CONTRIBUTIONS TO THE ASSESSMENT OF THE QUALITY OF GRASSLANDS FORAGE COMPONENTS OF AGROSILVOPASTORAL SYSTEMS FROM SOUTH-EAST TRANSYLVANIA

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Abstract

The paper presents a new method for evaluating the quality constituents of grasslands fodder according to the index of pastoral value, established on the basis of a floristic survey. 85 floristic surveys were studied, from 6 areas in the South-East Transylvania area, of which: three in the oak tree, two in the gorun tree and one in the beech tree. Quality analyses were performed on the feed samples regarding the main nutritional parameters. Following the statistical analysis through the linear correlations performed, the results highlighted the possibility of calculating the fodder quality components, knowing the index of pastoral value for grasslands in a distinct physical-geographical area. The data obtained can lead to a rapid evaluation of the quality of grasslands fodder with lower expenses, necessary for the preparation of pastoral arrangements and animal nutrition.

Keywords: *grassland fodder quality, pastoral value, agrosilvopastoral systems*

INTRODUCTION

The fodder quality of permanent grasslands is next to production, one of the main indicators of productivity.

The determination of quality is usually carried out through laboratory analyses, according to various quite laborious and expensive methods, which we do not insist on in the present paper.

With the determination of the pastoral value based on the floristic survey, a new possibility has opened up for a faster evaluation of the quality of a grassland, by which the optimal load with animals per hectare is determined with sufficient accuracy (DAGET, 1969; MOTCĂ *et al.*, 1994).

According to this working method, the pastoral value of the types of grasslands was determined for our country (ȚUCRA *et al.*, 1987) and practical habitats (MARUȘCA, 2008, 2021 a, b).

Following this, after establishing the pastoral value, it was possible to evaluate the cow's milk production during the grazing season (MARUȘCA *et al.*, 2018; MARUȘCA, 2023).

In the present paper, a first attempt is made to evaluate the fodder quality after establishing the pastoral value based on floristic survey in agrosilvopastoral systems.

MATERIAL AND METHOD

The studies were conducted over a period of three years (2020-2023). In order to establish the correspondence between the main substances and constitutive characteristics of the fodder quality of grassland production, 6 agrosilvopastoral systems from 520 m to 1150 m altitude were studied, of which three in the oak area, two in the gorun floor and one in the the beech (Table 1).

Table 1

General data on agrosilvopastoral systems in Transylvania

No. c.	Physical-geographic area	Locality (county)	Alt. m	Tree area or floor	Number of surveys
1.	Hârtibaciu Plateau	Rupea (BV)	520	Gorun *(Quercus petraea)*	7
2.	Homorod Depression	Mercheașa - Homorod (BV)	530	Oak *(Quercus robur)*	20
3.	Brașov Depression	Dobolii de Jos - Ilieni (CV)	555	Oak *(Quercus robur)*	10
4.	Homorod Depression	Jimbor - Homorod (BV)	615	Oak *(Pyrus pyraster)*	20
5.	Baraolt Mountains	Herculian - Bățani (CV)	660	Gorun *(Quercus petraea)*	14
6.	Gurghiu Mountains	Dulcea - Ibănești (MS)	1150	Beech *(Fagus sylvatica)*	14
AVERAGE (TOTAL)		**x**	**670**	**x**	**85**

Were drawn up 85 floristic surveys according to the *Klapp-Ellenberg* method of assessing the percentage participation in the grass carpet, in order to further evaluate the pastoral value (MARUȘCA 2019).

After drawing up the floristic surveys, on 100 square meters, samples of 200 grams of green mass were taken from the same area for fodder quality analyses in the laboratory.

The 85 grass samples were analysed by the Near Infrared Spectroscopy (NIRS) method to determine the content in crude CP, ASH, CF, ADF, ADL, NDF, DDM and DOM. Through statistical calculations, the correlation coefficients between the pastoral value of each survey and the fodder quality data from the analysis of the grass sample harvested from the same area were established, and finally the corresponding equations and graphs.

RESULTS AND DISCUSSIONS

It resulted in a large volume of data from which we present the synthetic floristic surveys carried out in the 6 areas under study: Rupea - BV, Mercheașa - BV, Dobolii - CV, Jimbor - BV, Herculian - CV și Ibănești - MS (Table2).

