Sjournals
Scientific Journals

Scientific Journal of Animal Science (2015) 4(12) 163-167
ISSN 2322-1704
doi: 10.14196/sjas.v4i12.1953

Contents lists available at Sjournals
Scientific Journal of Animal Science
Journal homepage: www.Sjournals.com

Original article

Evaluation of chemical composition of treated and untreated rice straw using urea

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ARTICLE INFO

Article history,
Received 21 November 2015
Accepted 22 December 2015
Available online 28 December 2015
iThenticate screening 25 November 2015
English editing 20 December 2015
Quality control 24 December 2015

Keywords,
Rice straw
Fermentation
Chemical composition

ABSTRACT

The study was carried out at Teaching and Research farm Adamawa State University Mubi, to evaluate the chemical composition of treated and untreated rice straw using urea. Rice straw as a crop residue is widely available in tropical countries and is used in an attempt to meet the energy requirements of growing ruminants. A major limitation to the use of rice straw is their high fiber content, low nitrogen and energy level. Therefore, treatment of rice straw with urea can lead to significant improvement in nutritional quality and greater utilization. The major objectives of the study was to Improve the nutritional value of rice straw using urea, to Evaluate the chemical composition of treated and untreated rice straw using urea. The dry matter, organic matter, crude protein, ether extract, Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), and Ash values are 60.62, 84.01, 12.29,1.07, 62.78, 41.48 and 13.40 for the urea treated rice straw and 75.56, 87.11, 3.22, 0.63, 68.18, 40.70 and 12.34% for the untreated rice straw respectively. The treatment of rice straw with urea has significantly at ($P<0.05$) reduced its dry matter content by 75.56 to 61.02 % and increased the value of crude protein by 3.22% to 12.29%.It is concluded that urea appears to be as efficient as any other source of ammonia in the treatment of straw. Therefore, the findings of this study will be beneficial to

farmers as it will provides improved simple method of formulating local animals' feeds using simple material like rice straw.

1. Introduction

Feed shortage both in terms of quantity and quality is a major problem hindering the development of livestock industry in developing Country such as Nigeria (Belete, 2006). A number of studies (Zhang *et al*., 1995) have also proven that crop residues are low in available nutrients, taking longer lag time and slow in rate of microbial fermentation. These characteristics of straw limit its intake and digestibility; thereby hamper the productivity of farm animals. According to BOARD (2003), crop residues like rice straw, barely, wheat, finger millet, maize and residues of pulses were found to be the second largest livestock feed sources during the dry season. Consequently, rice straw has become one of the dominant farm animal feed resources in the plain areas of Nigeria, mostly during the dry season (Belete, 2006). This resulted in the contribution of crop residues as livestock feed resource in Nigeria to provide about 50% of the total feed source for ruminant livestock (Jutzi et al., 1997).

Despite the rising dependence on crop residues as animal feeds, there are still certain constraints to their efficient utilization. However, poor quality roughages such as straws have the potential to improve animal feeds by employing different treatment strategies. The utilization of low quality roughages could be improved with supplementation of energy and nitrogen sources, chemical and/or physical treatment, and selection together with breeding of crops, which ultimately depend on the economic benefits and applicability (Ibrahim and (McDonald *et al*., 2002). Supplementation of poor quality feeds with nitrogen sources increases the rate and extent of digestion resulting in improved dry matter intake (Preston and Leng, 1987).

Treatment of straw with urea has currently received global attention because of easy access of urea at village level, cheaper price and its ability to break down cellulose besides adding non-protein nitrogen (NPN) to the straw (Sundstøl *et al.*, 1998). Treatment of straw with urea helps the ammonia to act upon the fibre and favour the release of soluble carbohydrates and energy for cellulolytic bacteria growth, and further enhancing efficient utilization of roughages. Moreover, urea application is relatively easy, less toxic and effective (Ibrahim and Schiere, 1998). Donovan et al. (1997) has also reported the importance of urea treatment for improving the nutritive value of cereal straws and its use in the developing countries of the tropics.

Farmers do not use it as animal feed; however they sale it to rice polishers with minimum price (0.10 cents /kg) (Belete, 2006). This is due to lack of understanding about the importance and system of feeding of rice bran to their animals. The cost-benefit analysis and feasibility of using ammoniated straw as animal feed in Nigeria was reported by Reherahie (2001), and Getu (2006) using concentrate supplement with urea treated barley, teff and wheat straw for crossbred lactating dairy cows. It is very important to note that cost of feeding is the major part of the total cost of milk production (Singh *et al.,* 1993), and hence reduction of feeding cost of dairy cows needs to receive due emphasis. A major limitation to the use of rice straw is their high fiber content, low nitrogen and energy level. Therefore, treatment of rice straw with urea can lead to significant improvement in nutritional quality and greater utilization. This research work is intends to find out the chemical composition of treated and untreated rice straw using urea and its application to animal feeds.

The study was carried out in Mubi local government area of Adamawa State, Nigeria. Mubi is located between latitudes 10°16'N of the equator and longitudes 13°16'E of the Greenwich meridian and has an elevation of 1906 feet above the sea level. The area falls under the Sudan savanna belt of Nigeria's vegetation (Adebayo, 2004). Mubi has a land mass of about 3,871km2 with a population of 1,239,845 people (NPC, 2006). The study area has tropical type of climate. The temperature of the region is warm to hot throughout the year, however there is usually a slight cold period between November and February. There is a gradual increase in temperature from January and April. The minimum and maximum temperature of the area are 18.1°C and 32.8°C and the mean annual rainfall range from 900-1050mm. Rainfall starts from April. Mubi is bounded by Borno state in the North, Hong and song local government in the west Maiha local government in the east.

