KRMIVA

ESTIMATION OF THE HAY NET ENERGY VALUE WITH DIGESTIBILITY COEFICIENTS OR REGRESSION EQUATION

OCJENJIVANJE NETTO ENERGETSKE VRIJEDNOSTI SIJENA KOEFICIJENTIMA PROBAVLJIVOSTI ILI JEDNADŽBOM REGRESIJE

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SUMMARY

The energy value of hay (n = 693), aftermath (n = 171) and fresh herbage from grassland (n = 158) were estimated by starch equivalent (SE) calculated from O. Kellner's and compared to SE calculated by the regression equation (Cmok, Stekar, Zagožen, 1987). The samples were taken at random. The digestibility coefficients from tables were selected by six persons, four of them selected twice. With a two-way analysis of variance we established that the were statistically significant differences among persons and with the same person. Regarding the small portion of explained variance it seems that the true reason for these differences is in the heterogeneousness of samples. Between both ways of SE calculation there is a statistically significant difference. The correlation coefficients were calculated for all pairs. The correlation coefficients between them are high (0.83 to 0.95). The value of hay and aftermath is estimated accurately enough and more objectively by a regression equation than by O. Kellner's.

Introduction

The estimation of energy of hay was the aim of many researches. The first known feed unit - Thaer's hay value (Heuwert) - was based on the net energy value of average quality meadow hay (cit. after Nehring, 1971).

The energy value of grassland fodder is much more variable than that of other feedstuffs, i.e. grain crops. It is influenced by the way of utilisation, ecological conditions and botanical composition.

To simplify the estimation of the hay energy value, and make it more objective the regression equation was developed (Cmok, Stekar, Zagožen, 1987):

$$SE = 23.700 + 1.014\,x_1 + 0.810x_2 - 0.734x_3 + 0.415x_4,$$

where is

x_1 = crude protein content

x_2 = ether extract content

x_3 = crude fibre content

x_4 = nitrogen free extract

For the equation calculation data on chemical composition of 207 well defined samples of hay were used. All data and variables in the equation were taken from the air dried hay (850 g dry matter on 1000 g of sample).

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Material and methods

The number of 1022 samples (693 samples of hay, 171 samples of aftermath and 158 samples of fresh grassland forage) were included in the study. All samples were collected at random and were analysed in the same laboratory (Biotechnical faculty, Zootechnical Department). Average data on composition of hay, aftermath and fresh forage are presented in Tables 1, 2 and 3, respectively.

Table 1. The hay composition (%, n = 693)
Tablica 1. Sastav sijena (%, n = 693)

	Nutrient / Hranjive tvari					
	DM	XP	XL	XF	XA	XX
Mean value % Srednja vrijednost	85.07	9.44	2.32	28.13	6.53	38.61
Standard deviations Standardna devijacija	3.63	2.60	1.07	3.60	1.46	3.63
Coefficient of variability (%) Koeficijent varijabilnosti (%)	4.26	27.58	46.10	12.81	22.36	9.39
Minimum Najmanje	69.91	2.75	0.28	16.60	0.34	12.81
Maximum Najviše	93.66	19.15	7.53	39.50	16.44	48.80

Table 2. The aftermath composition (%, n = 171)
Tablica 2. Sastav otave (%, n = 171)

	Nutrient / Hranjive tvari					
	DM	XP	XL	XF	XA	XX
Mean value % Srednja vrijednost	84.04	10.69	2.31	25.93	7.31	37.87
Standard deviations Standardna devijacija	3.35	2.17	0.70	3.02	1.55	3.63
Coefficient of variability (%) Koeficijent varijabilnosti (%)	3.98	20.28	30.21	11.66	21.22	9.58
Minimum Najmanje	63.01	5.05	0.55	20.65	4.00	25.29
Maximum Najviše	91.66	16.15	5.24	35.43	14.35	46.56

The variation of all nutrients in all kinds of forage was high. We believe that the same is true for fodder from practical conditions (Stekar, 1977, Stekar and Golob 1987, Stekar et al. 1988).

Starch equivalents of all samples were calculated by two methods: standard with the digestibility coefficients as in Tables and with the above mentioned equation. The digestiblity coefficients were selected independently from Tables by six persons, four of them did it twice.

