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EFFECT OF HERBAL EXTRACT SUPPLEMENTATIONS IN FEED ON SERUM AND EGGYOLK LIPID PROFILE IN JABALPUR COLOUR LAYER BIRDS

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ABSTRACT

The present study was conducted to assess the effects of ginger, cinnamon, chicory and stevia extract-supplemented feeds on lipid profile in serum and egg yolk of Jabalpur colour birds. Fifty four Jabalpur colour birds of 32 weeks age were randomly divided into 9 groups of 6 birds each. One group (control) was fed normal basal feed whereas rest groups were fed on feeds supplemented with alcoholic extracts of various herbs, separately, at two levels each [ginger, cinnamon and stevia extract mixed with feed @ 2.5 and 5.0 g kg^{-1} feed and chicory extract @ 1.25 and 2.5 g kg^{-1} feed]. Blood samples were collected on 0, 14^{th}, 28^{th}, 42^{nd} and 56^{th} day and serum analyzed for changes in various biochemical parameters. The serum lipid profile showed a decreasing trend on herbal supplementation as compared to control. The total lipid was low in birds fed chicory (2.5 g kg^{-1} feed) and cinnamon (5 g kg^{-1} feed) followed by ginger (5 g kg^{-1} feed) and cinnamon (2.5 g kg^{-1} feed). The serum cholesterol and triglycerides showed more decrease in cinnamon (5 g kg^{-1} feed) and chicory (2.5 g kg^{-1} feed) fed birds than other groups. The increase in mean HDL concentration was significant in birds fed cinnamon (2.5 g kg^{-1} feed), and stevia (5 g kg^{-1} feed) on 56^{th} day. Low LDL and VLDL were observed in birds fed cinnamon (5 g kg^{-1} feed). The lowest concentration of egg yolk lipid and egg yolk cholesterol was noticed on 56^{th} day in birds fed cinnamon (5 g kg^{-1} feed), however least egg yolk triglyceride was low in chicory (2.5 g kg^{-1} feed) and cinnamon (5 g kg^{-1} feed) fed birds.

Key words: Chicory, cholesterol, cinnamon, ginger, Jabalpur colour bird, total lipid, triglycerides, stevia

INTRODUCTION

Hyperglycaemia and hyperlipidemia are characterized by disturbance in carbohydrate, protein and lipid metabolism. Complications are caused by complex interactions of genetic and environmental factors and life-style choices. Individuals with hyperglycaemia commonly have increased level of triglycerides, low density lipoproteins (LDL) and total cholesterol and decreased high density

lipoproteins (HDL). Complications such as hyperglycaemia and hyperlipidemia have been reported in domestic and captive animals including monkeys, dogs, cats, sheep, pigs, cattle, bison, horses, tree shrew, dolphin and budgies (Clark, 2003). Since ancient times, plants have been an exemplary source of medicines (Bhandari and Grover, 2002). Functional and nutraceutical foods have gained popularity all over the globe due to their health enhancing potential. Ginger (*Zingiber officinale* Roscoe) continues to be used as an important dietary spice and herbal medicine worldwide. Gingerols, the major pungent component of ginger, are known to enhance the insulin secretion and glucose clearance to prevent other diabetes-related disorders (Clark, 2003). Similarly, chicory (*Cichorium intybus* L.), a woody perennial herbaceous plant that contains volatile oils has been found beneficial in decreasing glucose and lipid levels in diabetic patients (Ghamarian *et al*., 2012). Cinnamon (*Cinnamom verum* Presl.), a spice obtained from the inner bark trees, is used in both sweet and savoury foods. Cinnamon has potential role in the prevention of insulin resistance, metabolic syndrome, and type-2 diabetes (Bolin *et al*., 2010). Stevia (*Stevia rebaudiana* Bertoni), a natural herb, is a low calorie sweetener. The oral administration of ethanolic extracts of stevia decreases blood glucose levels in normal and diabetic animals (Shukla *et al*., 2011). In view of above, the present investigation was aimed to assess the effects of various herbs on serum lipid profile and eggyolk lipid profile for designing low cholesterol eggs.