Table 2

Participation of forage and harmful species in the grass carpet with the average pastoral value of the grasslands

Species	FI	1 Rupea	2 Mercheașa	3 Dobolii	4 Jimbor	5 Herculian	6 Ibănești	Average
FORAGE GRASSES								
Festuca rubra	7	32,5	28,7	8,3	2,1	38,2	26,9	22,8
Agrostis capillaris	7	7,6	8,4	21,2	9,2	13,3	14,1	12,3
Festuca valesiaca	5	6,4			0,8			1,2
Cynosurus cristatus	7	6,0	1,6	6,6	1,3	1,2		2,8
Festuca rupicola	5	3,0			14,6			2,9
Trisetum flavescens	8	1,6						0,3
Arrhenatherum elatius	8	1,4			0,1	0,1	0,5	0,4
Briza media	5	1,0	0,2					0,2
Dactylis glomerata	9	1,0	0,2					0,2
Festuca pratensis	9	1,0	0,2		1,2	0,1		0,4
Alopecurus pratensis	8	0,4			0,1			0,1
Bromus tectorum	5	0,4						0,1
Holcus lanatus	6	0,4	0,1					0,1
Poa pratensis	8	0,3			0,6		7,0	1,3
Lolium perenne	9	0,3	12,3	30,1	25,9	2,5		11,9
Anthoxanthum odoratum	5		0,5					0,1
Festuca arundinacea	5		0,1					0,1
Phleum pratense	9		0,1	1,0	0,1			0,2
Poa annua	6		0,1				2,9	0,5
Species	FI	1	2	3	4	5	6	Average
Agrostis stolonifera	7			0,3				0,1
Poa chaixii	7						0,4	0,1
HARMFUL GRASSES								
Nardus stricta	3		1,6			8,9	23,1	5,6
Deschampsia caespitosa	3		0,2	2,7	0,8	0,9	2,6	1,2
Danthonia decumbens	3		0,5			0,3		0,1
Bromus secalinus	3		0,1					0,1
Bromus hordiacens	3				0,4			0,1
Calamagrostis epigeios	3						0,5	0,1

FORAGE LEGUMES								
Trifolium repens	8	0,4	9,6	12,4	15,7	8,5	4,1	8,5
Lotus corniculatus	8	3,0	2,6	0,8	0,5	1,3	0,2	1,4
Trifolium pratense	8	3,3	3,3	2,0	2,8	1,9	0,1	2,2
Trifolium campestre	7	6,0						1,0
Medicago falcata	7		0,1					0,1
Trifolium ervense	4				0,1			0,1
HARMFUL LEGUMES								
Genista tinctoria	3		1,5			0,4		0,3
Genista sagittalis	3					0,9		0,2
Dorychnium pentaphyllum	3		0,3					0,1
OTHER FORAGE SPECIES								
Centaurea phrygia	4	3,7	0,6	0,2	0,3	0,6		0,9
Salvia pratensis	4	1,6	0,5	0,3				0,4
Plantago lanceolata	6	1,2	2,5	1,4	1,4	2,1		1,4
Filipendula hexapetala	5	1,1	0,7					0,3
Plantago major	5	0,7	0,8	1,5	0,5	0,9		0,7
Galium verum	5	0,7	0,5		0,1		0,1	0,2
Achillea millefolium	6	0,6	1,7	2,5	1,7	1,2	1,5	1,5
Taraxacum officinale	5	0,4	3,2	1,2	1,2	0,9	0,1	1,2
Thymus pulegioides	4	0,3			1,6			0,3
Leontodon autumnalis	5		1,5			2,1	0,1	0,6
Prunella vulgaris	4		2,7	2,1	0,7	1,4	0,6	1,3
Fragaria viridis	4		1,0		1,3	0,4		0,5
Daucus carota	6		0,6	0,8	0,6			0,3
Thymus montanus	4		0,5			0,6	0,6	0,3
Cichorium intybus	5		0,2	0,8	0,2	0,2		0,2
Carex pallescens	4		1,1		0,3			0,2
Polygonum aviculare	5		0,9	0,5	1,2			0,4
Alchemilla vulgaris	6		0,1		0,2		0,1	0,1
Capsella bursa pastoris	4		0,1					0,1
Mentha longifolia	4		0,1		0,1			0,1
Urtica dioica	5		0,1		3,0	0,9	1,0	0,8
Veronica chamaedrys	4		0,1				0,9	0,2
Convulvulus arvensis	7			0,3				0,1
Species	FI	1	2	3	4	5	6	Average
Symphytum officinale	6				2,1			0,4
Verbena officinalis	4				0,1			0,1
Hieracium pilosella	4					0,6	0,3	0,2
Luzula campestris	4						0,1	0,1
Carum carvi	6						0,1	0,1
OTHER HARMFUL SPECIES								
Lysimachia vulgaris	3	1,4						0,2
Prunus spinosa	3	1,4						0,2

