

Original Research Article

Effects of soyabean oil and garlic-in-water supplementation on performance, carcass trait, organs weight, haematology, and serum cholesterol content of broiler chickens

Abstract

*In a trial lasting four weeks, 160 four-week old Arbor acre chickens were used to assess the effect of soyabean oil and garlic (*Allium sativum*) in-water on performance, carcass characteristics, organs weight, haematological variables and serum cholesterol content of broiler birds. They were allotted to 4 treatments of 10 birds (5 males and 5 females) per replicate in a 2×2 factorial arrangement in which there were two diets (non-soyabean oil and soyabean oil diets) with or without garlic supplementation in drinking water. The final live weight of birds were significantly ($P<0.01$) increased by the dietary treatments with broilers fed soyabean oil-based diet having significantly ($P<0.05$) higher weight gain than those fed the non-soyabean oil diet. Also, birds without garlic supplementation consistently had higher weight ($P<0.01$) than those offered garlic in drinking water. The water intake of birds given water supplemented with garlic (5.54; 5.64 L/bird) was significantly ($P<0.05$) lower than those without garlic supplementation (5.95; 5.83 L/bird). The haematological variables, serum cholesterol content, carcass characteristics and relative organs weight of the chickens were not significant different ($P>0.05$). The interactions of dietary oil supplementation and garlic-in-water was not significant ($P>0.05$) for all measured indices. Conclusively, supplementation of diet with soyabean oil led to better broiler performance and garlic-in-water failed to neither lower abdominal fat deposition nor reduce serum cholesterol.*

Key words: *Broilers performance, Garlic-in-water supplementation, Serum cholesterol, Relative organs weight and abdominal fat, Primal cuts*

Introduction

The poor performance of livestock in Africa was largely adduced to inadequate and imbalanced nutrition, high price and poor quality feeds and inefficiency in production and distribution in the feed industry which has greatly reduced animal protein supply ⁽¹⁾.

Currently, healthy eating trend is in favour of natural products. Natural feeding supplements such as plant oils like soyabean oil with low fat content and perceived growth-enhancing herbs are commonly used by poultry producers to improve performance. Soyabean oil is known to contain high proportions of unsaturated fatty acids which are believed to reduce heart related diseases. One of the widely used natural supplements to maintain and improve health of humans is garlic ⁽²⁾. It serves as antioxidant, anti-ageing and antihypertensive ⁽³⁾. It has a strong stimulating effect on the immune system and aromatic oils present in it enhances bird's digestion ⁽⁴⁾.

Allicin is the major powerful active ingredient in garlic and its repulsive odour and pungent taste makes it however, not to be widely used by humans as food. Reports ⁽⁵⁾ that supplementary garlic at 500mg/kg feed in diets of broiler chickens had no adverse effect on performance characteristics, reduced belly fat deposition and also improved meat quality by reducing the production of toxic secondary lipids oxidation products, especially malonaldehyde. There was also similar report ⁽⁶⁾ which showed reduction in intramuscular fat of broilers fed crushed fresh garlic at 0.3% of the ration.

However, report (7) indicated that laborious processes were involved in preparation of garlic powder and its subsequent incorporation into feeds. Therefore, it is conceivable that the addition of garlic in drinking water of broilers could be a way of exploiting the natural potentials of garlic to humans through broiler meat since monogastric animals have the ability to incorporate dietary components directly into their tissues. This study was therefore aimed at evaluating the effects of soyabean oil and garlic-in-water supplementation on performance, carcass trait, organs weight, haematology, and serum cholesterol content of broiler chickens.

Materials and Methods

Fresh garlic bulbs were blended with water into garlic slurry every day for the experimental chickens at 1.8g/L of water. A total of 160 four-week old Abor acre broiler starter chicks were randomly distributed into 4 treatment groups of 10 birds (5 males and 5 females) per replicate in a 2×2 factorial experimental design in which there were 2 diets (non-soyabean oil and soyabean oil diets) with or without garlic supplementation in drinking water. Birds were placed on their respective experimental diets and fed *ad libitum* for four weeks during which weekly feed intake, water intake, weight changes and mortality were measured.

