizable energy (Kcal/kg) | 2940 | 3027 |
| Crude fat | 7.91 | 6.57 |
| Crude protein | 23.12 | 20.09 |
| Lysine | 1.13 | 1.03 |
| Methionine | 0.53 | 0.44 |
| Cystine | 0.36 | 0.29 |
| Methionine + cystine | 0.89 | 0.73 |
| Calcium | 1.14 | 0.97 |
| Available phosphorus | 0.73 | 0.65 |
| Caloric-protein ratio | 127 | 151 |
| ME Kcal/kg: protein % | | |

Metabolizable energy: calculated according to Ellis (1981)

**Table (3): Chemical composition of the super concentrate used in the experimental diets formulation (Hendrix broiler concentrate)**

| | |
|---|---|
| Metabolizable energy | 1900 (Kcal/kg) |
| Crude protein | 32.00% |
| Lysine | 11.00% |
| Methionine | 2.80% |
| Methionine + cystine | 2.25% |
| Calcium | 8.00% |
| Available phosphorus | 5.00% |

All the slaughtered birds were used for dissection. The breast, thigh and drumstick of the left side of each carcass were dislocated, weighed and expressed as percentage of cold carcass weight. Taste panel was done for broiler's breast and thigh meat after wrapped individually in aluminum foil, and roasted in an electric oven at 175$^{o}$C for 90 minutes. Ten taste panelists were used to score colour, flavour, tenderness and juiciness of the meat, according to the guidelines of Cross *et al*. (1978). Statistical analyses were made by analysis of variance for a completely randomized design, according to Steel and Torrie (1986).

**RESULTS**

The effect of feeding different levels of cinnamon powder on broiler's performance is shown in Table (4). Final body weight, body weight gain, total feed intake and feed conversion ratio were significantly ($P<0.05$) affected by different level of cinnamon powder. Generally the inclusion of cinnamon powder in the experimental diets improved significantly ($P<0.05$) the broiler's performance. The diet with 5% level of cinnamon powder showed significantly ($P<0.05$) heaviest final body weight and body weight gain, highest total feed intake with the best feed conversion ratio in the comparison with the other experimental diets. The experimental treatments had no significant ($P>0.05$) effect on the mortality rate.

**Table (4): The effect of feeding different levels of cinnamon powder on performance of broiler chicks (1-42 days)**

| Parameter | A | B | C | D | SEM |
|---|---|---|---|---|---|
| Initial live weight (g/chick) | 45.18 | 45.13 | 45.37 | 45.01 | - |
| Final live weight (g/chick) | 1851.11$^{c}$ | 1950.01$^{b}$ | 2096.11$^{a}$ | 1981.20$^{b}$ | 9.74 |
| Body weigh gain (g/chick) | 1805.93$^{c}$ | 1920.91$^{b}$ | 2050.74$^{a}$ | 1936.19$^{b}$ | 9.60 |
| Total feed intake (g/chick) | 3611.86$^{c}$ | 3726.56$^{b}$ | 3937.42$^{a}$ | 3775.57$^{b}$ | 9.66 |
| Feed conversion ratio | 2.00$^{a}$ | 1.94$^{b}$ | 1.92$^{c}$ | 1.95$^{b}$ | 0.006 |
| Mortality % | 1.00 | 1.00 | 1.00 | 1.00 | 0.001$^{NS}$ |

A: Control (without cinnamon powder)
B: 3.0% cinnamon powder
C: 5.0% cinnamon powder
D: 7.0% cinnamon powder
SEM: Standard error of the mean
N.S. Not statistically significant (P>0.05)
Means on the same raw with the same superscripts are not significantly different (P>0.05).

Table 5 shows the effect of feeding different levels of cinnamon powder on carcass characteristic of the broilers. All the measured parameters were significantly (P<0.05) affected by the different levels of cinnamon powder. The inclusion of cinnamon powder in the broiler diets significantly (P<0.05) improved the dressing percentages and commercial cuts percentages (breast, drumstick and thigh) in comparison with the control diet. Birds fed with 5.0% level of cinnamon powder gave significantly (P<0.05) the highest of these values.