Table 3. The composition of fresh herbage from grassland (%, n = 158)
Tablica 3. Sastav svježe krme s travnjaka (%, n = 158)

	Nutrient / Hranjive tvari					
	DM	XP	XL	XF	XA	XX
Mean value % Srednja vrijednost	17.06	3.26	0.62	4.39	1.72	7.08
Standard deviations Standardna devijacija	3.57	1.04	0.24	1.18	0.63	1.98
Coefficient of variability (%) Koeficijent varijabilnosti (%)	20.96	31.93	38.86	26.92	36.57	28.01
Minimum Najmanje	10.27	1.28	0.19	1.67	0.93	3.27
Maximum Najviše	28.40	6.24	2.27	9.33	7.61	13.35

A two way analysis of variance was used to find out if the a personal preference exists of the selection of digestibility coefficients. The following model was used for calculation:

$$y_{ijk} = \mu + A_i + B_j + AB_{ij} + e_{ijk},$$

where are

μ mean value

A_i influence of i persons

B_j influence of j repetition

AB_{ij} influence of interaction

e_{ijk} random influences

The difference between net energy estimation according to Kellner and according to the regression equation was tested with t-test for each pair separately. Correlation coefficients were calculated for all pairs. Each group of samples (hay, aftermath and fresh herbage) was treated separately.

Results

The analysis of variance pointed out statistically very highly singificant differences between persons. The proportion of explained variance was 0.39%. According to Duncan test one person singificantly differs from all others. Mean values for hay net energy value by person, replications and regression equation are presented in Table 4.

The were no great differences beetween calculated mean values. Mean net energy values for persons varied from 28.18 to 29.54 (difference was 1.33 SE). SE calculated with regression equation was higher (31.33). The net energy estimation according to regression equation had the lowest coefficient of variability.

Correlation coefficients between persons were high - from 0.783 to 0.965.

Table 4. Mean values of starch equivalent for hay per person, repetition and regression equation
Tablica 4. Srednje vrijednosti za škrobnu vrijednost sijena po osobama, ponavljanjima i regresijskoj jednadžbi

Selector Selektor	Mean value Srednja vrijednost	Standard deviation Standardna devijacija	Coefficient of variability,% Koeficijent varijabilnosti,%
A repetition 1 A ponavljanje 1	28.79	6.565	22.8
A repetition 2 A ponavljanje 2	28.79	6.514	22.6
B repetition 1 B ponavljanje 1	29.47	6.950	23.6
B repetition 2 B ponavljanje 2	29.54	6.805	23.0
C repetition 1 C ponavljanje 1	28.62	6.117	21.4
C repetition 2 C ponavljanje 2	28.69	6.116	21.3
D repetition 1 D ponavljanje 1	28.42	6.668	23.5
D repetition 2 D ponavljanje 2	28.57	6.490	22.7
E	28.51	6.375	22.4
F	28.18	6.347	22.5
Regression equation Regresijska jednadžba	31.33	6.233	19.9

A high proportion of unexplained variance points out that persons, their replications and interactions among them were a minor source of variability. The main source of variability were samples, which were in our model treated as a random source of variability. T-test showed that despite of high correlation coefficients there were significant differences between the first and the second repetition in some persons (Table 5).

Table 5. t values and correlation coefficients per person in hay
Tablica 5. t vrijednosti i koeficijenti korelacije unutar osoba za sijeno

Selector-Repetition Selektor-Ponavljanje	t value t vrijednost	Correlation coefficient Koeficijent korelacije	Difference Razlika
A1-A2	0.13	0.985	not statistically significant nije statist. značajno
B1-B2	-1.25	0.973	not statistically significant nije statist. značajno
C1-C2	-3.15	0.996	statistically significant statist. značajno
D1-D2	-2.67	0.977	statistically significant statist. značajno

The differences between all groups of persons, repetitions and calculated values according to regression equation were examined by t-test and correlation coefficients were calculated. Between both ways of calculation there was a singificant difference in all cases, which was expected. The correlation coefficients between groups were high (from 0.898 to 0.952). To avoid differences among persons and to simplify the net energy value calculation the regression equation could be used.

The analysis of variance for samples of aftermath showed that differences between person and replications of the same person were not significant. The proportion of explained variance was 0.61%, higher than in hay but still very low. According to the Duncan test there were significant differences between some persons. It was interesting that differences did not exist among the same persons as in the case of hay. Mean values for aftermath net energy value per person, repetition and regression equation are presented in Table 6.

