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Evaluation of protein quality of seed materials of *Mucuna pruriens* as a feed ingredient for broiler birds

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Introduction

Soybean meal (SBM) and fishmeal were currently occupying a central role in the feedstuff of poultry birds. However, their inadequate supply leads to misappropriate increase in the price of the poultry feed and ultimately affects the growth of the poultry industry (UKACHUKWU, 2007). Hence, to meet the protein demands in the poultry industry, the recent research trends are being focused towards finding out an alternative/additional and economic protein source. In this connection, certain promising under-utilized legume grains have been received more attention and the research efforts are under-way on the possibilities of incorporation of such under-utilized legume grains as an alternative source of protein ingredient in the poultry feed (BRENES ET AL, 2002). Among the various under-utilized legumes, the velvet bean (VB) [*Mucuna pruriens* (L.) DC. var. *utilis* (Wall. ex Wight) Baker ex Burck] seeds merits a wider use as an alternative/additional protein source in many tropical countries (JANARDHANAN ET AL., 2003; PUGALENTHI ET AL., 2005).

Even though, few reports are available on the nutritional and antinutritional properties of VB seeds, the information regarding the suitable processing device for the utilization of velvet bean meal (VBM) as an alternative protein source in the poultry feed was found to be meager. Hence, the present study was carried out with a view to evaluate the growth performance of broiler birds fed with diets containing VBM as an alternative protein ingredient by replacing different levels of SBM at both starter and finisher phases to determine the suitable inclusion level of VBM as an alternative/additional and cost-effective protein source in the poultry feed.

Material and Methods

Collection of the seed sample

The seed materials of VB were collected from Mundanthurai, Tirunelveli District, Tamil Nadu, India.

Processing method

The whole seeds of VB were soaked in 0.2% $NaHCO_3$ solution (pH 8.6) for 4 h at room temperature (28 ± 2^{o}C) in the bean to $NaHCO_3$ solution ratio of 1:10 (w/v). After soaking, the seeds were autoclaved in distilled water at 103 x 10^3 Pa pressure (121^{o}C) for 30 min. then the seeds were rinsed with distilled water and dried at 55^{o}C for 6 h in a hot air oven. The processed as well as raw VB seeds were ground in a Willey Mill to 10 mm size and used for further analysis. The nutritional and antinutritional profiles were analyzed as per the methods described by VADIVEL AND PUGALENTHI (2010).

Poultry feeding trial

The VBM was included at 0, 7.85, 15.70, 23.56, 31.41 and 39.30% levels in the starter phase diets and 0, 5.49, 11.01, 16.54, 22.07 and 27.60% levels in the finisher diets by replacing the SBM in the experimental diets T1, T2, T3, T4, T5 and T6, respectively. These levels of inclusion

of VBM corresponds to the replacement of SBM proteins at protein at 0, 20, 40, 60, 80 and 100% levels in the starter and finisher phase broiler diets. A total number of 120 one-day-old commercial type male broiler birds (*Gallus domesticus*) were purchased from Shanthi Poultry Farm, Coimbatore, TN, India. These birds were maintained at Karpagam Animal House (Approved by Animal Ethical Committee, Government of India) and fed with a common proprietary feed (Hindustan Lever Ltd, Bangalore, India) initially for a period of 7 days. Then the seven-day-old birds with an initial body weight of 82 – 94 g were randomly allocated to six dietary treatments (T1 – T6) with four cages per treatment and five birds per cage (size 60 x 90 cm). Throughout the entire experiment, feed and water were given *ad libitum* on a daily basis. The feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR) and protein efficiency ratio (PER) were determined according to the methods explained by VADIVEL AND PUGALENTHI (2010).

Results and Discussion

Growth performance of broiler birds at starter phase

There was a significant level ($p < 0.05$) of difference in the FI values among the broiler birds fed with experimental diets T1-T6 (Table 1). The FI values demonstrated that the consumption of experimental diet was increased due to the inclusion of different levels of VBM. The BWG values of the broiler birds were not affected up to 40% level of replacement of SBM with VBM as a protein source. Nonetheless, if only the FCR and PER values were considered, SBM could be replaced up to 80% level with VBM, which raises the inclusion level of VBM up to 31.41%. However, results of the present study indicated that the VBM can possibly replace the SBM protein up to 40% level without any adverse effects on the weight gains of broiler birds at the starter phase. This replacement level translates to 15.7% inclusion of VBM in the starter broiler diet.

The regression analysis showed the existence of significant level of positive relationship in BWG and FCR with respect to FI, whereas the PER was negatively related to FI. Hence, the regression analysis clearly proved that the improvement on the levels of BWG and FCR of the broiler birds in T2 & T3 experimental groups were due to the consumption of starter phase poultry diets containing VBM as an alternative/additional protein ingredient by replacing 20 and 40% of SBM, respectively.

Table 1. Growth performance of the starter phase broiler birds fed with diets containing different levels of velvet bean meal (VBM).

