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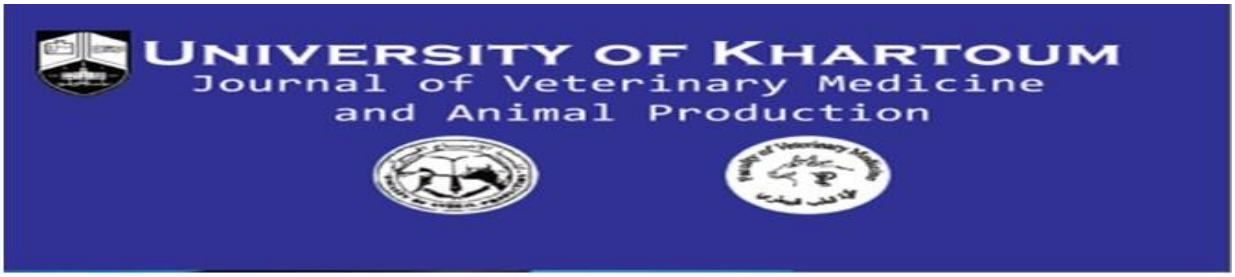

Effect of partial replacement of soaked chickpea seeds (*Cicer arietinum*L.) for groundnut cake on broiler performance, some blood biochemical parameters and carcass characteristics

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Abstract
The effect of replacing different levels of soaked chickpea seeds for groundnut cakes on broiler chicken was evaluated. An experiment was carried out using 200 one-day-old unsexed Ross 308 broiler chicks in a completely random design. Different levels of soaked chickpea seeds replaced groundnut cake at 0, 15, 30, 45 and 60%. Five starter and finisher diets were formulated according to National Research Council (NRC, 1994). Growth performance, blood biochemical parameters, carcass characteristics and histopathological aspects of liver and small intestine were studied. The chicks were randomly divided into the five dietary treatment groups; each of them was subdivided into four replicates of ten birds each. The experiment was conducted in an open- sided poultry house. The chicks were brooded and reared from one-day-old to six weeks of age in (1x1 m) pens with wood shavings litter. The results regarding chemical composition of chickpea seeds indicated positive nutritional components as it includes relatively moderate protein (20.2%) and high metabolizable energy (3290 kcal/kg). Body weight gain and FCR during starter phase were significantly ($P \leq 0.05$) deteriorated for birds fed on diet with 60% replacement level versus those fed the other diets. During finisher phase, significant ($P \leq 0.05$) improvement of PER was shown by birds fed on 30, 45 and 60% compared to 0 and 15% replacement level. For the overall period, birds fed on 30% replacement level grew insignificantly ($P \geq 0.05$) faster by 6.4% when compared to control. Dietary treatments had significant ($P \leq 0.05$) inconsistently effect on dressing%. Birds fed on 60% replacement level of soaked chickpea seeds showed significantly ($p < 0.05$) the highest plasma glucose compared to those fed diets A, B and D. Plasma Alanine amino transferase (ALT)/glutamate-pyruvate transaminase (GPT) and alkaline phosphatase (ALP) for birds fed different diets were not significantly ($p \geq 0.05$) different compared to the control. It could be concluded that soaked chickpea seeds could replace 30% of inclusion level of groundnut cake in broiler diets with improvement on overall performance. It is suggested that further research is necessary to evaluate other treatments such as roasting and cooking for chickpea seeds.

Keywords: Soaked chickpea, Broiler performance, Carcass characteristics, Internal organs, histopathology.

لمستخلص
اجريت هذه التجربة لدراسة تأثير الاحلال الجزئي لبذور الحمص المنقوعة في الماء محل امباز الفول على خصائص النمو، صفات الذبيحة، بعض خصائص الدم وانسجة الكبد والامعاء للدجاج اللاحم. تم احلال بذور الحمص محل امباز الفول بمعدلات 0، 15، 30، 45 و60% وذلك في العلف الابتدائي والنهائي. استخدم 200 كتكوت لاحم من سلالة الروس 308 بعمر يوم واحد غير مجنسة في كل تجربة. تم تغذية الكتاكيت تغذية حرة خلال فترتي البادئ وذلك لمدة 3 اسابيع ومن ثم تغذيتها على العلف الناهي حتى نهاية فترة التجربة والتي استمرت لستة اسابيع. وزعت الكتاكيت عشوائياً على 5 معاملات بواقع 4 مكررات لكل معاملة ويحتوي كل مكرر على 10 كتاكيت. حللت البيانات احصائياً باستخدام التصميم العشوائي الكامل. اوضح التحليل الكيميائي لبذور الحمص قيمتها الغذائية الجيدة حيث تحتوي على 20.2% بروتين خام و3290 سعر حراري ممثل/كجم علف. خلال فترة التغذية على العلف الابتدائي اظهرالوزن المكتسب ومعدل التحويل الغذائي تدهورا معنوياً ($P \leq 0.05$) في الطيور التي تم تغذيتها على معدل احلال 60% بالمقارنة بتلك التي غُذيت على الاعلاف الاخرى. اظهرت الطيور التي تم تغذيتها على 30، 45 و60% معدل احلال تحسناً معنوياً في معدل كفاءة البروتين مقارنةً بالطيور التي تم تغذيتها على 0 و15%. خلال الفترة الكلية للتجربة، تفوقت الطيور التي تم تغذيتها على معدل احلال 30% على تلك