Heleborus purpurescens	1	1,0						0,2
Stellaria graminea	1	0,9					0,2	0,2
Myosotis sylvatica	3	0,6						0,1
Campanula patula	3	0,3					0,3	0,1
Echium vulgare	3	0,3						0,1
Eryngium campestre	3	0,3			0,1			0,1
Ranunculus arvensis	1	0,3						0,1
Stachys germanica	3	0,3						0,1
Pyrus pyraster (juv.)	3		1,0	0,1		0,1		0,1
Agrimonia eupatoria	3		0,7	0,2	1,0	0,4		0,4
Crataegus monogyna	3		0,7	0,3	0,1	0,1		0,2
Centaurium erythrea	3		0,3			0,4		0,1
Ranunculus acer	1		0,3		0,2	0,1		0,1
Potentilla reptans	3		0,3		0,5	0,1	0,2	0,2
Lysimachia nummularis	3		0,2		0,1			0,1
Ranunculus sardous	1		0,2					0,1
Rosa canina	3		0,2	0,1	0,1	0,6		0,2
Juncus tenuis	3		0,3	0,5	0,2			0,2
Juncus conglomeratus	3		0,2		0,4			0,1
Carduus acanthoides	3		0,1		1,3	0,6	0,2	0,4
Cirsium vulgare	3		0,1	0,5	0,1			0,1
Geranium pratense	3		0,2	0,1				0,1
Glechoma hederacea	3		0,2	0,1	0,8		1,1	0,4
Galium cruciata	3		0,2	0,1		0,1		0,1
Sisymbrium officinale	3		0,1		2,1			0,4
Filago arvensis	3				0,4			
Malva sylvestris	3				0,2			0,1
Stellaria media	3				0,3		0,9	0,2
Xanthium spinosum	2				0,3			0,1
Carlina vulgaris	3					0,4		0,1
Pteridium aquilinum	3					0,4		0,1
Oxalis acetosella	3						0,2	0,1
Fagus silvatica (juv.)	3						3,1	0,5
Other species*)	3		0,7	0,3	0,5	0,5	0,3	3,7
Number species		38	65	33	57	41	34	45
Vegetation cover (%)		93,1	97,9	99,0	99,6	94,3	99,6	97,3
Species		1	2	3	4	5	6	Average
Fodder plants (%)		86,3	87,6	94,1	91,6	79,0	77,4	86,0
Harmful plats (%)		6,8	10,3	4,9	8,0	15,3	22,2	11,3
Pastoral value		63,6	68,0	79,7	72,6	60,7	47,7	65,4
% Compared to the average		97	104	122	110	92	73	100

*) Other harmful species, with 0.1% participation in the grassy carpet of grasslands: *Euphrasia rostkoviana* (sintetic survey 2,5); *Quercus robur* (2); *Hypericum perforatum* (2,6); *Lamium maculatum* (2); *Myosotis arvensis* (2); *Viola arvensis* (3); *Dipsacus sylvestris* (3); *Ranunculus repens* (3); *Arctium lappa* (4); *Cirsium furiens* (4,5); *Eradium cicutarium* (4); *Eleocharis palustris* (4); *Gypophylla muralis* (4,5); *Helianthemum nummularium* (5); *Leucanthenum nummularium*(5); *Leucanthenum vulgare*(5); *Lycopodium clavatum*(6); *Euphorbia amygdaloides*(6)

From these data, it follows that, on average, 45 species of cormophytes were found at a survey, which had a coverage of 97.3%, of which 86% with forage species and 11.3% with species harmful to the grass carpet and animals.

The best ratio between forage and harmful species of 94.1 - 4.9% was recorded in the agrosilvopastoral system with oaks from Dobolii - CV and the lowest ratio 77.4 - 22.2% in the beech floor at Ibănești – MS.

The participation of forage species in the grass carpet directly influences its pastoral value.

On average, the pastoral value in the agrosilvopastoral systems studied was 65.4 considered good, with large differences from 47.7 medium in the beech floor to 79.7 good - very good in the oak area (MARUȘCA, 2019).

