

THE CHEMICAL COMPOSITION AND POLLUANTS CONTENT OF SOME ECOLOGICAL AND CONVENTIONAL GREEN FORAGE SOURCES FOR DAIRY COW FEED

Gherasim NACU¹, Mircea POP^{1,*}, Daniel SIMEANU¹, Cristina RADU-RUSU¹, Roxana ZAHARIA¹, Vasile VINTILĂ^{2,*}

*E-mail: popim@uaiasi.ro; vasilevintilais@yahoo.com

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ABSTRACT. The quality of feed is very important in dairy milk production. The aim of the current paper was a comparative characterisation in terms of crude chemical composition, Ca and P, heavy metals (Pb, Cd, Zn, Cu), nitrates, nitrites and pesticides, for the natural meadow and green alfalfa, cultivated in ecological and conventional systems, utilised for feeding dairy cows. Sampling and analysis were performed according to established standards and working methods: drying for dry matter (DM); calcination for crude ash (C Ash); Kjeldahl method for crude protein (CP); Soxhlet method for crude fat or ether extract (EE), spectrophotometry for P, nitrates and nitrites; atomic absorption spectrometry for Ca, Pb, Cd, Cu and Zn; gas-chromatography for pesticides. For alfalfa, the highest values in the ecological system were for C Ash (12.68%), EE (2.50%), NFE (35.78%) and Ca (1.79%). For the natural meadow, the highest values in the

ecological system were for DM (25.72%), OS (89.32%), EE (2.76%), NFE (45.27%) and Ca (0.70%). The toxic heavy metal content was below the limits allowed (1 mg/kg Cd and 30 mg/kg Pb). For Pb, the values determined from the two feeds were between 0.06 mg/kg and 0.16 mg/kg and for Cd between 0.007 mg/kg and 0.02 mg/kg. The pesticides residuum was under the detection limit of 0.05 mg/kg DM for organo-chlorinated pesticides and 0.001 mg/kg for organo-phosphoric pesticides. All the studied forages were safe regarding pollutants (heavy metals, nitrites, nitrates and pesticides), but statistical differences existed between the production systems, such that the ecological system seems to be better.

Keywords: chemical composition; ecological system forages; heavy metals; pollutants.

¹ University of Agricultural Sciences and Veterinary Medicine of Iasi, Faculty of Animal Sciences, 3 Mihail Sadoveanu Alley, 700490 Iasi, Romania

² Cattle Breeding Research Station from Dancu, Iasi - 9 Ungheni Road, 707252 Iasi, Romania

INTRODUCTION

Knowledge of the chemical composition of each feed is mandatory in order to be able to prepare feed rations for dairy cows. There are recent data on alfalfa (Mielman *et al.*, 2017, Jadviga Andrzejewska *et al.*, 2020;) and meadow (Cop *et al.*, 2019; Simic *et al.*, 2019; Martin *et al.*, 2020), but the values differ depending on the variety, area, climate, and soil (Moreira and Fageria, 2010; Ulger and Kaplan, 2016; Cacan *et al.*, 2018) and permanent determinations are required. Many studies have shown that products obtained from organic farming (including milk) have a much lower risk of pollution compared to those from conventional agriculture (Worthington Virginia, 2001; Rembialkowska, 2004; Leste, 2006), being safer for human consumption. Milk is a food with high nutritional value, rich in nutrients, and recommended for daily consumption (Givens, 2007). Ecological cow milk can be obtained only by feeding the dairy cows with fodder resulting from ecological agriculture. Pollutants pass from the soil to plants (Haarstad, 2012) and reach the final consumer through the food chain (Neamțu *et al.*, 2007; Lapierre *et al.*, 2019). They can get into milk (Miclean *et al.*, 2018; Aydin *et al.*, 2019; Memon *et al.*, 2019) and into the human body. Some pollutants (heavy metals) remain in animal organisms (Khan *et al.*, 2018) and can cause serious disease in humans (Coon *et al.*, 2006). For these reasons, our team determined the chemical composition and the level of

pollution for two feeds used to obtain organic milk, compared to the conventional production system.

MATERIALS AND METHODS

The chemical composition for natural meadow was determined at the beginning of the flowering stage and for green mass alfalfa at the beginning of budding. Samples for laboratory analysis were gathered in accordance with the current standards (SR EN ISO 6497:2005; SR ISO 6498:2001), and for each element five determinations were made.