MATERIALS AND METHODS

The study was conducted in September, 2012 in the Department of Poultry Science, Adhartal, Jabalpur (India). The ginger and cinnamon extracts were prepared by soaking 500 g powdered ginger stem and cinnamon bark, separately, in 2 L ethyl alcohol (90%) for overnight and then extracted till complete exhaustion by percolating several times with ethanol as a solvent. The solvent was evaporated at 50^{o}C by using rotavapour apparatus connected to a vacuum pump till a semisolid ethanolic extracts were obtained which were finally dried in vacuum desiccators (Shalaby and Hamowieh, 2010). In case of chichory, the whole plant was used for extract preparation with 80% ethanol and concentrated at 40^{o}C using a rotavapour and dried (Pushpuraj *et al*., 2007). In case of stevia, dried leaves (1.0 kg) were first defatted with *n*-hexane and then extracted with medium-polar extract using benzene: acetone in 1:1 (v/v) ratio. The extract was then distilled and simultaneously dried *in vacuo* using rotatory evaporator (Mishra *et al*., 2011).

Fifty four birds of Jabalpur colour breed of 32 weeks age were equally divided into 9 groups. All birds were provided basal diet having 2700 ME kcal kg^{-1} feed and 17% protein. The bird groups were fed with feeds supplemented with ginger, chicory, cinnamon and stevia extracts, separately, @ 2.5 and 5.0 g extract kg^{-1} feed, except chicory where extract was supplemented @ 1.25 and 2.5 g kg^{-1} feed. Control group birds were fed on basal diet without any supplementation. All the birds were kept in individual cages under standard management conditions. Blood (2 mL) was collected birds from wing vein in a sterile vial with aseptic precautions. The serum was separated for biochemical estimations on 0th, 14th, 28th, 42nd and 56th day of the experiment. Lipids were extracted from egg yolk as per the method of Folch *et al.* (1957) using chloroform: methanol mixture (2:1 v/v). Egg yolk (1 g) was mixed with 15 mL chloroform: methanol mixture (2:1) and kept for 6 hr with intermittent shaking at 30 min. intervals, for the extraction of lipids. Centrifugation was done at 2000 rpm for 10 min. and supernatant collected. The same procedure was repeated with the leftover contents for further lipid extraction. Supernatant obtained was mixed with the above lipid extract in a measuring cylinder. Normal saline (5 mL) was added to the supernatant and kept undisturbed until 2 distinct layers *viz*., upper aqueous and lower organic layers were visible. Upper aqueous layer was aspirated out and then volume of organic layer made to 40 mL with chloroform: methanol mixture. This extract was used for the estimation of total lipids, cholesterol and

triglycerides. The total lipids were estimated by the method of Frings *et al.* (1972). Cholesterol, triglycerides, HDL cholesterol (Erba kits), LDL cholesterol and VLDL was estimated by using the formula given by Friedwald *et al*. (1972). Data was analyzed using hierarchial analysis of variance (Steel and Torrie, 1992).

RESULTS AND DISCUSSION

The total serum lipid content decreased significantly with the feeding of herbal extract supplemented feeds to the birds for longer time (Table 1). The lowest content (47.5%) was recorded in birds fed with 2.5 g chicory kg^{-1} feed followed by birds fed with 5 g cinnamon kg^{-1} feed (47%), 5 g ginger kg^{-1} feed (40%) and 2.5 g cinnamon kg^{-1} feed (39.7%). Supplementation of extracts to feeds decreased cholesterol level in birds significantly upto 56^{th} day in all the treatment groups. Cinnamon @ 5 g kg^{-1} feed (45.7%) and chicory @ 2.5g kg^{-1} feed (44.1%) caused significant reduction in cholesterol on 56^{th} day. A significant reduction was also observed in ginger and stevia treated groups on 56^{th} day. All the treatment groups showed significant reduction in serum triglycerides. Significantly lowest serum triglycerides were observed in birds fed with 5 g cinnamon kg^{-1} feed (37%) from 28^{th} to 56^{th} day, followed by ginger @ 5 g kg^{-1} feed (33%) on 56^{th} day.

