# Nutritive Value of Six Romanian Cultivars of Alfalfa as Hay and Semi-silage for Ruminants

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**Abstract**
Six alfalfa cultivars developed at the Institute of Agricultural Research –NARDI Fundulea have been tested as hay and semi-silage to determine their nutritive values. The studied cultivars were Daniela, Madalina, Sandra, Catinca, Teodora and Cezara, harvested at 2nd cutting in early bloom phase. In order to apply a mathematical simulation model for energy and protein metabolism in ruminants (Burlacu, 2002) the following parameters were determined: chemical composition (by Weende analysis), gross energy (adiabatic calorimetry), and organic matter digestibility (in vitro method). For the hay samples the crude protein was between 20.2% (Sandra) and 21.4% (Madalina), the crude fibre was between 30.6% (Madalina) and 39.1% (Teodora). The crude protein in semi-silage samples was between 21.5% (Madalina) and 23.6% (Cezara) and the crude fibre was between 32.5% (Cezara) and 33.9% (Teodora). The net energy (FUmilk) has the highest value in Cezara hay (0.74) and in Madalina silage (0.70). PDIN values (g/kg DM) for hay ranged from 122 (Cezara) to 143 (Madalina), and for semi-silage from 131 (Teodora) to 142 (Cezara). PDIE values (g/kg DM) for hay ranged from 77 (Madalina) to 73 (Sandra); for semi-silage there were virtually no differences between the cultivars, four of them (Daniela Madalina, Catinca, Cezara) having the same value, i.e. 69. In conclusion, finding the nutritive value of these cultivars will allow selecting the ones for optimal ruminant diets.

**Keywords**: alfalfa, nutritive value

## 1. Introduction

The production of alfalfa varieties with improved yield (for plants and seeds), and also with good quality as forage and good adaptability to adverse environmental conditions has been and still is the main objective of the breeding program for this plant. Recently, two new cultivars (Teodora, Cezara) have been registered in the Romanian Official Catalogue of Cultivars by the Institute of Agricultural Research – NARDI Fundulea – Schitea (2014) [1]. The objective of this paper is to make a preliminary study of the nutritive value of these new cultivars preserved as hay or semi-silage for ruminant diets by comparing them with 4 previously developed cultivars (Daniela, Madalina, Sandra, Catinca) already characterized for production by Schitea (2010) [2].

## 2. Materials and methods

All the six studied cultivars of alfalfa were in the second year of persistence and harvested at early flowering growth stage. The samples were collected at the 2nd cut, in 2016. They were preserved as hays by natural drying in laboratory without leafs or stems losses and as semi-silages.

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The semi-silages were prepared in laboratory recipients of 50 kg and fermented for 4 months.

**The chemical composition** of the cultivars samples was evaluated by the commonly accepted methods [3]: dry matter (DM), crude protein (CP), crude fibre (CF), ether extractives (EE), ash and nitrogen-free extractives (NFE). The organic matter (OM) in vitro digestibility was tested by Tilley-Terry (1963) method [4] applied on Ankom Daisy Incubator which simulates the rumen degradation and the stomach digestion. Briefly, the grounded 0.5 g of sample was placed in Ankom F57 filter bags and the bags were introduced in the incubation jar with buffered rumen liquid for 48 hours at $39^{O}$C. Further the bags were again incubated in the same conditions in pepsin 2‰ hydrochloric solution. Finally, the bags were dried and weighed, and next burned and the ash residue weighed.

**The mathematical model** for energy and protein metabolism simulation in ruminants, developed by IBNA Balotesti – Burlacu (2002) [5] was used to calculate the nutritive value. Upon determination of the gross energy (GE) by adiabatic calorimetry and applying the regression equations of the model there were calculated: the energy of the digestibility (DE) and the metabolizable energy (ME). The net energy value was expressed as milk feeding units (FUmilk), which is the net energy for lactation NEL relative to that for the reference barley (1 FU=6.07 MJ). The protein nutritive value of alfalfa samples was expressed as protein truly digested in the small intestine (PDI) after calculation of PDIN (digestible protein in the small intestine based on the degradable protein) and PDIE (digestible protein in the small intestine based on the fermentable energy of the OM).

## 3. Results and discussion

The chemical composition of the both preserved type of alfalfa cultivars is given in Table 1. Table 2 shows the energy and protein nutritional values of the same cultivars.

*Chemical composition of Alfalfa hays*

For the hay samples, the contents of CP, CF, EE, Ash or NFE (g/kg DM) were not significantly different one from another (Table 1). The CP was between 202 (Sandra) and 214 (Madalina) and the CF was between 306 (Madalina) and 391 (Teodora). These Romanian cultivars have an improved chemical composition because their values are greater than published ones of Burlacu (2002) [5]: 185 for CP and 292 for CF, and of Heuzé (2016) [6]: 182 for CP and 289 for CF.

**Table 1.** Chemical composition of the six alfalfa cultivars (g/kg DM)

| alfalfa cultivar | DM | CP | CF | EE | Ash | NFE |
|---|---|---|---|---|---|---|
| *(hay)* | | | | | | |
| Daniela | 907 | 214 | 359 | 8 | 78 | 344 |
| Madalina | 906 | 236 | 306 | 9 | 87 | 362 |
| Sandra | 895 | 202 | 349 | 8 | 83 | 359 |
| Catinca | 909 | 208 | 314 | 9 | 79 | 390 |
| Teodora | 909 | 213 | 391 | 8 | 78 | 310 |
| Cezara | 908 | 203 | 336 | 8 | 95 | 360 |
| *(semi-silage)* | | | | | | |
| Daniela | 415 | 222 | 326 | 19 | 80 | 360 |
| Madalina | 457 | 215 | 327 | 14 | 81 | 363 |
| Sandra | 415 | 229 | 328 | 17 | 81 | 345 |
| Catinca | 423 | 230 | 329 | 17 | 82 | 342 |
| Teodora | 383 | 218 | 339 | 15 | 83 | 336 |
| Cezara | 337 | 236 | 325 | 17 | 93 | 328 |

*Chemical composition of Alfalfa semi-silages*

As presented in Table 1 the CP content (g/kg DM) was between value 215 (Madalina) and 236 (Cezara), and the CF was between value 325 (Cezara) and 339 (Teodora). As mentioned above the cultivars have greater values than Burlacu (2002) [5]–176 for CP; 316 for CF–and Heuzé (2016) [6]–191 for CP; 295 for CF.

