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Short communication

Effect of triple super phosphate supplementation on degradability of rice straw and ammonia nitrogen concentration

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ABSTRACT

Two way analysis of variance in duplicate were used to assess the degradability of rice straw with triple super phosphate (TSP: $Ca(H_2PO_4)_2{\cdot}CaSO_4{\cdot}2H_2O$) as a source of phosphorous (P) at six levels (0, 2, 4, 6, 8 and 12 g/kg) for each of the five different incubation times (0, 6, 12, 24 and 48 h). The effects of P (TSP) levels and time were significant for in vitro dry matter and organic matter degradability. For NH_3-N concentration in rumen fluid the effect of P and time were significant. For in vivo digestibility eight bucks average live weight 7.63 ± 0.19 kg were selected. The DM, ADF and OM digestibility were significantly higher in P group than control group. The digestibility of CP was higher in P group than control group. It can be concluded that P has an important role in ruminant digestion and metabolism. As low quality forages are deficit in P, supplementation of P can improve the low quality forages. Thus ruminants can proper utilize this low quality forages.

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1. Introduction

Rice straw which is commonly used as basal feed for ruminants in the developing countries has low nutritive values. The high level of lignification and silicification are the main constrain for rice straw digestibility in ruminants (Van Soest, 2006). Rice straw is an agricultural waste and its availability is abundant, but up to now its utilization is still limited (Syamsu et al., 2007). Feeding ruminants with rice straw only will cause live weight loss and possibly health problem (Nguyen Van et al., 2003). Supplements increase the utilization of low quality forages, but the requirement for these supplements is more than their availability, especially in developing countries (Devendra and Sevilla, 2002). Therefore, it is necessary to look for alternative natural or artificial feed supplements that can improve the utilization of rice straw.

Phosphorus (P) is very important for normal rumen metabolism, skeletal growth, production and reproduction. Rumen microbes have specific P requirements to degrade the cell walls of feedstuffs. Also, rumen microbes need P to maintain metabolism and growth (Komisarczuk et al., 1988); and total P content of rumen microorganisms ranges from 2 to 6% of the dry matter (Valk et al., 2000). Bacterial proliferation is strongly dependent on a sufficient supply of P. Phosphorus deficiency occurs in young calves and dry cows due to lack of supplementary feeding (McDonald et al., 2002). Most of the normal forages consumed by

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ruminants are low in P content than the requirement (Khan and Chaudhry, 2012). In herds reared at pasture, Phosphorus can be considered, worldwide, the major mineral deficiency causing economic impact (Underwood and Suttle, 1999). Therefore, increasing use of poor quality roughages and by-products, generally deficient in P, animals need to be supplemented with this mineral to meet their nutritional requirements. So farmers from developing countries are looking for alternative source of P that is cheap and easily available. TSP can be used as an alternative source which contains 48% phosphorus penta oxide (P_2O_5) and 21.12% P. It was not only the sources of P but also provides calcium and sulphur. Therefore the present study was carried out to examine the effect of triple super phosphate supplements to enhance the utilization of low quality forages like rice straw by ruminants.

2. Materials and methods

2.1. Experimental work plan

This study was evaluated the suitability of different levels of TSP as a source of P on the in vitro rumen degradability and fermentation profiles of rice straw at different incubation times. Proximate analyses of feed samples were performed following the methods of AOAC (2004) and in vivo digestibility trial was conducted with bucks.

2.2. Characterization of feed sample

2.2.1. Processing of feed sample

Rice straw was dried in the sun. After drying the sample was coarse ground to approximate size (1 mm) using a grinder (blender machine) and measured by analytical balance (Setra, M-EL-410s, USA).

2.3. Preparation of buffer solution

The buffer solution was prepared as described by McDougall (1948) according to the formula for synthetic saliva with some modification (Khan and Chaudhry, 2010).

