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Effect of long term feeding of raw and sun-dried garlic *(allium sativum)* **on performance and lipid metabolism of broiler chicks**

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Introduction

Cholesterol is an extremely important biological molecule that has roles in membrane structure as well as being a precursor for the synthesis of the steroid hormones and bile acids. Both dietary cholesterol and that synthesized de novo are transported through the circulation in lipoprotein particles. The same is true of cholesteryl esters, the form in which cholesterol is stored in cells.

The synthesis and utilization of cholesterol must be tightly regulated in order to prevent over-accumulation and abnormal deposition within the body. Of particular importance clinically is the abnormal deposition of cholesterol and cholesterol-rich lipoproteins in the coronary arteries. Such deposition, eventually leading to atherosclerosis, is the leading contributory factor in diseases of the coronary arteries.

Garlic (allium sativum) and its preparations have been widely recognized as agents for prevention of various metabolic disorders such as atherosclerosis, hyperlipidemia, thrombosis, hypertension and diabetes. Several clinical reports have shown that garlic has cholesterol-lowering effect in humans and animals due to the presence of sulphur- containing bioactive compounds in its homogenates (Silagy and Neil 1994, Neil et al 1996, Chowdhury et al 2002). Allicin has been reported as the principal compound in aqueous garlic extract or raw garlic homogenate responsible for this effect. When raw garlic bulb is chopped or crushed, the enzyme allinase activates alliin, a non-protein amino acid present in the intact garlic, to produce allicin (allyl 2-propenethiosulphinate or dially thiosulphinate). Other important sulphur- containing compounds present in garlic homogenates are allyl methyl thiosulphonate, I-propenyl allyl thiosulphonate and y-L-glutamyl-S-alkyl–L-cysteine (Banerjee Maulik 2002)

However, some reports suggest that not all preparations of garlic are hypocholesterolemic (Simon et al 1995, Berthold et. al 1998, McCrindle et al 1998). The reasons given for the different effects of garlic on lipid metabolism include the preparation methods, bioactive compounds in the various garlic preparations and the duration of the study (Amagase et al 2001). This study was therefore designed to investigate the effects of raw and sun-dried garlic on lipid metabolism and hematological parameters in broiler chicks

Materials and Methods.

Source and Preparation of Garlic

Locally produced garlic bulbs were purchased from a commercial market in Northern Nigeria and ground with the husk into a paste. A portion of the paste was thinly spread in a glass ware and sun-dried for two days and the dried substance was ground again to obtain dry garlic powder. The garlic paste and garlic powder were incorporated into broiler starter and finisher diets at 0, 1, 2, and 3% levels at the expense of wheat bran (inclusion level was calculated to exclude moisture content).. The composition of the starter's diet is shown in Table 1.

Feeding and Management of Birds.

One hundred and forty seven Anak day-old broiler chicks were randomly distributed into seven dietary treatments of twenty-one birds each. Each dietary treatment consisted of three replicates of seven birds each. The chicks were reared in deep litter with feed and water supplied ad-libitum. The management of the birds was as outlined by Oluyemi and Robert (1979). The trial lasted for 56 days.

Table 1: Gross Composition of Experimental Diets for Broiler Starter (g/100g)

Ingredients (%)	0% Powder (1)	Garlic1% Powder (2)	Garlic2% Powder (3)	Garlic3% Powder (4)	Garlic1% Paste (5)	Garlic2% Paste (6)	Garlic3% Paste (7)
Maize	51.0	52.0	52.5	53.0	52.0	52.5	53.0
PKC	8.0	6.0	5.0	3.5	6.0	5.0	3.5
Wheat Bran	4.0	3.0	2.0	1.0	3.0	2.0	1.0
GNC	10.0	11.0	11.0	11.5	11.0	11.0	11.5
Soya Bean	20.5	20.5	21	21	20.5	21	21
Sun-Dried Garlic	0	1	2	3	0	0	0
Ingredients*(%)	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Raw Garlic	0	0	0	0	1	2	3
M.E (kcal/kg)	2903.44	2901.98	2892.2	2880.6	2901.98	2892.2	2880.6
Protein (%)	22.49	22.51	22.42	22.34	22.51	22.42	22.34

*Ingredients: Fish Meal -3%, Bone Meal -1.5%, Oyster Shell -1.2%, Salt -0.25%, Premix - 0.25%, Methionine - 0.15%, Lysine

Experimental Parameters Measured

The weekly feed intake and weight gain were recorded. Feed conversion ratio was calculated during the 8 weeks experimental period.

