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Effect of Dietary Supplementation of *Citrullus colocynthis* Seeds on Performance and Carcass Yield of Broiler Chickens

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Absract: An experiment was conducted to study the effect of *Citrullus colocynthis* seeds on the performance of broiler chickens, using diets containing four levels of *C. colocynthis* seed powder (0%, 2%, 4% and 6%). Three hundred sixty males one day of age chicks (Ross strain) were randomly allotted to four treatments with three replicates. All groups were fed *ad libitum* from one day to 49 days of age. Data were analyzed according to the completely randomized design, and Duncan's multiple range test was used for means comparison. Live body weight, carcass weight and dressing percentages significantly ($P \leq 0.05$) increased as the dietary level of *C. colocynthis* seeds increased. Feed intake, feed conversion ratio and abdominal fat pad weight significantly ($P \leq 0.05$) decreased as the dietary level of seed supplementation increased. The group fed on 6% had significantly ($P \leq 0.05$) the heaviest gastrointestinal weights (empty intestine, empty gizzard) and heart and liver weights. Therefore, *C. colocynthis* seeds can be added to broiler feeds up to 6% without adverse effects.

Key words: *Citrullus colocynthis*; broiler chickens; gastrointestinal tract; abdominal fat

INTODUCTION

Citrullus colocynthis, a member of the family Cucurbitaceae, grows as a wild perennial in desert regions of the world (Khan and Gul 1975). In Sudan, it is found throughout the plain of western, northern and central regions and used in traditional medicine as purgative and anthelmintics agents (Adam 1987). It is known locally as 'Handal'. The toxicity of five

Sudanese plant species credited with medicinal value for man, *C. colocynthis, Jatropha aceroides, Jatropha glauca, Solanum dubium* and *Lagenaria siceraria*, were studied by giving the dried or minced plants to Nubian goats, Desert sheep or Zebu calves (Barri *et al.* 1983). The clinical, haematological and pathological changes indicated that the five plant species reduced the ability of the liver to synthesize protein.

One hundred grammes of unprocessed seeds was reported (Sawaya *et al.*1983) to contain 556 kilo calories gross energy, 6.7 g H_2O, 23.6 g protein, 47.2 g fat, 19.5 g total carbohydrates, 1.5 g fibre, 3.0 g ash, 46 mg calcium, and 58 mg phosphorus. Linoleic acid was the dominant fatty acid (50.6%) followed by oleic (25%). Lysine, which is a limiting essential amino acid, has a chemical score of 65% of the total protein (Duke 1983). The seeds in particular are rich in lysine, methionine and cystine (5.5% of the protein), and the protein digestibility *in vitro* is 75.9%, compared with casein which is 95.0% (Sawaya *et al.* 1986). They added that chickens grow normally with up to 15% processed whole seeds in the diet, but using the unprocessed meal at the same level (15%) depressed growth and feed efficiency. Bakhiet and Adam (1995) showed that when feeding 7-day old Bovan egg-type chicks a ration supplemented with *C. colocynthis* seeds at 10% and 2% of the basal diet for six weeks, the average body weight and the efficiency of feed utilization are markedly depressed in the chicks fed on 10% *C. colocynthis*. Atole *et al*. (2009) concluded that *C. colocynthis* can be used at low levels as an anti diabetic drug without causing any toxic effect. *C. colocynthis* shows antibacterial and anticandidal properties and can be used as a broad-spectrum antimicrobial agent (Marzouk *et al*. 2009).

There is scarce information in the Sudan on the optimum level of *C. colocynthis* seeds in the broiler rations. Therefore, the objective of this experiment was to study the effect of *C. colocynthis* seed powder as a natural feed supplement on the performance of broiler chickens and to find out the best inclusion level.

