Scientific Papers. Series D. Animal Science. Vol. LXIII, No. 1, 2020
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

RESEARCH ON THE IMPACT OF THE ADDING THE APPLE VINEGAR IN RATION OF THE HEAVY LAMBS AND MONITORIZING THE RUMINAL pH AND AVERAGE DAILY GAIN

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Abstract

The study's objectives are based on the monitoring of ruminal pH and average daily gain (ADG) in Karakul of Botoșani lambs, following the addition of apple vinegar to ration. The study was conducted on a group of 90 weaned lambs. The ration consisted 30% chopped natural hay and 70% feed concentrated. The lambs were divided into 3 equal batches: control group (G1), experimental group (G2) at which ration was supplemented with 8 ml of apple vinegar/day/animal and experimental group (G3) was supplemented with 12 ml of apple vinegar/day/animal. As a result of study, was observed differences between the control group and the experimental groups. Thus at the batch G1 there was a daily average increase of 260 g, at the batch G2 290 g and at G3 310 g. Control group (G1) showed an average ruminal pH of 5,4 and experimental groups (G2 , G3) an average of 5,9. There are differences between the groups studied through variations of ruminal pH and ADG denoting that apple vinegar may have a potential influence.

Key words: *apple vinegar, lambs, pH.*

INTRODUCTION

Sheep have a physiological capacity for meat production, which is a source of protein to feed the people. Use of high-concentrate diets for feedlot lambs will boost their efficiency, as the ingredients that make up these diets typically have high concentrations of digestible constituents (INRA, 1988). The potential effect of the reduction in the availability of forage is catastrophic and, ultimately, livestock farmers rely on concentrates and grains as a major source of nutrients, which, in turn, reduces the profitability of sheep farming. In this sense, livestock farmers have started to use alternate feeds, by-products and certain additives in ruminant diets as a way of lowering feed costs (Yáñez-Ruiz, 2004). The vinegar has been used for domestic and cooking purposes for decades. In folk medicine, vinegars are known to be perfect for various forms of health problems. Vinegars are derived worldwide from various sources of carbohydrate, including cane, corn, rice, grapes, plums and other fruit juices (Barneveld, 1999). The famous and common vinegar of today's whole food world is apple vinegar (AV), which has been proclaimed to have several different health benefits. AV is produced from fermented apple juice, where the bacteria and the yeast convert the fruit sugars into ethanol cider and transform ethanol into acetic acid in a second fermentation phase (Barry and McNabb, 1999). Different theories have been suggested to clarify the possible health effects of AV (Archimède et al., 2010; Barneveld, 1999). Antiglycemic properties may be due to slower gastric emptying, reduced disaccharidase activity, enhanced insulin sensitivity, or increased glycogen production (Ogimoto and Imai, 1981). Acetic acid is the dominant organic acid in AV. Succinic, ascorbic, formic, citric and oxalic acids are other acids present in AV (Barneveld, 1999). The following processes have been proposed to explain the lowering effects of acetic acid on blood glucose levels, blood lipids, and BW: tardy gastric emptying, decreased disaccharidase activity, stimulation of adenosine monophosphate-activated protein kinase (AMPK) pathway, increased insulin secretion, enhanced postprandial satiety, and decreased energy intake (Newbold et al., 2015). A broad variety of feed additives has been researched and implemented for the modulation of rumen fermentation in the production of sheep. In addition to supplying direct nutrients, such as rumen-protected lysine, supplementation of AV was a key nutritional approach to modifying rumen function and animal performance (Chai et al., 2015; Patra and Saxena, 2011). Use of high-concentrate diets, primarily grains, is increasingly frequent in ruminant feed to increase body weight. Nevertheless, this form of diet includes carbohydrates that are readily fermentable in rumen and raise the risk of disorders such as ruminal acidosis and hepatic abscesses (Abarghue et al., 2010; Dehority, 1984; Yáñez-Ruiz, 2004). This disease is primarily attributed to the excessive accumulation of organic acids in rumen, which causes a decrease in ruminal pH (< 5.8) and lesions in the gastrointestinal barrier (Marie-Magdeleine et al., 2014; Martinele et al., 2014). Ruminal acidity contributes to the death of the Gram-negative bacteria with the resulting release of endotoxins (lipopolysaccharides, LPS), affecting the productive performance of the animal (Haro et al., 2019; Kamra, 2005).