The dry matter content (DM) was determined by drying the samples at 105°C for 6 hours, in an ESAC 50 type electric drying oven. The operation was repeated until a constant mass was obtained, in accordance with standard SR ISO 6496:2001 and SR ISO 712:2010.

Crude ash (C Ash) was determined in accordance with standard ISO 2171:2010 and AOAC 1990, by calcinations of samples at 550°C, using a Superterme STC 611.06 calcination oven.

Organic substance content (OS) was determined as the difference between the DM and ash.

Crude protein (CP) was determined using the Kjeldahl method (ISO 5983-1:2006).

Determination of the crude fat or ether extract (EE) was realised by extraction with organic solvents (petroleum ether) using the indirect Soxhlet method, in accordance with ISO 6492:2001 and utilising the Solvent Extractor SER 148-VELP device.

Determination of crude fibre (CF) was realised in accordance with SR EN ISO 6865:2002. The semi-automatic method for fibres extraction by a VELP Five 6 was used, and the reagents were: hydrochloric acid 0.5 mol/l, sulphuric acid

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0.13 mol/l, acetone, n-octanol - antifoaming agent, and acetone.

Determination of the nutritional parameters helped us to calculate the quantity of nitrogen-free extract (NFE) substances, using the following formula:

$$\text{NFE}\% = \text{OS}\% - (\text{CP}\% + \text{EE}\% + \text{CF}\%)$$

The fibres content was determined by titration with neutral detergent in accordance with standard SR EN ISO 16472:2006. Determination of acid detergent fibre was realised respecting standard SR EN ISO 13906:2008.

The content of P was determined by the spectrophotometric method using molybdovanadate reagent at a wavelength of 430 nm in a Shimadzu UV Mini 1240 spectrophotometer. The calibration curve was drawn at 5 points by preparation from standard phosphorus solution of some solutions with different phosphorus concentrations: 5, 10, 15, 20, 25, 30 and 40 mg/l.

The Ca content was determined by using the atomic absorption spectrometry method in accordance with SR EN ISO 6869:2002 using an AA-6300 Shimadzu atomic absorption spectrometer with flame, at a wavelength of 422.6 nm, in comparison with the lanthanum-caesium control solution. The calibration curve was designed at 3 points by preparation from calcium standard solution of some solutions with different concentrations: 0.5, 1.5, 2.0 mg/l.

The heavy metals content (Pb, Cd, Cu and Zn) was determined in accordance with SR EN 14082:2003 and AOAC, 1990, by using the atomic absorption spectrometric method (AAS) on a GBC-Avanta spectrometer. Calibration curves for lead were realised at 5 points (0.5; 1; 2.5; 5 and 7.5 mg/l), for cadmium at 5 points (0.2; 0.5; 1; 1.5 and 2 mg/l), for copper at 3 points (1; 2 and 4 mg/l) and for zinc at 4 points (1; 2; 3 and 4 mg/l). The wavelengths at which the concentrations

of the metals were determined were as follows: Pb, $\lambda = 217$ nm; Cd, $\lambda = 228.8$ nm; Cu, $\lambda = 324.7$ nm; Zn, $\lambda = 213.9$ nm (Nacu *et al.*, 2018).

Determination of the organo-chlorinated and organo-phosphoric pesticides residuum was realised by the gas-chromatography method, in accordance with standard SR EN ISO 14181:2001, SR EN ISO 14182:2001 for nutrients. As standard solution, a mix of 80 organo-chlorinated and organo-phosphoric pesticides was utilised.

Nitrates and nitrites were determined in accordance with SR 13175:1993. The method consisted in the extraction of nitrites from the sample for analysis by deproteinisation of the extract and highlighting through a colouration reaction in red nuances of nitrites, with sulfanilamide and N-(1-naphthyl) ethylenediamine dihydrochloride. Photocolorimetry was realised at a wavelength of 538 nm. Nitrates were determined by reduction of those nitrites in the presence of cadmium followed by a colouring reaction and colorimetry. The spectrophotometer Shimadzu UV Mini 1240 was also used.

The data obtained were statistically processed and interpreted. The position and variation estimators (arithmetic mean, variance, standard deviation of mean and variation coefficient) were calculated. The differences between the two production systems were established using the statistical software IBM SPSS 21.0 through Tukey test with two variables, that is, the T-test (2-tailed).