Following the determinations made on the grass samples from each floristic survey, it was possible to statistically analyses the two variables, composed of the index of pastoral value and each element of forage quality (Table 3).

Table 3

Statistical indexes of the variables

	Valid N	Mean	Minimum	Maximum	Variance	Std.Dev.	Standard Error	Cv [%]
PV	85	64.40000	15.88889	88.88889	231.6985	15.22165	1.651019	23.6
CP	85	16.29176	7.10000	26.90000	17.2681	4.15550	0.450727	25.5
ASH	85	10.33882	6.30000	13.80000	1.9557	1.39848	0.151686	13.5
CF	85	30.87294	23.00000	46.70000	22.9639	4.79207	0.519773	15.5
ADF	85	35.07294	29.00000	49.20000	18.7903	4.33478	0.470173	12.4
ADL	85	3.54118	1.50000	5.90000	1.0875	1.04281	0.113109	29.4
NDF	85	58.83765	47.90000	79.10000	43.2821	6.57892	0.713584	11.2
DDM	85	60.72471	32.90000	78.80000	95.9881	9.79735	1.062672	16.1
DOM	85	57.36471	32.20000	75.30000	88.2937	9.39647	1.019191	16.4

** Pastoral Value (PV), Crude Protein (CP), Ash (ASH), Crude fiber (CF), Acid Detergent Fiber (ADF), Lignin (ADL), Neutral Detergent Fiber (NDF), Digestibility Dry Matter (DDM), Digestibility Organic Matter (DOM)*

Table 3 presents the statistical indices (mean, minimum and maximum, variance, standard deviation, standard error and coefficient of variation) of the nine studied variables.

Regarding the determined variables, from the total of the drawn up floristic surveys, the

lowest pastoral value (PV) was 15.88, the highest was 88.88 and the average pastoral value was 64.40.

The crude protein (CP) content of the analysed forages recorded a minimum value of 7.1% and a maximum value of 26.90%, the average value being 16.29%.

The crude ash content (ASH) recorded a mean value of 10.33% and the standard error was 0.15.

The digestibility coefficient of dry matter (DDM) averaged 60.72%, and the minimum value was 32.90% and the maximum value was 78.80%.

Analysing the size and significance of the determined correlation coefficients, it can be seen from Table 4, that between the pastoral value and the determined quality parameters there were statistically assured interdependence relationships.

Table 4

Matrix of correlation coefficients

	PV	CP	ASH	CF	ADF	ADL	NDF	DDM	DOM
PV	1.00	0.55	0.57	-0.57	-0.55	-0.59	-0.43	0.55	0.56
CP		1.00	0.82	-0.89	-0.89	-0.43	-0.78	0.93	0.92
ASH			1.00	-0.74	-0.77	-0.34	-0.78	0.68	0.67
CF				1.00	0.98	0.37	0.90	-0.93	-0.91
ADF					1.00	0.34	0.94	-0.93	-0.91
ADL						1.00	0.31	-0.34	-0.33
NDF							1.00	-0.79	-0.76
DDM								1.00	0.99
DOM									1.00

There was a statistically significant positive linear correlation ($p \leq 0.001$) between pastoral value and crude protein content ($r = 0.55^{***}$) (Figure 1 a). Also, a statistically assured positive linear correlation ($p \leq 0.001$) existed between pastoral value and crude ash ($r = 0.57^{***}$) (Figure 1 b). A positive linear correlation ($p \leq 0.001$) was also established between pastoral value and digestibility coefficients (DDM and DOM) with correlation coefficients $r = 0.55^{***}$ and $r = 0.56^{***}$ respectively (Figure 1 c and Figure 1 d).

