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THE QUALITY OF ROE DEER (*CAPREOLUS CAPREOLUS*) DIET IN THE WINTER AND SPRING PERIODS BASED ON RUMEN CONTENTS

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SUMMARY

The purpose of this study is to compare the specifics of winter and spring diets of the roe deer using rumen content analysis. A chemical analysis was performed on a total of 13 samples of roe deer rumen contents: 7 samples of winter diet rumen contents and 6 samples of spring diet rumen contents. The following parameters were examined in this study: the level of crude protein and the content of fiber (NDF, ADF and ADL). The results obtained were processed by descriptive statistics and compared using F-tests. Consequently, certain deviations in the quality of roe deer nutrition were found in both winter and spring periods of the year. A lack of protein and energy can pose significant problems to roe deer, especially in the cooler periods of the year. Approximately a total of 17MJ/day is the maximum assumed energy required for animals kept in enclosure. The need for crude protein varies from 30.8% to 34.4% DM. This problem can be tackled if roe deer are adequately fed with quality bulky and concentrated feed, despite the fact that the animals adapt metabolically to seasonal variations.

Key words: Roe deer, rumen content, fiber content, crude protein, diet

Abbreviations: ADF - acid detergent fiber; ADL - acid detergent lignin; DM - dry matter; NDF - neutral detergent fiber

INTRODUCTION

Roe deer are the most numerous cervids (*Capreolus capreolus*) (Marcon et al., 2019) and a species of great economic importance (Militko et al., 2020). Depending on the part of the year, the roe deer's feed varies from vegetative parts of herbaceous and woody plants to seeds and fruits (Tixier & Duncan, 1996). Roe deer consume soft food (grass, green plants and hay), tough food (young twigs and shrubs) and hard food (forest fruits, chestnuts and acorns) (Beuković & Popović, 2014). Roe deer are very picky and choose the food of higher quality for grazing. If the incidence of family plants in the diet is less than or greater than 60%, mammalian herbivores can be considered specialists or generalists according to their feeding behavior (Shipley et al., 2009; Freschi et al., 2021). On the basis of the digestive tract morphology, Hofmann (1989) described roe deer as a "typical concentrate selector" and the most widespread species of deer in Europe. Freschi et al. (2021) found that the feeding habits of Italian roe deer are consistent with those of the European roe deer, i.e. a browser whose diet is based on a large number of plant species. In one study, roe deer were found to make a strict selection of preferable plants when offered a large assortment of plants in a diet (Maizeret, 1988). However, Kossak (1983) reported that roe deer did not exhibit a clear preference for any particular plants in the diet offered.

As roe deer can often be found searching for food in arable areas, the quality of their nutrition largely depends on the structure of plant crops in those fields and the season. Militko et al. (2020) stated that roe deer require food with a digestibility of at least 58%, preferring easily digestible parts of the plants. In addition to herbaceous plants (which predominate in their spring and summer diets), young leaves, green tree shoots, shrubs and buds are also a significant source of their food (Militko et al., 2020). Cornelis et al. (1999) concluded that dry grasses, herbs, lichen and green shoots of trees dominate the winter diet of roe deer, rendering such a diet low in quality ingredients. Extreme environmental changes are very challenging for wild animals (Arnold, 2020). In winter, roe deer are usually fed on highly lignified twigs (that represent a poor source of energy), various types of shrubs, tree bark and buds (Popović et al., 2009). In spring and summer, roe deer have a much larger selection of food available.

As the chemical composition of the food that roe deer consume during the year is variable, it is important to compare the quality of their spring and winter diets, especially according to the amount of crude protein and fiber (namely neutral detergent fiber - NDF, acid detergent fiber - ADF and acid detergent lignin - ADL). Assessing and comparing the quality of roe deer diet during the winter and spring periods of the year can provide the information on the quality of food consumed by roe deer and the level of nutrition required during the cooler periods of the year when the availability of food is low.

Although a typical herbivore, roe deer can also be exposed to hazardous substances. Tissues of roe deer can contain higher amounts of Cd than tissues of wild boars because roe deer consume the green parts of plants (not just various grains as wild boars) which can contain Cd (Srebočan et al., 2011).

MATERIAL AND METHODS

Animals and sample collection

In this study, roe deer rumen contents were analyzed in the winter and spring periods according to the levels of crude protein and crude fiber (NDF, ADF and ADL). The quality parameters observed were statistically processed and the values of descriptive statistics (namely the mean, minimum and maximum values) were determined.

A chemical analysis was performed on a total of 13 samples of roe deer rumen contents: 7 samples of winter diet rumen contents and 6 samples of spring diet rumen contents. The samples were collected in the hunting ground of Barajevo, in the vicinity of Belgrade, Serbia (44°34'51.3156"N 20°24'56.736"E). It is a mixed habitat with continental vegetation in the form of forests and forest edges. There are also agricultural biotopes in the area with agricultural land where roe deer search for food. The results obtained were divided into two groups, after which F-tests were used to determine statistically significant differences between the groups. The statistical analysis was performed using the Statistica software (TIBCO Software, USA). The results obtained were processed by descriptive statistics and compared using F-tests.

Chemical analysis

Crude protein (CP) levels were determined according to the standard Kjeldahl method (AOAC Official Method 2001.11). Moreover, ADL, ADF and NDF levels were determined using an Ankom Fiber Analyzer A2000 (Ankom Technology, NY, USA), in keeping with the methods approved by the manufacturer (Ankom Technology, 2017; 2017a; 2020).