RESULTS AND DISCUSSION

The content of DM of *natural meadow* gathered at the beginning of flowering from the conventional system was 16.81% in the 1st year and 15.31% in the 2nd year, values below

the limits cited in the literature of 17.2% (Pop *et al.*, 2006; Jarrige *et al.*, 1986) ~ 24.12% (Burlacu *et al.*, 2002). The mean values obtained for samples from the ecological system (25.72% in the 1st year and 22.58% in the 2nd year) exceed the upper limit of the mentioned interval. The differences between the two systems were very significant (*Table 1*) and are due to the different time of forage harvesting. In the conventional system, the harvested plants were in the beginning phase of sprouting, while in the ecological system, the harvested plants were in the flowering phase.

The DM content of *green mass alfalfa* (mean values), before budding, both for samples from the ecological system (20.13% and 25.8%) and for those gathered from the conventional system (21.89% and 26.32%), are above the maximum limit of the interval found in the literature, which is 14.4% (Jarrige *et al.*, 1986) and 15% (Pop *et al.*, 2006). The statistical differences between the two systems were insignificant for both research years. The alfalfa samples were harvested in the first year when the plants were at the beginning of flowering, while in the second year the harvest was done later, in the vegetation phase at the end of flowering.

Regarding the Ash content from *natural meadow*, the mean values (11.58% and 10.78%) for the analysed samples from the conventional system in the two consecutive years exceeded the maximum interval value of 9.4% (Kaya *et al.*, 2004) and 10.3%, and the

values of 6.07% and 7.02% obtained for the ecological system are below the minimal value of the mentioned interval. The statistical differences between the two systems were very significant for both research years. The ash content of *green mass alfalfa* had mean values which were within the variation limit of 8% (Preston, 2010) and 12.9% (Jarrige *et al.*, 1986), both for samples gathered from ecological system and for those gathered from the conventional system. The statistical differences between the two systems were very significant for both research years.

For the OS content of *natural meadow*, the mean values of 81.31% and 80.67% found for samples gathered from the conventional system and respectively of 89.32% and 87.37% found for the samples gathered from the ecological system were below the minimal limit of the interval cited in the literature of 89.7% (Avci *et al.*, 2006) and 90.7% (Kaya *et al.*, 2004). The statistical differences between the two systems were significant for the 1st year and for the 2nd year. The mean values for the OS content of *green mass alfalfa* were of 86.18% and 82.12% for samples gathered from the conventional system and 81.65% and 81.56% for the ones gathered from the ecological system, and the statistical differences between the two systems were distinctly significant for the 1st year and insignificant for the 2nd year of production.

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Table 1 - The chemical composition of analysed ecological and conventional forages (% DM)