**Table (5): Means values for the dressing carcass percentages and commercial cut of broiler carcasses**

| Parameters | A | B | C | D | SEM |
|---|---|---|---|---|---|
| Hot dressing percentages | 68.22$^{c}$ | 69.70$^{b}$ | 70.02$^{a}$ | 69.75$^{b}$ | 0.16 |
| Cold dressing percentage | 67.92$^{c}$ | 68.60$^{b}$ | 69.03$^{a}$ | 68.63$^{b}$ | 0.13 |
| Breast as % of cold carcass | 24.05$^{c}$ | 25.48$^{b}$ | 26.62$^{a}$ | 25.50$^{b}$ | 1.33 |
| Drumstick as % of cold carcass | 14.32$^{c}$ | 15.70$^{b}$ | 16.11$^{a}$ | 15.72$^{b}$ | 0.30 |
| Thigh as % of cold carcass | 15.31$^{c}$ | 16.56$^{b}$ | 17.85$^{a}$ | 16.65$^{b}$ | 0.02 |

Table 6 shows the effect of feeding different levels of cinnamon powder on non-carcass components as the percentage of body weight. All the measured parameters were significantly (P<0.05) affected by the addition of cinnamon powder to broiler diets with the exception of the heart percentage which was insignificant. Generally, the inclusion of cinnamon powder in broiler diet increasing the liver and gizzard percentages and decreased the abdominal fat percentage. The highest abdominal fat percentage was significantly (P<0.05) recorded by the control diet.

**Table 6: Body weight and organ proportions of broiler chickens**

| Parameters | A | B | C | D | SEM |
|---|---|---|---|---|---|
| Final body weight (g/chick) | 1851.11$^{c}$ | 1950.01$^{b}$ | 2096.11$^{a}$ | 1981.20$^{b}$ | 9.74 |
| Abdominal fat as % of body weight | 2.24$^{a}$ | 1.95$^{b}$ | 1.92$^{b}$ | 1.94$^{b}$ | 0.016 |
| Liver as % of body weight | 2.00$^{b}$ | 2.72$^{a}$ | 2.75$^{a}$ | 2.73$^{a}$ | 0.01 |
| Heart as % of body weight | 0.53 | 0.55 | 0.56 | 0.56 | 0.012$^{NS}$ |
| Gizzard as % of body weight | 2.15$^{b}$ | 2.83$^{a}$ | 2.85$^{a}$ | 2.84$^{a}$ | 0.013 |

Table 7 shows the effect of dietary treatment on subjective scores for breast and thigh of broiler meat. All the measured scores (tenderness, juiciness and colour) were insignificantly affected by the inclusion of

cinnamon powder in broiler diet with the exception of flavour which was significant (P<0.05). Bird fed with cinnamon powder showed significantly (P<0.05) the highest flavour scores for both breast and thigh meat in comparison with the control group.

**Table 7: Subjective scores for the breast and thigh of broiler meat**

| Parameters | A | B | C | D | SEM |
|---|---|---|---|---|---|
| **Tenderness** | | | | | |
| Thigh | 5.65 | 5.64 | 5.60 | 5.63 | $0.03^{Ns}$ |
| Breast | 5.58 | 5.52 | 5.51 | 5.51 | $0.03^{NS}$ |
| **Juiciness** | | | | | |
| Thigh | 5.56 | 5.61 | 5.60 | 5.62 | $0.03^{NS}$ |
| Breast | 5.57 | 5.53 | 5.50 | 5.52 | $0.02^{NS}$ |
| **Flavour** | | | | | |
| Thigh | $5.55^{b}$ | $6.63^{a}$ | $6.71^{a}$ | $6.65^{a}$ | 0.13 |
| Breast | $5.56^{b}$ | $6.57^{a}$ | $6.83^{a}$ | $6.60^{a}$ | 0.12 |
| **Colour** | | | | | |
| Thigh | 5.26 | 5.42 | 5.50 | 5.43 | $0.03^{NS}$ |
| Breast | 5.30 | 5.25 | 5.40 | 5.30 | $0.02^{NS}$ |

Table 8 shows calculation of total cost, revenues and net profit for the experimental groups. The results obtained from the economic study indicated that, treatment (c) with 5.0% cinnamon powder showed the highest profitability ratio (1.28) in comparison with the control group.

