

ENERGETIC AND PROTEIN VALUES OF NEW BULGARIAN FEEDSTUFFS¹

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Abstract: The aim of the study was to evaluate the energetic and protein values of some new Bulgarian feedstuffs (green forages and Industrial by-products). The evaluation was made on the basis of data on chemical composition (Weende method) according to the new energy and protein evaluation system. For each feed the following parameters are given: calculated values of GE, ME, NEL, NEG; for protein value: calculated values of PDIA, PDIME, PDIE, PDIMN and PDIN.

Key words: energetic value, protein value, new feedstuffs in Bulgaria

Introduction

The ability of feedstuffs to supply energy and protein for the metabolic processes within the animals body is therefore of a great importance in determining its nutritive value (*Close and Menke, 1986*). In general, the looking for new feedstuffs has a great importance too, because of the ability to supply animals nutritional needs is increasing. And because of development of livestock farming systems is closely related to the forage resources available. The attention is on to evaluate both nutritive value (*Iliev et al., 2004*) and some relationship (*Kirilov et al., 2005*). In recent time there is an increasing interest to evaluate of grasslands (*Radović et al., 2003; Simić et al., 2003; Sokolović et al., 2003*), because of consumers pretentions for feed quality and food safety.

Many authors mentioned that recommended method for expressing the energy value of ruminant feeds is in terms of ME which could be calculated from different ways. As mentioned *Kirilov et al. (2005)* more suitable method for theoretical protein value express is on French system (*Verite et al., 1978*).

The follow the universal system of feed evaluation, ME and PDI must be found for some Bulgarian feeds. Thus, the purpose of this paper is to estimate some methods to calculation of ME and PDI in ruminant feeds.

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Materials and Methods

Forages: Six forages were used in our investigation: four green forages from the region of Tirgovishte (*Vicia villosa*, *Trifolium aneztom*, Annual white clover and Annual winter vetch) and two industrial by-products taken from manufactory “Tzaramil” in town Losnitsa near to Razgrad (maize oil meal and maize germ). Chemical composition was determined by Weende method (Table 1) at the Institute of Animal science Kostinbrod.

Energy value was calculated by the following order:

1. Gross Energy (GE), after *DLG (1997)*, using the data in fact for chemical composition:

$$GE(\text{MJ/kg DM}) = 0,0239\text{gCP} + 0,0398\text{gEE} + 0,020\text{gCF} + 0,0175\text{gNFE}$$

2. Metabolizable Energy (ME), calculated from the digestible nutrients using the equation after:

Van Es (1978):

$$ME(\text{MJ/kg DM}) = 0,0172\text{DCP} + 0,0377\text{DEE} + 0,0138\text{DCF} + 0,0146\text{DNFE}$$

NRC (1989):

$$ME(\text{Mcal/kg}) = -0,45 + 0,04453 \text{ TDN}\%$$

DLG (1997):

$$ME(\text{MJ}) = 0,0312\text{gDEE} + 0,0136\text{gDCF} + 0,0147\text{g}(\text{DOM-DEE-DCF}) + 0,00234\text{gCP}$$

and using equations which based on the chemical composition after:

Waissbach et al. (1990):

$$ME(\text{MJ/kg DM}) = 14 + 0,0004\text{gCP} - 0,0148\text{gCA} + 0,0028\text{gCF} - 0,000053\text{gCF}^2$$

Schenkel (1998):

$$ME(\text{g/kg DM}) = 14,06 - 0,0137\text{gCF} + 0,00483\text{gCP} - 0,0098\text{gCA}$$

3. Netto Energy:

for Lactation (NEL) after *GfE (1995):*

$$NEL(\text{MJ/kg DM}) = 0,6 \times (1 + 0,004(q-57) \times \text{ME}), \text{ where } q = \text{ME}/\text{GEx}100$$

and for Growth (NEG), after *Garret (1980):*

$$NEG(\text{Mcal/kg}) = 1,42\text{ME} - 0,1740\text{ME}^2 + 0,0122\text{ME}^3 - 1,65$$

The theoretical protein value of forages was calculated after *Verite et al. (1980)*, on the following order:

1. $\text{PDIA} = 1,11 \times \text{CP} \times (1 - \text{RDP}) \times \% \text{RDP}$
2. $\text{PDIME} = 0,093 \times \text{FOM}$
3. $\text{PDIMN} = 0,64 \times \text{CP} \times (\text{RDP} - 0,10)$
4. $\text{PDIE} = \text{PDIA} + \text{PDIME}$
5. $\text{PDIN} = \text{PDIA} + \text{PDIMN}$

Results and Discussion

Chemical composition of feedstuffs: Table 1 presents the content of the nutrients of the new Bulgarian feedstuffs. For green forages, protein content is between 16,52 (annual clover) till 22,46 % (*Vicia villosa*). By-products from maize have 16,99 and 12,37% CP. There is normal crude fat content in green forages around 4%. It is interesting the crude fat content of maize meal – 16,24%. In crude fiber and nitrogen free ash there are is nothing unusual.