التي تم تغذيتها على العلف الضابط وذلك بنسبة 6.4%. وفيما عدا معدل التصافي فان الاغذية التجريبية لم يكن لها اثر على خصائص الذبيحة. عند المقارنة بالعلف الضابط لم يكن هنالك اختلاف معنوي عن الاعلاف الاخرى فيما يتعلق بانزيمات الكبد GPT و ALP. من نتائج هذه الدراسة نستخلص ان بذور الحمص المنقوعة في الماء يمكن ان تحل 30% محل امباز الفول في علائق الدجاج اللاحم مع تحسن في الآداء الكلي.

Introduction

Over the past few years world grain prices have fluctuated dramatically but generally have increased and continue to do so. Protein concentrates have also increased in price and at a more consistent rate during the past years. The intensive poultry production is based on diets high in cereal grains and conventional protein sources. However, the need to reduce the impact of imported concentrates on poultry producers has led to search for alternative local protein sources. Grain legumes play an important role among vegetable materials used in animal diets. World legume production has steadily increased (FAO, 1994). On the other hand, chickpea seeds *Cicer arietinum* have been reported to be suitable as a protein source for broiler chickens (Farrell *et al*., 1999, Viveros *et al*., 2001 and Christodoulou *et al*., 2006). Chickpea is considered as good source of highly digestible protein (Bahl, 1990). However, it is high in lysine and low in methionine (Cheeke, 1998). Chickpea is like other legumes contains a variety of anti-nutritional factors (ANF) such as protease and amylase inhibitors as well as lectins, polyphenols and oligosaccharides which impair nutrients absorption from the gastrointestinal tract and result in detrimental effects on animal health and growth (Chavan *et al*., 1989 and Perez-Maldonado *et al*., 1999). In order to improve the nutritional value of chickpeas in broiler chicken diets, it is essential that ANF activity is removed (Van der Poel, 1989). In comparison to soybean (*Glycine max* L.), peas (*Pisum sativum* L.) and common beans (*Phaseolus vulgaris* L.), chickpea shows less problems with regards to these factors (ANF) (Singh, 1988). Raw chickpeas can be included in poultry feed up to 15-20%, to support growth and egg production (Bampidis *et al*., 2009). Higher inclusion levels of chickpea in poultry diets can be used after the removal of the anti-nutritional factors. There is an urgent need to investigate alternative protein sources suitable for poultry. Accordingly, the objective of this study is aimed at evaluation partial replacement of soaked chickpea seeds for groundnut cake on broiler performance, carcass characteristics and some blood biochemical parameters.

Materials and Methods

Chemical analysis of chickpea

Chickpea seeds under test were obtained from local crop market in Jebal-Awlia. Chemical composition of raw and soaked chickpeas seeds is shown in Table 1. The nutrients composition of raw and soaked chickpea was determined according to the methods of the Association of Official Analytical Chemicals (AOAC, 1990). Lysine, metionine and methionine±cystine were obtained from Abreu and Bruno-Soares (1998). Metabolizable energy, ME (kcal/kg) of chickpeas was calculated according to the equation suggested by Lodhi *et al*. (1976) as follow:

ME (Mjoule/Kg) = 1.549 ± 0.0102 (CP g/kg) ± 0.0275 (EE g/kg) ± 0.0148 (NFE g/kg) – 0.0034 (CF g/kg).

