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Review on Feeding Value of Rice Gluten Meal

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A B S T R A C T

The search of alternative feed ingredients in poultry nutrition is a continuous process in the pursuit of economical poultry production. Feed costs are primarily driven by the cost of protein sources. Substitution of expensive protein sources with lower cost ingredients would potentially reduce the cost of the feed. Rice gluten meal (RGM) is a by-product of wet milling of rice obtained during starch extraction and syrup preparation. It is relatively a new feedstuff having brownish coloured and coarse powdery texture. Commercial traders categorise RGM as a high crude protein and energy ingredient which is priced lower than soybean meal. Rice gluten meal is high protein and high energy alternate feed resource that can be utilized for livestock and poultry feeding for economic production.

Introduction

Feed is the major constituent in the poultry and livestock production accounts for 65-75% of total recurring expenditure. Overall growth in human, livestock and poultry populations has outpaced the growth in cereals production leading to severe feed shortages and consequent rise in feed cost. Feed costs are primarily driven by the cost of protein sources. Substitution of expensive protein sources with lower cost ingredients would potentially reduce the cost of the feed. Poultry and livestock industry depends on soybean meal as a source of dietary protein due to its uniform quality and ideal amino acid profile. Instability in its production, indiscriminate exports and higher demand has resulted in its shortage leading to its higher price.

The soybean production in the country was about 11.86 MT in 2013-14 and soybean tops the list of total oil seed production in the country (Agriculture statistics, 2018). Soybean meal requirement is 11.9 MMT by 2025.

Soybean meal is used 40% towards poultry & livestock feeding, so there is net shortage per year is about 2.5 MMT during 2014-2025. As there is scarcity of soybean meal at reasonable price, there is need to utilize locally available alternate protein sources (Mandal, 2017).

Asia is the primary production region for rice with over 90% of global production. China tops the list of rice production followed by India. The search of alternative feed ingredients in poultry nutrition is a continuous process in the pursuit of economical poultry production. India is the second largest producers of rice in the world after China, producing approximately 109.7 MT rice in 2016-17 (Agriculture statistics, 2018). Now days, certain newer rice by products are available in appreciable quantities and cheaper rate that can be utilized as protein sources from rice processing industries such as rice gluten meal (RGM).

Rice gluten meal (RGM) is a by product of wet milling of rice obtained during starch extraction and syrup preparation. It is relatively a new feedstuff having brownish coloured and coarse powdery texture. Commercial traders categorise RGM as a high crude protein and energy ingredient which is priced lower than soybean. Most of the research works were limited to only corn gluten meal. Regarding the feeding value of RGM, scanty studies were done in broiler (Sherazi *et al.*, 1995; Metwally and Farahat, 2015; Wani, 2017) and Cattle (Kumar *et al.*, *f*2016; Malik *et al.*, 2017). Flow diagram of gluten meal (Heuze *et al.*, 2015) preparations are presented hereunder (Fig.1).

Chemical composition of RGM

Metwally and Farahat (2015) reported that RGM contained on as such basis (%) Moisture 7.6, DM 92.4, CP 57.6, EE 3.16, CF 1.45, NFE 28.95, ash 1.24, calcium 0.23, phosphorus 0.40 and MEn (kcal/kg) 3330. Kumar *et al.,* (2016) reported that RGM (g/kg dry matter) contained organic matter 950, crude protein 464, ether extract 34.4, ash 50, neutral detergent fibre 404, acid detergent fibre 173, hemicellulose 231, acid detergent lignin 38.4 and metabolizable energy (MJ/kg) 13.2. Wani (2017) reported RGM contained moisture (%) 7.70, DM 92.30, CP 50.00, EE 6.92, CF 9.47, TA 4.37, NFE 21.54, Ca 0.62, P 0.78 and gross energy 4537 kcal/kg. Metabolizable energy (ME) value of RGM on as such basis reported 3330 kcal/kg (Metwally and Farhat, 2015), 3152 kcal/kg (Kumar *et al.,* 2016) and 3031 kcal/kg (Wani, 2017). Furthermore, the drying process can have crucial influence not only on variability of nutrients but also on concentration and availability of amino acids in different samples. Wani (2017) reported *In vitro* pepsin-pancreatin digestibility (IVDPP) of RGM 81.29% and available carbohydrate 24.27%. Rice gluten meal is also high in methionine, an amino acid required for adequate feathering and saves cost of extra methionine supplementation in the diet. Amino acid composition of rice gluten meal (RGM) is presented in Table 1.

