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Some physiological effect of Different Protein Sources in Ruminants Ration: A Comparative Review

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ABSTRACT

The ruminants' productive capacity was enhanced by the addition of protein sources high in non-hydrolyzed protein to the rumen because of their palatability, availability in large quantities, balanced amino acid composition, and rapid decomposition in the rumen. The various commonly used soybean meals is one of the protein sources in ruminant feed and the most widely used in nutrition. However, its high cost led to the search for alternatives to it at a lower cost; one of these additives is corn gluten meal, which is a by-product of the manufacturing process. Because corn gluten meal has a protein content of 60–65% crude protein, it eliminates the need to supplement traditional feed with protein sources, lowering the cost of feed. Urea is one of the most essential nitrogenous additives that are used to improve the nutritional value and benefit of coarse feed, and because it has a value almost equal to the concentrates for ruminants, urea decomposes in the rumen at high speed to ammonia, which is used to produce amino acids and microbial protein by microbiology, and those substances are utilized as protein substances by the animal.

Keywords: Corn gluten, Proteins, Ruminants, Soybean meals, Urea.

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INTRODUCTION

Feeding ruminants according to their raw protein needs may not only be available through grazing, but at the same time, grazing reduces the risks caused by an increase or decrease in these raw protein **(Erickson & Kalscheur, 2020).** Improving the quality of the protein used in the feed of lambs from the productive performance ensures obtaining a material return for fattening projects **(F.A.O., 2000).** The differences in plant-based protein sources used in the nutrition feeding of ruminants in general and developing lambs, in particular, give greater freedom in the composition of the feed components (**Alkass *et al.*, 2021).** Since these sources are characterized by being different in the content and arrangement of amino acids included in their composition **(Capper, 2020).** Therefore, the difference in the source of protein often leads to a differentiated effect on the productive performance and hematological and biochemical parameter of blood serum **(Burd *et al.*, 2019).**

It is noted that the difference in the effect of the protein source on the productive state of the ruminant animals may be due to the difference in the rumen environment as well as the difference in the type and arrangement of the amino acids that make up that protein as a result of their influence on the metabolism of food **(Mariotti, 2019).** Protein sources also differ in their degradability in the rumen, some of which are slightly hydrolyzed **(Kumar *et al.*, 2015).** Microbial protein alone cannot compensate for the great need for protein in developing ruminants **(Ma *et al.*, 2021).** Among those plant sources of crude protein that have recently been used in the feeding of farm animals espically in ruminants, are corn gluten, soybeans, and urea **(Imran *et al.*, 2018)**. Therefore, this article review aimed to determine the comparative effect of using various protein sources such as corn gluten,soybeans,and urea on the physiological performance of ruminants.

Protein in the ruminant's feed

Protein is of great importance in the nutrition of ruminants because the need of ruminants for it changes depending on their productive and physiological state, so protein must be provided to the animal in what meets its need and suits its productive state **(Xia *et al.*, 2018)**; the need for protein in food increases during pregnancy and lactation **(Ismail *et al.*, 2020).** Anumber of experiments have shown the importance of separating the need of microbiotic in the Rumen and the need of the host animal for nitrogen in order to reach the maximum benefit from food as well as improve the amount of benefit from protein intake **(Chen *et al.*, 2021).**

Proteins are essential compounds for the organs and tissues of the body and are formed by the interrelation of many amino acids, the number of which reaches more than 20 amino acid **(Saro *et al.*, 2020).** Proteins differ in their content of amino acids, and animals differ in their needs for amino acids in quantity and quality depending on their type and production **(Henchion *et al.*, 2017).** The substantial value of protein in food usually depends on the extent to which it is helpful to the body, and the vital value increases as the content of amino acids increases, which corresponds quantitatively and qualitatively to the needs of the animal and the requirements of the type of production **(Nafikova *et al.*, 2021).**

