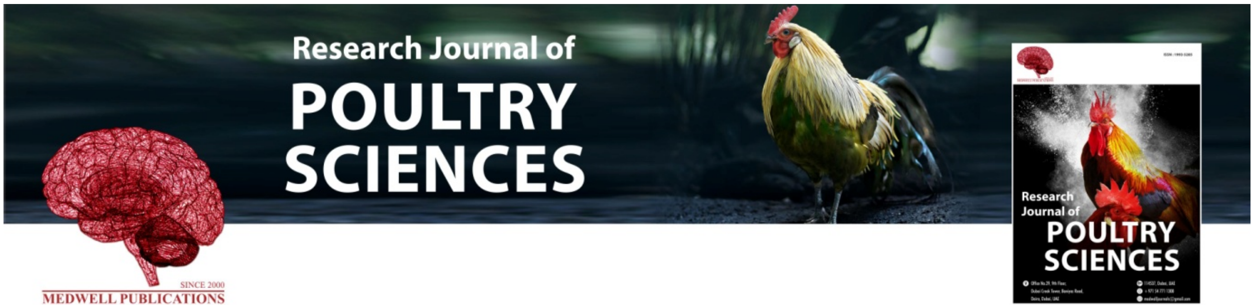

Effect of Dietary Levels of Raw Chickpea (*Cicer arietinum* L.) Seeds on Layers Performance, Egg Quality and Plasma Constituents

[1]A. Tamador Algam, [2]Khadiga A. Abdel Atti, [3]Wafaa Babiker Zomrawi, [4]Rashid H. Osman and Mojahid A. Abdalhag

[1]*Department of Animal Production, Faculty of Agricultural Technology and Fish Science, Al Neelain University, Khartoum, Sudan*

[2]*Department of Animal Nutrition, Faculty of Animal Production, University of Khartoum, Khartoum North, Sudan*

[3]*Department of Animal Production, Faculty of Agriculture and Natural Resources, University of Bakht Elruda, Sudan*

[4]*Department of Poultry Production, Faculty of Animal Production, West Kordofan University, El-Nuhud 20, Sudan*

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Corresponding Author:
A. Tamador Algam
Department of Animal Production, Faculty of Agricultural Technology and Fish Science, Al Neelain University, Khartoum, Sudan

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Abstract: Experiment was conducted to evaluate the effect of feeding chickpea seeds on layer's performance, egg quality and serum constituents. Eighty of 30 weeks old Hi-sex laying hens were fed four iso-caloric and iso-nitrogenous experimental diets containing 0, 5, 10 and 15% raw chickpea seeds were formulated to meet the nutrients requirements as outlined by NRC in 1994. Experiment was in a Completely Randomize (CRD) comprised layer hen diet. Each treatment was replicated four times with fife birds/replicate. Parameters measured were feed intake, body weight gain, Feed Conversion Ratio (FCR), protein efficiency ratio, some blood parameters (glucose, cholesterol, triglyceride, total protein, calcium and phosphorus) egg quality (external and internal egg characteristics) and profitability. The results indicated that feed intake was significantly ($p<0.05$) depressed with increasing the level of chickpea seeds in the diet. Egg weights, FCR, body weight loss and hen-day egg production were not affected $p>0.05$ by the dietary treatments. External egg quality characteristics were not influenced $p>0.05$ by the dietary treatment, except shell weight decreased for group received control and 5% chickpea seeds. Internal quality characteristics were not affected $p>0.05$ by the dietary treatments, except yolk high and yolk index were significantly $p<0.05$ lower for group received 5 and 15% chickpea seeds. Egg yolk color was affected p>0.05 by the dietary treatments was improved as the level of chickpea seeds increased. Serum glucose, total protein, phosphorus, calcium and Triglyceride were affected by dietary treatments. Serum cholesterol was decrease by feed 10% and 15 chickpea seeds and lower for group received 15% chickpeas seeds. High profit was recorded for egg production birds received 15% chickpea seed.

INTRODUCTION

As human population continues to grow with the greatest growth expected in countries that are already suffering from chronic hunger and malnutrition there will be need to ensure food safety for all and especially the more susceptible sector of human population[1].