Experimental birds

One-day-old unsexed broiler chicks of a strain (Ross 308) were hatched on 26/7/2015 and purchased from commercial hatcheries. A total of 200 chicks were selected on the basis of uniform initial live body weight (45.5 g ± 0.14). The chicks were divided into five treatment groups of forty birds each and randomly assigned to the dietary treatments. Each group was further divided into four replicates of ten birds each. The chicks were reared from one-day-old to six weeks of age in 20 pens (1x1 m) with wood shavings litter.

Housing

The experiment was conducted in an open- sided poultry house in the poultry unit, Faculty of Agricultural Technology and Fish Sciences, Department of Animal Production, University of Elneelain. The feeding trial was extended for six weeks. The chicks were reared in an east-west house, constructed from of cemented reinforced red brick wall and the rest to the ceiling was made of wire netting on north and south sides. The floor was made of cemented red brick and the roof was made of corrugated iron sheath. The pens were constructed using iron posts with wire netting.

Experimental diets

Five approximately isocaloric and isonitrogenous starter and finisher diets were formulated according to National Research Council (NRC, 1994). Soaked chickpea seeds were replaced groundnut cake at 0.0% (control), 15%, 30%, 45% and 60% in diets: A, B, C, D and E, respectively. For the first 3 weeks, the chicks were fed starter diets and thereafter they were fed on finisher diets. The compositions of starter and finisher diets are shown in Tables 1. and 2., respectively.

Management

The birds in each pen had continuous access to one metallic fountain drinker and the diets were fed *ad libitum*. Feed samples were analyzed for proximate composition according to the methods outlined by the AOAC (1990). Continuous light was provided throughout the experimental period by a combination of natural light and artificial one. Broiler chicks were given mix vaccine (IB± Newcastle clone) at 5 days of age; also they were vaccinated against infections bursal disease (Gumboro) at 2 and 3 weeks of age. At fourth week, chicks were vaccinated via Newcastle (clone). Vitamins offered as a supportive doze before and after vaccination.

Experimental procedure

Feed intake, body weight and body weight gain were determined weekly on a pen basis. Mortality was recorded daily as it occurred to adjust feed intake. From the records of feed intake and weight gain, feed conversion ratio (FCR) was calculated as feed intake per weight gain. Protein efficiency ratio (PER) was calculated as weight gain per protein consumed.

At the end of the experiment, birds were fasted from feed for an overnight and then weighed and manually slaughtered. The carcasses were washed and allowed to drain and eviscerated by ventral cut. Liver, heart, gizzard, intestine, abdominal fat were weighed. The dressing percentage on hot base was calculated as hot carcass weight to live weight. Relative weights of internal organs and cuts (breast, thigh and drumstick) were calculated.

Blood samples were taken from jugular vein during slaughtering of four random birds per pen. The blood was received in a10 ml test tube. Nine test tubes per treatment were used and placed diagonal to ease serum separation.

Blood biochemistry

Blood samples were allowed to clot and sera were separated by centrifugation at 3000 rpm for 5 minutes and stored at 4ºC until to be analyzed. Plasma total protein concentration was determined by Biuret reagent methods as described by Gornall *et al*. (1949). Plasma albumin was determined by Bromocresol green method of Doumas *et al*. (1971). Plasma Globulin was determined by the difference between plasma total protein and plasma albumin (King and Wooton, 1965). Plasma urea was determined by urease/salicylate method of Chaney and Marbach (1962). Plasma uric acid concentration was Uricase/Peroxidase method of Analyst (Barham and Tinder, 1972). Plasma glucose was determined by Glucose oxidase/peroxidase method of Trinder (1969). The plasma cholesterol level was determined by an enzymatic Endpoint method using a kit (Randox laboratory – London of Abell *et al*. (1952). The plasma creatinine level was determined by colorimetric method using a kit (Randox laboratory – London of Bartels and Bohmer, 1972). The concentration of calcium was determined by Methyl Thymol Blue method described by Gindler and King (1973). Inorganic phosphorus was determined by the PhosphomolYbdate/UV method described by Gamst and Try (1980). The plasma GOT level was determined by IFCC method of Quimica Clinica and Comite Cientificoand (1987). The plasma GPT level was determined by IFCC method of Quimica Clinica and Comite Cientificoand (1987). The plasma ALP level was determined by IFCC method of Clin Chem Clinbiochem (1983).

Statistical analysis

The experiment was arranged in a complete randomized design. Data were statistically evaluated by the general linear model (GLM) procedure of SAS (SAS Institute, 2003). Duncan's multiple range tests (Steel and Torrie, 1980) was used to compare the treatment means with significant differences.