MATERIALS AND METHODS

Animals and experimental design

The experiment was carried out between April and June (2019) at a private farm from the village Albesti, county Botosani, Romania. A total of 90 weaned lambs, Karakul of Botoşani with average 25.5 kg body weight (bw) were evaluated. The animals were divided in three groups; each provided with food and water, which consisted in various levels of apple vinegar. In pre-experimental period, the animals were respectively numbered with an ear tag and then subject to the control of endo- and ectoparasites with doramectin at 0.3 mg kg^{-1} and immunized for clostridiosis (Covexin®9). The experimental period lasted 70 days, with 30 days of adaptation and 40 days of the experiment period.

Forage chemical analysis

The determination of TMR (total mixed ratio), was realized with the NIR Analyzer (Perten DA 7200). The diets were formulated supplying the nutritional requirements for sheep within the 20-30 kg weight range for daily gains of over 250 g according to the recommendations of NRC (2007). The TMR was made up of chopped natural hay (30%), corn grain (58.8%), soybean meal (8%), dicalcium phosphate (0.05%), limestone (1.9%), bicarbonate (0.75%) and premix mineral (0.5%). The remnants of food were collected daily and evaluated for chemical composition. Control group (G1) only benefited from TMR, experimental group (G2) the ration was supplemented with 8 ml of apple vinegar/day/animal and experimental group (G3) the ration was supplemented with 12 ml of apple vinegar/day/animal. In every tenth day of experimentation period all animals were weighed for average daily gain (ADG) determination and ruminal fluids (cca 20 ml) were obtained 2-4 h after the morning feeding, from three slaughter lambs randomly selected from each treatment. Each container with ruminal fluid was sealed, labelled and transported to the laboratory, where the pH was analyzed with the InoLab pH-meter. To determine body weight, we used a weighing "Platform scale". Lambs were weighed at the beginning and end of the experimental phase after a solid-feed starvation duration of 12 h (water available ad libitum). The average daily gain (ADG) was determined as the total weight gain (TWG) over the feedlot duration divided by the number of days of the experiment.

Statistical analysis

The results were analysis the ruminal pH and average daily gain means were compared with the Tukey test. Statistical calculations were performed with the IBM SPSS V.22 software.

RESULTS AND DISCUSSIONS

During the 40 days of experiment, four determinations were made (the ruminal pH and the body weight were analyzed four times), the observed results being recorded in Table 1 and Figure 1.

Table 1. Average daily gain determination

	First determination (tenth day)		Second determination (twentieth day)		Third determination (thirtieth day)		Fourth determination (fortieth day)		
ELEMENT	**Mean of AVG (g)**	**Standard deviation**	**Mean of AVG (g)**	**Standard deviation**	**Mean of AVG (g)**	**Standard deviation**	**Mean of AVG (g)**	**Standard deviation**	**p-value**
Group 1	*255*	*10.22*	*263*	*10.1*	*264*	*12.46*	*261*	*9.61*	*0.02*
Group 2	*281*	*7.93*	*299*	*9.45*	*286*	*8.5*	*294*	*8.45*	*0.013*
Group 3	*306*	*8.32*	*316*	*9.89*	*308*	*8.39*	*310*	*7.9*	*0.011*

As can be seen in Table 1, at the first analysis, performed on the tenth day of experiment, a mean of average daily gain of 255 g was recorded in the G1 group, 281 g in the G2 group and 306 g in the G3 group, these values were similar to those previously reported by Chai et al. (2015). Thus, significant differences are observed regarding the average daily gain, between the three groups taken in the study right from the first analysis of the results. The greater ADG in lambs from G2 and G3 group results in the first determination. At the second determination, a mean of average daily gain of 263 g in G1, 299 in G2 and 316 in G3 was observed. On the thirtieth day of the experiment, a mean of ADG of 264 g was recorded in the control group, 286 in G2 and 308 in G3. Significant differences between the three groups taken in the study are also observed in the last determination, made on the fortieth day of the experiment.