Food is the major cost in the layer and meat chicken industries. Over the past few year's world grain prices have fluctuated dramatically but overall have increased and continue to do so. Protein concentrates have also increased in price and at a more consistent rate. During the past year or so they have risen particularly sharply[2]. There is therefore an urgent need to investigate alternative ingredients suitable for feeding to poultry. There have been a number of excellent reviews of the more commonly available grain legumes[3] and more recently by Petterson *et al*.[4]. Chickpeas can be used as a high energy and protein feed in poultry diets to support growth and egg production. In common with other grain legumes, chickpeas can also contain anti-nutritional factors such as trypsin and chymotrypsin inhibitors that can impair the utilization of the nutrients by poultry. It has been demonstrated that legume protein is the natural protein suitable to complement that present in cereal grains.

In general, legume grains comprise an important part of the human diet in developing countries in tropical and subtropical areas where their nutritional contribution is of paramount importance a large segment of the populations in these areas have limited access to food of animal origin. This has been the case with chickpea which has seldom been used in animal nutrition. However, if the economics of its production were improved, either by increasing the yield or by the introduction of mechanization of the crop, the chickpea can be a good alternative to the imported protein sources in animal feed. The available information on the nutritional value of chickpeas for layers is limited[5]. Therefore, the objective of this study was to evaluate the effect of including dietary levels of raw chickpeas (*Cicer arietinum* L.) seeds on layer's performance, egg characteristics and blood parameters.

MATERIALS AND METHODS

Experimental site, duration and housing: The experiment was carried out in poultry experimental house Faculty of Animal Production, Khartoum University during winter season for 11 weeks. The first three weeks for adaptation on treatment diets. The ambient temperature during the experimental period ranged between 24 and 30°C (Metrological Department shambat). The experimental house is an open side partitioned in to 16 pens (1×1 m).

Experimental birds: Total of 80 layer hens of 27 week's old were randomly divided for four groups with 4 replicates (5 hens per replicate). In Completely Randomized Design (CRD). The birds were vaccinated at day old against Marek's disease and against Newcastle and infectious bronchitis at 5 days old then by injection at 16th weeks of age. Chicks were also vaccinated against infectious bursal disease (Gumboro) at 2 weeks and 4th weeks. Lasota was administered at 4th weeks and 7th weeks. Fowl box vaccine was applied at 10th weeks. De-wormer was administered at 11th weeks. Hens were selected according to ability of laying.

Experimental diets: Four dietary treatments were formulated according to the standard nutrient requirements for layers stated in the NRC, containing raw chick peas (*Cicer arietinum* L.) of levels 0% (control diet) 5, 10 and 15%. Each dietary treatment was randomly allocated to 4 replicate. The percent of dietary ingredients and treatments samples were analysis are shown in Table 1 and 2. Treatments samples were analyzed by the method of analysis stated by the Chemists[6].

Data collection and experimental design: Feed intake was weekly determined using an electronic digital balance by subtracting the quantity of feed unconsumed from the added quantity. Birds were weighed at the beginning and at the end of the experiment period in each groups (5 hens/replicate) and their weights were divided by hen's number to obtain average live weight of bird and body weight change on average basis were calculated by subtraction of last live weight from that of the start. Eggs were collected twice a day, early morning and late afternoon. Daily laid eggs for each pen weekly recorded, weekly feed intake and feed conversion ratio FCR for each pen was determined as follow: weekly feed consumption (g) per dozens of eggs produced weekly. Daily egg production was calculated from the number of eggs laid expressed as a percentage of the number per pen on weekly basis all-over the experimental period.

Table 1: Proximate analysis and anti-nutritional factors of chickpeas seeds

Items	Chickpeas seed
Dry matter	93.10
Either extractives	3.78
Crude protein	24.31
Crude fiber	13.57
Ash	3.02
Nitrogen free extractives	48.41
Tannin	0.06
Poly phenol	0.03
Phytic acid	0.64
Digestibility	83.38
ME (kcal kg^{-1})	2540