Two female broilers were randomly selected from each replicate and sacrificed by severing the carotid arteries with subsequent exsanguinations. Feathers were removed after scalding and the birds were cut opened, eviscerated, the internal organs harvested and separated. The live weight, bled weight and dressed weight were taken. Birds were carefully dissected in to primal cuts and each weighed and expressed as percentage of live weights. The internal organs and abdominal fat were also weighed and the weights expressed as percentage of live weights of the birds.

Blood samples were obtained from the jugular vein of two birds per replicate at the end of four weeks of feeding with syringe and needle into bottles containing anticoagulant (ethylene diamine tetra acetate; EDTA) for haematological samples while those for serum cholesterol were collected in bottles without EDTA. Serum was separated from the clotted blood and centrifuged into clean bottles. Determination of haemoglobin concentration using cyanomethaemoglobin method and packed cell volume was as described (8). Red blood cell count was by haemocytometer method (9). Total leucocytes counts were determined using Neubauer haemocytometer after appropriate dilution. Blood constants (mean cell volume, mean cell haemoglobin, mean cell haemoglobin concentration) were calculated using appropriate formulae (10). Serum Total cholesterol concentrations was determined by enzymatic methods (11). Feed and garlic samples were analysed (12).

Data were analysed using Minitab Statistical Package (v.10.2, Minitab Inc. USA) and significant differences compared using the Duncan multiple range test of the same package.

Table 1: Gross composition (%) of experimental diets

Ingredients	Dts	
	Non-soyabean oil	Soyabean oil
Maize	48.00	40.00
Maize offal	15.00	18.00

Brewer's dried grain	5.25	8.25
Soya bean oil	-	2.00
Others*	31.75	33.75
Total	100.00	100.00
Calculated		
Crude Protein %	19.02	19.80
ME kcal/kg	2911.40	2941.60
Analyzed (%)		
Crude Protein	19.41	19.52
Crude fibre	5.85	6.05

88 Others*: Soyabeans meal=14.00%, groundnut cake=14.00%, bone meal=2.00%,
 89 limestone=0.50%, salt=0.50%, premix=0.25%, methionine=0.30%, lysine=0.20%
 90

91 Results and Discussion

92 The proximate composition of garlic and experimental diets as shown in Table 2 revealed that
 93 the crude fibre content of garlic was 2.40% which is similar to the value of 2.10% crude fibre
 94 reported for garlic ⁽¹³⁾. The crude protein (CP) content of the garlic was 20.03%. Earlier
 95 documentation by ⁽¹⁴⁾ and ⁽¹³⁾ indicated CP values of 17.35% and 15.30% respectively for
 96 garlic. The calculated crude protein of the finisher non-soyabean oil diet (19.62%) and
 97 soyabean oil diet (19.80%) in Table 2 were similar to the analyzed crude protein of 19.41%
 98 and 19.52% for non-soyabean oil and soyabean oil diets respectively.

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Table 2: Proximate composition of garlic and experimental diets (%)

Composition (%)	Garlic	Starter diet	Finisher diets	
			Non-soyabean oil	Soyabean oil

Dry matter	31.55	87.44	92.73	91.87
Crude protein	20.03	23.01	19.41	19.52
Crude fibre	2.40	4.5	5.85	6.05
Ether extract	1.26	4.10	5.71	7.43
Ash	1.30	5.28	7.98	7.55
Nitrogen free extract	6.56	50.47	53.78	51.32

Table 3 shows the final live weight of the birds and total weight gain were significantly ($P<0.01$) affected by the dietary treatments with broilers fed soyabean oil-based diet having significantly ($P<0.05$) higher weight gain than those fed the non-soyabean oil diet which agreed with earlier report ⁽¹⁵⁾. Also, birds on without garlic supplementation consistently had higher values ($P<0.01$) than those offered garlic in drinking water which is consistent with earlier observation ⁽¹⁶⁾. However, in this current study, interactions between diets and garlic supplementation were not significant ($P>0.05$).

