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Effect of supplementing non-starch polysaccharide hydrolyzing enzymes in guar meal based diets on performance, carcass variables and bone mineralization in Vanaraja chicken

S.V. Rama Rao, B. Prakash*, M.V.L.N. Raju, A.K. Panda, O.K. Murthy

Project Directorate on Poultry, Indian Council of Agricultural Research, Rajendranagar, Hyderabad 500030, Andhra Pradesh, India

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ABSTRACT

The aim of the experiment was to find out the possibility of utilizing guar meal (GM) as a source of protein in Vanaraja chicken diet. In experiment-I, 432 one day-old Vanaraja chicks were distributed into 72 battery brooder pens (replicates) as per complete randomized design. The chicks received soybean meal (SBM) based control diet containing 10.9 MJ metabolizable energy (ME) and 200 g protein per kg. Another two basal diets (BD) containing two levels of GM (75 and 150 g/kg) were prepared with similar ME and protein levels of the control diet. The three diets were fed either without or with an enzyme premix (xylanase 3250, glucanase 1200, cellulase 890, mannanase 4000 and protease 4000 unit/kg diet) from 1 to 42 days of age. Inclusion of GM at 75 g/kg with or without enzymes supplementation resulted in similar body weight (BW) gain (BWG) and feed efficiency with that of control diet. However, supplementation of GM at 150 g/kg with or without enzyme premix ($P<0.01$) depressed the BWG and feed conversion ratio (FCR) at 21 days, but not at 42 days of age. In Experiment-II, 420 one day-old Vanaraja chicks were distributed randomly into 70 battery brooder pens having 7 treatments with 10 replicates. The chicks received SBM based control diet containing 10.9 MJ ME and 200 g protein/kg. Another BD containing 200 g/kg of GM was prepared with similar ME and protein level of the control diet. Further, five BDs with GM 200 g/kg diets were fed with incremental levels of enzyme premix. Inclusion of 200 g GM/kg without enzyme supplementation significantly ($P<0.01$) depressed the BWG and FCR. However, diet with incremental levels of enzyme supplements along with 200 g GM/kg appeared to have higher BW compared to the GM control diet at 42 days of age. Liver fat and protein were higher ($P<0.01$) in groups fed 200 g GM/kg supplemented diets compared to those fed SBM based control diet. These results indicated that, feeding chicks with 200 g GM/kg diet with incremental levels of enzyme supplements resulted in improved performance compared to other 200 g GM/kg supplemented dietary groups at 42 day of age. Therefore, it has been concluded that GM can be incorporated up to 150 g/kg in Vanaraja diet without affecting the performance at 42 days of age. Guar meal at 200 g/kg supplementation resulted in depression in performance. However, supplementation of non-starch polysaccharide hydrolyzing enzymes improved the performance of Vanaraja birds compared to those fed 200 g GM/kg without enzymes.

Abbreviations: AF, abdominal fat; BD, basal diet; BWG, body weight gain; BWt, body weight; CP, crude protein; FCR, feed conversion ratio; GM, guar meal; L, linear; ME, metabolizable energy; NPP, non-phytate phosphorus; Ns, non-significant; NSP, non-starch polysaccharide; Q, quadratic; RTC, ready to cook; SBM, soybean meal; SEM, standard error of the mean.

* Corresponding author. Tel.: +91 9490881723; fax: +91 4024017116; mobile: +91 9177215003.
E-mail address: drbhukyaprakash@gmail.com (B. Prakash).

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1. Introduction

Shortage of feed ingredients gives every scope to search for alternate feed resources for sustaining production and reducing the cost of chicken feed. Guar (*Cyamopsis tetragonoloba*) is a drought tolerant legume extensively grown in tropical countries. Guar is primarily cultivated to cater the culinary preparations besides using the seeds extract (guar gum) for various industrial activities like pharmaceuticals, oil well drilling mud, ore flotation and paper making. To produce gum (galactomannan), guar seeds are split, which yields protein rich germ fraction and low protein husk fraction as by-products (Conner, 2002). These two fractions are usually recombined to produce guar meal (GM), which contain similar amount of crude protein (CP) and are less expensive than soybean meal (SBM) (Bakshi, 1966). Increased production of guar beans and scarcity of SBM, which is the prime choice of protein source in poultry diet, may offer expanded opportunities to use the GM in least cost poultry feeds. Further, about 88% of the CP in GM is present as true protein and rich in arginine (Verma and McNab, 1984a), but low in methionine and lysine (Verma and McNab, 1984b) compared to SBM. Similarly, Ambegaokar et al. (1969) suggested that tryptophan, methionine and threonine are the first three deficient amino acids in GM compared to whole egg protein. Further, GM also a moderate source of energy, which ranges 8.39 and 8.66 MJ/kg (raw and autoclaved, respectively) (Nagpal et al., 1971).

