# Effect of feeding velvet beans *(Mucuna pruriens)* on the lipid profile of broiler chickens

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## Abstract

The effect of feeding velvet bean (*Mucuna pruriens*) meal on the lipid profile in broilers was investigated. Two hundred, 14 days old broiler chicks were randomly allocated to five dietary treatments in a completely randomized design and feeding continued for four weeks. Maize and soybean meal based control feed and four test diets prepared from the control feed by incorporating velvet beans at 10, 15, 20 and 25% levels served as five dietary treatments. Feed intake was unaffected by velvet beans. Serum total cholesterol level was lowered by 9.5, 9.7, 15 and 16% in birds fed with 10, 15, 20 and 25% velvet bean diets. Birds fed 25% VB diet showed an increase in HDL level by 8%. LDL level was lowered by 43.1, 36.5, 25 and 23.4%, respectively in birds fed with 25, 20, 15 and 10% velvet beans. Velvet beans reduced the serum triglyceride levels. Results suggest that Velvet beans contain a strong cholesterol lowering effect in broilers.
**Key words:** Velvet beans, broilers, cholesterol

## Introduction

Meat and other animal products can play a significant role in alleviating the nutritional status of the people. Meat is an excellent source of high-quality and readily digestible protein**.** They are also good sources of micronutrients (Layrisse et al., 1990; Bender, 1992).

Presence of cholesterol in meat and other animal originated foods is a main factor discouraging the consumption of such foods. Now a days, people are more concern about the nutritional quality and related possible health hazards of dietary components. Most of the people restrict eating meat due to the fear of having high cholesterol content in meat (Abeywardena, 2003). This situation has led to missing of an excellent source of nutrients in the diet thus causing protein malnutrition in Sri Lanka.

Therefore it is a timely need to reveal measures to produce meat with low cholesterol level as it will make meat more attractive to the people and hence meat consumption could be increased. It then will have a significant effect to reduce the protein malnutrition problem as well as to reduce the health hazards due to consumption of meat. One way of lowering meat cholesterol is to incorporate cholesterol reducing factors into the diets of meat producing animals.

Some of the studies done on velvet beans (*Mucuna pruriens*) have indicated a cholesterol lowering effect of velvet beans (Carew, 1998a; Del Carmen, 1999; Iauk, 1989 and Carew, 2003). However, it has not been investigated in detail so far.

Velvet bean is used as a cover crop, human food or as an animal feed in many areas of the world. It is found in some parts of Sri Lanka and consumed by local people. Though it can be grown very easily under the climatic conditions of the country (Ravindran, 1988), this valuable crop is not yet properly exploited in Sri Lanka. People who are traditionally consuming velvet beans have claimed for various medicinal properties of it. Therefore the present study was conducted to investigate whether velvet beans possess any cholesterol lowering effect and whether it can be used as a protein feed for broiler chickens.

**Materials and methods**

The study was conducted in the Sabaragamuwa University of Sri Lanka. Two hundred unsexed day-old broiler chicks of Hubbard strain were obtained from the hatchery of National Livestock Development Board, Miriswatta Farm. They were commonly brooded for 14 days in a floor brooder and fed on a commercial broiler starter feed ad *libitum* during brooding. On the 14 $^{th}$ day, chicks were divided into 20 groups of 10 and transferred to 20 deep litter pens. Five dietary treatments were assigned to 20 groups with 4 replicates per treatment according to a complete randomized design (CRD).

Dried, velvet bean seeds were collected from shops and farms in Balangoda, Pelmadulla, Godakawela and Ratnapura areas. The whole beans were heated by keeping in a laboratory oven at 130 $^{0}$C for 30 minutes as described by Carew et al. (2003). Seeds were then ground using a laboratory mill to pass through a 0.25 mm screen and stored in airtight polythene bags at room temperature until used for then trial. Samples of velvet beans were subjected to proximate analysis and the reference value of 2370 kcal/kg (Del Carmen et al., 1999) was used as the metabolizable energy of velvet bean. The reference values were also used for amino acids and mineral contents of velvet beans (Del Carmen et al., 1999) in formulating test diets.

**Table 1. Composition of experimental diets**

| | Level of velvet bean in the diet | | | | |
|---|---|---|---|---|---|
| **Ingredient (%)** | **0%** | **10%** | **15%** | **20%** | **25%** |
| Rice polish | 21.5 | 21.3 | 23 | 24 | 24 |
| Maize | 38 | 35.3 | 31 | 27.7 | 24 |
| Fish meal | 4 | 4 | 4 | 4.4 | 5.4 |
| Soybean meal | 20.3 | 19.4 | 18.5 | 17 | 14 |
| Coconut Poonac | 10 | 3.7 | 1.9 | 0 | 0 |
| Velvet beans | 0 | 10 | 15 | 20 | 25 |
| Calcium carbonate | 1.8 | 1.9 | 1.9 | 1.9 | 1.9 |
| Di-calcium phosphate(DCP) | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Lysine HCl | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| DL-Met | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Coconut oil | 3 | 3 | 3.3 | 3.6 | 4.3 |

| | | | | | |
|---|---|---|---|---|---|
| Salt | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Vitamin mineral premix | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Calculated nutrient levels (per kg):** | | | | | |
| Metabolizable energy (MJ) | 13.33 | 13.32 | 13.31 | 13.32 | 13.32 |
| Crude protein(g) | 200.32 | 200.18 | 200.22 | 200.32 | 200.24 |