**Table 8: Total cost, revenues and net profit of broiler chicks fed on different levels of cinnamon powder**

| Item | A | B | C | D |
|---|---|---|---|---|
| **Cost (SDG)** | | | | |
| Chick purchase | 6.0 | 6.0 | 6.0 | 6.0 |
| Management | 4.0 | 4.0 | 4.0 | 4.0 |
| Feed | 11.20 | 11.90 | 12.30 | 12.50 |
| Total cost | 21.40 | 21.90 | 22.30 | 22.50 |
| **Revenues** | | | | |
| Average eviscerated carcass weight (kg) | 1.26 | 1.35 | 1.46 | 1.38 |
| Price (SDG/kg) | 23.00 | 23.00 | 23.00 | 23.00 |
| Total revenues | 28.98 | 31.05 | 33.58 | 31.78 |
| **Net profit** | | | | |
| Total revenues | 28.98 | 31.05 | 33.58 | 31.74 |
| Total cost | 21.40 | 21.90 | 22.30 | 22.50 |
| Net profit/bird | 7.58 | 9.15 | 11.28 | 9.24 |
| Net profit/kg meat | 6.01 | 6.77 | 7.72 | 6.69 |
| Profitability ratio/kg meat | 1 | 1.12 | 1.28 | 1.11 |

Total cost calculated according to 2014 a current (2014) price of meat 23 (SDG)/kg

## DISCUSSION

The effect of feeding different levels of cinnamon powder on productive performance of broilers is shown in Table 4. Treatment effect on final body weight, body weight gain, total feed intake and feed conversion ratio was significant (P<0.05). The inclusion of cinnamon powder in diet of broilers significantly (P<0.05) enhanced the body weight and the body weight gain in comparison with control group. The diet with 5.0% level of cinnamon powder showed significantly (P<0.05) heaviest final body weight and body weight gain compared with control diet, while there was no significant difference between the diets with

3.0% and 7.0% cinnamon powder. The improvement in body weight gain of broiler fed with cinnamon powder may be due to the active materials such as cinnamaledhyde in cinnamon which was considered as digestion stimulating factor. Cinnamon extracts have been reported to stimulate the poultry digestive system and improve liver function and digestive enzyme (Al-Kassie, 2009). It is also reported that some compounds of medical plants extracts such as cinnamaldehyde improve digestion in broilers through stimulating the secretion of salivary glands and increasing activity of pancreatic and intestinal mucosa enzymes (Taback *et al.*, 1999). This result was in line with the finding of Sang-oh *et al.* (2013) who reported that, the body weight of the cinnamon powder groups were increased significantly ($P<0.05$) when compared to the control group. The body weight of the 5.0% cinnamon group was significantly ($P<0.05$) higher than the other cinnamon groups, while there was no significant difference between the 3.0% and 7.0% cinnamon groups. Similar results were obtained by Jamroz and Kamel (2002) who stated that, broilers fed with a combination of herbal oils (capsaicin, carvacrol and cinnamaldehyde) showed higher body weight gain compared with the control group.

The feed intake significantly ($P<0.05$) tended to be higher for the birds fed with cinnamon powder diet in the comparison with the control diet. The diet with 5.0% level of cinnamon powder recorded significantly ($P<0.05$) the highest feed intake compared with the other experimental diet. The increase in feed intake for the birds fed on diet supplemented with cinnamon powder may be due to the fact that, there is an evidence to suggest that herbs, spices and various plant extracts have appetite and digestive stimulating properties (Kamel, 2001). This result was in line with the finding of Sang-oh *et al.* (2013) who reported that, the feed intake was slightly higher in cinnamon groups than in control group. Similarly, Al-Kassie (2009) mention that, the chicken fed with cinnamon had higher feed intake compared with the control treatment.