*Nutritive values*

The OM digestibility was very similar for all cultivars (Table 2), even though they were hay or semi-silage, because it was the same growth stage, the same cut number and the same harvesting condition. It was one exception for Cezara hay OM digestibility which was 62.15%, a greater value than the average 59.43%. The preservation methods play also an important role in the nutritive value of alfalfa: correctly made silages have a higher ME and OM digestibility than hay [7]. But here, the short time of ensiling did not influence the OM digestibility or ME, and also not the DE and the net energy (FU milk) values because are no differences between hays and semi-silages. The presented OM values were lower than the published values of Heuze (2016) [6]: 61.8% for hay, 66.1% for silage, but they were closed to Burlacu (2002) [5] values: 59% for hay, 60% for silage.

The Romanian cultivars had DE values [MJ/kg DM] of 9.83 for hays and 9.41 for semi-silages which are lower than the values of Heuze (2016) [6]: 10.6 for hay and 11.3 for silage, and of Burlacu (2002) [5]: 10.13 for hay and 10.79 for silage. The ME [MJ/kg DM] for tested cultivars was 7.79 for hays and 7.45 for semi-silages, also lower than cited values: 8.4 for hay and 8.9 for silage (Heuze, 2016) [6], and 8.11 for hay and 8.17 for silage [5].

As presented in Table 2 the highest net energy for hays has the Cezara cultivar (0.74 FU milk), near to the 0.76 value of Burlacu (2002) [5]. For semi-silages the Madalina cultivar has the highest net energy value (0.70 FU milk) but it is much lower than the 0.82 value of Burlacu (2002) [5].

**Table 2**. Nutritional value of the six alfalfa cultivars

| alfalfa cultivar | in vitro OM digestibility (%) | GE [MJ/kg DM] | DE [MJ/ kg DM] | ME [MJ/ kg DM] | NEL [FUmilk/kg DM] | PDIN [g/kg DM] | PDIE [g/kg DM] |
|---|---|---|---|---|---|---|---|
| | | | *(hay)* | | | | |
| Daniela | 59.03 | 19.33 | 9.86 | 7.8 | 0.72 | 128 | 75 |
| Madalina | 58.97 | 19.34 | 9.76 | 7.72 | 0.71 | 143 | 77 |
| Sandra | 58.33 | 19.17 | 9.61 | 7.63 | 0.70 | 123 | 73 |
| Catinca | 60.4 | 19.29 | 10.07 | 8.02 | 0.73 | 126 | 75 |
| Teodora | 57.71 | 19.35 | 9.65 | 7.6 | 0.70 | 130 | 74 |
| Cezara | 62.15 | 18.93 | 10.00 | 7.94 | 0.74 | 122 | 75 |
| average | 59.43 | 19.26 | 9.83 | 7.79 | 0.72 | 129 | 75 |
| | | | *(semi-silage)* | | | | |
| Daniela | 58.27 | 19.37 | 9.55 | 7.57 | 0.69 | 133 | 69 |
| Madalina | 58.93 | 19.30 | 9.63 | 7.64 | 0.70 | 129 | 69 |
| Sandra | 56.95 | 19.40 | 9.30 | 7.35 | 0.67 | 138 | 68 |
| Catinca | 57.69 | 19.39 | 9.44 | 7.46 | 0.68 | 138 | 69 |
| Teodora | 57.51 | 19.28 | 9.32 | 7.38 | 0.67 | 131 | 67 |
| Cezara | 57.75 | 19.23 | 9.24 | 7.28 | 0.66 | 142 | 69 |
| average | 57.85 | 19.33 | 9.41 | 7.45 | 0.68 | 135 | 69 |

GE=gross energy; DE=digestible energy; ME=metabolizable energy; NEL=net energy for lactation; FUmilk=feed unit for lactation/milk; PDIN=digestible protein in the small intestine based on the degradable protein); PDIE=digestible protein in the small intestine based on the fermentable energy of the OM)

The six tested Romanian cultivars have greater PDIN values (g/kg DM) than Burlacu (2002) [5] which had 107 for hay and 108 for silage. For hays, the results (Table 2) ranged from value of 122 (Cezara) to 143 (Madalina) with an average value of 129, and for semi-silages, they ranged from value of 131 (Teodora) to 142 (Cezara) with an average value of 135.

The same situation is for the PDIE values (g/kg DM) where reference values of Burlacu (2002) [5] where: 68 for hay and 59 for silage. The presented results for hays ranged from value of 77 (Madalina) to 73 (Sandra) with an average value of 75 (Table 2). On the PDIE values for semi-silages there were virtually no differences between the cultivars, four of them (Daniela Madalina, Catinca, Cezara) having the same value, i.e. 69.

## 4. Conclusions

In this preliminary study there were no significant differences between cultivars for nutritive energy or protein values but it could be said that Madalina and Cezara cultivars have the best results. It will be necessary to test further alfalfa crops of all cultivars for a whole perspective about their nutritive values. And knowing these values will be useful for alfalfa producers and also for animal farmers to choose the most adequate cultivar as ruminant feed.

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