2. Materials and methods

The sample for the research work was obtained from Vama rice farm around Arha-kunu Mubi South Local Government Area 6Km away from Adamawa State University Mubi, Adamawa State, Nigeria.

2.1. Preparation of sample

The rice straw was prepared by dissolving 3kg of urea in 50 liters of water and applied to 50kg of chopped rice straw. The sample contains three treatments. Treatment one (T1) under goes no fermentation process i.e. control, Treatment two (T2) was fermented for 14 days, while treatment three (T3) was fermented for 21 days. The treated rice straw was placed in a plastic barrel container and made airtight by covering it with polyethene sheets and the container's lid. It was then allowed to ferment for 14 and 21 days, after which it was removed, a portion of the sample taken for laboratory analysis.

2.2. Chemical analysis

Samples of feed were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE) and Ash were analysed according to the standard procedures of AOAC (1990). The neutral detergent fibre (NDF) and acid detergent fibre (ADF) were analyzed according to Van Soest et al. (1991) method.

3. Results and discussion

The treatment of rice straw with urea has significantly at ($P<0.05$) reduced its dry matter content by 75.56 to 61.02 %. Therefore, the value treated dry matter is lower than untreated by 14.54% which is similar to the report of Islam, (2009). The results showed that both feeds sample have comparable nutrient profile although the urea treated rice straw had a higher crude protein value (12.35%) than the untreated rice straw (3.22%). This suggests that urea treatment increased the crude protein content of rice straw.

Table 1
The proximate analysis.

Parameters	Untreated rice straw	Urea treated rice straw (4%) 14 days incubation	Urea treated rice straw (4%) 21 days incubation
DM (g/100g)	75.56	60.62	61.02
Organic Matter (OM)	87.11	84.01	84.53
Crude Protein	3.22	12.29	12.35
Ether Extract (EE)	0.63	1.07	1.27
NDF	68.18	62.78	62.26
ADF	40.70	41.48	41.87
Ash	12.34	13.40	13.55

DM = dry matter; CP = crude protein; NDF = Neutral Detergentfibre,ADF = Acid Detergent Fibre, EE = ether extract; NFE = nitrogen-free extracts.

The treatment of rice straw with urea increased its nitrogen content due to the addition of non-protein nitrogen. This collaborate the reports of other studies that urea ammoniation increases the crude protein content of feed materials (Yakubu et al., 2007 and Ambaye, 2009). There was significant ($P<0.05$) increase. The percentage increase in crude protein (12.35%) due to urea treatment in this study is lower than the values reported by Yakubu et al. (2007) and Ambaye (2009). This may be attributed to the higher content of crude protein in the original material. The value of crude protein 3.22% for the untreated rice straw is in line to the result findings of 3.20%, reported by Rahman and Akbar, (2009). The chemical analysis showed that treatment of rice straw with urea increased ash content of straw from 12.34% to 13.55% and decreased the NDF content from 68.18% to 62.26%.Treating the rice straw with urea improve the nutritive value, increase the digestibility of DM, OM,CP, NDF and ADF. The dry matter, organic matter, crude protein, ether extract, Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF),and Ash values are 60.62, 84.01, 12.29,1.07, 62.78, 41.48 and 13.40 for the urea treated rice straw and 75.56, 87.11, 3.22, 0.63, 68.18, 40.70 and 12.34% for the untreated rice straw respectively. The urea

treated rice straw had slightly higher organic matter and Neutral Detergent Fibre contents but lower ether extract and ash contents than the untreated rice straw. The dry matter content of the untreated rice straw in this study fall within the range repoted (71.71) by Rahman, (2009), but lower than the 89.50 and 90.53% previously reported by Yakubu et al. (2007); Ambasankar and Chandrasekan (2002), respectively.

The result of treated 1.06% and untreated 0.61% ether extract of this research work is similar with the result findings reported by Khaleduzzaman and Bostami, (2009). The rice straw used in the present study contained considerably less ether extract and ash.

The proximate compositions of the experimental diets (Table 1) showed that the samples have comparable nutrient compositions. The comparable nutrient compositions of the experimental feed may be attributed to the initial quality of the treated material. It has been reported that the effect of urea treatment is more pronounced for materials whose initial quality is very poor compared to those with better original quality (Chenost, 1995).

4. Conclusion

Studies have shown that several treatments have been used to improve the degradability and voluntary intake of rice straw, such as physical or chemical treatments, the practical use of these treatments is still restricted in terms of safety concerns, costs and potentially negative environmental consequences. Moreover, the use of urea to treat rice straw may be an alternative way to shorten the period of the incubation and cutting cost of feed treatment. It is concluded that urea appears to be as efficient as any other source of ammonia in the treatment of straw. The result of this study indicated that the chemical composition of rice straw can be highly varied when treated with urea which resulted in modification of the chemical composition of the rice straw. Urea treatment may therefore be most suitable for small-scale farmers to improve the quality of straws, particularly varieties showing a low degradability.

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How to cite this article: Midau, A., Mubi, A.A., Kwaji, Z., 2015. Evaluation of chemical composition of treated and untreated rice straw using urea. Scientific Journal of Animal Science, 4(12), 163-167.