

**RUMEN FERMENTATION AND DIGESTIVE PHYSIOLOGY IN SHEEP:  
CHARACTERISTICS DEPENDENT ON DIET COMPOSITION****<sup>1</sup>F.Sh. Normammedova, <sup>2</sup>B.O.Ochilov**<sup>1</sup>Samarkand zarmed university, Samarkand, Uzbekistan[Feruza.normammedova@gmail.com](mailto:Feruza.normammedova@gmail.com)<sup>2</sup>Impuls medical institute Chirchiq Branch, Chirchiq, Uzbekistan

**Abstract:** The article analyzes the main mechanisms of digestive physiology in sheep, rumen fermentation, and the influence of diet composition on the utilization of nutrients. During the study, the fermentative activity of the rumen microflora and physiological characteristics such as dry matter digestibility were evaluated based on scientific literature. The results showed that high-fiber diets enhance the activity of cellulolytic microorganisms and increase the efficiency of rumen fermentation. It was also established that changes in diet composition significantly affect the rumen pH environment, nutrient breakdown, and metabolic processes.

**Keywords:** sheep, rumen, fermentation, digestive physiology, microbiota, nutrient digestion, volatile fatty acids, metabolism.

**Introduction**

The intensive development of the livestock sector worldwide has made the in-depth study of the physiological mechanisms of nutrient digestion in ruminant animals one of the priority areas of modern biology and veterinary science. In particular, the ability of sheep to efficiently utilize high-fiber plant biomass is closely related to their complex, evolutionarily developed digestive system. In sheep, nutrient assimilation is not merely a simple fermentative breakdown but the result of complex symbiotic relationships between the organism and billions of microorganisms [1,2]. The multi-compartment stomach system of sheep, particularly the rumen compartment, functions as a natural biological fermenter, ensuring the breakdown of complex polysaccharides in plant cell walls [2]. As a result of the fermentative activity of the rumen microbiota, cellulose, hemicellulose, and other structural carbohydrates are broken down into volatile fatty acids. These metabolites serve as the primary energy source in the sheep's body and play an important physiological role in maintaining overall metabolic homeostasis [3]. According to modern scientific views, the efficiency of rumen fermentation is one of the fundamental factors determining animal productivity, feed conversion, and metabolic stability. In particular, diet composition and feed quality directly regulate the balance of rumen microorganisms. While high-fiber diets stimulate the development of cellulolytic bacterial populations, feeds rich in starch and rapidly degradable carbohydrates can sharply alter the direction of fermentation and lead to disruption of rumen pH balance [4]. This results in sub-clinical acidosis, reduced fermentative activity, and decreased efficiency of nutrient digestion. Fundamental studies on ruminant physiology emphasize the role of rumen microbiota not only in nutrient digestion but also in protein biosynthesis, nitrogen metabolism, and immunological stability [5].

In recent years, global feed resource shortages, increasing ecological pressure, and rising demands for productivity in livestock farming have further intensified the need to study digestive physiology at the molecular and microbiological levels. Researchers have noted that high-fiber diets prolong the retention time of feed in the rumen and enhance cellulose breakdown. From this perspective, studying the diet-dependent physiological changes in digestive physiology and rumen fermentation in sheep is of both theoretical and significant practical importance. The aim

of this study is to provide a comprehensive analysis of rumen fermentation, microbiological processes, and the physiological characteristics of nutrient digestion in sheep .

### Materials and Methods

The research was conducted on local coarse-wooled breed sheep raised in livestock-specialized areas of Samarkand region. The region's sharply continental climate, with high temperatures and drought observed in the summer season, was selected as the experimental setting because it significantly affects feed quality and metabolic processes in ruminants. During the study, animal housing and feeding conditions were standardized according to zoohygienic requirements. Physiological and biochemical analyses were performed at the vivarium of the Biochemistry Institute of Samarkand State University. The control group was fed the standard ration used in practice on the farm. The experimental group received a physiologically balanced ration rich in high-fiber and biologically active components. The diet composition was normalized in terms of dry matter, crude protein, crude fiber, metabolizable energy, and mineral substances. In the experimental group, the proportion of structural fibers in the ration was increased, and biological components that activate rumen fermentation were used. Dry matter digestibility and nutrient utilization coefficients were calculated based on classical balance trials. Blood samples were analyzed for total protein, albumin, globulin, glucose, and urea levels using a biochemical analyzer. The activity of cellulolytic bacteria was assessed by anaerobic cultivation. The obtained results were statistically processed using biometric methods. Calculations included the arithmetic mean (M), standard error of the mean ( $\pm m$ ), and reliability level. Differences between groups were evaluated using Student's t-test. Differences at  $p < 0.05$  were considered statistically significant.