ME = Calculated according to equation of Lodhi

Table 2: Percentage composition and calculate chemical analysis of rations

	Treatments (%)			
Feed staffs (%)	0	5	10	15
Sorghum	62.4	61.9	60.4	58.3
Groundnut meal	12.0	11.6	10.0	10.0
Sesame meal	6.00	5.00	5.00	300.
Chickpea	00.0	5.00	10.0	15.0
Wheat brand	6.00	2.80	0.80	1.20
Super concentrate*	5.00	5.00	5.00	500.
Di-calcium phosphate	1.50	1.50	1.50	1.50
Methionine	0.00	0.00	00.0	00.0
L. stone	6.50	6.50	6.50	6.50
Premix**	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Calculated analysis				
Crud protein (%)	18.74	18.76	18.74	18.71
Crud fiber (%)	3.72	3.93	4.16	4.68
Calciume (%)	3.37	3.35	3.35	3.32
A.Vphosphorus (%)	0.62	0.61	0.61	0.598
Lysine	0	0	0	0
Methionine	0	0	0	0
ME (kcal kg^{-1}) diet	2853	2864	2858	2842
Determined analysis				
Dry matter	93.16	88.81	90.50	93.20
Ether extract	3.78	3.07	3.56	1.13
Crude fiber	10.98	9.65	10.25	8.47
Nitrogen free extract	51.43	55.19	53.12	55.15
Ash	15.13	13.84	14.59	14.28
ME (Mj kg^{-1})	12.35	12.54	12.45	12.48
CP	18.20	18.29	18.05	18.20

*Super concentrate per kg = 35% Cp, 2000 kcal ME, 4.5% Crude fibre, 2% EE, 6-8% Ca, 4.6% Av. P, 2.3% Sodium, 5.7% Lysine, 2.1% Methionin, 2.6% Methionine+cystine, 200.000 IU kg^{-1} Vitamin A, 40.000 IU kg^{-1} Vitamin D3, 300 mg kg^{-1} Vitamin E, 40 mg kg^{-1} Vitamin K3, 30 mg kg^{-1} Vitamin B1, 80 mg kg^{-1} Vitamin B2, 40 mg kg^{-1} Vitamin B6, 0.5 mg kg^{-1} Vitamin B12, 180 mg kg^{-1} Pantothenic Acid, 500 mg kg^{-1} Niacine, 15 mg kg^{-1} Folic Acid, 10.000 mg kg^{-1} Choline Chloride, 1.200 mg kg^{-1} Manganese, 1.000 mg kg^{-1} Zinc, 1.200 mg kg^{-1} Iron, 120 mg kg^{-1} Copper, 10 mg kg^{-1} Iodine, 4 mg kg^{-1} Selenium

Egg quality measurement: Egg quality was determined every 2 weeks as following: two eggs were selected for quality measurements for each replicate (8/treatment) and weighed using an electronic digital balance. The measurements for eggs length and width were taken by using 0.02 mm vernier caliper. Eggs sample were then broken on petri dish, albumin weight was calculated by the differences between egg weight and the combination weight of shell and yolk, albumin height was measured by 0.02 mm vernier in the middle of thickened area. The yolks were carefully separated from the albumin and weighed their heights and diameters were measured using 0.02 mm vernier, yolk color was determined with roche yolk color fan. Egg shells were weighted directly following egg breaking, after dried and cleaned of any adhering albumin and peeled of any shell membranes, thereafter, sample were taken to measure shell thickness using 0.02 mm vernier.

The egg quality parameters are: egg color, egg shape index which was obtained by dividing maximum width by maximum length. Shell, albumin, yolk percentage were calculated as the proportion of their weights to the egg weight. Albumin and yolk indices were determined as a proportion of their heights to their diameters. Albumin yolk index determined as the ratio of albumin weight to yolk weight. Egg shell surface was computed using the formula of Carter[7]:

$$\text{Area} = 3.9782\,\text{Xw}^{0.7065}$$

Where:
W : Resemble weight of fresh egg

Haugh's unit was calculated from the values obtained from albumin height and egg weight by the following formula:

$$\text{Haughs unit} = 100 \log (\text{H}+7.57-1.7\text{W}^{0.37})$$

Where:
H : The albumin height in millimeter
W : The egg weight in gram

Collection of blood samples: Blood samples were taken from 2 birds per pen from the vein using syringe and kept under -20°C for further hematological and biochemical blood analysis.

Statistical analysis: Data were subjected to Analysis of Variance (ANOVA) according to Steel and Torrie[8] and the differences between means were tested using Duncan's multiple range test.

RESULTS AND DISCUSSION

The effect of dietary levels of chickpeas seeds on overall performance of layers shown in Table 3 indicated that the overall feed intake for the 8 weeks of experimental and daily intake of feed per hen were differ between treatment groups. Feed intake was consistently declined with increasing dietary levels of chickpeas seeds in comparison with the control diet, the hens consumed significantly ($p>0.05$) less feed when the diets contained 10 and 15% raw chickpeas seed this result was

Table 3: Overall performance of laying hens (30-37th) weeks of age as affected by dietary inclusion of raw (*Cicer arietinum* L.)