Table 1: Changes in serum total lipids, total cholesterol and triglycerides in birds fed on feeds supplemented with ginger, chicory, cinnamon and stevia extracts at different time intervals

Parameters	Herbal extract (g kg^{-1} feed)		Duration				
			0 d	14 d	28 d	42 d	56 d
Serum total lipids (mg dL^{-1})	Control		765.4±12.1	771.9^{3}±11.1	779.0^{3}±11.4	786.9^{4}±11.8	791.3^{4}±12.0
	Ginger	2.5	784.9^{e}±14.1	$721.2^{d;2}$±12.5	$655.6^{c;2}$±14.4	$603.4^{b;3}$±12.2	$540.8^{a;3}$±14.3
		5.0	765.1^{e}±10.3	$670.9^{d;1}$±12.1	$597.0^{c;1,2}$±13.0	$533.7^{b;1,2}$±13.8	$461.1^{a;2}$±14.3
	Chicory	1.25	774.5^{e}±13.3	$714.8^{d;2}$±14.5	$646.7^{c;2}$±12.5	$581.1^{b;2,3}$±11.5	$485.0^{a;2,3}$±9.6
		2.5	794.1^{e}±17.5	$698.6^{c;1,2}$±15.5	$597.1^{c;1,2}$±13.0	$503.3^{b;1}$±10.9	$417.8^{a;1}$±12.7
	Cinnamon	2.5	797.5^{c}±14.0	$714.6^{bc;1}$±11.3	$640.1^{b;2}$±17.5	$549.0^{ab;2}$±9.2	$476.2^{a;2}$±12.0
		5.0	787.0^{e}±10.5	$687.5^{d;1,2}$±12.3	$582.2^{c;1}$±13.5	$501.8^{b;1}$±10.6	$417.8^{a;1,2}$±10.9
	Stevia	2.5	793.6^{e}±9.5	$715.2^{d;2}$±13.3	$630.9^{c;2}$±14.8	$560.7^{b;2,3}$±12.9	$501.4^{a;2,3}$±13.1
		5.0	799.4^{e}±16.3	$716.0^{d;2}$±14.4	$634.9^{c;2}$±16.2	$561.7^{b;2,3}$±12.5	$496.1^{a;2,3}$±10.6
Serum total cholesterol (mg dL^{-1})	Control		179.5±6.2	181.7^{2}±6.0	180.6^{2}±5.8	$181.9^{1,3}$±6.2	182.0^{3}±5.4
	Ginger	2.5	194.1^{c}±7.8	$174.5^{bc;1,2}$±7.5	$162.9^{b;1,2}$±7.3	$150.3^{a;2}$±7.0	$137.2^{a;2}$±6.5
		5.0	187.4^{c}±6.5	$167.7^{bc;1,2}$±6.6	$148.8^{b;1}$±6.2	$132.1^{a;1,2}$±5.6	$116.7^{a;1}$±6.7
	Chicory	1.25	184.6^{c}±7.4	$167.7^{bc;1,2}$±7.2	$152.2^{b;1}$±7.5	$140.1^{a;2}$±7.5	$128.9^{a;2}$±6.8
		2.5	186.8^{c}±6.5	$161.8^{bc;1}$±6.8	$144.4^{b;1}$±6.5	$121.3^{a;1}$±6.1	$104.4^{a;1}$±7.0
	Cinnamon	2.5	185.2^{b}±6.4	$170.4^{b;1,2}$±6.2	$155.8^{ab;1,2}$±6.0	$145.5^{ab;2}$±5.7	$124.9^{a;2}$±5.3
		5.0	185.5^{e}±5.6	$167.3^{d;1,2}$±6.2	$145.4^{c;1}$±6.8	$122.8^{b;1,2}$±7.1	$100.6^{a;1}$±6.4
	Stevia	2.5	190.1^{c}±6.4	$171.0^{c;1,2}$±6.6	$157.2^{bc;1,2}$±6.3	$149.3^{b;2}$±6.5	$140.6^{a;2}$±6.8
		5.0	192.9^{c}±6.3	$171.6^{b;1,2}$±6.3	$158.9^{b;1,2}$±6.3	$143.9^{ab;2}$±6.5	$134.7^{a;2}$±6.5
Serum triglycerides (mg dL^{-1})	Control		266.8±8.7	267.1±10.92	269.3^{2}±9.3	266.6^{2}±10.6	263.9^{3}±10.6
	Ginger	2.5	279.8^{c}±9.4	257.5^{bc}±9.5	$237.3^{b;1}$±9.5	$220.6^{ab;1,2}$±10.9	$200.5^{a;1,2}$±9.1
		5.0	286.7^{c}±10.5	264.7^{bc}±10.8	$242.9^{b;1,2}$±10.0	$219.2^{ab;1,2}$±9.3	$191.8^{a;1,2}$±7.9
	Chicory	1.25	288.9^{c}±8.6	267.7^{bc}±8.2	$250.8^{b;1,2}$±9.1	$224.1^{ab;1,2}$±8.4	$203.7^{a;1,2}$±8.3
		2.5	286.0^{c}±8.3	263.4^{bc}±.8.3	$241.4^{b;1,2}$±7.7	$218.7^{a;1,2}$±8.1	$194.1^{a;1,2}$±8.1
	Cinnamon	2.5	290.4^{b}±10.4	269.2^{b}±10.7	$248.76^{b;12}$±10.2	$224.1^{ab;1,2}$±8.0	$201.5^{a;1,2}$±9.0
		5.0	291.5^{c}±9.2	261.8^{bc}±8.6	$233.7^{b;1}$±8.2	$208.1^{ab;1}$±8.0	$183.4^{a;1}$±8.1
	Stevia	2.5	285.0^{c}±6.6	269.4^{bc}±6.4	$249.5^{b;1,2}$±.6.2	$233.1^{ab;2}$±7.1	$216.1^{a;2}$±7.1
		5.0	289.5^{c}±7.4	268.9^{bc}±7.3	$247.7^{b;1,2}$±7.7	$229.0^{ab;1,2}$±6.1	$207.0^{a;1,2}$±6.6