Previously, when the protein is mentioned in diets, it was referred to as crude protein (C.P.), which is what the diet content nitrogen multiplied by the coefficient 6.25 **(*Boulos et al.*,2020).** For several years, crude protein was relied on in the composition of diets due to the lack of knowledge of other types of protein, but after the development in nutrition research, it was noted that crude protein consists of two molecules: A hydrolyzed protein in the rumen (Rumen degradable protein, RDP), and a non-hydrolyzed protein in the rumen reaches the small intestine (Undegradable dietary protein, U.D.P.) **(Putri *et al.*, 2021).**

Recently, a trend has emerged that is interested in balancing the proportion of crude protein in the Bush based on the ratio between RDP and UDP protein in the rumen, so it is necessary to follow a diet that contains the appropriate integrated proportions of them, and the provision of large amounts of crude protein is no longer an acceptable solution to the difference in the degree of decomposition in the Rumen, which is one of the most wasteful processes in the digestive system of ruminants **(Tacoma *et al.*, 2017).** Recommended **N.R.C. (2001)** that there is a need for Microbiology in the Rumen from the decomposed nitrogen in it in addition to the need for the animal itself from the non-decomposed protein inside the Rumen, and the microbial protein reaching the small intestine may not fill the animal's need for amino acids to reach the highest production of animal weight gain, so modern systems of feeding in ruminants are working to achieve the best production of microbial proteins reaching the small intestine and supplementing it with non-decomposed food protein in the Rumen and digestible in the intestine **(Bahrami-Yekdangi *et al.*, 2016).**

Rumen degradable protein (RDP)

Protein is one of the most expensive components of the rations in the feeders for ruminants, which decomposes into free amino acids in the Rumen by hydrolysis of the peptide bonds that bind the amino acids, and then the process of extracting the amine group from the amino acids is carried out, and this results in carbon dioxide **(Rimola *et al.*, 2009).** In addition to the remaining carbon chains of amino acids after removing the amine group, which enters the Krebs cycle or turns into volatile fatty acids as a final product of protein metabolism **(Neinast *et al.*, 2019).**

As for ammonia resulting from the protein decomposition process, it is used as a source of nitrogen for microorganisms, one of the best sources of nitrogen for fiber-digesting bacteria **(Ribeiro *et al*., 2020).** Some research has indicated an improvement in the efficiency of microbial growth in Rumen and improved digestion of dry and organic matter and raw fiber with increased peptides in Rumen fluid **(Ren *et al.*, 2019).** The hydrolyzed protein in the Rumen supplies the rumen microbiota with ammonia nitrogen, amino acids, and peptides, and a decrease in the amount of hydrolyzed protein in the Rumen will result in a decrease in the animal's performance **(Wang *et al.*, 2018).** The rapid decrease in the concentration of ammonia nitrogen in the Rumen indicates either the rapid growth of microorganisms and their consumption of ammonia nitrogen in the synthesis of a microbial protein or the absorption of ammonia nitrogen through the rumen wall **(Hackmann & Firkins, 2015).**

The total concentration of ammonia nitrogen and volatile fatty acids tends to increase linearly with increasing hydrolyzed protein in the Rumen, and stated that the decomposition of food protein plays a vital role in estimating the need of ruminant animals **(Nur Atikah *et al.*, 2018).** This helps to determine the extent to which this protein contributes to filling the need of microorganisms in the Rumen, as well as the amount of protein that passes through the Rumen without decomposition and which will be digested later by the host animal **(Manoukian *et al.*, 2021).** A study by **Nisa *et al.* (2008)** noted that increasing the levels of hydrolyzed protein in the Rumen above the permissible limit in ruminants increases the ammonia level in the Rumen, which increases ammonia nitrogen in the blood.

Rumen undegradable protein (RUP)

Nitrogenous sources that reach the small intestine and are digested by enzymatic secretions include non-decomposed bush protein in the Rumen, a microbial protein synthesized in the Rumen with a small part coming from enzymatic secretions and dissections of the internal tissues lining the digestive tract (endogenous nitrogen) **(Zhong *et al.*, 2022).** The rumen undecradable protein in the Rumen is the protein that bypasses rumen fermentation and quickly crosses out of the Rumen **(Hailemariam *et al.*, 2021).** Research and experiments conducted under various production and nutritional conditions have shown that the processing of amino acids by microbial protein alone is insufficient to meet the animal's need, so there is a need to provide it with a protein source that does not decompose in the rumen but is absorbed and digested in the small intestine like protected Amino acids **(Singh *et al., 2015*).**