	Levels of seeds (%)					
Parameters	0	0.5	1	1.5	SEM	Sig.
Feed intake (g/hen/8week)	6284[a]	6100[ab]	5129[c]	5500[bc]	231.95	S
Feed intake (g/hen/day)	112.21[a]	108.9[ab]	91.59[c]	98.22[bc]	4.142	S
Total laid eggs (egg/hen/8week)	42.90	39.90	38.70	40.30	1.97	NS
Hen-day egg production (%)	76.61	71.25	69.11	71.96	3.51	NS
FCR (Kg feed/dozens of egg)	1.47	1.54	1.33	1.37	0.064	NS
Body weight change (g)	-5.33	5.44	67.06	-6.25	33.74	NS

[a, b] mean with different superscripts along rows are significantly different ($p<0.05$), values are means of 4 replicates, 5 birds each, (n = 20), NS = Non-significant difference ($p>0.05$), SEM = Standard Error of treatment Means

Table 4: Effect of dietary raw chickpeas seeds on serum constituents of laying hens

	Parameters levels of chickpeas seed (%)					
Variables	0	5	10	15	SEM	Sig.
Glucose (mg dL^{-1})	162.88	159.75	170.0	180.13	12.49	NS
Total protein (g dL^{-1})	3.16	3.40	3.91	3.15	0.193	NS
Triglyceride (mg dL^{-1})	86.63	92.38	72.13	90.13	12.24	
Cholesterol (mg dL^{-1})	130.3[b]	110[ab]	116.3[ab]	96.25[a]	14.17	S
Calcium (mg dL^{-1})	10.16	9.98	112.36	9.80	0.633	
Phosphorus (mg dL^{-1})	14.29	13.00	14.70	14.34	0.498	

[a,b]mean with different superscripts along rows are significantly different ($p<0.05$), values are means of 8blood sample, NS = Non-Significant difference ($p>0.05$), SEM = Standard Error of treatment Means

agreement[9] when use the same level of cow pea seed and disagree with Senkoylu *et al*.[10] when use different levels of soy pea he (SB) found no significant $p>0.05$ difference in feed intake between the control diet and that with 22% SB. However, increasing SB in the diets from 10-22% was significantly increased feed consumption. The pattern of feed intake indicated that the differences in feed consumption between the treatment groups were not likely to be due to the direct effects of SB inclusion levels in feed intake associated with the inclusion of chick pea seeds in layers diets may be due to some anti-nutritional factors such as trypsin inhibitors, protease inhibitors, haemagglutinins, tannin and phytate which lower the digestibility therefore reduce the consumption[11]. No different was observed among dietary treatments in FCR (kg feed/d). Mean values of external quality characteristics of eggs from 31st 38nd week of age layers fed dietary levels of chickpeas seeds revealed the dietary treatments had no effect on egg shape index. Egg weight, shell weight, shell thickness and shell percentage these results are in agreement with the data of Senkoylu *et al*.[10] egg mass and FCR were significantly improved with the FFSB diets. Particularly, improved FCR or cracked eggs percentages. Albumen height was not affected by the dietary treatments, suggesting better with the low addition level 10% than high addition levels of FFSB (16 and 22%). Unfortunately, we do not have any data regarding the None of the levels (0, 10, 16 and 22%) of dietary FFSB significantly $p>0.05$ affected either external or internal egg qualities (Table 4). Increasing the level of dietary FFSB from 0-22% did not significantly $p>0.05$ alter eggshell weight, eggshell thickness or checked that increased dietary FFSB had no adverse effect on albumen quality. Senkoylu *et al*.[10] he found no differences in egg production, feed intake, egg weight and shell quality with the diets of FFSB (with TMEn, 2,970 kcal kg^{-1} CP, 38.28%; ether extract, 18.78%) added at 0, 12.5, 17.5 and 22.5% which were fed to 42 and 80 week old groups of laying hens for 16 week with 128 hens per group (8 reps per diet per age) in which the laying hens breed was not indicated. Significant $p<0.05$ improvement in FCR (from 2.23-2.17) and an increase from 2.37-3.83% in the percentage of large eggs 66-70 g egg, albeit with no difference between the treatments in egg production 81.4 and 81.7% or feed intake (98 and 97 g/hen)[10] also Esonu *et al*.[1] reported when use the inclusion of soybean hull in the diet of laying birds up to 30% with or without safzyme® supplementation did not adversely affect performance, egg quality indices, carcass characteristics and hematology $p<0.05$ with respect to egg quality parameters, egg max length, egg max width, egg weight, egg shape index, shell surface, shell thickness, shell percentage weren't differing between treatments, however, higher shell weight was recorded for 10% chickpea compared to control diet and 5% chickpeas levels. No significant effect in, shell percentage, egg shape index, max length and max width throughout laying period from 31-37th week. egg weight, egg shell surface and shell weight was significantly increased at 3s5st and 37th weeks of age. Shell thickness was significantly higher at 31st week while it showed similar at 33, 35 and 37th week.