Blood collection

Blood was collected through the jugular vein using needles and syringes from three birds per replicate on days 14, 28, 42 and 56 of the experimental period. Blood for analysis of haematological parameters were collected in EDTA bottles while the blood for analysis of serum lipids was collected into sterile sample tubes without anticoagulant. The serum was separated by centrifugation at 2000rpm for 10 minutes. The sera were stored at -20°C until further analysis

Analysis of serum lipids

The serum samples were analyzed for Total cholesterol, Triglycerides and High Density Lipoprotein using Randox kit. The Low Density Lipoprotein was calculated using Friedeward formula.

Analysis of Data

All data collected were subjected to analysis of variance of completely randomized design using the SAS (1999) package and the means were separated using Duncan multiple range test of the same software. Values are expressed as mean±SEM. The level of statistical significance was $p < 0.05$.

Results and Discussion

Broilers Performance

It was observed that inclusion of raw garlic paste and sun-dried garlic powder in the diets of starter and finisher broilers at 1, 2 and 3% had no significant ($P > 0.05$) effect on the feed intake, weight gain, feed conversion ratio and haematological parameters as averaged over the eight week period (Tables 2 and 3). This agrees with the report of Reddy et.al (1999) and Chowdhury et.al. (2002) who recorded no significant differences in the values of feed intake, weight gain and

feed efficiency when laying hens were fed 2, 4, 6, 8 and 10% of garlic. It was also observed in the current study that period did not have significant (P > 0.05) effect on feed intake, weight gain, feed conversion ratio.

Table 2: Influence of dietary garlic on feed intake, body weight gain and feed conversion ratio

	Treatments						
	1	2	3	4	5	6	7
Average. feed intake gm/bird/day)	77.9±13.03	78.4±10.27	85.4±2.88	86.2±6.73	82.6±2.44	82.8±7.62	90.0±3.77
Average. weight gain (gm/bird/day)	22.1±5.65	21.7 ±5.10	27.5±2.74	24.5±3.24	27.0±0.57	27.9±4.23	26.5±0.04
Feed conversion ratio	3.6±0.30	3.7±0.42	3.1±0.44	3.5±0.32	3.1±0.06	3.0±0.36	3.4±0.15

p >0.05 No significant difference

Serum Lipids

Table 4 shows the effect of feeding sun-dried garlic powder and raw garlic on serum lipids of broiler chicks. There was a significant (P> 0.05) decrease in the values of Total Cholesterol (TC), Triglycerides(TG) and Low Density Lipoprotein concentration (LDL) as the inclusion levels of both raw and sun-dried garlic increased in the diets. The highest reduction of TC was observed in birds fed 2% raw garlic. A similar pattern was observed in the values of TG and LDL. Myung et; al 1982, reported 30% reduction in plasma cholesterol when rats were fed diets supplemented with 2 or 3% garlic powder while Chowdhury et.al (2002) recorded 15, 28, 33 and 43% reduction in serum cholesterol when laying hens were fed 2, 4, 6, and 8% garlic paste respectively but no further reduction was observed when birds were fed 10% inclusion of garlic paste. A similar observation was made in the current study in which the inclusion of 2% of raw garlic and sun-dried garlic powder in broiler chick diets significantly (P< 0.05) reduced TC, TG and LDL concentrations while 3% raw or sun-dried garlic gave no further reduction.

Table 3: Effect of Age of birds on Haematological Parameters of Birds Fed various levels of raw and sun-dried Garlic

	Age (weeks)				P-value
	2	4	6	8	
Haemoglobin(g/dL)	8.5 ±0.38	8.7 ±0.38	8.7 ±0.33	9.6 ±0.09	0.000
PCV(%)	27.5 ±1.30	30.8 ±0.99	33.7 0.70	34.5 ±0.73	0.001
Red Blood Count($x10^6$/dL)	4.7 ±0.32	4.9±0.32	6.3±0.12	6.5±0.19	0.000
White Blood Count($x10^3$/dL)	10.1±0.63	10.2±0.63	12.4±0.57	12.9±0.45	0.000
Lymphocytes(%)	63.2±2.04	64.1±1.86	62.1±0.70	65.6±1.18	0.145
Neutrophils(%)	36.8±1.97	35.9±1.86	37.9±0.70	34.4±1.20	0.146

The significant reductions observed in Total Cholesterol (TC, Triglycerides (TG and Low Density Lipoprotein Concentration (LDL in this study were probably due to the effect of garlic on the activities of lipogenic and cholesterogenic enzymes such as malic enzyme, fatty acid synthase, glucose-6-phosphate dehydrogenase and 3-hydroxy-3-methyl-glutary-coA(HMG CoA reductase. Yu-Yan and Liu (2001 reported significant reductions in the activities of these hepatic enzymes in broiler birds fed raw garlic at varying levels. Chi et. al (1982 also reported that garlic increased the excretion of cholesterol, as manifested by enhanced excretion of acidic and neutral steroids, after feeding rat with garlic.