MATERIALS AND METHODS

Preparation of the *C. colocynthis* seeds powder and the experimental rations

The seeds were brought from Elobied market. They were rinsed in running water for 24 hours, sun dried for 36 hours and ground by a local grinder. The powder was then added to broilers' ration at different levels (0%, 2%, 4% and 6%) to formulate the four experimental diets. Samples from the seeds powder and the different diets were analysed (proximate analysis) in the Nutrition laboratory of the Faculty of Animal Production, University of Khartoum (Table 1).

A total of 360 day old male broiler chicks (Ross strain) were weighed and divided randomly into twelve groups, each of 30 birds of the same average weight. The experimental diets were formulated according to the nutrient requirement for broiler chickens as stated by NRC (1994).

The experimental groups were randomly assigned to the four dietary treatments with three replicates. The chicks were fed on the starter mash diets from one day of age up to 21 day of age; they were then shifted to the finisher mash diets (Table 1) up to 49 day of age. During both phases of feeding, the birds were fed *ad-libitum* a balanced broiler diet not supplemented with *C. colocynthis* seeds (Control), a rate of 2% *C. colocynthis* seeds (CCS 2%), 4% (CCS 4%) and 6% (CCS 6%).
All the management programmes, including vaccination and medication, were properly executed.

Data collection

Feed intake was recorded daily, and the weekly intake was calculated for all subgroups. At the end of the experiment, the cumulative feed intake was calculated. All chickens from each subgroup were weighed weekly, and the average live body weight was obtained. Average feed conversion ratio for all subgroups was weekly calculated, on the basis of kilogrammes of feed consumed to one kilogramme body weight gain; also, the cumulative feed conversion ratio was determined. Six chickens with approximately average body weight were randomly selected from

each treatment and were slaughtered. Live body weight, carcass weight, head weight and shanks weight were recorded. The dressing percentage was calculated on the basis of hot carcass weight to live body weight. The internal organs weights were taken (empty gizzard, empty intestine, liver, heart and abdominal fat pad).

Statistical analysis

The collected data were subjected to analysis of variances, based on completely randomized design (Steel and Torrie 1980), and the differences between treatments means were examined by Duncan's multiple range test.

Table 1. Ingredients and chemical composition of starter and finisher diets supplemented with different levels of 'Handal' (*Citrullus colocynthis*) seeds

Ingredient	Starter				Finisher			
	CCS 0%	CCS 2%	CCS 4%	CCS 6%	CCS 0%	CCS 2%	CCS 4%	CCS 6%
Maize	30.0	30.0	30.0	30.0	29.0	28.5	28.0	27.5
Sorghum (Feterita)	27.0	26.0	25.0	24.0	26.0	26.0	26.0	26.0
Groundnut meal	30.0	29.5	29.0	28.5	27.0	26.0	25.0	24.0
C. colocynthis seed*	0.0	2.0	4.0	6.0	0.0	2.0	4.0	6.0
Wheat bran	4.0	4.0	4.0	4.0	7.0	7.0	7.0	7.0
Super concentrate**	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Groundnut oil	1.5	1.0	0.5	0.0	3.5	3.0	2.5	2.0
Oyster shell	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sand	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total	100	100	100	100	100	100	100	100

Table 1. Cont.

Ingredient	Starter				Finisher			
	CCS 0%	CCS 2%	CCS 4%	CCS 6%	CCS 0%	CCS 2%	CCS 4%	CCS 6%
Calculated chemical analysis								
Dry matter (%)	95.0	95.5	95.8	95.2	95.4	95.1	95.0	95.8
Crude protein (%)	22.0	21.5	21.7	21.5	20.8	20.5	20.2	20.4
Crude fibre (%)	4.8	4.6	4.8	4.6	4.9	4.7	4.8	4.7
Calcium (%)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Phosphorous available (%)	0.36	0.36	0.36	0.35	0.35	0.35	0.35	0.34
Ether extract (EE %)	4.9	5.0	5.1	5.2	7.6	7.6	7.8	7.8
Metabolisable energy ME kcal/kg***	3070	3041	3080	3060	3200	3180	3175	3166
Determined chemical analysis								
Dry matter (%)	93.6	93.5	93.7	93.9	94.6	94.8	95.0	95.1
Crude protein (%)	21.7	21.6	21.6	21.6	20.2	20.2	20.1	20.1
Crude fibre (%)	4.9	4.8	4.6	4.5	4.7	4.5	4.4	4.4
Ash (%)	2.7	2.6	2.8	2.7	2.8	2.8	2.7	2.7
Nitrogen free extract (%)	58.7	58.8	59.1	59.5	61.2	61.5	62.1	62.2
Ether extract (%)	5.6	5.7	5.6	5.6	5.7	5.8	5.7	5.7
Metabolisable energy ME kcal/kg***	3028	3035	3038	3040	3184	3179	3175	3172