Results and Discussion

The results regarding chemical composition of chickpea seeds (Table 1) indicated positive nutritional components as it includes relatively moderately protein (20.2%), which is agreed with Christodoulou *et al*. (2006) who reported 20.9% crude protein. Crude protein and crude fiber were similar to values obtained by Brenes *et al*. (2008). The protein content of chickpea seems to vary considerably depending on the variety and growing conditions. Bampidis and Christodoulou (2011) reported that protein levels of chickpeas vary between 13.7% and 34.0%.

Table 1: Chemical composition of raw and soaked chickpea

Item	**Raw chickpea**	**Soaked chickpea**
ME*	3142 kcal/kg	3290 kcal/kg
Crude protein	20.40	20.18
Crude fat	5.0	6.0
Crude fiber	6.4	6.6
Dry matter	91.9	93.6
Crude ash	3.31	1.80
Calcium	0.17	0.17
Total phosphorous	0.07	0.07
Tannin	0.50	0.49

* ME Calculated according to equation of Lodhi *et al.* (1976)

Growth performance during starter phase (0-3 week), finisher phase (4-6 week) and overall period is shown in Table 4. The results revealed that feed intake

Table 2: Ingredients and chemical composition of experimental broiler starter diets containing partial replacement levels of soaked chickpea for groundnut cake

	Replacement levels of chickpea for groundnut cake, %				
Ingredients	**0 (A)**	**15 (B)**	**30 (C)**	**45 (D)**	**60 (E)**
Sorghum	59.06	56.37	56.66	55.50	56.00
Groundnut cake	29.00	24.65	20.30	15.95	11.6
Chick pea	0.0	4.35	8.70	13.05	17.40
Sesame cake	0.50	1.00	3.70	4.05	4.29
Wheat bran	0.51	2.47	0.47	1.50	1.1
Super concentrates*	5.00	5.00	5.00	5.00	5.00
Nacl	0.30	0.30	0.30	0.30	0.30
Limestone	1.20	1.23	1.17	1.22	1.26
Dical phosphate	0.12	0.05	0.00	0.00	0.00
L-Lysine	0.07	0.04	0.02	0.00	0.00
DL-Methionine	0.14	0.14	0.12	0.13	0.15
Cholin chloride	0.20	0.20	0.20	0.20	0.20
Mycotoxin binder	0.20	0.20	0.20	0.20	0.20
Vegetable oil	3.70	4.00	3.16	2.90	2.50
Calculated analysis					
ME* (kcal/kg)	3182	3189	3187	3177	3184
CP	24.8	23.6	23.1	22. 0	21.0
Crude fiber	4.5	4.5	4.2	4.1	3.8
Ca	1.0	1.0	1.0	1.0	1.0
Av. Phosphorous	0.45	0.44	0.43	0.43	0.42
Lysine	1.1	1.1	1.1	1.1	1.1
Methionine	0.57	0.57	0.56	0.57	0.58
Meth. ±Cystine	0.81	0.80	0.81	0.81	0.81
Determinedanalysis					
CP	25.5	23.0	23.0	22.8	19.4
Crude fiber	7.0	6.8	6.8	5.6	5.4
EE	4.8	5.2	5.6	4.8	4.0
Ash	6.2	7.1	6.9	6.4	9.3

* Cp 40%, ME 2000 kcal/kg, C.fiber 3%, EE 3%, Ash 34%, Ca 8%, Av. P 1.38%, Lysine 12%, Methionine 3%, Methionine±Cystine 3.5%.

Vitamin A 250000 IU/Kg, Vitamin D3 50000 IU/Kg, Vitamin E 500Mg/Kg, Vitamin K3 60 Mg/Kg, Vitamin B1/ Thiamin 20 Mg/Kg, Vitamin B2/ Riboflavin 100 Mg/Kg, Niacin Vitamin PP 600 Mg/Kg, Pantothenic acid/ Vitamin B3 160 Mg/Kg, Vitamin B6/ Pyridoxine 40 Mg/Kg, Vitamin B12 300 Mcg/Kg, Biotin/ Vitamin H 2000 Mcg/Kg, Choline 10000 Mg/Kg, Vitamin C 4000 Mg/Kg, Folic Acid 30 Mg/Kg, Iron 800 Mg/Kg, Manganese 1400 Mg/Kg, Copper 120 Mg/Kg, Zinc 1000 Mg/Kg, Iodine 6 Mg/Kg, Cobalt 12 Mg/Kg, Selenium 3 Mg/Kg.