Protected Methionine and protected lysine consider the most important protected amino acids that supplement ruminants diets, which in turn leads to an increase in the amount of feed freely ingested with an improvement in feed conversion efficiency **(Sok *et al.,* 2017).** Several experiments have shown that the pattern of amino acids reaching the small intestine can be significantly different from that found in digested food depending on the effect of microbial activity in the Rumen, so several attempts have been made using several physical and chemical parameters of leeches to protect the protein from decomposition in the Rumen in order to modify the quantity and quality of amino acids reaching the small intestine and thus improve the performance of the animal **(Wang *et al.,*2016).** The passage of the protein through the Rumen without decomposition and its arrival in the intestine does not necessarily mean that it will be digested efficiently by the animal. The choice of poorly decomposed proteins in the Rumen and containing the amino acid model that complements that part of the microbial origin will work to give the desired model of the mixture of digested food matter continued to the duodenum **(Boucher *et al.,*2009).**

It is worth noting that there are pronounced differences in the response of lambs to various non-hydrolyzed protein sources depending on how much nitrogen this protein is absorbed in the animal's small intestine **(Xie *et al.,* 2015).** That the provision of non-hydrolyzed protein in the Rumen of ruminants serves not only to provide the need for protein for tissue building, growth, and production but part of this non-hydrolyzed protein in the Rumen will serve as a source of recycled nitrogen to the Rumen **(Jahan-Mihan *et al.,* 2011).**

Corn gluten meal (C.G.M.)

Gluten is a protein compound consisting of two substances, Glutenin, which is the basic structure of gluten and gives hardness, and Gliadin, which is characterized by its softness and viscosity, as it binds the Glutenin molecules together and thus prevents them from leaking during the process of washing the gluten **(Shewry, 2019).** One of the by-products carried out on corn grains by the wet method is corn gluten, characterized by a high percentage of crude protein of up to 60% and a percentage of fat is about 2.5%. Fiber is about 1% and is a good source of the amino acid methionine and cysteine-rich in sulfur that the body needs, but it is poor in the amino acid arginine, lysine, and tryptophan **(Gorissen *et al.,* 2018).** It is easily digestible, corn gluten is a rich source of the vitamin B group, and vitamin E contains low amounts of phosphorus **(Das *et al.,* 2021).** Corn gluten meal is widely used in the composition of feed for farm animals due to its high protein content, high level of yellow xanthophyll pigment, and relatively low cost of purchase **(Peng *et al.,* 2017).** Due to their unbalanced amino acid composition, they must be mixed with gain or dietary compounds, or the deficiency of amino acids is filled with artificial supplements to provide the requirement of amino acids in rations **(Darabighane *et al.,* 2020).**

Soybean meal (S.B.M.)

Soybean meal is one of the essential sources of feed materials used in feeding ruminants as a source of protein, and its protein content is about 40-47% **(Shen *et al.,* 2015).** The soybean gain is a result of extracting oil from soybean seeds. It is also considered to have a higher nutritional value than other plant sources in terms of its high percentage of crude protein with a balanced content of amino acids. However, it is low in calcium, phosphorus, carotene, and vitamin D **(Colmenero and Broderick, 2006)**. The content of soybean gain from non-decomposed protein is estimated at 25-35%, and therefore most of the amino acid protein is decomposed by scraping, and the decomposition products are exploited to meet the needs of microorganisms of nitrogenous compounds **(Feizi *et al.,* 2020).**

Urea

Urea is one of the most popular industrially prepared substances that has become a prestigious place in the nutrition of ruminants. Urea is prepared by the Union of ammonia and carbon dioxide under high pressure and heat **(Wahyono *et al.,* 2022).** Gradually dissolving urea provides nutritional and economic value to livestock, allowing a safe and effective replacement of corn and soybeans in the Bush (whose prices have recently increased significantly) while raising the quality of the Bush, which benefits the breeder with improved overall health in the herd and increased economic yield **(Xu *et al.,* 2019).**