As an ultimate result of study, was observed differences between the control group and the experimental groups. Thus at the batch G1 there was a daily average increase of 260 g, at the batch G2 290 g and at G3 310 g. Values for these parameter were in the range previously reported by others for lambs which was fed with high-cereal concentrates and slaughtered at about 25-30 kg BW (Archimède et al., 2010; Detmann et al., 2012; Patra and Saxena, 2011). In the current study, the two groups had comparable initial BW; however, final BW and ADG was greater in the groups G2 and G3 compared with the control group, indicating that lambs fed on the AV were more efficient in converting nutrients to growth.

Ruminal pH is an important indicator of the status of the ruminal microbial ecosystem in ruminants (Guyader et al., 2014).

The pH of the rumen liquid sampled in this study varied from 5.2 to 6.24, these values being within below the normal physiological range of 6.5-6.7 as outlined by Van Soest (1994). In the control group, which did not benefit from AV, a lower pH is observed than in the other two groups. This low pH level (in G1) can lead to ruminal acidosis and as can be seen in Figure 1, AV acted as a buffer against lowering the pH, keeping it within normal limits.

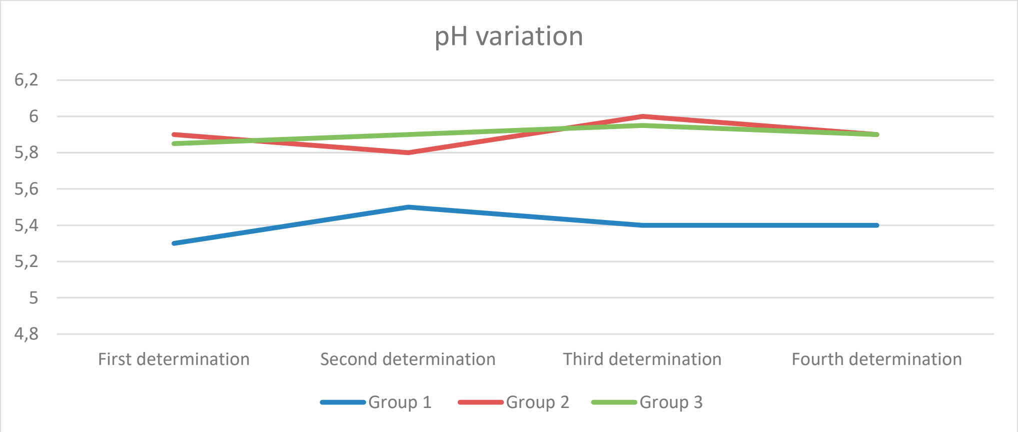

Figure 1. Ruminal pH variation in the three groups

Guyader et al. in 2014 indicated an optimum ruminal pH value for methanogen growth is between pH 6.0 and 7.5, with the maximum growth rate of this microorganism occurring at near-neutral pH, and a decrease in ruminal pH results in slower methanogen growth and reduced activity. In the cases of groups G2 and G3, which benefited from 8 ml of apple vinegar/day/animal, respectively 12 ml of apple vinegar/day/animal, it is observed that the ruminal pH remained constant between 5.8-6, values considered normal by other researchers (Göçmen et al., 2001; Heuzé et al., 2016).

CONCLUSIONS

In conclusion, when opting for the administration of a high proportion of concentrates, in order to fatten lambs, AV contributes significantly to improving the average daily gain by regulating the ruminal pH, maintaining ruminal health. Ruminal pH has a wide variety of effects on rumen physiology and fermentation, include methanogenesis. Ruminal pH is the result of interactions between the production of organic acids from microbial fermentation of feed, the bicarbonate flow into the rumen from saliva and the secretion through the ruminal epithelium, the absorption and passage of SCFA (short-chain fatty acid) and probably the absorption of ammonia. There were small differences between groups G2 and G3, so we can conclude that an amount of 8-12 ml of apple/day/animal vinegar is optimal for maintaining the ruminal environment under normal conditions. So we can see that apple vinegar has a significant potential to regulate ruminal pH and keep pH at normal values, preventing the occurrence of possible rumen disorders. The lambs in the groups that benefited from the AV supplement (G2 and G3) performed better than the animals in the control group, with ADG having clearly superior results.

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