* *C. colocynthis* seed contains: 15.2% CP, 5.3% CF, 26.4% EE, 48.1% NFE, 2.1% ash and 3160 ME kcal/kg.

** Super concentrate contains: 40% CP, 2% EE, 2% CF, 10% calcium, 4% available phosphorus, 12% lysine, 3% methionine and 3.2% methionine + cystine with added vitamins and minerals.

*** Metabolisable energy was calculated according to the formula derived by Lodhi *et al.* (1976). ME= 1.549 + 0.0102 CP + 0.0275 oil + 0.0148 NFE – 0.0034 fibre

RESULT S AND DISCUSSION

There were insignificant (P>0.05) differences in feed intake during the first three weeks (Table 2), but there was very slight reduction in feed consumed with increase in the level of *C. colocynthis* seeds. However, the control group consumed significantly (P≤ 0.05) the highest cumulative feed, whereas the group fed on the diet supplemented with 6% *C. colocynthis* seeds consumed significantly (P ≤ 0.05) the lowest feed. This may be attributed to the bitter taste of seeds which is due to the colocynthin and colocynthetin (James and Duke, 1983), which may affect the palatability of the diet. It may also be due to the high value of the metabolisable energy that increases with the increase in seed level and because chicken feed to maintain their body temperature.

There were insignificant differences in weight gain during the first four weeks; however, there was a very small increment in body weight as the level of the seeds increased (Fig. 1). The final live body weight was significantly (P≤0.05) heavier in chickens fed on the ration supplemented with 6% of the seeds (Table 3). These findings are in accord with those of Sawaya *et al.* (1986) who found that chickens grew normally with up to 15% processed whole seeds in the diet. Moreover, the improvement in growth performance of the chickens receiving the highest levels of the processed seeds may be attributed to the presence of growth promoting factors within the *C. colocynthis* seeds. It may be, as well, due to the high levels of essential amino acids and essential fatty acids present in the seed (Duke 1983; Sawaya *et al.*1983; Sawaya *et al.* 1986). However, small differences were found in the weekly body weight gain with levels of *C. colocynthis* seeds inclusion in the diets (Fig. 1). No differences in body weight gain were found during the first four weeks, but there were small differences during the fifth, sixth and seventh weeks of age.

Table 2. Effect of feeding different levels of 'Handal' (*Citrullus colocynthis*) seeds on weekly feed intake (g) and feed conversion ratio of broiler chickens

Age	Treatment				C.V. (%)
	CCS 0%	CCS 2%	CCS 4%	CCS 6%	
	Weekly Feed Intake (g)				
Week 1	107a	106a	106a	105a	0.85
Week 2	191a	189a	188a	186a	1.13
Week 3	317a	308a	306a	303a	1.05
Week 4	534a	523b	518b	515b	1.45
Week 5	784a	783a	780a	777a	1.00
Week 6	991a	989a	982a	982a	0.47
Week 7	1122a	1120a	1115ab	1109b	0.40
Cumulative feed intake	4046a	4018b	3995c	3977d	0.23
	Weekly Feed Conversion Ratio				
Week 1	1.64a	1.63a	1.61a	1.59a	1.05
Week 2	1.69a	1.67ab	1.66ab	1.63b	0.73
Week 3	1.76a	1.70b	1.67c	1.64d	1.20
Week 4	1.78a	1.74b	1.72b	1.69c	0.76
Week 5	1.91a	1.89ab	1.88ab	1.85b	1.41
Week 6	2.02a	2.01a	1.99ab	1.96c	1.14
Week 7	2.18a	2.17ab	2.15b	2.13c	0.63
Cumulative feed conversion ratio	1.95a	1.93ab	1.91b	1.85c	0.37

