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Original Article

Usage of treated rice straw with exogenous anaerobic bacterial enzymes (ZAD) for Ossimi sheep

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Abstract The objectives of this study were to verify the potential benefits of growing green barley on anaerobic enzyme (ZAD) treated rice straw. In addition, the work intended to investigate the effect of this treatment on digestibility parameters in Ossimi sheep. A complete random design was used to distribute twelve mature male of Ossimi sheep (45.0 + 0.5 kg wt.) on the following treatments: Rice straw with grown barley (RSGB) without either ZAD or orange pulp (control, T1), RSGB plus ZAD (T2), RSGB plus orange pulp (T3) and RSGB + ZAD + orange pulp (T4). The obtained results could be summarized as follow:

1. Significant decreases were observed in %CF from 38.09 for T1 to 32.01 and 30.02 for rations T4 and T2 respectively ($P < 0.05$). Percentage values of NDF were 70.01, 72.10 and 76.01 for rations T4, T2 and T1 respectively ($P < 0.05$); while %ADF values were 50.05, 52.10 and 58.10 for rations T4, T2 and T1 respectively ($P < 0.05$) %ADL was 6.01 for T4 versus 8.01for T1. Significant increases in %CP content to 7.96, 7.10, 7.95 were observed for rations T4, T3, T2 respectively compared to the control ration which was 5.75 ($P < 0.05$).
2. Adding ZAD to RSGB significantly increased ($P < 0.05$) %TDN to 55.02 and 59.02 for treatments T2 and T4 respectively and increased digestibility coefficients of CP to 72.43 and 77.70 respectively.
3. Rams fed rations T2, T3 and T4 had significantly higher values of ruminal ammonia-N 3 h post feeding values were 25.41, 25.03, 25.96 mg/100 ml respectively and total volatile fatty acids 3 h. Post feeding values were 8.20, 8.13 and 8.26 meq/100 ml respectively.
4. Adding either ZAD, orange pulp or both to RSGB significantly increased ($p < .05$) plasma total protein values were 6.43, 6.23, 5.82 g/dl for treatments T4, T3, and T2 respectively, while treating rations with ZAD reflected low level of GPT 6 h. Post feeding values were 20.64 and 20.61 for treatments T2 and T4 respectively versus T1 (20.90 μ/l).

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It could be concluded that the anaerobic enzyme matrix (ZAD) improved the nutritive value of soilless green barley and improved their digestibility coefficients in Ossimi sheep.

Introduction

The acute shortage of conventional feedstuffs for livestock feeding resembles a big problem for animal production in Egypt. The big feed gap between the requirements and the available sources forced the planners and nutritionists to look for non-conventional resources where there is no competition with humans. Such agricultural by-products are available around the year but are not efficiently used (Abd El fattah, 2009).

The problems of feeding lignocellulosic materials to farm animals are in general, low protein content, high crude fiber, low digestibility coefficients and the content of some anti-nutrition factors such as tannins and alkaloids (Kholif, 2005).

Thus, to increase the digestibility of these lignocellulosic materials, it is important to breakdown the linkage between cellulose, hemicellulose and lignin or breakdown the compact nature of the tissue (Kholif, 2005).

One of the main shortcomings of rice straw as an animal feed is the low digestibility of its major organic constituents; and the cell wall components. Several treatments and processing methods are being studied around the globe to improve the nutritive value of the lignocellulosic residues; several chemical treatments which aimed at delignifying or disrupting the lignin carbohydrate complex have been tested in attempts to improve the accessibility and exposure of structural carbohydrates to ruminal cellulolytic microorganisms. Some physical treatments such as ball-milling, steaming or irradiation have also been tested. Chemical pretreatment appeared more improvement particularly the digestibility of the hemicellulose fraction (Gado, 1997).

Colombatto et al. (2003) found that, the enzyme product (Liquicell 2500, Specialty Enzymes and Biochemical, Freson, CA) was derived from *Trichoderma reesei* and contained mainly xylanase and cellulase activities. With the addition of these enzymes at concentrations of (0.5, 2.55 and 5.1 mL/g of DM), the absence of ruminal fluid increased ($P < 0.001$) the release of reducing sugars from xylan and the mixture after 20 h of incubation at 20 °C. Incubations with ruminal fluid showed that enzyme (0.5 and 2.55 mL/g of DM) increased ($P < 0.05$) the initial (up to 6 h) xylanase, endoglucanase, and β-D-glucosidase activities in the liquid fraction by an average of 85%. It was concluded that enzymes enhanced the fermentation of cellulose and xylan by a combination of pre- and post-incubation effects (i.e., an increase in the release of reducing sugars during the pretreatment phase and an increase in hydrolytic activity of the liquid and solid fractions of the ruminal fluid) which was reflected in a higher rate of fermentation, whereas the physical treatments had a greater effect on cellulose digestion (Feng et al., 1996; Johnson et al., 1993; Chen et al., 1994), Biological treatments are alternative treatments to modify the digestion of fibrous materials by ruminants. The fungal decay of straw by white-rot fungi improved the *in vitro* dry matter digestibility of the decayed substrate (Dawson and Tricarico, 1999). Besides, Mahrous et al., 2005 had studied the effect of biological treatments (ZAD, fungus and ZAD with fungus) of rice straw on feed intake, digestibility coefficients, nutritive value, nitrogen balance and some rumen liquor and blood parameters. All of the treated rice straw groups did not significantly affect urea, total protein, albumin, globulin, GOT and GPT compared to untreated rice straw groups.

The purpose of this study is to investigate the potentiality of growing barely grains on treated rice straw. This goal will be accomplished through a metabolism trial using Ossimi rams measuring blood parameters, rumen parameters, chemical composition, cell constituents (fiber fraction) and digestibility coefficients of the **RSGB**.

Materials and methods

This study was carried out to investigate the effect of biological treatment (bacterial enzyme treatment) on poor quality roughages (I. e. rice straw and orange pulp) to improve its nutritive value as ruminant feeds.

The experiments were carried out at the laboratory of the Rumen Ecology Center, (Metabolic Unit) and the Experiment Farm of the Meat and Milk Development Center (in Shalakan), Faculty of Agriculture, Ain Shams University, and in the Egyptian company (ECARU).

Preparing of rice straw

This experiment was carried out to avoid rice straw boiling during the preparation process before planting on it, which was the procedure followed in all previous experiments, for the purpose of sterilization and wetting, also to be free from most of its impurities.

The first experiment was performed for the distinction between growing barley on the soaked straw without boiling and boiled straw, in order to save one of the steps that hamper the processing of straw and use it on a large scale; the results showed that there is no significant difference between the two treatments. However, we benefited from reducing the time and effort and employment of users to boil the straw before planting.

Widely adopted experiment

In this experiment, 1.34 tons of rice straw was used and soaked in water with ZAD enzyme, at the same time 152 kg of barely seeds was soaked in the same way as the straw. The concentration of enzyme in soaking water was 3 ml per 1 kg of either rice straw or barely seeds. The soaked straw was placed on plastic sheets, then the soaked seeds were spread and irrigated with the rest of soaking seeds in water, after that it was covered with a plastic sheet for the first 6 days only of 15 days of the summer season; the plants were irrigated daily with 10 ml enzyme (ZAD) per 1 l of water for the first 6 days.