Specification	n	Natural grassland				Alfalfa green				
		1st year		2nd year		1st year		2nd year		
		X±sx	V%	X±sx	V%	X±sx	V%	X±sx	V%	
DM	Conv.	5	16.81±0.53 ^a	7.03	15.31±0.56 ^a	8.17	21.89±0.82 ^a	8.33	26.32±0.86 ^a	2.41
	Eco.	5	25.72±1.13 ^d	9.81	22.58±1.04 ^d	10.32	20.13±0.28 ^a	3.10	25.8±0.28 ^a	7.29
Ash	Conv.	5	11.58±0.31 ^a	6.05	10.78±0.36 ^a	7.51	8.01±0.10 ^a	2.87	11.12±0.08 ^a	4.81
	Eco.	5	6.07±0.14 ^d	5.20	7.02±0.16 ^d	4.99	10.37±0.26 ^d	5.54	12.68±0.27 ^d	1.71
OS	Conv.	5	81.31±1.98 ^a	5.46	80.67±2.09 ^a	5.79	86.18±0.96 ^a	2.50	82.12±1.05 ^a	2.15
	Eco.	5	89.32±0.92 ^c	2.31	87.37±0.95 ^b	2.43	81.65±0.82 ^c	2.26	81.56±0.78 ^a	2.85
CP	Conv.	5	11.43±0.54 ^a	10.55	10.24±0.60 ^a	13.08	26.97±0.29 ^a	2.43	28.58±0.32 ^a	2.52
	Eco.	5	8.04±0.21 ^d	5.75	7.83±0.19 ^c	5.36	25.21±0.30 ^c	2.65	26.81±0.33 ^c	3.02
EE	Conv.	5	2.51±0.12 ^a	13.11	1.97±0.12 ^a	13.20	2.03±0.14 ^a	14.88	2.19±0.03 ^a	5.50
	Eco.	5	2.76±0.09 ^a	7.11	2.25±0.11 ^a	10.67	2.09±0.02 ^a	2.57	2.5±0.16 ^a	14.00
CF	Conv.	5	25.94±0.97 ^a	8.36	29.31±0.99 ^a	8.40	22.15±0.64 ^a	6.43	23.46±0.61 ^a	6.45
	Eco.	5	30.02±0.83 ^b	6.21	32.02±0.86 ^c	6.03	20.73±0.61 ^a	6.57	21.56±0.62 ^a	5.84
NFE	Conv.	5	41.93±2.86 ^a	15.27	30.88±3.03 ^a	20.01	32.86±1.37 ^a	9.43	28.89±1.53 ^a	11.31
	Eco.	5	43.50±1.27 ^a	5.84	45.27±1.23 ^c	6.08	35.78±1.38 ^a	8.40	29.69±1.75 ^a	5.84
NDF	Conv.	5	53.63±1.20 ^a	5.01	54.42±1.66 ^a	6.82	39.06±0.50 ^a	2.87	40.01±0.55 ^a	8.39
	Eco.	5	64.43±1.14 ^d	3.98	65.23±1.11 ^d	3.80	34.91±1.29 ^b	8.26	35.41±1.33 ^b	3.07
ADF	Conv.	5	25.70±1.17 ^a	10.21	26.31±1.14 ^a	9.73	23.41±0.70 ^a	6.69	23.75±0.75 ^a	10.51
	Eco.	5	30.07±0.84 ^c	6.27	31.04±0.90 ^b	6.48	21.55±0.96 ^a	10.01	22.65±1.06 ^a	7.03
Ca	Conv.	5	0.59±0.20 ^a	7.09	0.561±0.02 ^a	6.79	1.351±0.013 ^a	2.10	1.408±0.014 ^a	2.20
	Eco.	5	0.68±0.25 ^c	8.02	0.701±0.02 ^d	6.99	1.787±0.04 ^d	4.34	1.807±0.032 ^d	3.78
P	Conv.	5	0.30±0.02 ^a	11.40	0.270±0.01 ^a	11.03	0.311±0.012 ^a	8.50	0.351±0.010 ^a	6.26
	Eco.	5	0.355±0.017 ^c	10.64	0.383±0.016 ^d	9.13	0.251±0.022 ^b	19.27	0.271±0.023 ^b	19.17

Different exponents for the same indicator and year, show significant differences for mono-factorial analysis of variance (ANOVA): p<0.05 for ^{ab}, p<0.01 for ^{ac}, p<0.001 for ^{ad}

The CP content of *green mass alfalfa* before budding, with mean values of 25.21% and 26.81% for

samples gathered from the ecological system, were within the limits found in the literature of 19% and 25.6%

(Preston, 2010), while the mean values established for the samples gathered from the conventional system (26.97% and 28.58%) exceeded the maximum limit of the above-mentioned interval. The statistical differences between the two systems were distinctly significant for both research years.

In the case of EE for *natural meadows*, the identified mean values of 2.51% and 1.97% for the analysed samples from the conventional system and 2.76% and 2.55% for those from the ecological system are within the limits presented in the literature of 1.9% (Kaya *et al.*, 2004) and 4.5% (Avci *et al.*, 2006). The statistical differences between the two systems were insignificant for both years of study.

The mean values established for the content of EE in *green mass alfalfa* were 2.03% and 2.19% for samples gathered from the conventional system and 2.09% and 2.75% for those gathered from the ecological system. Also in this case, the statistical differences between the two systems were insignificant for both years of study.

The interval between 27.2% (Jarrige *et al.*, 1986; Pop *et al.*, 2010) and 31% (Kaya *et al.*, 2004) included the mean values established in our own research for the CF content of *natural meadow*: 25.94% and 29.31% for samples gathered from the conventional system, as well as the 30.02% in the 1st year for the ecological system. However, the value of 32.02% CF found in the samples from the ecological system in the 2nd

year was higher than the maximum limit from the literature. The statistical differences between the two systems were distinctly significant.