Effect of RGM feeding on body parameters

Sherazi *et al.,* (1995) reported significant ($P<0.05$) differences among treatment groups in weight gain and feed consumption without affecting feed efficiency and dressing percentage on inclusion of rice protein meal up to 10% level in broiler chicken.

Metwally and Farahat (2015) reported that 12.5% RGM had the same performance parameters like the control diet and there was no significant ($P>0.05$) difference between the different treatments in body weight (BW), body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR). Serum lipid profile, glucose, total protein, albumin and globulin of the different treatment were within the normal range and did not affect by increasing the level of rice gluten meal up to

12.5%. They used the inclusion level of RGM at 0, 2.5, 5.0, 7.5, 10 and 12.5%. There were no significant (P>0.05) difference in the dressing percentage and internal organs among treatments. Digestibility of DM, CP, EE, NDF and starch were similar across different treatments without any significant (P>0.05) difference. Kumar *et al.,* (2016) found that RGM could replace ground nut cake (GNC) in the concentrate mixture of growing calves up to 75% level without any adverse effect on feed intake and digestibility of nutrients, nitrogen balance, average daily gain (ADG) and feed efficiency. Also calves did not differ in haematological variables like glucose, blood urea nitrogen, plasma proteins and non-esterified fatty acids.

Malik *et al.,* (2017) reported that replacement of GNC by RGM and maize gluten meal (MGM) at 75% level did not differ significantly (P>0.05) in dry matter intake, CP, feed efficiency and haematological variables among various groups in growing Sahiwal cattle. But, average daily gain (ADG) and nitrogen balance was greater in MGM supplemented group than control, but RGM supplemented groups did not differ significantly (P>0.05) in these parameters.

Wani (2017) reported 0, 5, 7.5, and 10% RGM groups were showed significantly (P<0.01) higher feed intake compared to 12.5 and 15% RGM groups in broilers. No significant (P<0.05) difference was reported up to 15% RGM groups in BW, BWG and FCR.

There was no significant (P>0.05) difference observed between the control and various treatment groups in nutrient utilization, immune response, carcass traits, haematology, serum biochemical parameters and gut health of broiler chicken. Feed cost per kg live weight and meat yield were significantly (P<0.05) decreased in RGM supplemented groups (5, 7.5, 10, 12.5 and 15%).

Dinani *et al., (*2018a) reported RGM can be incorporated safely in broiler diet without any adverse effect on gut health and intestinal histomorphometry. Dinani *et al., (*2018b) concluded that rice gluten meal (RGM) can safely incorporated in broiler diet without any adverse effect on haematological and serum biochemical. Dinani *et al., (*2018c) found that feeding rice based distillers dried grains with solubles and RGM combination improved humoral immunity, while CMI did not show any significant effect. Dinani O.P. (2018d) reported that RGM is high energy and high protein feed ingredient that can be utilized for economic broiler production.

Ongmoo *et al., (*2018) reported that inclusion of 17.5% level of RGM was found to be significantly (P<0.01) beneficial on shell thickness and shell weight. However, enzyme supplementation did not have any significant (P>0.05) effect on both shell thickness and shell weight. Different inclusion levels of RGM had significant (P<0.05) increased influence on shape index, albumin index, haugh unit and yolk colour index. However, enzyme addition did not show any significant (P>0.05) effect on shape index, albumin index and yolk index. It was concluded that RGM incorporation had beneficial effect on egg quality traits in laying hens.