* ME Calculated according to equation of Lodhi et al. (1976).

during starter phase was not significantly (P≥0.05) influenced by the dietary treatments. However, dietary treatments had significant (P≤0.01) effects on body weight gain, FCR and PER during starter phase. During this phase, body weight gain was significantly (P≤0.05) reduced for birds fed on diet E versus those fed the other experimental diets. On the other hand, FCR for birds fed diet C was significantly (P≤0.05) the best when compared with those fed diet D or E and similar to those fed diet A or B. PER was significantly (P≤0.05) improved for birds fed diet C versus those fed diet A, B or E. These results are inconsistent with that of Maghsoud *et al*. (2014) who included four levels (0, 5, 10 and 15 %) of raw and soaked chickpea seeds in broiler diets and found no significant effect on the performance of broiler chicks. Also, inclusion of 20% raw chickpeas in the diet of growing chickens had no effect on growth performance (Brenes *et al*., 2008). However, Laudadio and Tufarelli, (2010) reported that broiler fed processed pea showed a significant increase in weight gain. During finisher phase, all growth performance parameters were not significantly (P≥0.05) different except for PER (P≤0.01)..

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Table 3: Ingredients and chemical composition of experimental broiler finisher diets containing partial replacement levels of chickpea for groundnut cake.

	Replacement levels of chickpea for groundnut cake, %				
Ingredients	**0 (A)**	**15 (B)**	**30 (C)**	**45 (D)**	**60 (E)**
Sorghum	69.35	69.35	69.65	69.55	67.95
Groundnut cake	16	13.6	11.2	8.80	6.4
Chick pea	0.0	2.4	4.8	7.2	9.6
Sesame cake	1.26	1.04	1.66	3.8	6.12
Wheat bran	3.46	4.30	3.12	1.60	1.10
Super concentrates*	5.00	5.00	5.00	5.00	5.00
Nacl	0.30	0.30	0.30	0.30	0.30
Limestone	1.11	1.17	1.16	1.08	1
Dical phosphate	0.00	0.00	0.00	0.00	0.00
L-Lysine	0.09	0.10	0.07	0.05	0.03
DL-Methionine	0.03	0.04	0.04	0.02	0.00
Cholin chloride	0.20	0.20	0.20	0.20	0.20
Mycotoxin binder	0.20	0.20	0.20	0.20	0.20
Vegetable oil	3.00	3.30	2.60	2.20	2.10
Calculated analysis					
ME (kcal/kg)	3178	3189	3180	3185	3189
CP	20.3	19.4	19.0	19.0	19.0
Crude fiber	4.0	3.9	3.7	3. 5	3.5
Ca	0.90	0.91	0.91	0.91	0.91
Av. Phosphorous	043	0.43	0.42	0.42	0.43
Lysine	1.0	1.0	1.0	1.0	1.0
Methionine	0.44	0.44	0.44	0.43	0.43
Meth. ±Cystine	0.63	0.63	0.63	0.63	0.64
Determined analysis					
CP	21.2	19.9	20.0	19.2	19.2
Crude fiber	5.8	3.8	5.2	4.8	4.4
EE	5.00	5.60	4.4	4.2	4.2
Ash	6.4	6.5	4.2	5.6	5.1

*As shown in Table 2.

Table 4: The effect of dietary partial replacement of soaked chickpea for groundnut cake on broiler performance, during starting, finishing and overall period.

