Utilization of Rice Dried Distillery Grain with Soluble as Feed for Ruminants

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Abstract—*Wet distillers grains (WDG), dried distillers grains (DDG) and dried distillers grains with solubles (DDGS) are the by-products derived from production of alcohol from grains and these by-products are cheap and available whole year round. DDGS is the product obtained after the removal of ethyl alcohol by distillation from the yeast fermentation of a grain or a grain mixture by condensing and drying at least ¾ of the solids of the resultant whole stillage and drying it by methods employed in the grain distilling industry. The DDGS product obtained from Rice Distillery is called Rice Distillers Dried Grains with Solubles (RDGS). In India the low quality rice and broken rice is increasingly being used in the ethanol industry. So in future, a large amount of RDGS is likely to be available in the country. The proximate composition (% DM) in terms of OM, CP, EE,CF, NFE and Total Ash were 94.97±0.09, 48.43± 0.69, 5.45 ± 0.16, 7.27±0.07, 33.86±1.15 and 5.03 ± 0.09, respectively. The cell wall constituents (% DM) in terms of NDF, ADF, Cellulose, ADL,TCHO, NSC and AIA were 40.50 ± 0.9, 16.82 ± 0.6, 7.65 ± 0.24, 7.19 ± 0.53, 42.91± 1.5, 2.40 ± 0.68 and 0.95 ± 0.06, respectively. Total replacement of Soybean meal (25 % of the concentrate mixture) in control diet by rice DDGS in treatment group has improved the growth rate and digestibility of most of the nutrients significantly. Studies on lactation performance of Jersey crossbred cattle have shown that feeding of rice DDGS replacing soybean meal totally in concentrate mixture had no adverse effect on DM intake, milk yield and FCM yield. The milk composition was unaffected. The comparative much lower price of rice DDGS than soybean meal economized the ration a lot.*

1. INTRODUCTION

Though India is among the leading producer of milk, meat and wool in the world; productivity of our animals is 40% lower than the global average due to inadequate and unbalanced feeding, inappropriate health care, and also due the lack of scientific breeding of animals. Feed accounts up to at least 60% of total expenditure of a farm but at present, the country faces huge deficit green fodder and concentrate feeds. The available feeds and forages are poor in quality, being deficient in energy, protein and minerals. The situation is further aggravated due to increasing growth of livestock particularly that of genetically upgraded animals.

In the last 40 years, the production and the use of fossil fuels raised environmental concerns due to limited reserves and high emission of carbon dioxide. Hence, society sought a renewable and less polluting fuel such as ethanol. Recent demand for ethanol is strong and this demand is driven largely by the Clean Air Act amendment of 1990, which requires the use of reformulated gasoline to reduce air pollutants. Ethanol production has increased over the past 10 years, resulting in greater quantities of ethanol byproducts known as distillers grains and solubles [11]. In India 536.5 thousand litre ethanol was produced in 2009, This amount will increase significantly in future to fulfil the demand of fuel as well as the liquor industry. Wet distillers grains (WDG), dried distillers grains (DDG) and dried distillers grains with solubles (DDGS) are the by-products derived from artisan production of alcohol from rice and these by-products are cheap and available the whole year round.

2. DDGS & RDGS

Fermentation and distillation of alcohol from grains has been known for at least 10,000 years. The earliest recorded reference to distilling whisky in Scotland dates back to 1494. The recovery of materials from grains which has undergone fermentation (distillers' feed) was developed by the beverage distilling industry. Traditionally, distillers byproducts have been dried and sold as a protein source for ruminants and nonruminants.

Distillers Dried Grains with Solubles (DDGS) is the product obtained after the removal of ethyl alcohol by distillation from the yeast fermentation of a grain or a grain mixture by condensing and drying at least ¾ of the solids of the resultant whole stillage and drying it by methods employed in the grain distilling industry. The predominating grain shall be declared as the first word in the name. Accordingly the DDGS product obtained from Rice Distillery is called Rice Distillers Dried Grains with Solubles (RDGS).