Means superscripted with different alphabets and numbers vary significantly ($P_{0.05}$) in a row or in a column.

A significant increase in mean HDL concentration was noticed in bird groups fed 2.5 g cinnamon kg^{-1} feed and stevia 5 g kg^{-1} feed on 56th day (Table 2). The variation was non-significant in other treatment groups. Serum LDL cholesterol was significantly reduced in all treatment groups upto 56th day. Lowest LDL cholesterol was recorded (48%) in cinnamon (2.5 g kg^{-1} feed) followed by ginger (5 g kg^{-1} feed) and chicory (2.5 g kg^{-1} feed) groups. Different herbal preparation reduced VLDL concentration significantly. VLDL decreased in cinnamon treatment from 14th day (5 g kg^{-1} feed) onward was lowest on 56th day with a reduction to the extent of 37%. Supplementation of ginger (5 g kg^{-1}) and chicory (2.5 g kg^{-1}) in feed significantly reduced VLDL as compared to other group on 56th day. Ginger acts as a hypolipidemic agent (Sharma *et al*., 1996) and prevented hyper-cholesterolemia and development of atherosclerosis in cholesterol-fed rabbits. Fuhrman *et al*. (2000), Akhani*et al*. (2004), Al-Amin *et al.* (2006) and Abd-Elraheem *et al.* (2009) have reported that ginger treatment significantly decreased serum glucose, cholesterol, triglycerides, LDL-cholesterol and VLDL-cholesterol.

The plasma HDL-cholesterol significantly increased in treatment groups (Table 2). Ugwuja *et al.* (2010) reported that plasma HDL-cholesterol was comparable among the animal groups while plasma total cholesterol, triglycerides and LDL-cholesterol were significantly ($P_{0.05}$) reduced on ginger treatment. Ginger is used for the treatment of liver disorders and is also capable of improving CCl_4 induced hyperlipidemia (Hassan and EL-Gendy, 2003). Further, the groups receiving ginger @ 0.1 and 0.2% of the diets showed better performance and serum profiles in broilers (Mohamed *et al.*, 2012).

Table 2: Changes in serum HDL, VDL and VLDL cholesterol in birds fed on ginger, chicory, cinnamon and stevia extract-supplemented feeds at different intervals and doses