Table 1. Chemical composition (%+ DM) of new Bulgarian feedstuffs
Tabela 1. Hemijski sastav (%+ SM) novih bugarskih hraniva

Forages/ Krmiva	% DM/SM	In % of DM/u % SM			
		CP	EE	CF	NFE
Green forages/ Zelena krmiva					
Vicia 1	15.54	22.75	4.09	28.20	35.55
Vicia 2	17.46	22.16	4.11	27.69	36.78
<i>Vicia average</i>	<i>16.50</i>	<i>22.46</i>	<i>4.10</i>	<i>27.94</i>	<i>36.16</i>
Trifolium 1	16.48	17.19	4.20	25.90	42.85
Trifolium 2	15.88	18.25	4.21	24.77	42.18
<i>Trifolium average</i>	<i>16.18</i>	<i>17.72</i>	<i>4.20</i>	<i>25.24</i>	<i>42.52</i>
Annual clover /godišnja detelina 1	16.56	16.51	3.24	25.98	44.63
Annual Clover/ godišnja detelina 2	18.87	16.54	3.31	24.98	45.13
<i>Clover average/ Detelina prosek</i>	<i>17.72</i>	<i>16.52</i>	<i>3.28</i>	<i>25.44</i>	<i>44.88</i>
Annual Vetch/godišnja grahorica 1	15.14	24.11	4.29	27.75	34.84
Annual vetch /godišnja grahorica 2	16.66	24.97	4.01	28.54	34.56
<i>Annual Vetch average/ Godišnja grahorica prosek</i>	<i>15.9</i>	<i>24.54</i>	<i>4.11</i>	<i>28.14</i>	<i>34.70</i>
Industrial by products/ Nus proizvodi industrije					
Maize oil meal/ Kukuruzno brašno	92.72	16.99	16.24	20.67	44.08
Maize germ/ Kukuruzne klice	86.45	12.37	10.04	8.46	66.25

Energy value: Table 2 presents the ME which was calculated by different means. It is indicated that the green forages have smaller energy values than by-products. In the group of green forages there is not so great differences in ME content – minimum levels are in the range from 9,35 MJ (*Vicia villosa*) till 9,63 MJ (Trifolium). The maximum levels are in the smaller range – from 10,39 MJ (*Vicia villosa*) till 10,55 MJ (Annual vetch). ME values of by-products, calculated by different authors are between 11,96 MJ till 14,25 MJ (maize oil meal) and 12,87 MJ till 16,11 MJ (maize germ).

Table 2. Energetic value of new Bulgarian feedstuffs (in kg DM)
 Tabela 2. Energetska vrednost novih bugarskih hraniva (u kg SM)

Energetic Parameters/ Energetski parametri	FORAGES/KRMIVA					
	Vicia	Trifolium	Clover/ detelina	Vetch/ grahorica	Maize Meal/ Kukuruzno brašno	Maize Germ/ Kukuruzne klice
GE, MJ	18.95	18.42	18.21	19.24	22.38	20.24
ME, MJ on:						
- Van Es (1978)	9.48	10.26	-	-	14.00	16.10
- NRC (1989)	9.75	9.63	9.50	9.96	13.27	14.15
- DLG (1997)	9.41	10.52	-	-	14.25	12.87
- Weißbach et al. (1990)	9.35	9.87	9.89	9.44	12.09	13.48
q, %	49.34	53.58	54.31	49.06	54.02	66.58
- Schenkel (1998)	10.39	10.45	10.45	10.55	11.96	13.13
q, %	54.82	56.73	57.17	54.83	53.44	64.87
NEL, MJ	5.44	5.84	5.87	5.48	7.17	8.40
NEG, MJ	6.95	6.78	6.60	7.28	15.06	16.16

The comparison of the different calculations shows that there is not any sure thing to say which is the best one. On our opinion, the calculation of ME from the digestible nutrients (Van Es, 1978; DLG, 1997 and NRC, 1989) is more complicated, because it needs data in fact for digestibility. When we have no such data, using the full or partial chemical composition is better choice. Except that this way is easier.

Generally, because of agree in the definition of the components of energy systems, e.g. ME in scientist in different countries it could be said that the best method to calculate ME for main feedstuffs is that based on the digestible nutrients, followed by that based on the chemical composition of the feed.

Protein value: Table 3 present the protein value which was calculated intermediate step by step on final PDI value after French system. Shortly said, calculated theoretical values in the group of green forages are higher than values in the group of industrial by-products (103 – 153 g/kg DM versus 73 – 88 g/kg DM). Our results for PDI are correct if we will take account chemical composition especially crude protein content and the in general positive relationship between crude protein and PDI levels. This was confirm in our investigation. There was very interesting to see the different levels and the possibilities to utilization of forage protein in different sector of digestive tract, expressed by the different parameters.