Grains are the primary resources for ethanol production using either a wet milling or dry-grind process. During the dry-grind process, about 90% of starch in grains can be fermented into ethanol and carbon dioxide, and the reminder of the grain constituents such as protein, lipids, fiber, minerals, and

vitamins are concentrated into DDGS [4]. In the United States, corn is used predominately for producing DDGS. Conventional ethanol production consists of 6 sequential steps, which include dry milling, liquefaction, saccharification, fermentation, distillation, and co-product recovery. During the last step of co-product recovery, condensed solubles are mixed with distillers wet grains to become wet distillers grains with solubles (WDGS) and then dried into DDGS. Rice distillers' grain is a by-product of the processing of rice wine which is produced from the distillation of fermented grain, steam cooked at 131.8ºC and 2.6 kg/m²pressure. It is an important by-product of the distillers industries in Asian countries.

3. POTENTIAL OF RDGS AS RUMINANT FEED

Rice Distillers Grain with Soluble (RDGS) is a potential agro industrial byproduct of the ethanol industry. In India the low quality rice and broken rice is increasingly being used in the ethanol industry. So in future, a large amount of RDGS is likely to be available in the country. RDGS is a very good source of protein, Fibre and minerals. It is a good source of phosphorus and maximum of it present as non phytate form which is readily available to animal. Distillers grains with solubles have been reported to be a good source of rumen undegradable protein (RUP) and energy for ruminants and may be included up to approximately one third of the diet for lactating dairy cows. Thus, it can be an excellent animal feed resource for reducing ration cost, replacing portions of expensive protein meals such as soyabean meal, fish meal, canola meal, groundnut cake, maize gluten meal etc. and hence reducing the feed cost for farmers and feed manufacturers.

The nutrients in distillers' grains are closely related to the grains from which they are made.These byproducts are utilized gas animal feeds in beef and dairy diets, as well as other animal production systems [2]. This continuing increase in ethanol production has changed the animal feeding systems due to the large supply of byproducts originating from the milling process. Distiller’s grain is being fed to poultry and aquatic animals as a protein source. It may provide livestock with high protein content with good amino acid profile as compared to other common protein supplements. RDGS may have a comparable or higher biological worth than other rice byproduct and other fermented byproduct because of its low cost and comparable performance results. It can be ideally used as a primary feed, not just because it contain high protein, but also due to high NDF and mineral content. Data available indicate that the composition usually reflects the nutrient content of the grain after removal of starch via fermentation to ethanol. Reports are there [9] on reduction in CH4 production in dairy and beef cattle when DDGS was added to the ration .

The concentrations of protein, fat, fibre and other nutrients in the DDGS from various grain sources usually reflect proportionately increased concentrations of those components relative to the starting grain after starch removal. Other similar product like corn DDGS, sorghum DDGS, barley DDGS, wheat DDGS are being used in livestock and poultry feeding. Work done on utilization of these DDGS on various domestic animals, poultry and aquatic life is available but very little information is available on utilization of RDGS in livestock feeding.

3.1 Nutrient Composition

Most starch in the grain is converted to ethanol during the fermentation process, resulting in a large amount of fiber in DDGS. This high concentration of fiber in DDGS contributes to the greater concentration of GE and lower apparent total tract digestibility of energy (76.8% vs. 90.4%) compared to source grain. Consequently, the measured values of DE and ME in DDGS are similar to the DE and ME values in Source grain [12]. In a recent study at NDRI, Kalyani, the DM% of RDGS was 89.58 ± 0.09. The proximate composition (% DM) in terms of OM, CP, EE,CF, NFE and Total Ash were 94.97±0.09, 48.43± 0.69, 5.45 ± 0.16, 7.27±0.07, 33.86±1.15 and 5.03 ± 0.09, respectively. The cell wall constituents (% DM) in terms of NDF, ADF, Cellulose, ADL,TCHO, NSC and AIA were 40.50 ± 0.9, 16.82 ± 0.6, 7.65 ± 0.24, 7.19 ± 0.53, 42.91± 1.5, 2.40 ± 0.68 and 0.95 ± 0.06, respectively.

Rice-based DDG have been reported to have higher contents of protein (47.5%) and fiber (15.8%) in comparison with those of corn-based DDGS [8]. The concentration of yeast protein contained in DDGS was reported [3] to be 1.4% (DM-basis).

