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Nutritional composition of rice distiller dried grain with solubles as a feed source for livestock

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Abstract

A research study was carried out to assess the nutrient composition, calcium, phosphorus, salt and urea content in high protein Rice Distiller Dried Grain with Solubles (rDDGS), a byproduct of the ethanol manufacturing process. Six (6) samples were procured from various sources for the study. The proximate composition (% DM) in terms of crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen-free extract (NFE), and total ash (TA) was 66.49 ± 0.61 , 3.95 ± 0.09 , 2.20 ± 0.09 , 20.04 ± 0.39 , and $7.32 \pm 0.33\%$, respectively. The acid insoluble ash (AIA) content was 5.20 ± 0.24 percent. The calcium and phosphorus content in rDDGS were 0.15 ± 0.02 and $0.61 \pm 0.01\%$ respectively. The percentage of salt and urea content in high protein rice DDGS were 0.22 ± 0.01 and Below Detectable Level (BDL) of 0.1. Hence, rice DDGS can be used as a potential protein source in livestock and poultry diets.

Keywords: Rice DDGS, chemical composition, calcium, phosphorus

Introduction

Distiller's dried grains solubles (DDGS) is a novel protein source. Distillers dried grains with solubles (DDGS) are nutrient dense by products generated through the enzymatic and microbial fermentation of cereal grains, primarily utilizing selected strains of yeast widely utilized in livestock and poultry nutrition (Buenavista *et al.* 2021) [2]. DDGS serve as a valuable partial substitute for conventional, cost intensive protein feed ingredient like soyabean meal owing to their elevated concentrations of metabolizable energy, crude protein, and bioavailable phosphorus. However, the compositional variability of DDGS is attributable to differences in grain type, fermentation protocol, and processing conditions. However, such compositional variation can adversely affect both their nutritional reliability and commercial value, necessitating rigorous quality control and standardization measures in feed applications. There is very little information available in the literature about the nutritional assessment of rDDGS, while the majority of study work is restricted to maize and wheat DDGS. Because of its increased availability, it is imperative to explore its nutritional and feeding value. Therefore, the nutrient composition, calcium, phosphorus, salt and urea status were analysed so that the DDGS can be used as a potential protein source in formulating livestock and poultry diets.

Materials and Methods

A total of six samples of high protein rice DDGS produced during different production batches were procured from the ethanol industry producing DDGS from rice grain sources. To perform chemical analysis, the samples were ground and oven dried using a Wiley mill for fitting through a 2 mm screen. The samples were analysed for proximate composition and acid insoluble ash. Calcium, phosphorus, salt and urea were analysed as per the method described in AOAC 2023 [1].

Results and Discussion

The proximate composition (% dry matter) in terms of crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen-free extract (NFE), and total ash (TA) in rice DDGS were 66.49 ± 0.61 , 3.95 ± 0.09 , 2.20 ± 0.09 , 20.04 ± 0.39 , and $7.32 \pm 0.33\%$, respectively (Table 1). The acid insoluble ash (AIA) content was $5.20 \pm 0.24\%$.

The moisture content in this study was within the range between 7 to 11%. However, Kaninde (2022) [5] observed the moisture content of rDDGS varying between 14 and 19%. Variation in moisture content in this study might be due to substantial drying that might have occurred before procurement and sampling.

The findings showed that rice DDGS has a high amount of crude protein. The results were in line with the findings of Ranjan *et al.* (2017) [8]. However, Kaninde, (2022) [5]; Dinani *et al.*, (2018) [4], Yogi *et al.*, (2017) [12] and Talsani *et al.*, (2021) [10] reported lower protein values ranging from 42.60 to 48.43% in rDDGS compared to the values in the present study. The probable reason for high crude protein content may be due to the variability of rice grain used, the rate of solubles being removed during rDDGS production (Buenavista *et al.* 2021) [2]. Xue *et al.* (2012) [11] also reported 28.5% CP in Chinese rDDGS produced from the fermentation of rice along with bran. The results are also not in cognisance with the findings of Spiehs *et al.* (2002) [9], who reported values between 29 and 30 percent and attributed the lower values to different grain composition. Higher crude protein content reported for conventional DDGS derived from corn, wheat and rDDGS revealed high fermentation of soluble carbohydrates like starch.