As scanty references are available on rice gluten meal, therefore; some references regarding the utilization of corn gluten meal are also described as both are gluten proteins though there utilization may be different. Waldroup (2000) reported that corn gluten meal (CGM) could be included in broiler diets without impairing performance at rate of 10%.

However, Rose *et al.,* (2003) demonstrated a significant increase in feed intake when broiler chicks were fed a diet containing 10% CGM. Koreleski (2003) reported CGM at 10% level in broilers diets, supplemented with liquid and dried CGM products had no negative effect on growth performance compared to control diets. Silva *et al.*, (2003) observed positive effect of CGM supplementation and reported that FCR improved with increasing CGM level. Ismail *et al.*, (2005) reported that CGM supplementation in broiler diets showed adverse effect on carcass traits at more than 9% inclusion level. Hassanzadeh and Hosseinkhani (2014) reported that better weight gain and FCR were obtained in the birds were fed 12% of CGM in different weeks of experimental period in the broiler diets.

Giannenas *et al.*, (2017) conducted a study to examine the combined effects of adding a dietary protease, reducing the levels of soybean meal (SBM) and introducing corn gluten meal (CGM) in the ration of a group of broilers. Five hundred forty chicks were divided into three dietary treatments with six replicates of thirty birds each. The first group (Control) was fed a conventional diet based on corn and soybean meal, containing 21% w/w crude protein (CP). The second group (Soy-Prot) was supplied a corn and SBM-based diet containing a lower level of CP (20% w/w) and 200 mg of the protease RONOZYME® Proact per kg of feed. The third group (Gluten-Prot) was fed a diet without soybean-related constituents, which was based on corn and CGM and with CP and protease contents identical to those of the diet of Soy-Prot group. The growth performance of the broilers supplied the Soy-Prot diet was similar to the broilers supplied the control diet. However, the broilers which were fed the Gluten-Prot diet at the end of the trial showed a tendency (P<0.01) for lower weight gain and feed intake compared to those of the control diet.

Table.1 Amino acid composition of rice gluten meal (RGM)

Amino Acids	% (As such basis)[1]	% (CP basis)[2]
Lysine	1.57	3.19
Arginine	4.40	6.50
Methionine	2.65	2.08
Cystine	1.23	0.81
Threonine	1.95	3.16
Leucine	4.29	6.33
Isoleucine	2.36	5.23
Valine	3.24	5.40
Phenylalanine	3.13	5.90
Tyrosine	2.95	3.34
Histidine	1.34	1.81
Glycine	2.37	4.17
Alanine	3.17	6.29
Glutamic acid	9.60	16.6
Aspartic acid	4.72	7.25
Serine	2.70	4.00
Proline	2.46	4.32
EAA	-	39.6
NEAA	-	46.8

1: Metwally and Farahat (2015); 2: Kumar *et al.*, (2016)