3.2 Minerals & Fatty Acids

RDGS was found to be a good source of certain macro (Ca, P and Mg) and micro (Mn, Fe, Zn and Co). The bioavailability of P in DDGS is expected to be higher than in typical plant ingredients because of the fermentation process involved in ethanol production. The fatty acid composition revealed that RDGS is a good source of Oleic acid (MUFA) and Lenoleic Acid (PUFA). The concentration (as % of total fat) of essential fatty acid (Lenoleic acid) was much higher than GNC and MOC but lower than SBM. However, Lenoleic acid as % of DM is higher in RDGS than SBM as the Fat % of RDGS was much higher than SBM.

3.3 Growth Performance, Nutrient digestibility and Feed conversion efficiency

Supplementation of corn DDGS improved ADG and feed conversion efficiency of growing steers [5]. Supplementation of calves with 0.9 kg/d dried distillers grains plus solubles (DDGS) increased ADG [6]. Supplementation of DDGS increased ADG of growing beef calves regardless of pasture quality or basal cattle performance [1]. Progeny from cows fed DDGS during lactation had greater average daily gain compared with progeny from cows fed a control diet [14]. The effect of wheat dried distillers grain with solubles inclusion in a finishing diet of beef cattle was studied. No differences in

organic matter intake, final body weight and average daily gain were observed among treatments. However, steers fed WDG had greater (P<0.01) feed conversion ratio than those fed Control diet [7] .

Inclusion of corn or sorghum DDGS replacing Soybean meal did not affect ADG, DMI or Feed conversion efficiency in growing and finishing beef cattle [16]. Similar non significant difference in feed intake, ADG, and blood metabolites were observed in feedlot beef steers fed diets that varied in proportion of wheat dried distillers grains with solubles (DDGS) replacing barley grain or barley silage [17].

In a recent study at NDRI, Kalyani on crossbred Jersey calves, total replacement of soybean meal (25 % of the concentrate mixture) in control diet by rice DDGS in treatment group has improved the growth rate and digestibility of most of the nutrients significantly. The comparative much lower price of rice DDGS than soybean meal economized the ration a lot.

3.4 Effect on Lactation Performance

Supplementation with one of two diets either dried distillers grains with solubles (DDGS) or soybean meal (CON), to the lactating animals did not affect the milk production [14]. Milk Protein was decreased (P = 0.01) and fat was increased (P = 0.01) in milk from DDGS compared with CON cows. Saturated FA content of milk was decreased (P<0.01) in DDGS compared with CON cows, which resulted in an increase (P<0.01) in monounsaturated and polyunsaturated FA, including cis-9, trans-11 conjugated linoleic acid [14].

Increase in milk yield and concentration of milk protein and Reduction in milk fat percentage and yield were reported [13] when cows consumed the diet containing distillers grain. The inclusion of DDGS had no effect on lactose percentage, 4% fat-corrected milk yield, milk fat yield, and milk protein yield [15]. Neither dry matter intake nor milk yield was affected by inclusion of triticale dried distillers grains plus solubles (TDDGS) or corn dried distillers grains plus solubles (CDDGS). The data suggested that TDDGS can replace CM or SBM in the diets of lactating dairy cows without adverse effects on production [10].

Studies conducted at National Dairy Research Institute, Kalyani on lactation performance of Jersey crossbred cattle have shown that feeding of rice DDGS replacing soybean meal totally in concentrate mixture had no adverse effect on DM intake, milk yield and FCM yield. The milk composition in terms of milk fat, protein, ash, total solid and SNF was unaffected. The milk yield increased by around 5 percent and thus economized the ration.

Overall, it is obvious that DDGS and RDGS can serve as potential alternative nutrient source for the ruminants. The improvement of production performance may be the resultant of several factors such as better chemical profile of RDGS, improvement of digestibility of nutrients, reduction of CH_4 production due to increased fat in diet, presence of yeast cells and some other hidden factors. RDGS can economically replace SBM fully in concentrate mixture of growing calves and lactating cattle without any adverse effect and thus economize the ration and enhance the net profit. However, long term feeding trial in cattle or other ruminants is recommended to ascertain the effects of feeding such distillery by-products on productive performance and health.

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