Means in a row followed by the same letter are not significantly different at P=0.05, according to Duncan's Multiple Range Test.

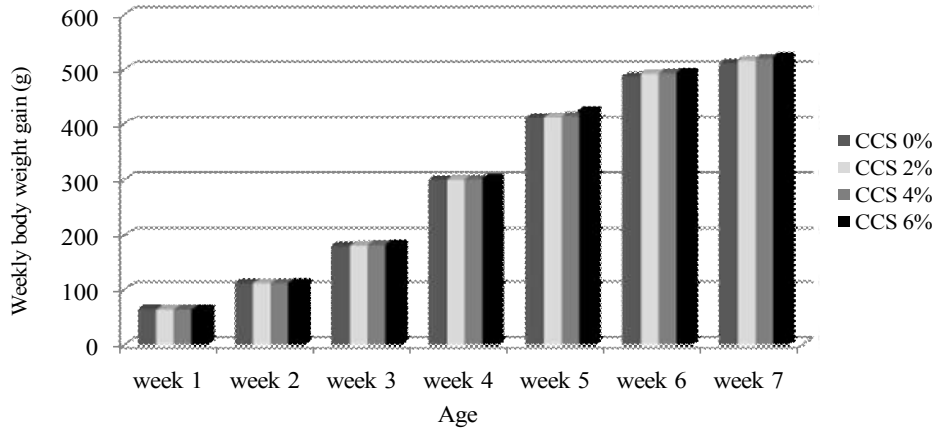

Fig. 1. Effect of dietary supplementation of *Citrullus colocynthis* seeds on weekly body weight gain (g) of broiler chicken

Table 3. Effect of feeding different levels of 'Handal' (*Citrullus colocynthis*) seeds on some of the gastrointestinal tract and other external organs of broiler chickens

Parameter	Treatment				C.V.%
	CCS 0%	CCS 2%	CCS 4%	CCS 6%	
Live body weight (g)	2167.0b	2175.0b	2183.0b	2283.0a	1.27
Carcass weight (g)	1585.0b	1598.0b	1613.0b	1733.0a	1.18
Intestine weight (g)	87.0b	88.3b	91.0b	97.6a	2.62
Gizzard weight (g)	86.0a	88.6a	90.3a	92.6a	2.85
weight (g)	50.0b	52.6b	54.0b	61.0a	4.06
Heart weight (g)	10.6a	11.0a	11.6a	12.6a	7.53
Abdominal fat pad weight (g)	58.0a	43.0b	38.0c	32.0c	5.20
Head weight (g)	68.0b	69.0ab	69.3ab	71.0a	1.82
Shank weight (g)	96.6a	96.6a	97.0a	100.0a	2.44
Dressing %	73.0b	73.6b	73.8b	75.6a	0.96

Means in a row followed by the same letter are not significantly different at P=0.05, according to Duncan's Multiple Range Test.

