ASSESSMENT OF FORAGE QUALITY OF LEAVES OF TREES AND SHRUBS, WIDESPREAD IN AGROSILVOPASTORAL SYSTEMS IN DOBROGEA

Teodor MARUȘCA[*], ANDREOIU Andreea C. *, Elena **, TAULESCU Elena MIHĂILĂ*, MEMEDEMIN Daniyar *, TÎBÎRNAC Marcel ***

** Research - Development Institute for Grasslands Braşov*
*** University Transilvania Brasov*
**** National Forestry Research-Development Institute (INCDS) „Marin Drăcea"*
**** ****maruscat@yahoo.com*

Abstract

Climate change with the global warming that generates it, produces profound changes in the grass carpet of permanent grasslands, until their temporary drying in the summer months. Animals lacking green fodder consume leaves of shrubs and tree saplings, whose fodder quality is less known, which is why this study was done. The highest crude protein content of 24.2-24.7% was obtained in the leaves of Quercus pubescens and Robinia pseudoacacia and the lowest, 12.4% in Fraximus ornus.
Crude fiber content was very low, below 4%, in the leaves of Crataegus monogyna, Rosa canina and Cornus mas. The dry matter digestibility coefficient of over 85% was obtained in the leaves of the woody species: Quercus pubescens, Ulmus campestre and Cornus mas. The consumption of leaves and shoots of these woody species by animals prevents their establishment and uncontrolled expansion to the detriment of the grass carpet in agrosilvopastoral systems.

Keywords: woody species, fodder quality leaves, dry matter digestibility, Cluster analysis

INTRODUCTION

In the current conditions of climate change, agrosilvopastoral systems prevent the negative effects of global warming on grassland grass and livestock during the grazing season.

In countries with a hotter and drier climate around the Mediterranean Sea, in mid-summer, grassland production is greatly diminished and of low fodder value.

In this limiting situation, animals mainly consume the leaves of some woody species, which do not dry out (PEREVOLOTSKY et al., 1998; RABABAH et al., 2008).

Similar climate conditions are currently found in Dobrogea, Moldova, Transylvania and other hilly and plain areas in the south of our country, where animals frequently consume leaves and twigs of various woody species.

Research on the fodder quality of these fodder resources is less in our country, studies on the species *Sarothamnus scoparius*, introduced to us for hunting purposes (MARUȘCA și colab., 1999).

Likewise, in conditions of fodder crisis, due to prolonged droughts in our country, the so-called foliage of

different trees and shrubs was frequently used to save animals during the cold season (PUȘCARU și DINU, 1968, cited by MARUȘCA, 2001).

During the field trips, from the dry summers of 2023-2024, in Dobrogea, it was found that the grassy carpet of the pastures was almost completely dry and the animals also consumed the leaves of shrubs and tree saplings.

The present work makes a first analysis of the forage quality of the leaves, as an additional resource in animal feed during the grazing season.

MATERIAL AND METHOD

The researches were carried out in the summer of 2023 and 2024, in the area of Dobrogea, in Tulcea county, where the state of almost complete drying of the grassy carpet of the pastures was found.

From 6 localities of Tulcea county, marked on the map (Figure 1), a number of 12 samples of leaves, consumed by animals, were taken from different trees and shrubs (Table 1), in the order of their distribution.