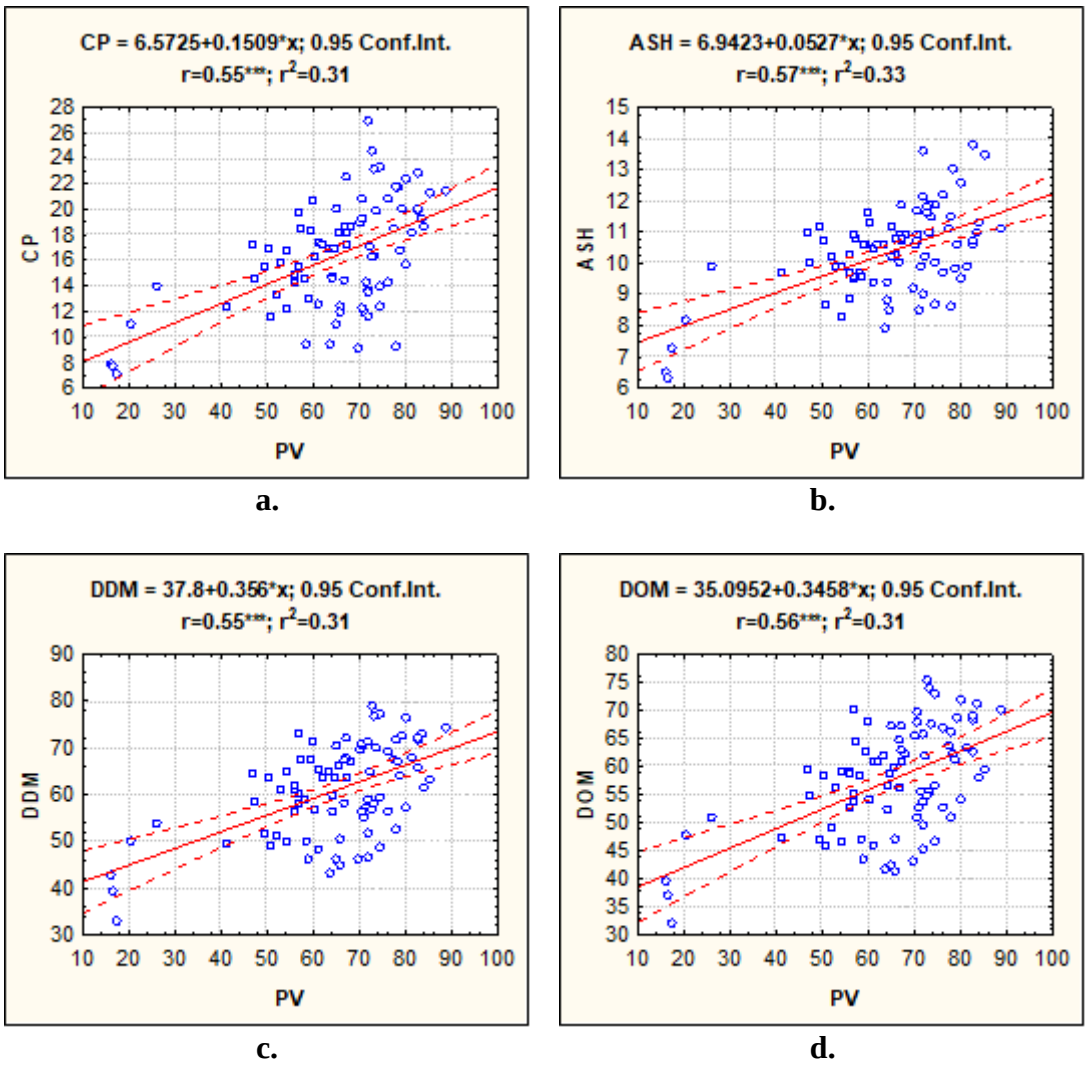

Fig. 1. Correlation between pastoral value and: a. CF, b. ASH, c. DDM, d. DOM

A statistically assured negative linear correlation ($p \leq 0.001$) was established between pastoral value and crude fiber content (r = -0.57***). The pastoral value was also negatively correlated with the content in cell walls: ADF (r = -0.55***), ADL (r = -0.59***) and NDF (r = -0.43***).