Guar meal contains two main deleterious factors, which limit its use as poultry feed. Primarily is the residual gum, which is roughly 18–20% of the GM (Nagpal et al., 1971), and the other is trypsin inhibitor (Bakshi, 1966; Couch et al., 1967). Nevertheless, inclusion of GM germ fraction at 75 g/kg of the diet supported the growth, and feed conversion and similar to that observed with maize SBM diet in broilers (Lee et al., 2003). However, majority of the researchers have reported that reduction in performance of broilers fed diet containing GM at 25 g/kg or higher levels (Anderson and Warnick, 1964; Conner, 2002). Further, higher levels of GM in diets causes diarrhoea, depresses growth rate and increases mortality of broilers (Verma and McNab, 1982; Patel and McGinnis, 1985) and decreases egg production and feed efficiency of laying hens (Ehsani and Torki, 2010).

Supplementation of microbial enzymes in poultry diets based on GM appears to be an effective method to minimize the deleterious effects of guar gum. Supplementation of β-mananase to feed containing GM reduced intestinal viscosity and alleviated the deleterious effects associated with feeding of GM (Lee et al., 2003). Further, addition of β-mannanase facilitates higher inclusion level of GM from 25 to 50 g/kg in diet (Lee et al., 2005). However, Kamran et al. (2002) did not observe improvement in performance and carcass variables in broilers fed diet containing 5, 100 and 150 g GM/kg. Though, they suggested that GM could be used below 100 g/kg in broiler rations without any adverse effects.

Vanaraja is a multi-coloured chicken variety is suitable for free range poultry farming, which is being widely reared across the India under diversified agro-climatic conditions (Zuyie et al., 2009; Rama Rao et al., 2013). However, they require balanced feed during their initial 6 weeks of age (Rama Rao et al., 2006) before they are left loose under the free range condition. In spite of existing reports of processed GM inclusion, very few researchers have used higher levels of GM with various concentrations of non-starch polysaccharide (NSP) hydrolyzing enzymes in broiler diets. Therefore, the present study was designed to test the possibility of including higher levels of GM with and without supplementing NSP hydrolyzing enzymes in Vanaraja chicken diet.

2. Materials and methods

Two experiments were conducted to find out the effect of supplementing 0, 75 and 150 g of GM/kg diet (Experiment-I) with or without NSP hydrolyzing enzymes and 200 g GM/kg diets (Experiment-II) with incremental levels of NSP hydrolyzing enzymes in iso-caloric (10.9 MJ/kg) and iso-nitrogenous (200 g CP/kg) diets (Table 1). Guar meal and SBM were analyzed for CP, crude fibre, crude fat, arginine, methionine, cysteine, lysine, threonine, isoleucine, phenyl alanine, Ca and phosphorus (Table 2).

2.1. Experiment-I

A total of 432 one day old Vanaraja chicks were randomly and equally distributed into 72 battery brooder pens (replicates). On day one, chicks were wing banded and housed in wire-floored stainless steel battery brooders. The brooder temperature was maintained at 35 ± 0.5 °C until 7 days of age and gradually decreased to 27 °C by 21 days of age, after which, chicks were maintained at room temperature (20 to 27 °C). Birds were vaccinated against Newcastle (7th and 28th day) and infectious bursal diseases (15th day). The experimental protocol was approved by the Institute Animal Ethics Committee. In Experiment-I, maize and soybean meal-based control diet was prepared with ME 10.88 MJ and 200 g CP/kg diet. Two basal diets (BD) containing 75 and 150 g GM/kg diet with similar energy and protein of control diet were prepared. Both basal and control diets were fed without and with NSP enzyme supplementation. Analyzed (Llames and Fontaine, 1994) amino acid content of feed ingredients was used to calculate and adjust a level of lysine and methionine in the experimental diets. The NSP hydrolyzing enzyme premix provided xylanase 3250, glucanase 1200, cellulase 890, mannanase 4000 and protease 4000 units/kg diet. Each diet was allotted at random to 12 replicates and fed *ad libitum* from 1 to 42 days of age. Body weight (BW) and feed intake were recorded at 21 and 42 days of age, and feed efficiency per pen was calculated as feed intake per unit BW gain (BWG).