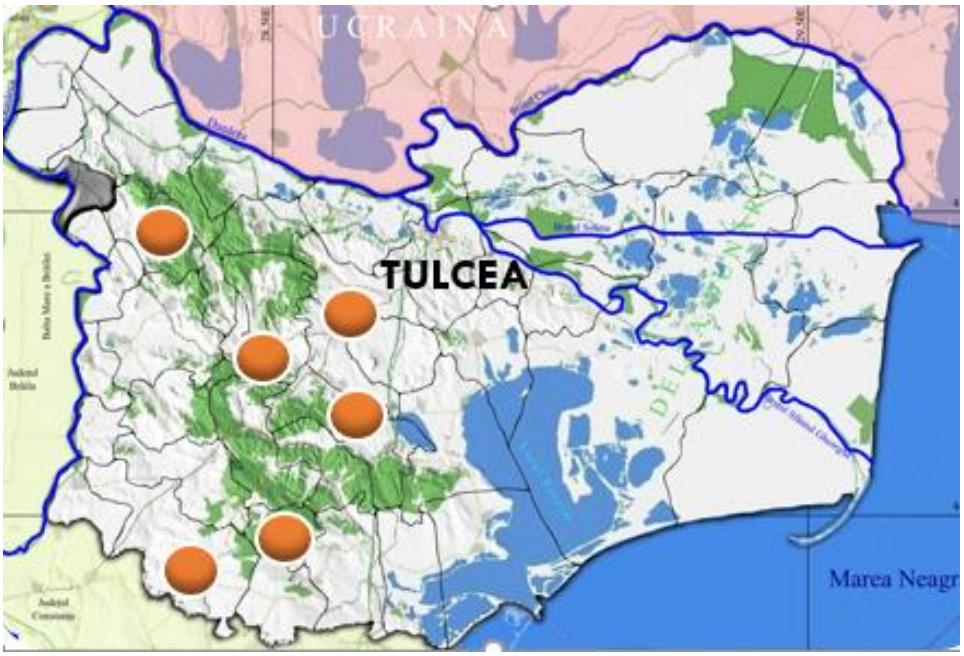


Fig. 1. Location of the localities where the leaf samples were taken

Table 1

Samples of leaves of shrubs and trees, from Tulcea county

No.	Sample leaves	*Acronym*	Location
1	*Crataegus monogyna*	*Cr. mon*	Altân Tepe
2	*Rosa canina*	*Rosa*	Greci
3	*Cornus mas*	*Co. mas*	Stejaru
4	*Carpinus orientalis*	*Ca. ori*	Altân Tepe
5	*Quercus pubescens*	*Q. pub*	Turda
6	*Quercus pedunculiflora*	*Q. ped*	Stejaru
7	*Pyrus pyraster*	*P. pyr*	Stejaru
8	*Tilia cordata*	*T. cor*	Altân Tepe
9	*Fraximus ornus*	*F. orn*	Altân Tepe
10	*Acer campestre*	*A.cam*	Stejaru
11	*Ulmus campestris*	*U. cam*	Stejaru
12	*Robinia pseudoacacia*	*R. pse*	Mihai Bravu

The 12 leaf samples were previously air-dried, after were dried in a forced convection oven type Memmert, at a temperature of 60°C to constant weight and were ground with a Grindomix GM 200 mill and prepared for analysis.

The following qualitative parameters were determined: crude protein (CP), ash (ASH), crude fiber (CF), acid detergent fiber (ADF), lignin (ADL), neutral detergent fiber (NDF), by the Near Infrared Spectroscopy technique, this has been widely used in many research areas because it is a rapid, simple and nondestructive technique (VIDICAN et al., 2000).

Principal Component Analysis (PCA) was also used for the interpretation of several data sets, being a technique to reduce the dimensionality of such data sets, increasing the interpretability, but at the same time minimizing the loss of information (IAN, 2005).

Another statistical processing method used was the Cluster analysis, regarding the similarity between the obtained data and the Euclidean distance was used.

RESULTS AND DISCUSSIONS

Following the analyzes performed, Table 2 presents the values of the main qualitative parameters analyzed, for the 12 samples of leaves from trees and shrubs. Regarding the crude protein content, the highest values were obtained in *Quercus pubescens* and *Robinia pseudocacia* leaves, 24.5% and 24.2%, respectively.

High values of the crude protein content were also recorded in the leaves of *Ulmus campestris* (19.7%) and *Crataegus monogyna* (19.4%).

The lowest value of the protein content was obtained in the leaves of *Fraximus ornus* (12.4%).

Table 2

The values of the main qualitative parameters analyzed for leaf samples of trees and shrubs

No.	Sample leaves	CP %	ASH %	CF %	ADF %	ADL %	NDF %	DDM %	DOM %
1	*Crataegus monogyna*	19,4	11,5	3,2	8,8	3,6	16,4	82,7	73,3
2	*Rosa canina*	15,0	10,9	1,9	6,3	0	19,4	84,6	67,9
3	*Cornus mas*	17,8	9,7	3,2	5,7	0,7	19,0	94,2	79,0
4	*Carpinus orientalis*	14,9	11,6	10,6	14,6	2,1	25,8	82,7	65,9
5	*Quercus pubescens*	24,7	13,2	10,8	15,5	3,3	29,4	85,3	76,8
6	*Quercus pedunculiflora*	18,2	11,5	15,7	18,9	2,8	33,2	76,9	66,9
7	*Pyrus pyraster*	16,7	9,8	11,0	15,4	3,9	28,8	75,2	70,4
8	*Tilia cordata*	16,9	11,5	17,0	20,4	3,1	33,4	72,3	61,2
9	*Fraximus ornus*	12,4	9,1	23,4	26,1	5,1	38,8	62,6	49,2
10	*Acer campestre*	14,2	12,0	9,3	13,0	1,0	24,6	74,8	52,3
11	*Ulmus campestris*	19,7	12,7	9,1	14,1	2,8	24,4	86,9	78,3
12	*Robinia pseudoacacia*	24,2	16,9	5,7	12,3	2,1	17,0	82,4	67,4

Regarding the total content in mineral elements (crude ash), the highest value was obtained in the leaves of acacia *Robinia pseudocacia*, (16.9%), and the lowest content was obtained in the mojdrean *Fraximus ornus* (9.1%).