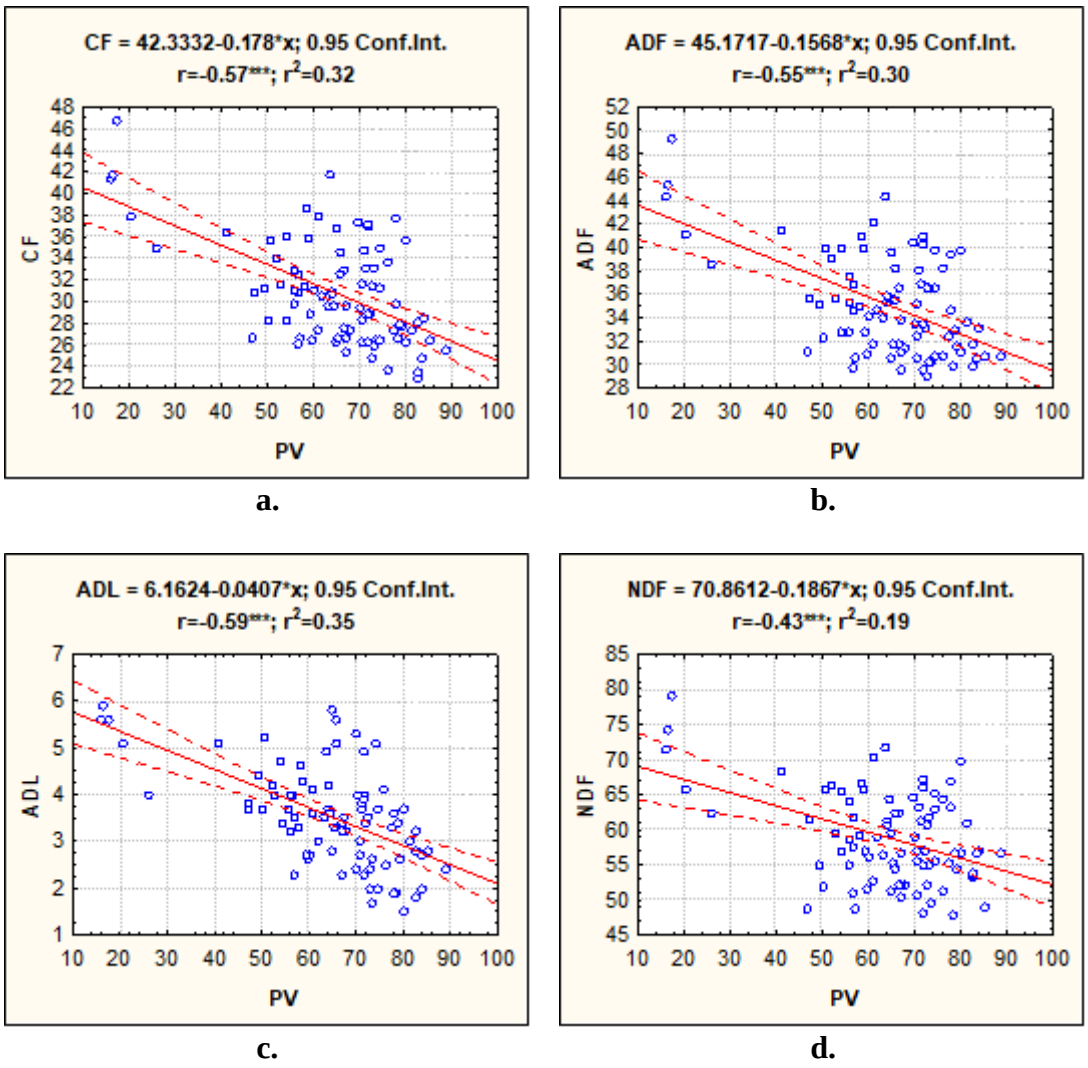

Fig. 2. Correlation between pastoral value and: a. CF, b. ADF, c. ADL, d. NDF

In conclusion, in the following agrosilvopastoral systems from South-East Transylvania, it will be possible to apply different calculation formulas to estimate the fodder quality, after establishing the pastoral value based on the floristic survey (Table 5).

Table 5

Formulas for calculating feed quality elements using pastoral value index (PV)

Parameter	Equation
CP	= 6,5725 + 0,1509 * PV
ASH	= 6,9423 + 0,0527 * PV
CF	= 42,3332 – 0,1780 * PV
ADF	= 45,1717 – 0,1568 * PV
ADL	= 6,1624 – 0,0407 * PV
NDF	= 70,8612 – 0,1867 * PV
DDM	= 37,8000 + 0,3560 * PV
DOM	= 35,0952 + 0,3458 * PV

This working method does not completely replace the classic forage quality analysis, but it can be used for some faster evaluations with very little expense.

CONCLUSIONS

By drawing up floristic surveys and taking grass samples regarding the forage quality analysis for a physical-geographical area, they can be established by calculating the correlation between the pastoral value (PV) and the constituents of the respective grassland forage.

Pastoral value indices evaluated based on floristic survey are multiplied by the determining correlation coefficients for each component of forage quality from CP, ASH, CF to DOM, finally resulting in their value level.

This index-based assessment model of pastoral value and concrete laboratory analyses, on a smaller area, can be generalized to larger bioclimatic areas with similar conditions and much lower expenses compared to known methods.

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