Regarding albumin measurements, albumin height, albumin weight and albumin percentage was not significantly differing among treatments. Haugh unit was no significantly affected by different dietary levels

Table 5: External egg quality of layers as affected by dietary raw chickpea

Treatment	Egg wight (g)	Max egg length (cm)	Max egg width (cm)	Egg shape index	Egg shell surface	Shell weight (g)	Shell (%)	Shell (mm) thickness
0%	56.450	55.440	42.620	0.0769	68.420	6.032^{a}	10.166	0.410
5%	57.780^{a}	55.750	43.080	0.7730	69.600	6.005^{a}	11.025	0.406
10%	56.670	55.490	43.900	0.7730	68.640	6.377^{b}	10.618	0.402
15%	56.780	55.770	43.560	0.7820	68.760	6.143^{ab}	10.809	0.392
Age (week)								
31	54.980^{a}	54.950	43.060	0.7840	67.210^{a}	5.725^{a}	10.420	0.421$_{a}$
33	56.470^{ab}	55.860	43.980	0.7700	68.470^{ab}	5.966^{ab}	10.550	0.397^{b}
35	57.800^{a}	55.660	43.040	0.7740	69.620^{b}	6.272$_{bc}$	10.850	0.396^{b}
37	58.420^{b}	55.990	43.080	0.7700	70.110^{b}	6.594^{c}	11.290	0.396^{b}
Pooled ±SEM	0.776	0.351	0.344	0.0060	0.671	0.115	0.142	0.000^{8}

$^{a, b}$means in the same column with different superscripts were significantly different (p<0.05), values are means of 4 replicates, 2 sample each (n = 32)

raw chickpeas seeds. These result agreements with Balaiel *et al*.[9] she found The effect of dietary levels of cowpea seeds on internal quality characteristics of eggs of 31-42nd week of age layers revealed that albumin height, albumin diameter, albumin index, yolk height, yolk diameter, yolk weight, yolk percentage and haugh unit did not appear to be affected by the dietary treatments.

Higher albumin height was recorded at 35th week. Comparable albumin weight was lower at 31st week and 33rd weeks then increased at 35th and 37th weeks. Albumin percentage was no significantly affected by different dietary levels raw chickpeas seeds while lower and comparable albumin percentage was noticed at 31st week. Haugh unit was significant affect by hen age, lower Haugh unit recorded at 31st week while higher Haugh unit was noticed at 35th week (Table 5).

Regarding yolk measurements, yolk color was affected significantly by dietary treatments was improved as level of raw chickpeas seed increased lower value recorded in control diet, a similar observation was report by Balaiel *et al*.[9] and Ciurescu and Pana[12] when used same level cowpea. Also yolk color affected by layer's age was improved at 31st week and 37th weeks than lower value at 33rd week and 35th weeks. Yolk height was higher for control and 5% diets and lower for 10 and 15% chickpeas diet. Yolk diameter, yolk weight and yolk percentage was no affected by dietary treatments. Diets 10% chickpeas showed lower yolk index comparable with other treatments they were the same value.

Yolk height significantly affected by layer's age, lower and comparable yolk height was noticed at week 31st and 33rd while higher and comparable was recorded at week 35th and 37th. Narrower yolk diameter was observed at age of 33, 35 and 37th weeks. Whereas, the wider yolk diameter was noticed at age of 31st week. Significantly increased of yolk index by increasing the age was recorded from 35-37th weeks of age, 33st week of age was recorded similar value to 33rd week of age. Yolk weight was no significantly affected by hen age. No

Table 6: Internal egg quality of layers as affected by dietary inclusion of raw chickpeas see