The feed conversion ratio was affected significantly ($P<0.05$) by the experimental diets. There was a significant ($P<0.05$) improvement in the feed conversion ratio for the birds fed on the diets which were supplemented with cinnamon powder in comparison with the control diet. The best feed conversion ratio was significantly ($P<0.05$) recorded by the diet with 5.0% level of cinnamon powder. The improvement of body weight and feed conversion ratio are due to the active materials (cinnamaldehyde and eugenol) found in cinnamon, causing greater efficiency in the utilization of feed, resulting in enhanced growth (Taback *et al.*, 1999). Moreover, the better feed conversion ratio may be attributed to the antibacterial activity of cinnamon powder in the broiler diets (Hernandez *et al.*, 2004; Valero and Salmeron, 2003; Dickens *et al.*, 2000; Ouattara *et al.*, 1997) which inhibit the growth of harmful bacteria including *E. coli* in the intestinal tract resulting in more nutrients are absorbed by the birds. Additionally, the beneficial antioxidant compounds of medical plants may have also a positive effect on nutrient uptake in terms of protection of the intestinal villi (Norajit *et al.*, 2007).

As shown in Table 5, the hot and cold dressing percentages were significantly ($P<0.05$) increased for birds fed on cinnamon powder based diets in comparison with the control diet. Birds fed with 5.0% cinnamon powder showed significantly ($P<0.05$) the highest hot and cold dressing percentages, although, the difference between diets 3.0% and 7.0% was insignificant. These results were inline with the finding of Sang-oh *et al.* (2013) who mention that, the dressing percentage was significantly ($P<0.05$) higher in the cinnamon powder groups than the control group. The highest levels were observed in the 5.0% cinnamon powder treatment groups, while no significant difference was observed between 3.0% and 7.0% cinnamon powder groups. Similar results were reported by Al-Kassie (2009) who reported that, the diet supplemented with oil extract derived from cinnamon (100 and 200 ppm) significantly ($P<0.05$) improved the dressing percentage in comparison with the control group. The addition of cinnamon powder to broiler diets significantly ($P<0.05$) increased the percentages of commercial cuts (breast, drumstick and thigh). The diet with 5.0% level cinnamon powder recorded the highest percentages of these values, while there was no significant difference between 3.0% and 7.0% cinnamon powder groups. These results were in agreement with those reported by Sang-oh *et al.* (2013) who found that, the thigh and breast muscle were significantly ($P<0.05$) higher in cinnamon powder groups than the control group.

As shown in Table 6 the inclusion of cinnamon powder in the broiler diets significantly ($P<0.05$) increased the liver and gizzard percentages and decreased the abdominal fat percentage compared to the

control diet. The reduction in the percentage of abdominal fat for the diets that supplemented with cinnamon powder may be due to the fact that, the addition of cinnamon powder to broiler diet increase the secretion of lipase and secondary bile acids. As a result, lower amount of fatty acid were accumulated in abdominal cavity because of high lipid metabolism due to lipase secretion. The result coincided with the finding of Najafi and Taherpour (2014) who stated that, the diets supplemented with 0.4% and 0.8% cinnamon powder significantly ($P<0.05$) decreased abdominal fat pad compared to the control diet. Moreover, the improvement of liver and gizzard percentages may be due to the fact that the inclusion of cinnamon powder in broiler diets could stimulate the digestive system in broilers, improve the function of liver and increase the pancreatic digestive enzymes. Enhancement of the metabolism of oil, carbohydrates and proteins in the major organs would increase growth rate of these organs (Langhout, 2000; Mellor, 2000a; 2000b).

As shown in Table 7 no significant differences were observed between all treatment groups in subjective meat quality attributes (colour, juiciness and tenderness) of the breast and thigh meat with exception of flavour. The diets supplemented with cinnamon powder recorded significantly ($P<0.05$) highest flavour score in comparison with control diet. The increase in the score of flavour of cinnamon powder groups could be due to the presence of essential oils of cinnamon powder in the muscle tissues of the meat. Cinnamaldehyde is the major essential oil contained in cinnamon, comprising 89.47% of cinnamon powder, 99.80% of water extract and 73.31% of ethanol extract (Kim and Kim, 2000).

As shown in Table 8, the economical evaluation of the experimental diets indicated that, the diet with 5.0% level cinnamon powder showed the highest profitability ratio (1.28) as compared to the control group. This might be due to the highest return of the weight gains recorded by this group of chicks.

It could be concluded that the incorporation of cinnamon powder in broiler diet as feed additive at 5.0% level significantly enhanced the productive performance and meat quality of broiler chicks.

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