	Replacement levels of chick pea for groundnut cake, %					
Parameter	0 (A)	15 (B)	30 (C)	45 (D)	60 (E)	±SEM
0-3 wk						
Feed intake (g/b)	1060.2±58.3	1054.7±39.8	1077.3±39.9	1079.1±36.4	1062.3±50.8	22.9
Body weight gain (g/b)	798.8^{a} ±41.3	781.2^{a}±41.6	821.4^{a}±35.5	769.0^{a} ±39.4	672.6^{b}±10.9	17.8
FCR (g Fi/g Bwtg)	1.33^{c}±0.04	1.35^{bc} ±0.05	1.31^{c}±0.01	1.41^{b} ±0.06	1.58^{a} ±0.05	0.02
PER (g Bwtg / g Pi)	3.04^{c} ±0.09	3.13^{bc}±0.12	3.32^{a}±0.02	3.29^{ab}±0.14	3.11^{c}±0.102	0.05
4-6 wk						
Feed intake (g/b)	2569.9±167.1	2712.3±156.5	2626.9±132.7	2642.4±515.6	2634.2±199.9	89.8
Body weight gain (g/b)	1330.2±130.2	1403.7±159.6	1443.4±69.3	1431.1±158.9	1382.2±100.3	64.2
FCR (g Fi/g Bwtg)	1.94±0.08	1.94±0.13	1.82±0.05	1.85±0.32	1.91±0.05	0.04
PER (g Bwtg / g Pi)	2.55^{b}±0.102	2.7^{b}±0.16	2.92^{a}±0.09	2.89^{a}±0.75	2.82^{a}±0.08	0.05
Over all						
Live body weight (g/b)	2173.9±161.7	2229.9±200.3	2310.0±93.7	2245.3±194.9	2099.6±108.4	79
Feed intake (g/bird) (g/b)	3630.2±215.6	3767.0±190.2	3704.2±170.3	3721.5±542.0	3696.5±249.8	109.7
Body weight gain (g/bird)	2129.0±161.5	2184.9±200.1	2264.8±93.6	2200.1±194.8	2054.8±108.2	78.9
FCR (g Fi/g Bwtg)	1.71^{bc}±0.05	1.73^{ab}±0.09	1.64^{c}±0.03	1.69^{bc}±0.22	1.80^{a}±0.04	0.03
PER (g Bwtg / g Pi)	2.71^{c}±0.09	2.82^{bc}±0.14	3.05^{a}±0.06	3.02^{a}±0.49	2.91^{ab}±0.07	0.05

Values are means of 4 replicates per treatment (8 birds/ replicate).

[ab] Means ± SD with different superscripts in the same row were significantly different (P≤ 0.05).

SEM: Standard error of the means from ANOVA d.f 15.

included four levels (0, 5, 10 and 15 %) of raw and soaked chickpea seeds in broiler diets and found no significant effect on the performance of broiler chicks. Also, inclusion of 20% raw chickpeas in the diet of growing chickens had no effect on growth performance (Brenes *et al*., 2008). However, Laudadio and Tufarelli, (2010) reported that broiler fed processed pea showed a significant increase in weight gain. During finisher phase, all growth performance parameters were not significantly ($P \geq 0.05$) different except for PER ($P \leq 0.01$). However, birds fed diet C gained numerically 8.5% weight versus the control. Likewise, FCR for birds fed diet C improved by 6.2% versus the control. Moreover, significant ($P \leq 0.05$) improvement of PER was shown by birds fed on diet C, D or E versus A or B. Overall live body weight, body weight gain and feed intake were not significantly ($P \geq 0.05$) affected by the dietary treatments. However, birds fed diet C grew faster by 6.4% when compared to control. Feeding diet C had significantly ($P \leq 0.01$) improved FCR when compared with those fed diet B or E. Similarly, PER was significantly ($P \leq 0.01$) improved for birds fed diet C compared to those fed diet A or B. these improvements may due to a valuable protein, mineral and vitamins of chickpea seeds (Bampidis *et al*., 2009). These results are coincided with that of Johnson and Eason (1990) who did not observe differences in performance of birds fed with 20% chickpea. However, the present results are in disagreement with the findings of Viveros *et al*. (2001) and Farrell *et al*. (1999), who observed a negative effect of inclusion of chickpea up to 36% in the diet. The variation in the effect of chickpea seed on broiler performance could be due to the different amounts of antinutritional factors among batches of the same legume (Brenes *et al*., 2008). Saini *et al*. (1992) observed a large variation in concentrations of trypsin and chymotrypsin inhibitors of chickpea grown in Australia, and owed this to the location and year of cultivation. In addition, Singh and Jambunathan (1981) showed that trypsin inhibitor activity of two varieties of chickpea varied considerably among different genotypes. Moreover, processing methods could substantially affect the nutritive value of legumes (Ghadge *et al*., 2008). For instance, soaking improves chickpeas nutritional value. As a soaking treatment, gives good results in reducing anti-nutritional factors of chickpeas and also improves the utilization of starch, fat and protein. Through soaking, amounts of nutrients that are difficult to be reach by digestive enzymes become free (Sufi and Janmoh).