Table 3. Protein value (g/kg DM) of new Bulgarian feedstuffs
 Tabela 3. Proteinska vrednost (g/kg SM) novih bugarskih hraniva

Forages	PDIA	PDIME	PDIE	PDIMN	PDIN
Vicia average/Vicia prosek	49	54	103	90	139
Trifolium average/Trifolim prosek	39	55	94	70	109
Clover average/Detelina prosek	36	56	92	67	103
Vetch average/Grahorica prosek	55	53	108	98	153
Maize oil meal/Kukuruzno brašno	47	54	101	41	88
Maize germ/Kukuruzne klice	33	68	101	40	73

Conclusions

The study shows specificity of the used new Bulgarian feedstuffs – green forages and industrial by products.

The basic aim of feed evaluation is to provide qualitative comparison between feedstuffs. This can readily be achieved in a system on ME. Five methods, used for calculation of ME do not lead to wide differences in the calculated ME – values.

Prediction of protein value from PDI levels is a good way for total estimation of protein feeding value of forages.

ENERGETSKE I PROTEINSKE VREDNOSTI NOVIH BUGARSKIH HRANIVA

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Rezime

Cilj ovog istraživanja je bio ocean energetske i proteinske vrednosti nekih novih hraniva u Bugarskoj (zelena krmiva i nus-proizvodi industrije). Ocena je urađena na bazi podataka o hemijskom sastavu (Weende metoda) prema novom sistemu ocene energetske i proteinske vrednosti. Za svako hranivo su dati sledeći parametric: izračunate vrednosti za GE-bruto energija, ME-metabolička energija, NEL-neto energija za laktaciju, NEG-neto energija za porast; i za proteinsku vrednost: izračunate vrednosti PDIA, PDIME, PDIE, PDIMN i PDIN.

Ključne reči: energetska vrednost, proteinska vrednost, nova hrani-va u Bugarskoj

References

1. CLOSE W and K.H.MENKE(1986): Selected Topics in Animal Nutrition. A manual prepared for the 3th Hohenheim course on animal nutrition in the tropics and semi – tropics, 2nd edition. Deutches tiftung fur Internationale Entwicklung und Zentralstelle fur Ernährung und Landwirtschaft (West Germany)
2. DLG (1997): Universitet Hohenheim – Dokumentations – stele (Ed.): DLG – Futterwerttabellen Wiederkauer, 7th ed. Auft., DLG-Verlag, Frankfurt/M., 212.

3. GARRETT W.N. (1980) Energy utilization by growing cattle as determined by 72 comparative slaughter experiments, *Energy Metab. Proc. Symp.*, 26, 3 – 7.
4. GfE (1995): Zur Energiebewertung beim Wiederkauer, *Proc. Soc. Nutr. Physiol.*, 4, 121 – 123.
5. ILIEV F., Z.CHINDARSKA, L. KOZELOV and M. IGNATOVA (2004): Determination of energy and protein value of wheat bran, sunflower meal and fish meal, *Proc. Scientific conference, Stara Sagora*, v.III, 108 – 112.
6. KIRILOV A., J. P. DULPHY, M. JAILLER and M. DUDILLEU(2005): Protein value of forages and nitrogen balance in wethers, *Bulg. J. Agricultural Sci.*, 11, 1, 87 – 93.
7. NRC (1989): *Nutritional Requirements for Dairy Cattle*, 6th Rev. Ed. Nat. Acad. Press, Washington, D.C.
8. RADOVIĆ J., B. DINIĆ and V. PUDLO(2003): Productivity and quality of some birds' foot trefoil (*Lotus corniculatus* L.) varieties, In: *Optimal Forage System for Animal Production and the Environmental*, Ed. Kirilov A. et al., v. 8, 118 – 122.
9. SCHENKEL H.(1998): Methods for determination of energetic feed value – Scientific base and practical experience, *Arch. Tierernahrung*, 51, 2/3, 155 – 165.
10. SIMIĆ A., S. VUČKOVIĆ, B. ČUPINA and O. JORDANOVIĆ (2003): The influence of inter – row spacing on seed yield and seed quality of red fescue (*Festuca rubra* L.) and redtop (*Agrostis alba* L.), In: *Optimal Forage System for Animal Production and the Environmental*, Ed. Kirilov A. et al., v.8, 122 – 126.
11. SOKOLOVIĆ D.(2003): Dry matter yield components of perennial ryegrass (*Lolium perenne* L.) population, In: *Optimal Forage System for Animal Production and the Environmental*, Ed. Kirilov A. et al., v. 8, 126 – 130.
12. VAN ES A. J. H. (1978): Feed Evaluation for Ruminants, 1. The system in use from May 1977 onwards in the Netherlands, *Prod. Sci.*, 5, 331 – 345.
13. VERITE R., B. MICHALET-DOREAU, P. CHAPOUTOT, J. L. PEYRAUD and C. PONCET(1987): Revision du systeme des Proteines Digestibles dans l'Intestin (P.D.I.). *Bulletin Technique C. R. Z. V. Theix, INRA*, 70, 19 – 37.
14. WAISSBACH F., S. KUHLA and R. PRYM(1990): Modell und Methode zur Schotzung des energetischen Futterwertes auf der Basis der erweiterten Futtermittelanalyse.