Urea has no value for animals with a simple stomach, such as pigs, and poultry, as well as for calves and lambs whose Rumen has not fully developed **(Patra and Aschenbach, 2018).** Large cattle can benefit from them through Bush microbiology, where some produce the enzyme urease, which hydrolyzes urea into ammonia and carbon dioxide **(Emmanuel *et al.,* 2015).** Suppose the conditions are favorable for the activity of microorganisms in the Bush. In that case, they use the ammonia from the decomposition of urea or the ration's protein to form amino acids necessary for their growth and bodybuilding **(Chanu *et al.*, 2020).**

Effect of protein sources on physical blood parameters

A significant increase in the hemoglobin concentration in the blood when using different sources of protein levels, namely (yeast 3 g /kg feed, soya 15%, and urea 1.5%) compared with the control level **(Al Fares, 2012).** In another study by **Nasser *et al.* (2014),** they did not observe any significant effect on the number of erythrocytes, hemoglobin, Packed cell volume and Total White blood cell counts and their differential leucocytes ratios when using various nitrogenous sources of soybean gain, Black Seed, urea in the starter diets of weaned drinking calves. **Al-Sherwany *et al.* (2016)** noted a significant increase in the number of erythrocytes of the Fed Kurdish lambs at the nutritional levels of 8.2, 3.3% of body weight compared with the group fed at a lower level of 3.2% of live body weight and attributed the result in the increase in the number of erythrocytes to the increase in the weights of lambs.

Effect of protein sources on Biochemical blood parameters

Kazemi-Boncgenari *et al.* (2015) noted a significant increase in glucose concentration when using soybeans treated with xylose XSBM (7.5%) on day 35 compared to Days 4 and 56 in Holstein's calves. The study of **Arruda *et al.* (2020)** showed a significant decrease in the concentration of blood glucose in lambs when fed on distilled corn with solutes (DDGS) instead of soybeans (S.B.M.) in protein levels, and the reason for the decrease is due to the body's energy consumption at high levels for protein representation in the body. **Gopfert *et al.* (2006)** showed no significant effect on the concentration of blood cholesterol when feeding hybrid calves on a starter pack containing soybeans or soybeans and 10% of grape damage. While **Nasser *et al.* (2013)** noted a significant effect on the concentration of blood cholesterol when feeding on a starter pack containing soybean meal or soybean meal with dry Rumen contents of 8 16%. **Obeidat *et al.* (2019)** also explained the absence of a significant effect on cholesterol concentration in the blood serum when feeding on a feed containing vitamin E and heat-treated soybean meal in domestic ewes.

Al-Saedi (2016) also did not obtain any significant differences in the cholesterol concentration in the blood serum of Arab lambs fed at different protein levels. The control level was 100% concentrated feed and 10,20,30% hay treated with starch and urea. **Abdel Hameed *et al.* (2013)** indicated that there is a significant decrease in the concentration of triglycerides in the blood serum of Sudanese lambs fed on peanut residues treated with urea compared with the control level; he also attributed the reason for the difference in the level of triglycerides to the components of the feed, the type of treatment and the ages of the animals used. **Al-Saedi (2016)** also noted significant differences in the concentration of triglycerides in the blood serum of fed lambs at four protein levels control 100% concentrated feed, 10, 20, and 30% hay treated with church and urea at the level of 10%. **Al-Talib *et al.* (2010)** noted significant differences in the concentration of triglycerides in Fed Asiatic sheep's blood serum at three different urea levels (5.0, 1, 5.1%) in the ratio. **Gandra *et al.* (2016)** noted a significant increase in serum creatinine concentration in Jersey's calves when feeding on a raw soybean in the serum of calves compared to the treatment of raw soybeans, which led to a significant decrease in creatinine concentration. Also, **Gandra *et al.* (2016)** noted a significant increase in the concentration of HDL in Jersey calves fed on raw soybeans.

CONCLUSION

By extrapolating the topic of the article, it highlights what modern international and local research has included in the extent of the response of the ruminant animal's body to variant protein sources and indicating the best of them in terms of the biological effect on various physiological parameters of the animal's body.

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