MEDWIN PUBLISHERS
Committed to create value for Researchers

Journal of Ethology & Animal Science

Degradability of Legumes Proteins in Ruminant Nutrition

Jordan M*, Dragan T, Tanja V, Vladimir Z, Dragoslav Đ, Snezana A and Lugic Z

Institut for forage crops, R Serbia

Mini Review

Volume 2 Issue 2

Received Date: June 10, 2019

Published Date: July 08, 2019

***Corresponding author:** Jordan Markovic, Research associate, Institute for forage crops, 00 381 37251 Globoder, Kruševac, R Serbia, Tel: 0038137442583; Fax: 0038137441295; Email: jordan.markovic@ikbks.com

Abstract

Legumes are the main source of protein and the main constituents of ruminant meals. This place is occupied by the ability of biological nitrogen fixation and because of their high nutritional value. They significantly reduce production costs – less application of nitrogen mineral fertilizers and a lower proportion of concentrated nutrients in ruminants rations. In addition to the fact that legumes have a high nutritional value, their proteins are subject to rapid and intense degradation in the rumen. Consequently, the rate of protein degradation in the rumen directly affects the efficiency of the nitrogen utilization by ruminants. Generally, ineffective nitrogen utilization may be the result of imbalance between protein and carbohydrates in rations, which increases the risk of nitrogen losses and its secretion into the environment. Modern nutrition system, such as CNCPS (Cornell Net Carbohydrates and Protein System) enabled the detailed analysis of protein solubility and degradability. This allows adequate characterization of animal feedstuffs and their variability, predicting the extent and rate of degradation of carbohydrates and protein in digestive tract, as well as microbial protein supply.

Keywords: Legumes Crop; Protein Degradability; Ruminant Nutrition

Introduction

High levels of milk protein, increased nutrition costs, and environmental concerns have made nitrogen utilization a central component in balancing the meal. Excess of crude protein in rations can lead to unnecessary costs in the diet, and as a result there is no increased production of milk and milk protein. In addition, most of the excess nitrogen is excreted in urine and represents an ecologically labile form [1]. Balancing the protein according to metabolic needs, with an adequate ratio of protein degradable and non-degradable in the rumen, and without excessive nutrition will have positive effects on the cost of meals and profitability and on the environment [2]. A more efficient use of nutrients requires knowledge of the way in which different nutrients pass through the digestive tract.

Milk production would be significantly reduced if the protein fraction in the meal would not meet the minimum energy production needs, which is due to the rate of protein degradability [3]. For this reason, protein fractions are integrated into meal balancing models, based on the protein degradability and their utilization in the animal digestive tract [4]. The procedures for determining these fractions are based on the solubility of the protein in buffer and detergent solutions, and are adapted according to NRC [5] and CNCPS [3] for the determination of protein fractions in animal feeds.

Alfalfa and Red Clover Protein Degradability

Alfalfa and red clover have many of the attributes necessary for high milk production and maintenance of animal health. This includes a high level of nutrients, a high dry matter digestibility and an optimal ratio of structural and non-structural components. However, data on the nutritional value of forage crops in terms of nutritional fractions necessary for the formulation of meals in modern diet are missing. In fact, there is insufficient data on protein fractions and their degradability in the rumen. Knowledge of these data is necessary for the production of high quality feeds.

Table 1 illustrates the quantitative effect of variety of alfalfa and red clover on the protein fractions by CNCPS – PA, PB_1, PB_2, PB_3 and PC [6]. The slowly degradable PB_3 fraction associated with the plant cell wall and the intermediately degradable PB_2 fraction were higher in red clover than in alfalfa cultivars. Fast and intensive protein degradation leads to ineffective protein utilization from meals. These processes can be the basic limiting factors when legumes are used in nutrition [1]. The most favorable situation for animals is when the proteins pass to the small intestine where they dissolve to the amino acids and accept. Many authors found variation in protein degradation - between 19 varieties of *Medicago sativa* L. and 3 varieties of *Medicago falcata* L. [1], differences in the degree of protein degradability among 9 alfalfa varieties [7], and the other authors also found the difference between varieties, but they were contradictory during the vegetation period and years of exploatation [8]. In the second hand, some authors examined differences between 27 varieties of alfalfa in the content of non-degradable proteins, rates of degradation and yield of dry matter, and found slight genetic variation among varieties, but concluded that it is possible to combine high yields of DM and low rates in protein degradation [9].