Parameters	Herbal extract ($g\ kg^{-1}$ feed)		Duration				
			0 d	14 d	28 d	42 d	56 d
Serum HDL- Cholesterol ($mg\ dL^{-1}$)	Control		44.75±1.0	44.95±1.0	45.00^{1}±1.0	45.05^{1}±1.1	45.22^{1}±1.1
	Ginger	2.5	45.18±1.1	45.57±1.2	46.13^{1,2}±1.2	47.18^{1,2}±0.9	47.66^{1,2}±1.1
		5.0	45.75±0.9	46.35±1.0	46.88^{1,2}±1.0	48.40^{2}±1.0	48.90^{2}±1.0
	Chicory	1.25	46.13±0.7	46.68±0.6	47.11^{1,2}±0.7	47.60^{1,2}±0.6	48.00^{1,2}±0.9
		2.5	47.26±0.7	47.78±0.8	48.21^{2}±0.8	49.41^{2}±0.9	49.73^{2}±0.9
	Cinnamon	2.5	47.41±1.0	48.08±1.0	48.46^{2}±1.0	49.15^{2}±1.0	49.51^{2}±1.0
		5.0	45.70^{a}±1.4	46.25^{ab}±1.4	46.96$^{ab;1,2}$±1.4	48.51$^{ab;2}$±1.4	49.61$^{b;2}$±1.3
	Stevia	2.5	46.33±1.4	46.75±1.4	47.11^{1,2}±1.4	47.5^{1,2}±1.4	48.01^{2}±1.5
		5.0	45.91^{a}±1.3	46.73^{ab}±1.3	47.51$^{ab;1,2}$±1.2	49.15$^{b;2}$±1.2	50.51$^{b;2}$±1.2
Serum LDL- cholesterol ($mg\ dL^{-1}$)	Control		168.7±10.7	168.7±10.1	171.2±11.7	169.7^{2}±11.2	165.9^{2}±12.3
	Ginger	2.5	178.6^{b}±11.1	160.4^{b}±9.9	143.7^{ab}±11.5	129.3$^{ab;1,2}$±12.6	117.2$^{a;1,2}$±13.5
		5.0	182.9^{b}±12.1	165.6^{b}±12.0	148.0^{b}±11.6	126.1^{ab}±11.9	104.5$^{a;1}$±10.9
	Chicory	1.25	185.0^{b}±10.9	167.5^{b}±10.6	148.2^{b}±10.9	132.1$^{ab;1,2}$±10.9	114.6$^{a;1}$±11.1
		2.5	181.5^{b}±7.9	162.9^{b}±10.9	144.9^{b}±10.5	125.6$^{ab;1}$±12.2	105.8$^{a;1}$±9.4
	Cinnamon	2.5	184.9^{b}±11.8	167.3^{b}±12.1	150.5^{b}±12.01	129.4$^{ab;1,2}$±11.2	112.5$^{a;1}$±10.2
		5.0	187.5^{c}±9.2	163.2^{bc}±11.4	139.8^{b}±11.6	116.5^{ab}±11.8	97.3$^{a;1}$±11.7
	Stevia	2.5	181.6^{b}±9.0	169.4^{b}±11.4	152.5^{ab}±11.0	139.0$^{ab;1,2}$±11.8	124.9$^{a;1,2}$±14.2
		5.0	185.7^{b}±9.0	168.2^{b}±11.9	150.7^{b}±12.0	133.7$^{ab;1,2}$±11.1	115.1$^{a;1}$±11.1
Serum VLDL-cholesterol ($mg\ dL^{-1}$)	Control		53.23^{1}±1.3	53.41^{1}±1.9	54.02^{2}±1.3	53.31^{3}±1.4	52.77^{3}±1.4
	Ginger	2.5	55.96$^{c;1,2}$±1.8	51.48$^{c;1}$±1.7	47.45$^{bc;1,2}$±1.6	44.12$^{b;1,2}$±1.6	40.16$^{a;1,2}$±1.7
		5.0	57.33$^{c;2}$±1.6	52.93$^{c;1}$±1.6	48.56$^{bc;1,2}$±1.5	43.83$^{b;1,2}$±1.7	38.36$^{a;1}$±1.7
	Chicory	1.25	57.77$^{c;2}$±1.8	53.54$^{bc;1}$±1.8	48.82$^{b;1,2}$±1.8	44.80$^{ab;1,2}$±1.7	40.73$^{a;2}$±1.6
		2.5	57.20$^{c;1,2}$±1.7	52.67$^{b;1}$±1.6	48.27$^{bc;1,2}$±1.5	43.73$^{b;1,2}$±1.7	38.85$^{a;1,2}$±1.7
	Cinnamon	2.5	58.08$^{d;2}$±1.5	53.84$^{cd;1}$±1.3	49.74$^{c;1,2}$±1.4	44.81$^{b;1,2}$±1.8	40.28$^{a;1,2}$±1.6
		5.0	58.30$^{e;2}$±1.3	52.36$^{d;1}$±1.7	46.68$^{c;1}$±1.6	41.61$^{b;1}$±1.5	36.68$^{a;1}$±1.7
	Stevia	2.5	57.01$^{c;1,2}$±1.8	53.87$^{bc;1}$±1.7	49.90$^{b;1,2}$±1.8	46.61$^{ab;2}$±1.6	43.22$^{a;2}$±1.6
		5.0	57.90$^{c;2}$±1.6	53.78$^{c;1}$±1.6	49.54$^{bc;1,2}$±1.5	45.69$^{b;2}$±1.7	41.40$^{a;2}$±1.5