Crude fibre ($3.95 \pm 0.09\%$) and ether extract ($2.20 \pm 0.09\%$) levels were comparatively low, which indicates high protein rice DDGS contained low level of fibre and ether extract which is suitable for poultry diets including chicks. Several studies also reported a range of ether extract content (2.24 to 8.90%) and crude fibre content (4.89 to 10.85%) in rice DDGS (Dinani *et al.*, 2018; Ranjan *et al.*, 2017 and Talsani *et al.*, 2021) [4, 8, 10]. The crude fibre and ether extract content of high protein rice DDGS found in this study was lower when compared to the findings of Kaninde, (2022) [5]; Dinani *et al.*, (2018) [4]; Yogi *et al.*, (2017) [12] and Talsani *et al.*, (2021) [10]. The variation in the crude fibre and ether extract content in rDDGS may be due to differences in the nutrient content of DDGS produced from different grain sources as well as differences in the ethanol processing and drying process of DDGS (Pedersen *et al.*, 2014) [7].

The total ash content ($7.32 \pm 0.33\%$) is slightly elevated, with acid insoluble ash ($5.20 \pm 0.24\%$) due to the improper removing of stones from rice when they are ground for the fermentation purpose.

Table 1: Proximate composition in High Protein Rice DDGS (% Dry matter basis)

Parameters	Mean \pm SE
Moisture	8.45 \pm 0.11
Crude protein	66.49 \pm 0.61
Crude fibre	3.95 \pm 0.09
Ether extract	2.20 \pm 0.09
Nitrogen Free Extract	20.04 \pm 0.39
Total Ash	7.32 \pm 0.33
Acid Insoluble Ash	5.20 \pm 0.24

Each value is a mean of six observations.

Calcium, Phosphorus, Salt and Urea Content in High Protein Rice DDGS

The calcium and phosphorus levels were 0.15 ± 0.02 and $0.61 \pm 0.01\%$ respectively (Table 2) indicating that rDDGS may be a good phosphorus source. Patil *et al.* (2015) [6] reported lower calcium content ranging between 0.07-0.09%. The results are in corroboration with the findings of

Chatterjee *et al.*, (2017) [3] who reported higher calcium (1.13%) and phosphorus (0.41 to 0.95%) content in rDDGS. Further, the results indicate that this was lower than typical requirements for many livestock species, implying the need for supplementation, if rice DDGS is used extensively in feed formulations. Moreover, rice DDGS can be a valuable source of phosphorus, comparable to wheat and slightly lower than corn DDGS.

Table 2: Calcium, Phosphorus, Salt and Urea Content in High Protein Rice DDGS in High Protein Rice DDGS (%DMB)

Sl. No	Parameters	Mean \pm SE
1	Calcium	0.15 \pm 0.02
2	Phosphorus	0.61 \pm 0.01
3	Salt (as Chloride)	0.22 \pm 0.01
4	Urea	BDL of 0.1

Each value is a mean of six observations

BDL-Below Detectable Level

The salt and urea percentage in high protein rice DDGS was 0.22 ± 0.01 and below detectable limit of 0.1 percent respectively. It shows that the rice DDGS is free from urea adulteration. Hence, it could be stated that the absence of detectable urea confirms that the high protein rice DDGS are free from non-protein nitrogen sources.

Conclusion

The study indicated that rice DDGS is a rich source of crude protein containing minimal amount of fibre, moderate amount of ether extract, and minerals. Rice DDGS is a potential feed ingredient source for both livestock and poultry by replacing high cost conventional protein sources and also require mineral supplementation to meet the mineral requirement if rice DDGS is to be used extensively in ration formulations.

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