Cultivar	PA	PB_1	PB_2	PB_3	PC
K – 28	429.2^{a}	68.7^{a}	271.0^{b}	137.2^{a}	93.6^{b}
G+13R+CZ	421.6^{b}	33.5^{b}	410.6^{a}	26.6^{b}	107.6^{a}
Means	**425.4^{a}**	**51.1^{a}**	**340.8^{b}**	**81.9^{b}**	**100.6^{ns}**
K - 32	365.7^{ns}	25.3^{a}	447.3^{a}	72.4^{b}	89.7^{b}
K - 39	359.7^{ns}	0.0^{b}	399.4^{b}	199.2^{a}	115.4^{a}
Means	**362.7^{b}**	**12.7^{b}**	**423.4^{a}**	**135.8^{a}**	**102.6^{ns}**

Table 1: Content of CP fractions in alfalfa and red clover by CNCPS, g kg^{-1} CP.
K 28 – alfalfa, Serbian cv; G+13R+CZ – alfalfa, American cv; K 32 – tetraploide red clover; K 39 – diploide red clover; PA – non-protein nitrogen; PB_1 – rapidly degraded crude protein; PB_2 – intermediately degraded crude protein; PB_3 – slowly degraded crude protein; PC – bound crude protein Different letters denote significantly different means ($P< 0.05$).

Conclusion

Alfalfa and red clover differ in the content and ratio of degradable and non-degradable proteins. Alfalfa contains a higher proportion of PA fraction of crude protein, or non-protein nitrogen. As red clover contains a smaller fraction of the crude protein, PA fraction and a higher content of the PB_3 fraction than the alfalfa, it means that the red clover protein is more efficiently used in the animal's organism. The largest fraction of crude proteins is PB_2 of the crude protein fraction, which is decomposed with the medium-intensity rate.

Acknowledgements

The authors thank the Ministry of Education, Science and Technological Development of Republic of Serbia who funded this research as part of the project TR 31057.

References

1. Broderick GA (2003) Effects of varying dietary protein and energy levels on the production of lactating dairy cows. J Dairy Sci 86(4): 1370-1381.

2. Kalscheur KF, Vandersall JH, Erdman RA, Kohn RA, Russek-Cohen E (1999) Effects of dietary crude protein concentration and degradability on milk production responses of early, mid and late lactation dairy cows. J Dairy Sci 82(3): 545-554.

3. Fox DG, Tedeschi LO, Tylutki TP, Russell JB, Van Amburgh ME, et al. (2004) The Cornell Net Carbohydrate and Protein System model for evaluating herd nutrition of alfalfa cultivars. Can J Plant Sci 80: 315-325.

4. Lanzas C, Tedeschi LO, Seo S, Fox DG (2007) Evaluation of protein fractionation systems used in

formulating rations for dairy cattle. J dairy Sci 90(1): 507-521.

5. NRC – National Research Council (2001) Nutrient requirements of dairy cattle. Seventh Revised Edition, National Academy Press, Washington, D.C., USA.

6. Marković J, Dinić B, Blagojević M, Anđelković B, Babić S, et al. (2015) Effects of alfalfa and red clover cultivars on protein fractions by CNCPS system of analyzis. 4th International Congress, New Perspectives and Challenges of Sustainable Livestock Production, Belgrade, Serbia.

7. Skinner DK, Fritz JO, Klocke LL (1994) Protein degradability in a diverse array of alfalfa germplasm sources. Crop Sci 34: 1396-1399.

8. Griffin TS, Cassida KA, Hasterman OB, Rust SR (1994) Alfalfa maturity and cultivars effects on chemical and *in situ* estimates of protein degradability. Crop Sci 34(6): 1654-1661.

9. Tremblay GF, Michaud R, Belanger G, McRae KB, Petit HV (2000) *In vitro* ruminal undegradable proteins of alfalfa cultivars. Can J Plant Sci 80(2): 315-325.