Means superscripted with different alphabets and numbers vary significantly (P<0.05) in a row or in a column.

Feeding of chicory roots decreased the levels of plasma glucose, cholesterol and LDL-cholesterol and also reduced liver cholesterol, triglyceride and total lipids of streptozotocin treated diabetic rats (Bothayna, 2000). The alcoholic extract of chicory leaf powder also increased HDL contents (Nessrein*et al.,* 2007). Pushparaj *et al.* (2007) observed that the daily administration of chicory extract (125 mg kg^{-1}) for 14 day to diabetic rats attenuated serum glucose by 20%, triglyceride by 91% and total cholesterol by 16%. Lowering the concentration of total cholesterol, triglyceride, LDL, VLDL while significant increase in HDL concentration was recorded on chicory feeding (Ahmed *et al.,* 2009).

Khan *et al.* (2003a) found that cinnamon improved glucose and lipid profile in type 2 diabetic persons. Feeding aqueous bark extract of cinnamon to streptozotocin (STZ)-induced type-I diabetic rats revealed that total cholesterol, triglyceride, LDL-cholesterol and VLDL-cholesterol levels decreased significantly by 12.5, 23.9, 15.0 and 20.0%, respectively, as compared to their initial values (Hassan *et al*., 2012). The extract increased HDL-cholesterol and tissue glycogen by 25.0 and 172.3%, respectively, in diabetic rats. Similar effects have been reported by Balasasirekha and Lakshmi (2009) due to cinnamon supplementation to hyperlipidemics. Cinnamon doses significantly reduced the mean fasting serum triglycerides, cholesterol and LDL in type 2 diabetic individuals with a non-significant increase in HDL concentration (Khan *et al*., 2003b). However, Mahmood *et al*. (2011) observed non-significant change in the level of lipid related parameter at lower doses.

Table 3: Changes in egg yolk total lipids, cholesterol and triglycerides in colour birds fed with ginger, chicory, cinnamon and stevia extract-supplemented feed at different intervals