The crude fiber content was very low, below 4%, in the leaves of *Crataegus monogyna*, *Rosa canina* and *Cornus mas*. The highest crude fiber content was obtained in the leaves of *Fraximus ornus* 23.4%.

The digestibility coefficient of the dry matter had values above 85% in the leaves of *Cornus mas*, *Querques pubescens* and *Ulmus campestris*. The lowest value of DDM 62.6% was obtained in the leaves of *Franximus ornus*, which also recorded the lowest protein content.

PCA (Principal Component Analysis) was used by applying the Kaiser criteria.

The eigenvalues and eigenvectors were extracted from the correlation matrix and thus, the number of significant factors and the percentage of variance explained by each of them was calculated.

The slope of the graph curve showed that the weight with the highest (82.6403%) part of the variation was explained by the first two components PC1 and PC2 (Figure 2).

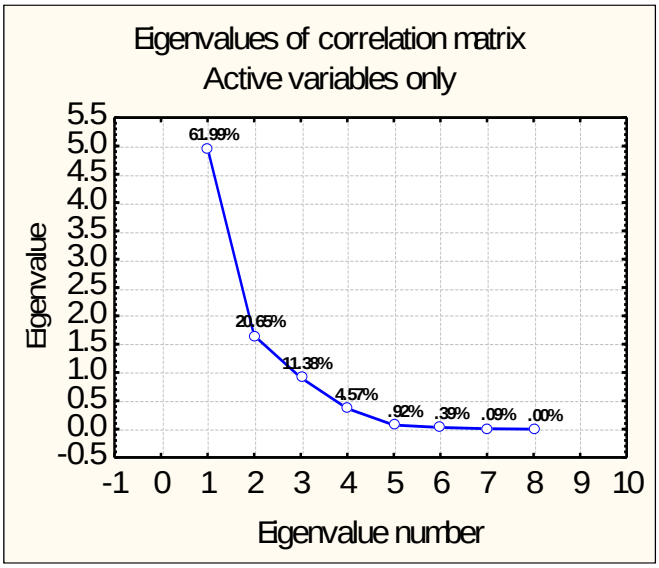


Fig. 2. The contribution of the main components and own values represented in descending order

Following Principal Component Analysis (PCA), 8 Components were obtained, listed in descending order in Table 4.

The first two components were selected applying the Kaiser rule (KAISER, 1960) and accounted for 82.6403% of the total variance (Table 4).

Table 4

Contribution of principal components (PCA) and the variables coefficients

Principal component	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	4.959234	61.99043	4.959234	61.9904
2	1.651987	20.64983	6.611221	82.6403
3	0.910649	11.38311	7.521870	94.0234
4	0.365467	4.56834	7.887338	98.5917
5	0.073874	0.92342	7.961211	99.5151
6	0.031104	0.38881	7.992316	99.9039
7	0.007459	0.09324	7.999775	99.9972
8	0.000225	0.00282	8.000000	100.0000

The first main component represented 61.9904%, and the second component represented 20.64983% of the total variance.

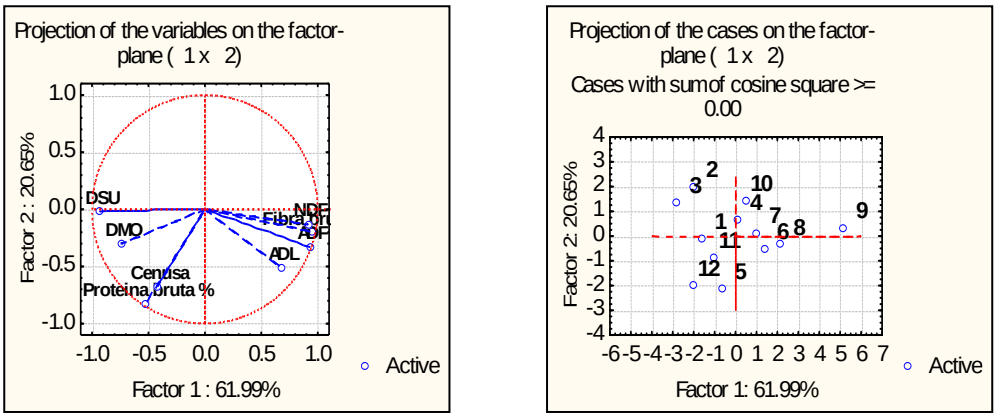
In Table 5, the coefficients of the variables that form PC 1 and PC 2 are presented, and the projection of the variables is shown in the Figure 3. Thus, PC 1 includes: Crude fiber (0.956), ADF (0.933), NDF (0.916) and ADL (0.677), which correlated positively with the first component and DDM (-0.929) and DOM (-0.745), which were negatively correlated with the first component, and the second main component was represented by crude protein (-0.827) and crude ash (-0.674).