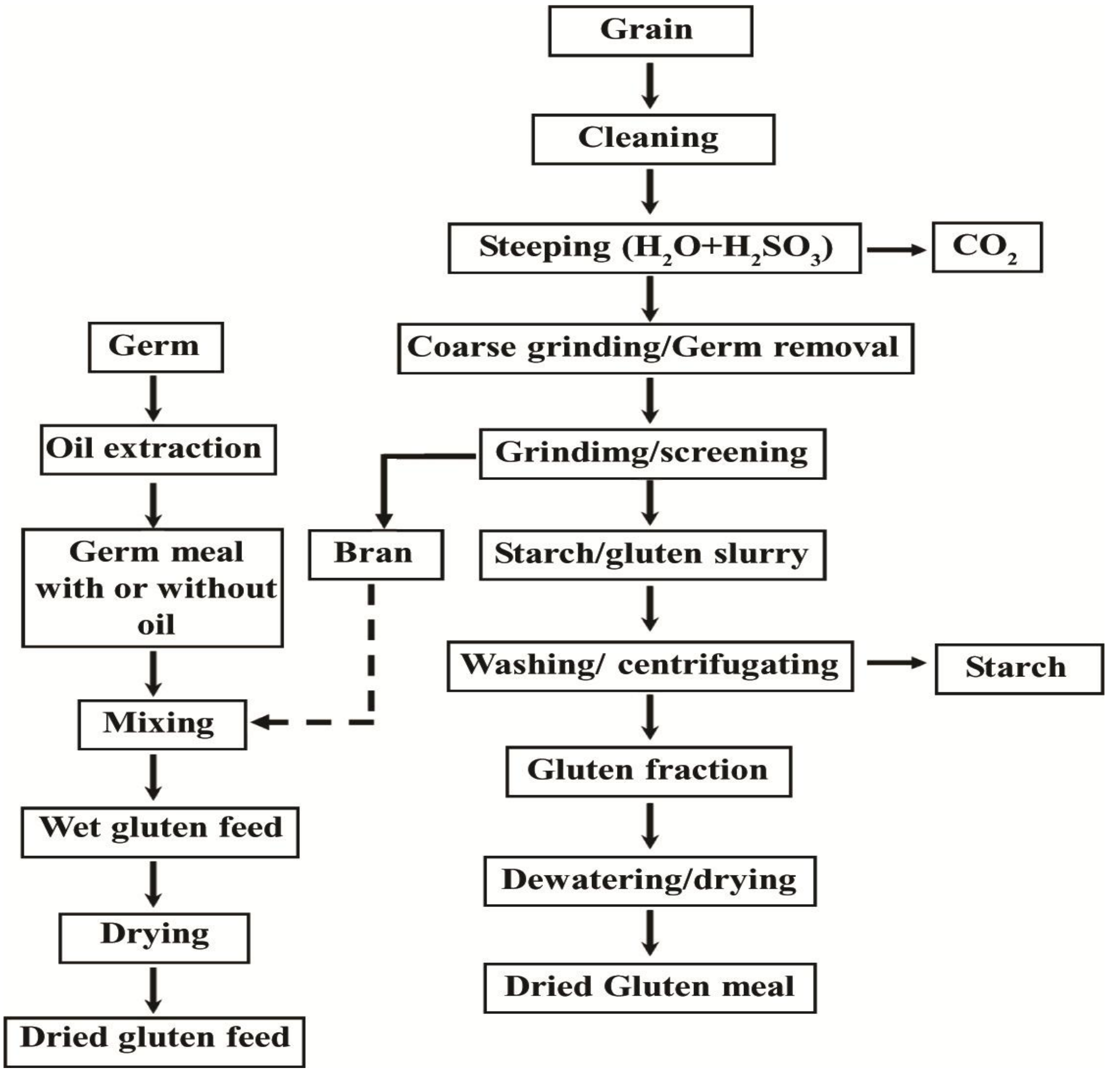

Fig.1 Flow diagram of gluten meal preparation

When compared to the control group, lower counts of *Clostridium perfringens* (P<0.05) were detected in the ileum and cecum parts, and lower counts of *Fusobacterium necrophorum* (P<0.01) were detected in the cecum part of the birds from the Gluten-Protease group. The evaluation of intestinal morphometry showed that the villus height and crypt depth values were not significantly different (P>0.05) among the experimental groups for the duodenum, jejunum and ileum parts. No significant differences (P>0.05) were observed in the quality of the breast and thigh meat and in the feed cost per kg body weight gain for the total duration of the growth period between the control and Gluten-Protease broiler groups.

Thus, it may be concluded that scanty research are available regarding feeding value of rice gluten meal so further studies are required. Rice gluten meal is high protein and high energy alternate feed resource that can be utilized for livestock and poultry feeding for economic production.

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