RESULTS AND DISCUSSION

The crude protein, ADF, NDF and ADL levels of roe deer rumen contents in the winter and spring periods are shown in Figure 1. The crude protein levels obtained indicate a statistically significant difference between the roe deer rumen contents in the winter and spring feeding periods ($p < 0.01$). Popović et al. (2009) established a significant difference in the amount of crude protein in rumen contents of roe deer during different periods of the year. They determined the highest amounts of nitrogen (6.74%) and crude protein (360.84 g/kg DM) in spring, which coincides with the abundance of quality green food available to roe deer. However, the lowest amount of crude protein was determined in autumn (247.27 g/kg DM) and winter (269.40 g/kg DM). Similar results were reported by Lathman et al. (1999) and Kramler & Homolka (2005). The quality of food consumed by roe deer cannot only be assessed by crude protein concentrations because nitrogen is also found in the saliva urea and rumen microflora of roe deer (Kramler & Homolka, 2005).

The NDF concentrations measured indicate a statistically significant difference between the roe deer rumen contents in the winter and spring feeding periods ($p < 0.05$). Popović et al. (2009) found that the concentration of crude cellulose in the rumen contents of roe deer varied significantly during the year (from 170.30 g/kg DM in spring to

322.95 g/kg DM in winter). The differences between the values obtained were statistically significant. This can be accounted for by the limited selection of food and scarce vegetation during the winter.

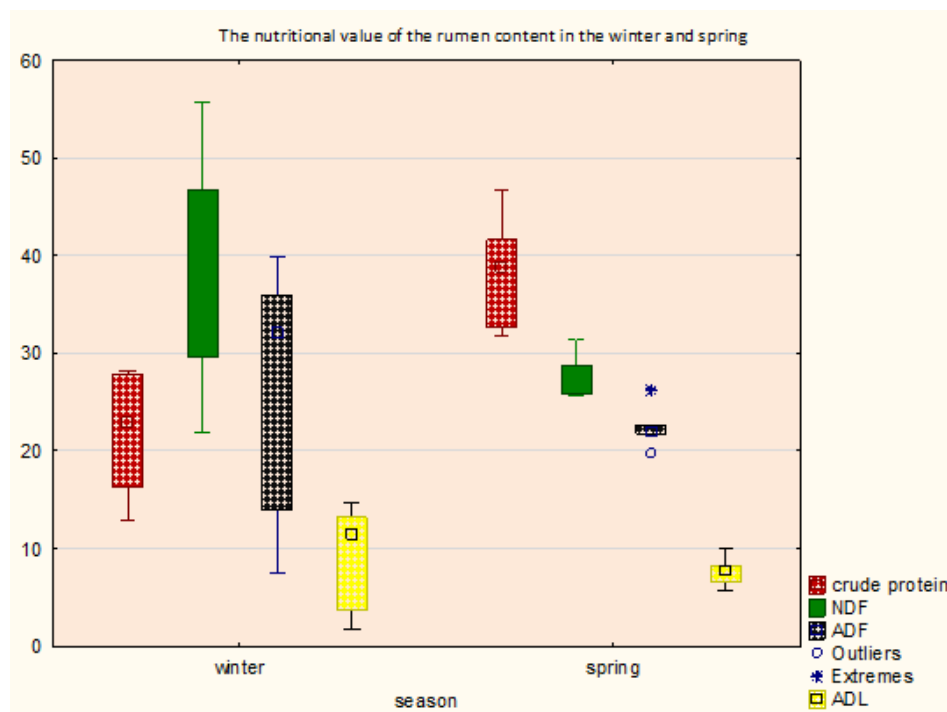


Figure 1. The nutritional value of roe deer rumen contents in the winter and spring periods (DM)

In contrast, Watanabe & Takatsuki (1993) found some variations in the amount of NDF in the sika's deer rumen content (62.54% in winter, 54.12% in summer and 57.45% in autumn). Compared to the cellulose content, the amount of NFE was the lowest during the winter. Therefore, it can be concluded that proteins and structural fibers are the main energy source for roe deer in winter. The change from winter to summer coat, and vice versa, is a good example of the acclimatization to living conditions (Arnold et al., 2015). Every ruminant species, roe deer included, limit their food intake during the winter to save digestive energy because their metabolism is lower during the cooler periods of the year (Bubenik & Lochman, 1956; Weiner, 1977; Dissen & Hartfiel, 1985; Arnold, 2013; König et al., 2020).

The ADF and ADL concentrations measured in this study suggest that there is no statistically significant difference between the roe deer rumen contents in the winter and spring feeding periods.

CONCLUSION

The feeding preferences of herbivores are of paramount importance to understanding their trophic niches, elective habitats and competition with other taxa (Imperio et al., 2012; Freschi et al, 2021). In this study, statistically significant differences were found between the rumen contents of NDF and crude protein in the winter and spring roe deer diets. This can be accounted for by the type and quality of plants which roe deer consume during different periods of the year. The content of crude protein was significantly higher in spring than in winter. The content of NDF was significantly higher in the winter period, which can be attributed to changes in the chemical composition of plants (namely the increasing share of structural carbohydrates (hemicellulose, cellulose and lignin) in the overall composition of carbohydrates) and the additional feeding of roe deer with hay, silage, etc.

Certain deviations in the quality of roe deer nutrition were found in the winter and spring feeding periods. A lack of protein and energy can pose a significant problem to roe deer, especially in the cooler periods of the year (Bauer & Schwarz, 2014). Meeting the roe deer's nutrient requirements (especially the protein and carbohydrate requirements) is crucially important for pregnant roe deer, which have increased nutrient requirements for fetus development and parturition preparation (which usually occurs in the period of lushest vegetation). Moreover, adequate amounts of nutrients are important for the normal body growth and development of reproductive organs of male roe deer, as well as the number, vitality and quality of sperm, which are the basic prerequisites for normal fertilization.

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Conflict of interest: The authors declare that they have no conflict of interest.

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