2.4. Collection of rumen fluid and preparation of buffer inoculum

The rumen fluid was collected from immediately after slaughtered a mature cow. The fluid was then transferred into a flask via filtering with a filter cloth. The filtered rumen fluid was transported to the laboratory by a flask (37 °C) for in vitro trial. The rumen fluid was pooled through two layers of the muslin cloth into pre warmed flask. The rumen fluid was mixed with pre warmed buffer at 1:3 (rumen fluid: buffer) ratio in a bottle which was covered with black polythene.

2.5. In vitro incubation

The incubations of rice straw were conducted in 50-ml centrifuge tubes each containing about 0.4 g of ground (1 mm) sample. TSP was added at six different levels (0, 2, 4, 6, 8 and 12 g/kg). Then 40 ml of buffered rumen fluid were added to each tube. The tubes were sealed with rubber stoppers fitted with pressure release narrow glass rod. Incubation was conducted at 38 °C in a water bath. After 0, 6, 12, 24 and 48 h the tubes were collected from water bath and submerged in an ice box to stop further fermentation. The liquid and residue were separated by filtering with filter cloth. The supernatant of the buffered rumen fluid was collected to determine ammonia concentration in rumen fluid and 20 ml of supernatant were acidified with 10 ml of 1 N HCl and kept in a tube. Residues were washed with distilled water and used to determine DM degradability. Acidified sample was distillated with 40 ml 40% NaOH solution into kjeldahl flask. Afterward, 20 ml 2% boric acid solution was placed into distillation set. After the distillation the sample was titrated with 0.1 N HCl.

2.6. In vivo trial

2.6.1. Live weight of bucks and dietary treatment

Eight young bucks (8–9 month) of Black Bengal goat were kept into individual pens for control and P group where each group contains four bucks and the average live weight was 7.63 ± 0.19 kg. In the control group 500 g napier grass and 250 g concentrate mixture (keshari bran 35%, soyabean meal 10%, wheat bran 10%, crushed gram 25%, crushed maize 20%) were provided per buck per day. For P group, 500 g napier grass and 250 g concentrate mixture along with 5 g TSP was provided per buck per day.

2.6.2. Measurement of feed intake

Feed intake and refusals were recorded daily. Bucks consumed all the concentrate but sometimes refused napier stem. For measuring feed intake napier grass was weighed every day before supplying to the buck; next morning left over of napier grass stem was weighed by top loading balance.

2.6.3. Collection and chemical analysis of faeces sample

Digestibility was determined by using total collection method. During collection period (10 days), complete collection of faeces from each group of bucks were taken in a polythene sheet daily in the morning, weighed, mixed thoroughly and 5% of it was sampled and stored at −20 °C. At the end of collection period faecal samples were composited by group and 10% of the composited samples were taken for analysis following the methods of AOAC (2004).

2.7. Statistical analyses

The in vitro data were analyzed by using ANOVA in General Linear model of Minitab to compare degradability and NH_3-N concentration of forages with different levels of P supplementation and the in vivo data were analyzed by using ANOVA following the principles of CRD using computer package GENSTAT (Lawes Agricultural Trust, 1997). Significant differences between means of different groups were compared by using the Tukey's test at $p > 0.05$.

3. Result

3.1. Chemical composition of roughages and concentrate mixture

The chemical composition of rice straw, napier grass and concentrate mixture used during the experimental period was shown in Table 1. DM and ADF were higher in rice straw than napier grass. On the other hand, CP and Ash were lower in rice straw than napier grass. The concentrate mixture contains higher CP and lower ADF and ash than rice straw and napier grass.

3.2. Effects of phosphorus supplementation (triple super phosphate, TSP: $Ca(H_2PO_4)_2{\cdot}CaSO_4{\cdot}2H_2O$) on rice straw degradability and fermentation profile

3.2.1. In vitro DM degradability of rice straw

The effects of P levels and time were significant for in vitro DM degradability. The DM degradability increased with higher level of P and longer incubation time (Table 2).

3.2.2. In vitro OM degradability of rice straw

The effects of P levels and time were significant for in vitro OM degradability. The OM degradability was increased with higher level of P and longer incubation time like dry matter degradability (Table 3).

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