Age per week	Albumin height (mm)	Albumin weight (g)	Albumin (%)	Haugh unit
31	9.107^{a}	33.530^{ab}	61.120	95.860^{a}
33	9.450^{a}	35.290^{a}	62.390	97.420^{a}
35	10.290^{b}	36.390^{b}	62.920	100.700^{b}
37	9.676^{a}	36.360^{b}	62.090	97.990^{a}
Treatments				
0%	9.429	35.460	62.590	97.180
5%	9.841	36.180	62.580	98.800
10%	9.815	34.390	60.710	98.820
15%	9.442	35.570	62.620	97.190
Pooled±SEM	0.205	0.752	0. 936	0.951

$^{a, b}$mean of the same column with different superscripts were significantly different (p<0.05), values are means of 4 replicate, 2 sample each (n = 32), SEM = Standard Error of treatments Means

effect of layer's age on yolk percentage was recorded. Albumin yolk index was no affected by layer age. Serum constituent results was in Table 6-8. Serum total protein was not significantly p>0.05 affected by dietary treatments. The effect of different dietary levels of chickpeas seeds on plasma constituents of (31-37nd) week of age layer chickens. There was no significant p>0.05 dietary effect for all plasma constituents except for cholesterol. For this diameters, birds fed the control diet and those given 5% cowpea seeds were similar p>0.05 and they were significantly p<0.05 higher compared to other dietary treatments. The lowest value of cholesterol was significantly p<0.05 observed for birds received 15% chickpeas seeds this result disagree of Balaiel[13] she found lower cholesterol in control follow by 5% cow pea. Economic feasibility study based on production cost: it is very difficult to figure out the economic advantages of an ingredient as a practical value, because the price of feed ingredients and their substitutive feed ingredients changes all the time. With respect to total feed cost, higher total feed cost was noticed for chick peas s diets over control diet this may due to the cost of chickpeas. Best net profit was recorded for 10% chickpeas seed and control diet as it was attained higher revenue and lower feed cost.

Table 7: Internal egg quality of layers as affected by dietary inclusion of raw chickpeas seeds

Age per weeks	Yolk color	Yolk height (mm)	Yolk diameter (cm)	Yolk index	Yolk weight (g)	Yolk (%)	Albumin yolk index
31	1.25	17.89[a]	38.65[ab]	0.460[a]	14.81[a]	26.560	2.380[b]
33	1	18.17[ab]	38.07[a]	0.477_b	15.42[b]	27.270	2.240[a]
35	1	18.88[c]	38.18[a]	0.490[c]	15.68[b]	26.320	2.340[ab]
37	1	18.48[bc]	39.23[b]	0.471[ab]	15.59[b]	26.760	2.320[ab]
Treatments							
0%	1	18.55[b]	38.79[b]	0.478_{ab}	15.19	26.195[a]	2.380[b]
0.5%	1.09	18.28[ab]	38.06[a]	0.480[b]	15.52	27.427[b]	2.240[a]
1%	1.06	18.56[b]	38.62[ab]	0.480[b]	15.52	26.788[ab]	2.320[ab]
1.5%	1.09	18.05[a]	38.65[ab]	0.467[a]	15.27	26.520[ab]	2.330[ab]
Pooled±SEM	0.077	0.311	0.455	0.000[8]	0.393	0.630	0.084

[a, b]mean in the same column with different superscripts were significantly different ($p<0.05$), Values are means of 4 replicate, 2 sample each (n = 32), SEM = standard error of treatments means

Table 8: The feeding economics of experimental diets

	Chickpeas seed levels			
Items	A (0%)	B (5%)	C (10%)	D (15%)
Feed cost per bird (SDG)	11.43	11.80	11.26	11.76
Feed cost per bird ($)	4.15	4.29	4.09	4.28
Average productivity per(egg)	47.80	44.55	43.60	49.00
Total returns (SDG)per dozen	31.87	29.70	29.07	32.67
Total returns per dozen ($)	11.59	10.80	10.57	11.88
Total cost per bird (SDG)	14.43	14.80	14.26	14.76
Total cost per bird ($)	5.25	5.38	5.19	5.37
Net profit per bird (SDG)	4.69	3.02	3.18	4.84
Net profit per bird ($)	1.71	1.10	1.16	1.70

Rate: 1$ = 2.75 SDG, SDG: Sudanese pounds

CONCLUSION

In general, raw chickpeas can be used in poultry diets, at inclusion levels up to 15% to support growth and egg production without any detrimental effects on birds. Higher inclusion levels of chickpeas in poultry diets can be used after the removal of the containing anti-nutritional factors, using heat treatment that improves chickpeas nutritional value.

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