Table 6. Mean values of starch equivalent for aftermath per person, repetitions and regression equation
Tablica 6. Srednje vrijednosti za škrobnu vrijednost otave po osobama, ponavljanjima i regresijskoj jednadžbi

Selector Selektor Repetition ponavljanje	Mean value Srednja vrijednost	Standard deviations Standardna devijacija	Coeficient of variability, % Koeficijent varijabilnosti, %
A repetition 1 A ponavljanje 1	33.28	4.255	12.8
A repetition 2 A ponavljanje 2	33.51	4.137	12.4
B repetition 1 B ponavljanje 1	32.64	5.746	17.6
B repetition 2 B ponavljanje 2	32.69	5.981	18.3
C repetition 1 C ponavljanje 1	33.31	4.242	12.7
C repetition 2 C ponavljanje 2	33.29	4.177	12.6
D repetition 1 D ponavljanje 1	33.47	4.239	12.7
D repetition 2 D ponavljanje 2	33.47	4.497	13.4
E	32.64	4.152	12.7
F	33.58	4.205	12.5
Regression equation Regresijska jednadžba	34.47	4.619	13.4

All statistical ecxaminations excluded a significant influence of person on mean value. But the low proportion of the explained variation showed that there were some differences caused by the great variability of samples. As in the case of hay there were significant differences from sample to sample. All correlation coefficients were high. Applying t-test we tried to find out if there were differences between the first and second repetition in the same person (Table 7). According to t-test differences between SE calculated with regression equation and SE calculated according to O. Kellner signficant differences existed for all pairs, persons and repetition. Mean SE calculated by regression equation was higher than mean SE calculated according to O. Kellner. The correlation coefficients between pairs were high (0.832 to 0.936), higher than between the persons.

Table 7. t values and correlation coefficients between the same persons in aftermath
Tablica 7. t vrijednosti i koeficijenti korelacije između osoba za otavu

Selector-Repetition Selektor-Ponavljanje	t value t vrijednost	Correlation coefficient Koeficijent korelacije	Difference Razlika
A1-A2	-2.24	0.950	statistically significant statist. značajno
B1-B2	-0.20	0.851	not statistically significant nije statist. značajno
C1-C2	0.36	0.993	not statistically significant statist. nije značajno
D1-D2	0-05	0.934	not statistically significant statist. nije značajno

With the regression equation more objective results were gained in aftermath than in hay.

In the samples of fresh grassland herbage the SE calculated from regression equation was significantly higher than SE calculated according to standard procedure, the coefficients of variation were also higher. The correlation coefficients between persons were higher than between pairs. Such result was expected because the regression equation was derived from hay data. For fresh herbage a new regression equation should be calculated.

Conclusion

The great variability of hay samples was the reason for singificant influence of person and repetition on the SE calculated according to O. Kellner. The SE calculated according to regression equation significantly differs from SE calculated according to O. Kellner.

The SE estimation according to regression equation gave a more objective estimation for all samples. For samples of fresh herbage the regression equation derived from the hay data was not suitable. A new one should be made.

Literature

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SAŽETAK

Energetska vrijednost sijena (n = 693), otave (n = 171) i svježe trave (paše) s pašnjaka (n = 158) procijenjeni su škrobnom vrijednošću (ŠJ) izračunatom prema O. Kellneru i uspoređeni sa SE izračunatom jednadžbom regresije (Cmok, Stekar, Zagožen, 1987.). Uzorci su uzeti nasumce. Koeficijente probavljivosti s tablica izabralo je šest osoba, od kojih je četvoro izabiralo dva puta. Dvosmjernom analizom varijance ustanovljeno je da postoje statistički značajne razlike među osobama i kod iste osobe. S obzirom na mali dio protumačene varijance izgleda da je pravi razlog ovih razlika raznorodnost uzoraka. Između oba načina ŠJ izračunavanja postoji statistički značajna razlika. Koeficijenti korelacije izračunati su za sve parove. Koeficijenti korelacije među njima su visoki (0,83 do 0,95). Vrijednost sijena i otave procijenjena je prilično točno i objektivnije jednadžbom regresije nego po O. Kellneru.

IZVLEČEK

Ocena neto energijske vrednosti mrve s koeficienti prebavljivosti in z regresijsko enačbo

Energijsko vrednost sena (n = 693), otave (n = 171) in sveže krme s travinja (n = 158) smo ocenili s škrobno vrednostjo (ŠV), izračunano po O. Kellnerju, in jo primerjali s ŠV, izračunano z regresijsko enačbo (Cmok, Stekar, Zagožen, 1987). Vzorci so bili naključni. Tabelarne koeficiente prebavljivosti je izbiralo šest oseb, od tega štiri dvakrat. Z dvosmerno analizo variance smo ugotivili, da obstajajo med izbiralci in znotraj izbiralcev statistično značilne razlike. Glede na majhen delež pojasnjene variance izhaja, da je pravi razlog te razlike v raznolikosti vzorcev. Med obema načinoma izračunana ŠV obstaja statistično značilna razlika. Za vsak par smo izračunali koeficient korelaciji. Koeficienti korelacij med njima so visoki (0,83 do 0.95). Vrednost sena in otave se oceni z regresijsko enačbo dovolj natančno in bolj objektivno kot po O. Kellnerju.