Similarly, the total weight gain was significantly influenced by diet ($P<0.05$) and garlic supplementation ($P<0.01$) but the interaction of the two factors was not significant ($P>0.05$). In addition, the feed intake of birds fed soyabean oil-based diet, though not significant ($P>0.05$), were slightly lower than those fed non-soyabean oil-based diet; while birds offered garlic-supplemented water had higher feed intake compared to those on no garlic supplementation which confirmed similar reported observation ⁽¹⁷⁾. However, the feed conversion ratio (FCR) was not significantly influenced by the diet, garlic supplementation and the interaction of the two factors but FCR values of birds fed soyabean oil-based diets (2.46 and 2.54) were lower than those fed non-soyabean oil-based diets (2.56 and 3.01) for non-garlic and garlic-in-water supplementation, respectively ($P<0.05$). Table 3 also shows that the water intake was significantly ($P<0.05$) influenced by garlic supplementation and not by diet and the interaction between two factors. The water intake of the experimental birds given water supplemented with garlic was significantly ($P<0.05$) lower than those offered water without garlic supplementation. This could be attributed to the pungent and repulsive odour of garlic which perhaps reduced the water intake. Also, apparent digestibility of crude protein (ADCP) was not significantly ($P>0.05$) influenced by the diet, garlic supplementation and the interaction of the factors.

Table 3: Performance of broiler fed diets containing soyabean oil with or without garlic-in-water supplementation

Diet	Non-soyabean oil		Soyabean oil		Statistical Significance		
	No	Yes	No	Yes	Diet	Garlic. Suppl.	DxG

Initial live wt. (kg/bird)	0.72±0.03	0.72±0.02	0.72±0.02	0.72±0.02	NS	NS	NS
Final live wt. (kg/bird)	2.37±0.06	2.25±0.03	2.39±0.03	2.36±0.04	**	**	NS
Total Weight gain (kg/bird)	1.64±0.06	1.44±0.12	1.67±0.03	1.63±0.03	*	**	NS
Feed Intake (kg/bird)	4.19±0.11	4.29±0.60	4.11±0.07	4.14±0.19	NS	NS	NS
FCR	2.56±0.12	3.01±0.62	2.46±0.04	2.54±0.15	NS	NS	NS
Water Intake (L/bird)	5.95±0.39	5.54±0.26	5.83±0.25	5.64±0.15	NS	*	NS
ADCP	83.99 ±6.04	77.91 ±16.02	69.39 ±10.34	70.38 ±14.64	NS	NS	NS

Mean ± Standard deviation; NS=Not significant ($P>0.05$), $*$ = $P<0.05$, $**$ = $P<0.001$; LW=live weight; FCR=Feed conversion ratio; ADCP=Apparent digestibility of crude protein; D×G=Interaction of diet & garlic supplementation.

Table 4 showed that the dressing percentage, eviscerated weight, drum stick, thigh and the abdominal fat were not significantly ($P>0.05$) influenced by diet, garlic supplementation and the interaction of the two factors which conformed to earlier observation⁽¹⁸⁾. Supplementary garlic-in-water significantly ($P<0.05$) increased the back weight of the chickens, while the breast of birds fed soyabean oil was significantly ($P<0.05$) higher than those fed non-soyabean oil. However, the drum stick and thigh were not significantly influenced ($P>0.05$) by the diet, garlic supplementation and the interaction of the two factors. Also, garlic-in-water supplementation only reduced abdominal fat deposition numerically from 19.15 to 18.92 and 19.75 to 18.38 g/kg live weight. This observation was contrary to the report on the likelihood of supplemental garlic in reducing fat deposition⁽¹⁹⁾.

Table 4: Carcass characteristics of broiler fed diets containing soyabean oil with or without garlic-in-water supplementation

Diet	Non-soyabean oil		Soyabean oil		Statistical Significance		
	Garlic	No	Yes	No	Yes	Diet	Garlic.

	Suppl.				Suppl.		
Dressing (%)	92.35	92.80	92.17	93.46	NS	NS	NS
Eviscerated (%)	79.27	78.57	79.76	80.73	NS	NS	NS
Back (g/kgLW)	160.78	179.40	165.01	181.50	NS	***	NS
Breast (g/kgLW)	203.04	194.00	212.59	213.81	*	NS	NS
Drumstick (g/kgLW)	104.66	99.60	100.00	99.78	NS	NS	NS
Thigh (g/kgLW)	111.10	106.47	112.61	110.76	NS	NS	NS
Abdominal fat (g/kgLW)	19.15	18.92	19.75	18.38	NS	NS	NS

Mean $\pm$ standard; NS= Not significant ($P>0.05$); $*$ = $P<0.05$; $***$ = $P<0.001$; D $\times$ G=Interaction of diet & garlic supplementation.