Carcass characteristics and internal organs of broiler chicks as affected by partial replacement of chickpea seeds for groundnut cake are presented in Tables 5. and 6, respectively. Dietary treatments had no significant ($P \geq 0.05$) effect on carcass characteristics expect for dressing percent which was inconsistently affected. The present findings are coincided with Garsen *et al*. (2008) who found that partial replacement of soybean meal with raw chickpeas resulted in similar carcass characteristics of broiler chickens, when graded levels of chickpea seeds were supplemented up to 48%. In contrast, Viveros *et al*. (2001) reported a significant increase of relative weights of the liver and gizzard and the relative lengths of duodenum, jejunum, ileum and caeca when raw chickpea seeds were included in broiler chicks' diets. Likewise, some carcass yield traits were adversely affected with inclusion of chickpeas in diets of broiler chickens (Christodoulou *et al*., 2006). It has been reported that some organs may become hypertrophic in chickens due to ANF contained in legume seeds (Huisman and Van der Poel, 1989). Brenes *et al*. (2008) showed that relative weight of liver and intestine increased with the increasing amount of chickpea seeds.

Results of the effect of partial replacement of chickpea seeds for groundnut cake on blood constituents are shown in Table 7. Serum albumen, total protein, P, and GOT were not significantly ($p \geq 0.05$) influenced by the dietary treatments. However, globulin, cholesterol, urea, glucose, Ca and GPT were significantly ($p \leq 0.05$) affected. Different levels of dietary chickpea seeds had no significant ($P \geq 0.05$) effect on serum glucose, cholesterol, total protein, calcium, and inorganic phosphorus (Taguia *et al*., 2003 and Algam *et al*., 2012). Serum uric acid, createnin and ALP were significantly ($p < 0.01$) influenced by the dietary treatments. Birds fed on 60% replacement showed significantly ($p < 0.05$) highest serum glucose compared to those fed diets A, B and D. Plasma GPT and ALP for birds fed different diets were not significantly ($p \geq 0.05$) different compared with the control. Generally GOT and GPT considered as liver enzymes which increased with liver damage (heptatocellular degeneration), so the non significant difference of GOT and GPT may indicated that no incidence of liver damage (Hermandez *et al*., 2004).

Conclusion

According to the present results, it could be concluded that soaked chickpea seeds could replace 30% of inclusion level of groundnut cake in broiler diets with improvements in overall parameters of performance.

Table 5: Carcass characteristics of broilers as influenced by partial replacement of soaked chickpea for groundnut cake

Parameter	Replacement levels of chickpea for groundnut cake, %					±SEM
	0 (A)	15 (B)	30 (C)	45 (D)	60 (E)	
Dressing%	73.9^{a}±1.1	72.0^{ab}±2.7	73.2^{ab}±1.2	70.7^{b}±2.1	72.8^{ab}±1.5	0.91
Hot carcass wt.	1630±356	1531±223	1598±197	1454±161	1455±190	117.8
Absolute breast wt. (g)	454.5±100.6	529.5±141.3	521.0±48.6	449.0±33.5	464.5±75.7	44.3
Relative breast wt.	28.3±5.3	34.2±4.2	32.9±4.8	31.0±2.4	31.8±1.8	1.9
Brest M/B	39.1±39.8	16.5 ±10.8	11.1±3.8	820.4±14.4	13.1 ±6.4	9.9
Absolute thighs wt. (g)	253.5±35.6	242.5±42.5	254.0±14.5	220.5±38.3	231.0±31.3	16.9
Relative thighs wt.	15.8±1.5	15.8±0.67	16.0 ±1.7	15.2±1.7	15.9 ±9.5	0.67
Thigh M/B	6.7±1.4	6.4±1.8	7.0±0.91	6.6±1.4	5.9±2.3	0.81
Absolute drumsticks wt. (g)	197±43.3	198.5±16.5	219.0±33.5	196.5±36.6	205.0±32.9	16.9
Relative drumsticks wt.	12.1±0.62	13.1±1.4	13.7±1.7	13.5±1.4	14.1±1.2	0.75
Drumsticks M/B	3.6±1.1	3.8±0.71	3.8±1.3	3.6 ±0.87	3.3±0.88	0.57
Absolute abdominal fat wt. (g)	48.5±10.7	59.0±25.3	51.8±15.0	57.5±12.1	42.3±13.6	8.1
Relative abdominal fat wt.	3.1 ±1.0	3.8 ±1.3	3.2 ±0.51	4.0±1.1	2.9±0.77	0.57

Values are means of 4 replicates per treatment.
^{ab} Means ± SD with different superscripts in the same row were significantly different (P≤ 0.05).
SEM: Standard error of the means from ANOVA d.f 15.