### Results and Discussion

During the experiment, the effect of diet composition on digestive physiology and rumen fermentation in coarse-wooled sheep raised in Samarkand region conditions was comprehensively studied. The results showed that the physiologically balanced, high-structural-fiber ration used in the experimental group significantly improved rumen fermentation, nutrient digestion, and metabolic parameters compared to the control group. The dry and sharply continental climate of Samarkand region is characterized by an increased proportion of structural fibers in natural pasture feeds during summer months.

**Table 1**

**Physiological parameters of rumen fluid (M $\pm$ m, n=10)**

№	Parameters	Control group	Experimental group	Difference, %
1	pH	6.08 $\pm$ 0.07	6.31 $\pm$ 0.05*	+3.8
2	Ammonia nitrogen, mg%	17.4 $\pm$ 0.6	15.9 $\pm$ 0.5*	-8.6
3	Total VFA, mmol/L	84.6 $\pm$ 1.9	89.8 $\pm$ 2.1*	+6.1
4	Acetate, %	57.1 $\pm$ 1.1	60.2 $\pm$ 1.0*	+5.4
5	Propionate, %	27.6 $\pm$ 0.8	26.1 $\pm$ 0.7	-5.4
6	Butyrate, %	10.8 $\pm$ 0.3	10.2 $\pm$ 0.2	-5.6

\*Note: statistically significant difference at  $p < 0.05$ .

The obtained results indicated that a physiologically optimal environment was formed in the rumen of the experimental group. In particular, the increase in pH to 6.31 $\pm$ 0.05 created a

favorable environment for the active development of cellulolytic bacteria. In the control group, a shift of the rumen environment toward a more acidic side was observed due to the higher proportion of concentrate feeds. The decrease in ammonia nitrogen in the experimental group indicates more efficient utilization of nitrogen by microorganisms. This situation reflects enhanced microbial protein biosynthesis. The effect of diet composition on nutrient digestibility was studied through balance trials.

**Table 2**  
**Nutrient digestibility coefficients (%)**

<b>№</b>	<b>Parameters</b>	<b>Control group</b>	<b>Experimental group</b>	<b>difference, %</b>
<b>1</b>	<b>Dry matter</b>	66.2±1.1	69.1±1.0*	+4.4
<b>2</b>	<b>Organic matter</b>	68.4±1.2	71.3±1.1*	+4.2
<b>3</b>	<b>Crude protein</b>	63.8±1.0	66.4±0.9*	+4.1
<b>4</b>	<b>Crude fat</b>	60.6±0.9	62.8±0.8	+3.6
<b>5</b>	<b>Crude fiber</b>	52.1±1.3	56.2±1.2*	+7.9

\*Note: statistically significant difference at  $p < 0.05$ .

The results showed a particularly significant increase in crude fiber digestibility in the experimental group. This is explained by the increased fermentative activity of cellulolytic bacteria. High structural fibers remained in the rumen longer and served as an optimal substrate for microorganisms. The increase in dry matter and organic matter digestibility indicates improved feed conversion efficiency, which is also of significant economic importance. This allows for increased sheep productivity, reduced feed consumption, and more efficient use of local feed resources.

### Conclusion

The studies conducted on coarse-wooled sheep in Samarkand region conditions scientifically confirmed the significant effect of diet composition on rumen fermentation and digestive physiology. The use of a high-structural-fiber, physiologically balanced ration enhanced the fermentative activity of the rumen microbiota and increased the efficiency of nutrient digestion. According to the experimental results, the rumen environment in the experimental group formed in a physiologically optimal state. The stabilization of the pH indicator created favorable conditions for the development of cellulolytic bacteria. As a result, the synthesis of volatile fatty acids, particularly acetate, increased, and the digestibility coefficients of dry matter and crude fiber were significantly higher than in the control group ( $p < 0.05$ ). Thus, the physiological optimization of the feeding system in sheep increases the efficiency of rumen fermentation, improves nutrient utilization, and ensures the stable course of metabolic processes.

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