The feed conversion ratio was significantly ($P \leq 0.05$) affected by the level of *C. colocynthis* seeds except in the first week (Table 2). However, during the second through the end of the experiment, the weekly and the cumulative feed conversion ratio of the control group of chickens had significantly ($P \leq 0.01$) the worst feed conversion ratio. The best feed conversion ratio was recorded for the group receiving the highest (6%) dietary level of the seeds. However, when unprocessed seed in the same level (15%) was used, growth and feed efficiency were depressed. These findings disagree with the observations of Chaudhary *et al.* (1989) who found that chickens fed on diets supplemented with 10% *C. colocynthis* and safflower seeds had slow growth. Similar results were obtained by Bakhiet and Adam (1995) who showed that when 7–day Bovans-type chicks were fed on unprocessed *C. colocynthis* seeds at 0%, 2% and 10% of the basal diet for 6 weeks, the average body weight and the efficiency of feed utilization are markedly depressed by using 10%. However, using 2% of unprocessed *C. colocynthis* seeds improved body weight compared with 0% and 10% (Bakhiet and Adam, 1995); these findings support the present experiment findings in that the 2% level resulted in better body weight than the control group (Table 2).

These differences in the findings may be due to the levels of supplemented seeds used by the three groups of researchers, which were higher than those in the present study, or may be attributed to the different chemical profile of the seeds. The chemical analysis of the seeds used in the present study (Table 1) indicated that they contain higher crude protein than that reported by Sawaya *et al.* (1986). Similarly, the oil content of the seed obtained in this study (26.4%) was higher than that found by the latter mentioned researchers (13%–19%).

Broiler chickens fed on diets supplemented with *C. colocynthis* seeds up to 6 % had significantly ($P \leq 0.05$) the heaviest live body weight and carcass weight. These groups also recorded significantly ($P \leq 0.05$) the highest dressing percentage. However, feeding broiler chickens on diets

supplemented with seeds had significant ($P \leq 0.05$) effects on the different parts of the gastrointestinal tract (Table 3). The group of birds fed on 6% seeds had significantly ($P \leq 0.05$) the heaviest gastrointestinal tract weight (empty intestine, empty gizzard), heart and liver weights. However, there was a negative relation between the abdominal fat pad (AFP) and the levels of seeds in the diet, where the control chickens had significantly ($P \leq 0.05$) the heaviest AFP. This may be due to the best utilization of energy of the diet and the high level of the unsaturated fatty acids (75%) found in the seeds, where linoleic acid was 38.0% and oleic acid 19% (Sawaya *et al.,* 1983). There were insignificant differences between treatments in the shanks and head weights (Table 3).

More work is needed on the chemical composition of *C. colocynthis* seeds with regard to its content of amino acids, fatty acids, minerals and other components (growth factors enzymes…etc). Also, more research work is required in the field of feeding all types of poultry on diets supplemented with *C. colocynthis* seeds, seed meal and oil.

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تأثير الإضافة الغذائية لبذور الحنظل (*Citrullus colocynthis*) علي أداء ووزن الذبيحة لفراخ اللحم

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المستخلص : أجريت تجربة لدراسة تأثير بذور الحنظل علي أداء فراخ اللحم بإستخدام أربعة مستويات من مسحوق بودرة بذور الحنظل (0% و 2% و 4% و 6%). وُزع 360 كتكوتاً عمر يوم من ذكور فراخ اللحم (سلالة روس) عشوائياً علي الأربع معاملات وبثلاثة مكررات. غُذيت كل المجموعات إلي مستوي حد الشبع منذ عمر يوم وحتي 49 يوماً، وحُللت البيانات بإستخدام التصميم العشوائي الكامل وإختبار مدَي دنكن لمقارنة المتوسطات. أظهرت النتائج زيادة الوزن الحي و وزن الذبيحة ونسبة التصافي معنوياً بزيادة معدل بذور الحنظل، بينما إنخفضت معنوياً كمية الغذاء المتناول و الكفاءة التحويلية ووزن الوسادة الدهنية البطنية. المجموعة التي غُذيت علي الغذاء الذي يحتوي علي نسبة 6% من مسحوق بذور الحنظل أظهرت معنوياً أعلي أوزان للأعضاء الداخلية (الإمعاء الدقيقة الفارغ والقانصة الفارغ والقلب والكبد). بالتالي يمكن إضافة مسحوق بذور الحنظل لعلائق فراخ اللحم بنسبة 6% دون أثار سلبية.