Parameters	Herbal extracts (g kg^{-1} feed)		Duration				
			0 d	14 d	28 d	42 d	56 d
Egg-yolk total lipids (mg dL^{-1})	Control		$315.02^{a}\pm3.7$	$314.51^{a;5}\pm6.9$	$314.71^{a;5}\pm11.1$	$321.21^{b;5}\pm8.1$	$327.67^{b;3}\pm8.4$
	Ginger	2.5	$315.21^{e}\pm6.7$	$304.14^{d;4,5}\pm8.3$	$292.50^{c;4}\pm8.2$	$267.66^{b;4}\pm7.6$	$237.47^{a;3}\pm7.6$
		5.0	$315.01^{e}\pm7.2$	$297.03^{d;3,4}\pm6.2$	$278.63^{c;3}\pm7.2$	$251.74^{b;3}\pm7.4$	$234.57^{a;3}\pm7.3$
	Chicory	1.25	$315.01^{e}\pm6.9$	$303.95^{d;4,5}\pm6.7$	$289.67^{c;4}\pm6.9$	$273.17^{b;4}\pm6.6$	$234.30^{a;3}\pm8.1$
		2.5	$314.41^{e}\pm7.0$	$295.68^{d;3}\pm6.8$	$272.72^{c;2}\pm6.6$	$236.92^{b;1,2}\pm8.2$	$220.48^{a;2}\pm7.3$
	Cinnamon	2.5	$313.86^{c}\pm6.9$	$289.99^{bc;2}\pm8.8$	$270.73^{b;2}\pm7.6$	$242.12^{ab;2}\pm8.0$	$223.63^{a;2}\pm7.1$
		5.0	$316.22^{e}\pm7.3$	$284.41^{d;1}\pm7.2$	$263.76^{c;1}\pm7.5$	$232.95^{b;1}\pm7.5$	$200.81^{a;1}\pm8.5$
	Stevia	2.5	$314.01^{e}\pm7.3$	$301.87^{d;4}\pm6.4$	$278.83^{c;3}\pm6.2$	$252.60^{b;3}\pm7.0$	$234.95^{a;3}\pm7.0$
		5.0	$315.38^{e}\pm6.8$	$295.63^{d;3}\pm6.6$	$268.97^{c;2}\pm7.4$	$243.64^{b;2}\pm7.4$	$224.14^{a;2}\pm8.1$
Eggyolk cholesterol (mg dL^{-1})	Control		179.52 ± 6.2	$181.7^{2}\pm6.05$	$180.58^{2}\pm5.7$	$181.89^{1,3}\pm6.2$	$182.01^{3}\pm5.4$
	Ginger	2.5	$194.12^{c}\pm7.8$	$174.52^{bc;1,2}\pm7.5$	$162.95^{b;1,2}\pm7.3$	$150.36^{a;2}\pm7.0$	$137.23^{a;2}\pm6.4$
		5.0	$187.40^{c}\pm6.5$	$167.74^{bc;1,2}\pm6.6$	$148.79^{b;1}\pm6.2$	$132.12^{a;1,2}\pm5.6$	$116.67^{a;1}\pm6.7$
	Chicory	1.25	$184.60^{c}\pm7.4$	$167.75^{bc;1,2}\pm7.2$	$152.16^{b;1}\pm7.5$	$140.14^{a;2}\pm7.5$	$128.92^{a;2}\pm6.7$
		2.5	$186.78^{c}\pm6.5$	$161.81^{bc;1}\pm6.8$	$144.38^{b;1}\pm6.5$	$121.36^{a;1}\pm6.1$	$104.38^{a;1}\pm7.0$
	Cinnamon	2.5	$185.26^{b}\pm6.4$	$170.42^{b;1,2}\pm6.2$	$155.83^{ab;1,2}\pm6.0$	$145.49^{ab;2}\pm5.7$	$124.92^{a;2}\pm5.3$
		5.0	$185.52^{e}\pm5.6$	$167.29^{d;1,2}\pm6.2$	$145.45^{c;1}\pm6.8$	$122.79^{b;1,2}\pm7.1$	$100.56^{a;1}\pm6.4$
	Stevia	2.5	$190.06^{c}\pm6.4$	$171.02^{c;1,2}\pm6.6$	$157.19^{bc;1,2}\pm6.3$	$149.27^{b;2}\pm6.5$	$140.65^{a;2}\pm6.8$
		5.0	$192.90^{c}\pm6.3$	$171.65^{b;1,2}\pm6.3$	$158.92^{b;1,2}\pm6.3$	$143.88^{ab;2}\pm6.5$	$134.74^{a;2}\pm6.5$
Eggyolk triglycerides (mg dL^{-1})	Control		183.11 ± 6.4	183.32 ± 6.4	$183.03^{2}\pm6.7$	$183.93^{2}\pm6.8$	$184.60^{2}\pm6.90$
	Ginger	2.5	$185.37^{b}\pm6.8$	$174.15^{b}\pm7.3$	$165^{ab;1,2}\pm7.0$	$156.9^{ab;1,2}\pm6.8$	$152.87^{a;1}\pm7.2$
		5.0	$180.60^{b}\pm7.0$	$173.60^{b}\pm7.7$	$164.20^{ab;1,2}\pm7.2$	$151.43^{a;1}\pm6.4$	$144.60^{a;1}\pm7.1$
	Chicory	1.25	$185.67^{b}\pm7.3$	$174.96^{b}\pm6.5$	$163.35^{ab;1,2}\pm7.1$	$156.22^{a;1,2}\pm7.5$	$149.79^{a;1}\pm7.3$
		2.5	$184.78^{b}\pm6.6$	$172.84^{b}\pm6.6$	$160.72^{ab;1,2}\pm7.0$	$153.14^{ab;1}\pm7.6$	$141.84^{a;1}\pm6.7$
	Cinnamon	2.5	$185.02^{b}\pm6.9$	$175.43^{b}\pm6.7$	$164.1^{ab;1,2}\pm5.1$	$154.19^{ab;1}\pm7.0$	$149.36^{a;1}\pm7.0$
		5.0	$182.75^{b}\pm7.2$	$170.54^{b}\pm6.8$	$160.18^{ab;1}\pm7.0$	$149.55^{ab;1}\pm7.7$	$141.39^{a;1}\pm7.5$
	Stevia	2.5	$183.86^{b}\pm6.4$	$173.86^{b}\pm6.6$	$166.09^{ab;1,2}\pm7.6$	$158.01^{ab;1,2}\pm7.0$	$151.67^{a;1}\pm6.9$
		5.0	$183.79^{b}\pm6.2$	$175.03^{b}\pm7.5$	$163.52^{ab;1,2}\pm7.2$	$155.93^{ab;1,2}\pm6.0$	$146.32^{a;1}\pm6.9$