The results from table 5 showed that the diet, garlic supplementation and the interaction of both did not significantly ($P>0.05$) influenced the weights of proventriculus, gizzard, liver, spleen and pancreas. This study conformed to previous reports by authors (20, 18). However, the weight of heart was significantly ($P<0.05$) influenced by diets and not by garlic supplementation or the interactions of both. It was observed that the heart of birds fed soyabean oil diet had significantly ($P<0.05$) lower value (3.05 ± 0.43 g/kg live weight) than those of birds fed non-soyabean oil diet (4.03 ± 0.38 g/kg live weight). However, it was observed that the numerical relative weights of all the organs of birds fed soyabean oil were lower than those fed non-soyabean oil diet. Similar organ development was obtained for birds offered garlic or no garlic in drinking water.

Table 5: Organ weight (g/kg live weight) of broiler fed diets containing soyabean oil with or without garlic-in-water supplementation

Diet	Non-soyabean oil		Soyabean oil		Statistical Significance		
	Garlic Suppl.	No	Yes	No	Yes	Diet	Garlic. Suppl.
Proventriculus		3.84 ±0.44	3.61± 0.98	3.29 ±0.72	3.34 ±0.67	NS	NS
Gizzard		15.10 ±2.17	16.91 ±3.13	14.80 ±2.15	16.14 ±2.53	NS	NS
Liver		17.27 ±1.52	18.25 ±1.58	18.25 ±1.58	17.78 ±1.51	NS	NS
Heart		3.99 ±0.30	4.07 ±0.47	3.47 ±0.53	3.53 ±0.32	***	NS
Spleen		1.07 ±0.30	1.07 ±0.37	0.90 ±0.19	0.88 ±0.31	NS	NS
Pancreas		2.05 ±0.50	1.96 ±0.34	2.08 ±0.66	1.86 ±0.45	NS	NS

Mean ± standard deviation; NS=Not significant ($P>0.05$); **= $P<0.001$; D×G=Interaction of diet & garlic supplementation.

Table 6 also showed that the haematological variables and the serum cholesterol content of the chickens were not significantly ($p>0.05$) affected. The haematological values were within the reported range ⁽²¹⁾. Addition of soyabean oil to diets and garlic-in-water supplementation numerically lowered serum cholesterol level (140.9 vs 136.6; 145.8vs 130.4 mg/dl). Furthermore, the serum cholesterol level of birds offered supplementary garlic had lower numerical value though not statistically significant ($P>05$) compared to those given water without garlic supplementation in agreement with similar earlier observation ⁽²²⁾.

Table 6: Blood indices and serum cholesterol contents of broiler fed diets containing soyabean oil with or without garlic-in-water supplementation

Diet	Non-soyabean oil		Soyabean oil		Statistical Significance		
	Garlic Suppl.	No	Yes	No	Yes	Diet	Garlic. Suppl.
ESR (mm/hr)		3.00	2.56	2.50	3.00	NS	NS
PVC (%)		29.38	30.75	30.13	29.00	NS	NS
RBC ($\times 10^6 \text{mm}^3$)		1.93	2.10	2.01	1.96	NS	NS
Hb (g/100ml)		9.79	10.31	10.08	9.66	NS	NS
MCHC (%)		33.31	33.53	33.44	33.32	NS	NS
MCH (pg)		50.96	49.21	50.13	49.76	NS	NS
MCV (μ^3)		152.96	146.75	149.83	149.36	NS	NS
Serum cholesterol (mg/dl)		140.90	136.60	145.80	130.40	NS	NS

ESR=Erythrocyte sedimentation rate, PVC=Packed cell volume, RBC= Red blood cell, Hb= Haemoglobin, MCHC=Mean cell haemoglobin concentration, MCH= Mean cell haemoglobin, MCV= Mean cell volume; NS= Not significant; D×G=Interaction of diet & garlic supplementation.

Conclusion

The final live weight of broilers fed soyabean diet was significantly ($P<0.01$) increased. Relative breast ($P<0.05$) and back ($P<0.01$) weights were significantly improved by soyabean and garlic in drinking water respectively. Haematological parameters of broiler chickens were not influenced by soyabean oil and garlic-in-water supplementation. Therefore, supplementation of soyabean oil in the diet led to better broiler performance and garlic-in-water helped to reduce the abdominal fat deposit with a concomitant serum cholesterol reduction.

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