Experimental diets	Feed intake (FI) (g/day)	Initial body weight (g)	Final body weight (g)	Body weight gain (BWG) (g/day)	Feed conversion ratio (FCR)	Protein efficiency ratio (PER)
T1	$72.39^{a} \pm 0.15$	$90.25^{a} \pm 0.24$	$876.20^{a} \pm 0.13$	$37.42^{a} \pm 0.28$	$1.93^{a} \pm 0.02$	$2.13^{a} \pm 0.12$
T2	$75.52^{b} \pm 0.11$	$82.40^{b} \pm 0.18$	$873.53^{b} \pm 0.11$	$37.61^{a} \pm 0.12$	$2.00^{a} \pm 0.31$	$2.05^{a} \pm 0.24$
T3	$77.13^{c} \pm 0.15$	$85.26^{c} \pm 0.16$	$869.22^{c} \pm 0.15$	$37.34^{a} \pm 0.27$	$2.06^{a} \pm 0.25$	$1.99^{a} \pm 0.28$
T4	$74.56^{d} \pm 0.26$	$89.35^{d} \pm 0.14$	$855.13^{d} \pm 0.21$	$36.48^{b} \pm 0.33$	$2.04^{a} \pm 0.15$	$2.01^{a} \pm 0.15$
T5	$78.52^{e} \pm 0.14$	$94.57^{e} \pm 0.23$	$840.36^{e} \pm 0.06$	$35.52^{c} \pm 0.14$	$2.21^{a} \pm 0.13$	$1.86^{a} \pm 0.24$
T6	$79.95^{f} \pm 0.24$	$86.41^{f} \pm 0.17$	$828.61^{f} \pm 0.22$	$35.30^{d} \pm 0.13$	$2.26^{b} \pm 0.05$	$1.82^{a} \pm 0.14$

[1]Values are mean and ± standard deviation of three separate determinations.

[2]Values in the same column with different roman superscript are significantly different ($p<0.05$).

Growth performance of broiler birds at finisher phase

A significant level of difference was noticed among the chickens fed with diets containing different levels of VBM with respect to FI at the finisher phase (Table 2). The FI level was found to be drastically increased in the poultry feed containing VBM by replacing higher level of SBM at 60% (T4), 80% (T5) and 100% (T6). Even though, a significant level of difference was noticed in the final body weight of the poultry birds, all the dietary treatments (T2-T6) resulted in better level of BWG, comparable with that of control (T1). Even, in the birds fed with experimental diet

T3 (containing VBM as a protein ingredient by replacing 40% of the SBM), the BWG was significantly higher than that of control.

Table 2. Growth performance of the finisher phase broiler birds fed with diets containing different levels of velvet bean meal (VBM).

Experimental diets	Feed intake (FI) (g/day)	Initial body weight (g)	Final body weight (g)	Body weight gain (BWG) (g/day)	Feed conversion ratio (FCR)	Protein efficiency ratio (PER)
T1	$118.37^{a} \pm 0.16$	$876.58^{a} \pm 0.13$	$1865.12^{a} \pm 0.13$	$47.09^{a} \pm 0.28$	$2.51^{a} \pm 0.02$	$1.97^{a} \pm 0.12$
T2	$120.27^{b} \pm 0.18$	$853.47^{b} \pm 0.11$	$1851.23^{b} \pm 0.11$	$47.52^{a} \pm 0.12$	$2.53^{a} \pm 0.31$	$1.96^{a} \pm 0.24$
T3	$121.70^{c} \pm 0.16$	$844.36^{c} \pm 0.15$	$1843.56^{c} \pm 0.15$	$47.57^{b} \pm 0.27$	$2.55^{a} \pm 0.25$	$1.94^{a} \pm 0.28$
T4	$124.13^{d} \pm 0.04$	$825.14^{d} \pm 0.21$	$1820.32^{d} \pm 0.21$	$47.38^{a} \pm 0.33$	$2.61^{a} \pm 0.15$	$1.89^{a} \pm 0.15$
T5	$127.05^{e} \pm 0.26$	$810.69^{e} \pm 0.06$	$1804.54^{e} \pm 0.06$	$47.33^{a} \pm 0.14$	$2.68^{a} \pm 0.13$	$1.85^{a} \pm 0.24$
T6	$132.54^{f} \pm 0.15$	$778.20^{f} \pm 0.22$	$1769.74^{f} \pm 0.22$	$47.19^{a} \pm 0.13$	$2.80^{a} \pm 0.05$	$1.77^{a} \pm 0.14$

[1]Values are mean and ± standard deviation of three separate determinations.
[2]Values in the same column with different roman superscript are significantly different ($p<0.05$).

When considering the FCR and PER, the VBM can replace SBM even up to 100% level. However, since there was a drastic increase in FI levels above the 40% level of replacement of SBM by the VBM, the poultry production cost will be increased. Hence, the VBM can be recommended as an alternative economic source of protein ingredient by replacing the SBM up to 40% level without any adverse effects on the growth performance of the finisher phase broiler birds. This 40% replacement corresponded to 11.01% inclusion of VBM in the broiler diets.
It was obvious from the regression analysis that the FI has positive relationship with BWG at significant level and negative relationship with respect to PER. Hence, the consumption of poultry diets T2 & T3 containing VBM as an alternative/additional protein ingredient by replacing 20 and 40% of SBM, respectively might be attributed the better BWG levels acquired by the broiler birds at finisher phase.

Conclusions and Outlook

The results of the present study revealed that processed VBM can replace the SBM protein up to 40% level as a cost-effective alternative/additional protein source in both starter and finisher phase poultry diets without any adverse effects on the growth performance of the broiler birds. Hence, after conducting a large-scale trial and extensive toxicological evaluation, VBM could be recommended as an alternative and economic source of protein ingredient in the poultry feed, which will reduce the over-dependence on the conventional legume proteins and also reduce the feed production cost to some extend and ultimately improves the growth of poultry industrial sector in many developing countries, including India.

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