Means superscripted with different alphabets and numbers vary significantly ($P<0.05$) in a row or in a column.

Consumption of stevia extract reduced the levels of cholesterol, triglyceride, LDL-C significantly while an increased in HDL-C in hypercholesterol-emic women (Sharma *et al.,* 2009) and reversed the effects of diabetes on reducing glucose, LDL-cholesterol and triacylglycerol levels (Junbi and Amer, 2010) and decreased the abdominal fat (Atteh *et al.,* 2012) Total egg yolk lipid content decreased significantly in every interval when supplemented with herbal drugs. The significant lowest concentration of eggyolk lipid was noticed at day 56 in cinnamon (5g kg^{-1} feed) supplemented feed group with 36.4% reduction, which was followed by chicory (2.5g kg^{-1} feed) and Stevia (5g kg^{-1} feed) with percentage reduction of 29.8% and 28.93%, respectively. Hebbar (2010) also found reduction in egg yolk total lipids in adult layer birds on 56 days of feeding dietary supplementations consisting of five plants, *A. sativum, C. cyminum, T. arjuna, T. cinnamon* and *T. cordifolia* in the ratio of 3:2:2:2:1. Similar findings were reported on feeding garlic oil and black cumin oil Shraddha (*et al.,* 2013) and aloe vera (Sinha, 2012). Egg lipids are confined to the yolk and account for about 30% of yolk fresh weight and 60% of yolk dry matter (Leskanish and Noble, 1997).

The egg yolk cholesterol estimates showed lowest concentration in cinnamon (5 g kg^{-1} feed) on day 56 of treatment with 37.61% reduction which was followed by cinnamon (2.5 g kg^{-1} feed) which resulted in 34.47% reduction, however all groups supplements with herbal drugs reduced cholesterol content significantly. Our results which showed reduction in cholesterol content was found cordinal with trend recorded on supplementations garlic oil and cumin oil (Shraddha *et al*., 2013); fenugreek and Banaba (Singh, 2012).Among the sources of cholesterol, egg is the major source of cholesterol in human diet (Beynen and Katan,1989).It has also been reported that cholesterol esters are core components of triglyceride rich lipoproteins and are much more amiable to manipulation than non-esterified cholesterol (Leskanish and Noble, 1997).

All herbal treatments reduced eggyolk triglyceride content as the time of treatment progressed and least concentration was recorded in chicory (2.5 g kg^{-1} feed) and cinnamon (5 g kg^{-1} feed) with reduction percentage of 23.23 and 22.6, respectively; however lower value were also noticed in ginger and stevia extract supplementation as compared to control. These results are supported by the findings of Hebbar (2010) who reported 19.19% reduction in egg yolk triglycerides on supplementing the diet by a polyherbal preparation consisting of five plants, *A. sativum, C. cyminum, T. arjuna, T. cinnamon* and *T. cordifolia* on 56 days of treatment. Different constituents or fractions such as saponins, tannins, triterpines, alkaloids, flavonoids, glycosides, etc. are present in the various herbal plants which are responsible for their antidiabetic and hypolipidemic properties (Hossain*et al*., 2011). The decrease in serum cholesterol after herbal supplementation in rats was supported by mRNA expression of enzymes related to lipid metabolism assessed by Park and Cha (2010).

Conclusion: The herbal supplements such as ginger, cinnamon, chichory and stevia can be used to reduce the lipid profile parameters in serum as well as in eggyolk of birds in order to design the low cholesterol eggs for health benefits in human beings.

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