Table 4: Effect of sun-dried garlic powder and raw garlic on serum lipid

Parameters (mg/dL)	Treatments						
	1	2	3	4	5	6	7
Triglycerides	68.7 ± 19.96^a	63.3 ± 15.20^b	53.3 ± 18.85^d	56.8 ± 18.38^c	60.8 ± 20.02^b	56.8 ± 18.15^c	57.6 ± 18.21^c
Cholesterol	116.5 ± 6.69^a	$108.4\pm8.87^{b,c}$	105.4 ± 9.61^c	$106.4\pm8.43^{b,c}$	110.8 ± 6.28^b	96.1 ± 7.76^d	$106.4\pm10.51^{b,c}$
HDL-Cholesterol	25.3 ± 4.97^a	31.5 ± 5.37^b	$36.9\pm4.91^{d,e}$	$35.1\pm6.08^{c,d}$	32.1 ± 5.86^b	37.7 ± 5.95^e	34.8 ± 5.84^c
LDL-Cholesterol	77.5 ± 8.21^a	$64.2\pm9.17^{b,c}$	57.9 ± 11.10^d	$59.9\pm9.25^{c,d}$	66.9 ± 7.43^b	47.0 ± 6.92^e	$60.1\pm11.65^{c,d}$

Means with the same superscript (a,b,c,d are not significantly different at p value <0.05

The results obtained in the present study also showed that the inclusion of raw and sun-dried garlic significantly (P<0.005 increased the value of High Density Lipoprotein (HDL). Average values of 24.5, 45.8 and 38.7% increase were observed when birds were fed 1, 2 and 3% sun-dried garlic powder while 26.9, 49.01 and 37.5% increases were observed when birds were fed 1, 2, and 3% of raw garlic respectively.

Conclusion

This study showed that raw and sun-dried garlic powders exert hypocholesterolemic effect in broiler chicks but have no negative effect on the performance of birds.

References

Amagase H., Petesch. B.L.,Matsuura H., Kasuga S and Itakura Y. (2001) Intake of garlic and its bioactive components J. Nutr. 131: 955-962

Banerjee K. S. and Maulik, K. S. (2002) Effect of garlic on cardiovascular disorder : a review. Nutrition Journal 1:4.

Berthold H.K.and Sudhop T.(1998)Garlic preparations for prevention of atherosclerosis. Curr Opin Lipidol 9: 565-569

Chi, M.S., koh, E.T., Stewart, T.J. (1982) Effects of garlic on lipids metabolism in rats fed cholesterol or lard. J. Nutr. 112: 241-248

Chowdhury S.R., Chowdhury S.D.and Smth T.K. (2002) Effect of dietary garlic on cholesterol metabolism in laying hens. Poult. Sci. 81: 1856-1862.

Friedewald W.I., Levy R.I. And Fredrickson D.S,1972 estimation of the concentration of low density lipoprotein cholesterol without the use of the preparative ultracentrifugation Clin. Chem 18:499

McCrindle B.W., Helden E. and Conner W.T.(1998) Garlic extract therapy in children with hypercholesterolemia. Arch Pediatr Adolesc Med. 152: 1089-1094

Myung S.C., Eunsook T.K. Stewart T.Y. (1982) Effect of garlic on lipid metabolism in rats fed cholesterol or lard J. Nutr.112: 241-248

Neil H.A. Silagy C.A. Lancaster T. Hodgeman J. Vos K., Moore J.W., Jones L., Cahill J and Fowler G.H. (1996) Garlic powder in the treatment of moderate hyperlipidaemia: a controlled trial and meta-analysis. J.R.Coll. Physicians Lond. 30:329-334

Silagy C and Neil A.(1994) Garlic as a lipid lowering agent. A meta-analysis J.R.Coll. Physicians Lond.28: 39-45

Simons L.A., Balasubramanian S., Von Konigsmark M., Parfitt A., .Simons J., and Peters W.(1994) On the effect of garlic on plasma lipids and lipoproteins in mild hypercholesterolemia. Atherosclerosis. 113: 219-226

Yu-Yan Yeh and Liu L. 2001 Cholesterol lowering effect of garlic extracts and organosulphur compounds: Human and animal studies. J. Nutr. 131: 9895-9935