Table 6: Internal organs of broilers as influenced by partial replacement of soaked chickpea for groundnut cake

Parameter	Replacement levels of chickpea for groundnut cake, %					±SEM
	0 (A)	15 (B)	30 (C)	45 (D)	60 (E)	
Absolute wt. of heart (g)	9.5±4.2	10.0±0.82	10.0±1.4	9.8±1.7	9.5±1.7	1.1
Relative wt. of heart	0.56±0.104	0.67±0.14	0.63±0.05	0.67±0.06	0.65±0.04	0.05
Absolute wt. of liver (g)	44.0±11.6	39.8±11.9	35.5±5.8	38.0 ±7.2	38.8±6.1	4.5
Relative wt. of liver	2.7±0.32	2.6 ±0.61	2.2±0.27	2.6±0.22	2.7±0.26	0.26
Absolute wt. of gizzard (g)	29.5±5.5	26.8±3.8	27.3±3.8	29.0±2.3	26.8±3.3	1.8
Relative wt. of gizzard	1.8 ±0.26	1.8 ±0.28	1.7±0.27	2.0±0.27	1.8 ±0.28	0.18
Intestine length (cm)	188.9±15.6	194.5±17.7	190.3±7.4	179.8±22.4	175.5±15.9	8.3
Absolute wt of Intestine (g)	64.5±14.8	72.5±17.2	65.0±5.8	65.5±21.6	64.3±10.8	7.5
Relative wt. of intestine	4.0±0.64	4.7±0.96	4.1±0.56	4.4 ±1.1	4.4±0.31	0.45

Values are means of 4 replicates per treatment (8 birds/ replicate).
[ab] Means ± SD with different superscripts in the same row were significantly different (P≤ 0.05).

SEM: Standard error of the means from ANOVA d.f 15.

Table 7: Blood biochemical parameters of broilers as influenced by partial replacement of soaked chickpea for groundnut cake

Constituents	Replacement levels of chickpea for groundnut cake, %					± SEM
	0 (A)	15 (B)	30 (C)	45 (D)	60 (E)	
Albumin g/dl	1.5±0.31	1.8±0.22	1.8±0.54	1.6±0.22	1.7±0.57	0.20
Total protein g/dl	2.6±0.35	2.4±0.22	2.5±0.30	2.5±0.26	2.7±0.34	0.14
Globulin g/dl	1.2 [a] ±0.30	0.67[b]±0.32	0.81[ab]±0.57	0.94[ab]±0.26	0.97[ab]±0.31	0.27
Urea mg/dl	4.5 [ab] ±3.14	3.2 [b]±2.12	3.9[ab]±2.73	5.9[a]±2.67	4.9[ab]±2.33	1.3
Uric acid mg/dl	1.9[c]±1.24	1.7[c]±1.09	3.3[b]±1.55	5.2[a]±1.44	3.8[b]±1.39	0.74
Creatnien mg/dl	0.13[b]±0.06	0.25 [a]±0.11	0.12 [b]±0.07	0.15 [b]±0.06	0.13 [b]±0.08	0.04
Glucose mg/dl	135.0 [b]±31.14	151.1 [b]±39.67	156.9 [ab]±45.83	153.9 [b]±29.31	190.8 [a]±33.02	18.2
Cholesterol mg/dl	33.7[ab]±30.23	39[ab]±23.96	20.1[b]±26.90	59.7[a]±39.50	58.8[a]±48.14	17.4
Ca mg/dl	9.7 [ab]±1.33	9.1 [b]±0.86	10.9 [a]±1.99	9.9 [ab]±0.97	10.3 [ab]±2.34	0.80
P mg/dl	7.2 ±1.55	7.3 ±1.22	6.8 ±1.77	6.6± 2.32	5.9±2.63	1.7
AST/GOT u/l	5.3 ±2.74	5.5 ±6.83	1.9 ±1.40	1.9 ±1.40	2.6±2.28	1.8
ALT/GPT u/l	4.6[ab]±1.96	6.4[a]±3.89	4.4[ab]±2.35	4.4[ab]±2.68	3.4[b]±1.44	1.4
ALP u/l	45.2[abc]±9.08	53.9[a]±9.25	50.6[ab]±6.82	43.6[bc]±11.67	37.0[c]±9.02	4.6

Values are means of 9 replicates per treatment.
[ab] Means ± SD with different superscripts in the same row were significantly different (P≤ 0.05).
SEM: Standard error of the means from ANOVA d.f 40.

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