A control diet based on maize and soybean meal was prepared to contain all the nutrients required by broiler finishers as recommended by NRC (1994). Four test diets were prepared by incorporating 10%, 15%, 20% and 25% velvet beans respectively to the control diet at the expense of soybean meal and coconut poonac (Table 1). Amounts of other ingredients were slightly adjusted to make the rations isoenergetic and isoproteic. Experimental diets in mash form were offered to birds *ad libitum* during 4 weeks. Birds had free access to drinking water all the time.

Group feed intake was recorded daily. Blood samples were collected from five randomly selected birds from each group on 21$^{st}$, 28$^{th}$, 35$^{th}$ days and at slaughter. They were collected by venupuncturing the wing vein of birds. Blood was collected to vacutainers with no additives for serum separation. The samples were stored at -20$^0$C until further analysis. Birds were slaughtered on 42 $^{nd}$ day by severing the jugular vein. Meat samples were obtained from the breast muscle and fat samples were obtained from the abdominal fat pad of three randomly selected eviscerated carcasses from each replicate group. They were stored in sealed, labelled polythene bags at -20$^0$C until further analysis. Blood samples at every week and meat and fat samples were subjected tolipid profile analysis (Total cholesterol, high density lipoproteins (HDL), low density lipoproteins (LDL) and Triglycerides) by enzymatic diagnostic kits (Diasys diagnostic kits). The cholesterol determination for each sample was made using the extraction procedure of Fisher and Leveille (1957). The cholesterol estimation was carried out according to the Liberman-Burchard method as described by Sabir et al. (2003).

Data were subjected to analysis of variance (ANOVA) with $p<0.05$ considered significant (SAS/SPSS, 2000). Duncan's Multiple Range Test (DMRT) (Duncan, 1955) was used to compare mean values.

**Results And Discussion**

The initial body weight of birds was similar in all treatment groups. The average feed intake during the trial period varied from 117.8 to 119.3 g/head/day without a significant difference ($p<0.05$) between treatments. Del Carmen *et al.* (1999) and Carew *et al.* (2003) found significantly reduced feed intake when raw velvet beans were introduced to broiler diets and it was partially but significantly reversed when velvet beans were heated before feeding indicating the anti-palatability factor was removed by heat treatment. Iyayi and Taiwo (2003) also found that incorporating heated velvet beans up to 33.3% level do not reduce the feed intake of broilers. Since heat treated velvet beans were used in the present

study, similar feed intake observed in all treatment groups agrees with the previous observations of Del Carmen *et al.* (1999), Carew *et al.* (2003) and Iyayi and Taiwo (2003).

**Serum lipid profile**

There was a significant negative linear correlation between the level of velvet beans in the diet and total cholesterol (r = 0.97), LDL (r = 0.97) and triglycerides (r = 0.97) concentration in serum. Serum HDL had a positive linear correlation (r = 0.77). As shown in Table 3, serum total cholesterol concentration was significantly lower ($p<0.05$) in birds who received velvet bean diets compared to the control group. Velvet beans at 20% and 25% reduced the serum total cholesterol by 15% and 16%, respectively. Total cholesterol was reduced by 9.6% up to 15% velvet beans in the diet. Similar cholesterol depressing effects due to feeding velvet beans in broilers have been observed by Carew *et al*. (1998a, 2002 and 2003). This is also in agreement with results reported on rats by Pant *et al*. (1968) and Iauk *et al*. (1989). Various effects on concentrations of insulin and glucagons (Beynen *et al.,* 1990; Ham *et al.,* 1993; Barath et al., 1990; Forsythe, 1986; Sanchez and Hubbard, 1991 and Scholz- Ahrens et al., 1990) have been reported due to feeding soy protein. Similar hormonal changes have been reported in rats after feeding velvet beans (Pant *et al.,* 1968; Iauk *et al.,* 1989). Sanchez and Hubbard (1991) found that the lower lysine: arginine ratio of soy protein decreases the secretion of insulin and increases the secretion of glucagon. As velvet bean also contains a similar lysine:arginine ratio, the same changes in insulin and glucagons in birds fed velvet beans can be expected. It is therefore suggested that lowering of insulin: glucagon ratio may have reduced cholesterol synthesis in birds and responsible for the hypocholesterolemic effect of velvet bean. Nagata et al. (1982) and Sugano et al. (1990) observed reduced serum cholesterol levels in rats fed soy proteins due to increased faecal steroid excretion, in particular bile acids. They found that this effect was partially caused by the binding of bile acids to soybean saponins. Similar mechanism can be expected in animals fed velvet beans, due to availability of saponins (Bressani, 2002).