Analysis of the main components, projection of variables in the main components (PC1 and PC2) are represented in Figure 3 and the coordinates of the variable factors, based on the correlations are presented in Table 5.

Table 5

Contribution of evaluated variables, based on correlations

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
CP	-0.531	-0.827	0.026	-0.034	-0.170	0.054	0.014	0.002
ASH	-0.422	-0.674	-0.594	-0.053	0.100	-0.048	-0.017	-0.003
CF	0.956	-0.202	0.048	-0.188	0.056	0.051	0.045	-0.008
ADF	0.933	-0.330	-0.014	-0.111	0.082	-0.005	0.015	0.012
ADL	0.677	-0.508	0.338	0.405	0.057	0.025	-0.026	-0.002
NDF	0.916	-0.128	0.190	-0.313	-0.079	-0.039	-0.052	-0.002
DSU	-0.929	-0.019	0.259	-0.213	0.117	0.102	-0.028	0.001
DMO	-0.745	-0.298	0.580	-0.078	0.047	-0.103	0.023	-0.001



1. Crataegus monogyna, 2. Rosa canina, 3. Cornus mas, 4. Carpinus orientalis, 5. Quercus pubescens, 6. Quercus pedunculiflora, 7. Pyrus pyraster, 8. Tilia cordata, 9. Fraximus ornus, 10. Acer campestre, 11. Ulmus campestris, 12. Robinia pseudoacacia

Fig. 3. a) Projection of variables in the main components (PC1 and PC2), and b. Projection of cases on the factor-plane

Cluster analysis was applied regarding the similarity, from the point of view of the qualitative parameters analyzed for the leaf samples, and from Figure 4 the grouping of three clusters is noted. The first cluster comprises the leaves of *Crataegus monogyna*, *Rosa canina* and *Robinia pesudocacia*.

The second cluster consists of the leaves of *Querqus pubescens* and *Ulmus campestris*, and the third cluster regarding the similarity, in terms of qualitative parameters, includes the leaves of: *Carpinus orientalis*, *Querqus peduculiflora*, *Tilia cordata* and *Pyrus pyraster*.

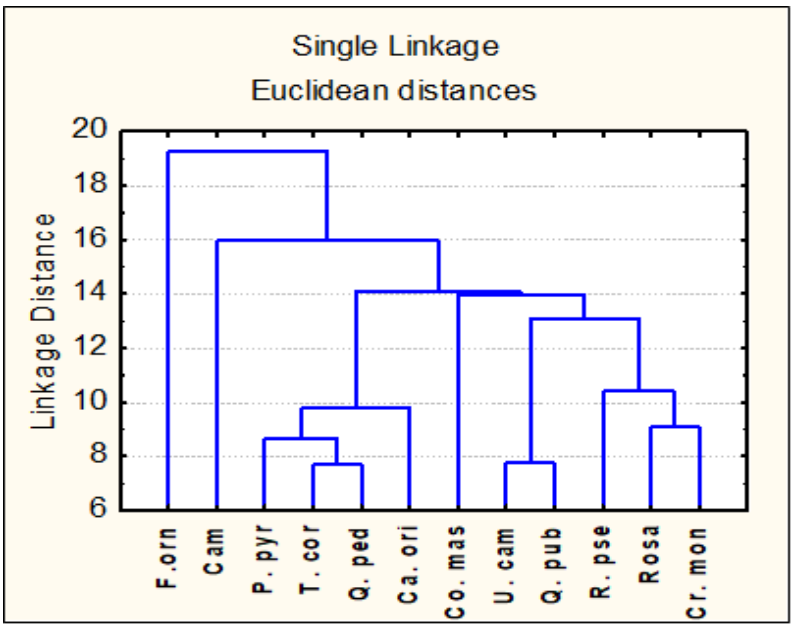


Fig. 4. Cluster analysis regarding the similarity, from the point of view of the qualitative parameters analyzed for the leaf samples

CONCLUSIONS

The highest values of crude protein content were obtained from Quercus pubescens leaves and *Robinia pseudoacacia*, 24,7%, respectively 24,2%.

The lowest value of the protein content was obtained in the leaves of *Fraximus ornus* (12,4%).

Crude fiber content was very low, below 4%, in *Crataegus monogyna* leaves, *Rosa canina* and *Cornus mas*.

The digestibility coefficient of the dry matter had values above 85% for *Cornus mas* leaves, *Querques pubescens* and *Ulmus campestris*.

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