**Table 3. Effect of dietary velvet beans on serum lipid profile and total cholesterol in meat and abdominal fat of broiler chickens (Mean ± SE).**

| Lipid fraction | Level of velvet beans in the diet | | | | |
|---|---|---|---|---|---|
| mg/dl | 0% | 10% | 15% | 20% | 25% |
| **Serum lipids:** | | | | | |
| **Total cholesterol** | 162.0±4.34$^{c}$ | 146.6±6.21$^{b}$ | 146.7±2.34$^{b}$ | 138.6±4.75$^{a}$ | 136.3±5.37$^{a}$ |
| **HDL** | 70.9±3.98$^{a}$ | 72.1±4.75$^{b}$ | 72.8±2.52$^{b}$ | 74.2±6.38$^{c}$ | 76.6±5.72$^{c}$ |
| **LDL** | 59.7±2.29$^{c}$ | 45.8±3.15$^{b}$ | 44.8±1.75$^{b}$ | 37.9±4.13$^{a}$ | 33.9±3.65$^{a}$ |
| **HDL/LDL ratio** | 1.2±0.53$^{a}$ | 1.6±0.59$^{b}$ | 1.6±1.87$^{b}$ | 2.0±1.12$^{c}$ | 2.3±0.95$^{c}$ |
| **Triglycerides** | 160.4±14.34$^{b}$ | 144.1±20.45$^{a}$ | 141.5±17.83$^{a}$ | 132.8±15.67$^{a}$ | 130.0±13.33$^{a}$ |
| **Total Cholesterol(mg/g) in:** | | | | | |
| **breast muscle** | 0.59±0.15$^{c}$ | 0.57±0.65$^{b}$ | 0.56±0.45$^{b}$ | 0.49±0.75$^{a}$ | 0.47±0.83$^{a}$ |
| **abdominal fat** | 0.90±0.16$^{c}$ | 0.87±0.71$^{b}$ | 0.85±0.23$^{b}$ | 0.80±0.57$^{a}$ | 0.79±0.71$^{a}$ |

a, b, c : Means with different superscripts in a row are significantly different ($p<0.05$).

All the birds that received velvet bean diets had significantly lower ($p<0.05$) levels of LDL concentrations compared to the control group and it was lowered by 43.1%, 36.5%, 25% and 23.4% respectively in birds fed with 25%, 20%, 15% and 10% velvet beans. Huff and Carrol (1980), Kim et al. (1980), Nagata et al. (1982), Thanaka et al. (1984), Van der Meer et al. (1988), Beynen *et al*. (1990) and Kirk et al.(1998) revealed that isoflavones in soy protein increase LDL receptor activity in animals and as a result, total and LDL cholesterol levels get decreased. Considering the same content of isoflavones in soybean and velvet beans (Bressani, 2002), similar mechanism can be expected with velvet beans too.

The serum HDL levels in birds fed with 20 and 25% of velvet beans were significantly higher ($p<0.05$) by 4.5% and 8% respectively as compared to the control group. 15% and 10% velvet bean diets increased the HDL level ($p<0.05$) by 2.6% and 1.7%, respectively compared to the control. The serum triglyceride concentration was lower ($p<0.05$) in all the birds fed velvet beans compared to the control group. But there was no significant ($p<0.05$) difference in serum triglyceride concentration among birds that received different levels of velvet beans. Khosla *et a*l. (1991) and Lovati *et al.*(1991 and 1992) reported that soy protein increases the removal of very low density lipoproteins (VLDL) from the blood. Composition of Velvet bean is also similar to that of soy protein (Carew et al., 2002). VLDL is the vehicles of transport of triglycerides in the body. Therefore removal of VLDL from the blood causes a reduction in triglyceride content as well. However according to the results, it is clear that the triglyceride lowering effect of velvet beans is similar up to 25% inclusion in the diet.

**Lipid profile in meat and fat**

The cholesterol content in broiler breast muscle was significantly lower ($p<0.05$) in birds fed with velvet bean diets than those on the control diet (Table 3). Compared to the control group, the total cholesterol contents in broiler meat of birds given 10%, 15%, 20% and 25% velvet beans were reduced by 4.1, 4.8, 17 and 20%, respectively showing a negative linear correlation ($r = 0.90$) between the two factors. This clearly shows the increasing hypocholesterolemic effect of velvet beans with increasing level of inclusion in the diet. The same pattern was observed in the cholesterol content of abdominal fat too. This effect could be a result of reduced cholesterol synthesis in the body due to hormonal changes caused by velvet beans.

**Conclusions**

It is concluded that heated velvet beans can be used as a source of protein in broiler diets up to 15% without affecting the feed intake. Velvet beans posses a strong cholesterol lowering effect which seems to be heat tolerant. It reduces total cholesterol, LDL and triglycerides while increasing HDL levels in broilers. This medicinal property of velvet beans will be of great interest to meat producers and consumers. Further studies are needed to test this effect on other meat producing animals and directly on humans.

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