In the case of CF content in the *green mass alfalfa* before budding, the values established for samples gathered from the ecological system, as well as those from the conventional system, were within the variation limit of 20.1% (Jarrige *et al.*, 1986) and 28.0% (Preston, 2010). The statistical differences between the two systems for this parameter were insignificant for both research years.

The NFE substances from *natural meadow* were between 41.93% and 30.88% for the samples gathered from the conventional system and between 48.50% and 45.27% for those from the ecological system. The statistical differences between the two systems were insignificant for the 1st year and distinctly significant for the 2nd year.

The NFE content of *alfalfa* was between 32.86% and 28.89% for the samples gathered from the conventional system and between 35.78% and 29.69% for those from the ecological system, the statistical differences between the two systems being significant for the 1st year and insignificant for the 2nd year of this study. The differences in raw chemical composition highlighted in the two feeds studied, in relation to the production system (conventional versus ecological), are determined more by the age of the plants at harvesting and not by the production system.

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The mean values of 64.43% and 65.23% for NDF from *natural meadow* for samples gathered from the ecological system are above the maximum limit of the interval found in the literature of 50.1% NDF (Kaya *et al.*, 2004) and 58.8% NDF (Avci *et al.*, 2006) and the values of 53.63% NDF and 54.42% NDF for samples gathered from the ecological system are within the mentioned interval. The statistical differences between the two production systems are very significant.

The mean values of NDF from *alfalfa* oscillated between 39.06% and 40.01% for the analysed samples from the conventional system and between 34.9% and 35.41% for those from the ecological system. The statistical differences between the systems were significant for both years of study.

For the ADF content of *natural meadow*, the mean values were between 30.07% and 31.04% for the samples gathered from the ecological system and between 25.70% and 26.31% for those gathered from the conventional system, the statistical differences between the two systems being significant.

The ADF content of the analysed *alfalfa* was situated below the minimal value of variation limit of 28% and 35% (Preston, 2010). The statistical differences between the two systems for this parameter were insignificant for both years of study.

The Ca content of the *natural meadow*, with mean values both for the samples gathered from conventional system (0.59% and 0.56%) and for those from the

ecological system (0.69% and 0.70%), were between the limits of 0.65% (Pop *et al.*, 2006; Jarrige *et al.*, 1986) and 0.92% (Burlacu *et al.*, 2002), the statistical differences being distinctly significant for the 1st year and very significant for the 2nd year. The higher concentration of Ca found in organically produced feed is caused by the lower growth rate of the plants and the natural balance of soil microorganisms.

The P content of *natural meadow* was 0.30% and 0.27% for samples gathered from the conventional system, being slightly under the minimal value of the interval found in the literature, while the values of 0.36% and 0.38% for samples gathered from the ecological system were between the variation limits of 0.35% (Jarrige *et al.*, 1986) and 0.39% (Burlacu *et al.*, 2002). The statistical differences between the two systems were distinctly significant in the 1st year and very significant in the 2nd year.

The Ca content of *green mass alfalfa* before budding for samples gathered from the ecological system were above the upper limit found in the literature, at 0.40% and 1.65% (Jarrige *et al.*, 1986). The mean values for samples gathered from the conventional system were between the above-mentioned limits, and the statistical differences between the two systems were very significant for both years analysed.

The statistical differences found between the two systems for this parameter were significant for both years of study.

All the mean values obtained for the *natural meadow* and *alfalfa* concentrations of toxic heavy metals (Pb and Cd) were below the maximum limit imposed by Reg. EU, 1275/2013 (30 mg Pb/kg and 1 mg Cd/kg fodder with 12% moisture). The obtained results together with the statistical significance of the differences between the concentrations found in the samples gathered from the two production systems are presented in *Table 2*.

In the case of the Pb concentration of *natural meadow*, the mean values were below the limit presented in the literature of 2.49 mg Pb/kg DM (Sothen, 2001) and 6.4 mg Pb/kg DM (Bianu and Nica, 2004). The statistical differences between the two production systems were distinctly significant for both research years.

For the Cd concentration in the analysed samples of *natural meadow*, the majority of the established mean values were below the limit found in the literature, the exception being samples gathered from the conventional system in the 1st year, which were in the interval of 4.3 - 15.7 mg Cd/kg DM (Miloş and Drinceanu, 1980). The statistical differences between the two systems for this parameter were very significant for both research years. For the Zn concentration in the case of *natural meadow*, the recorded differences between the two systems were insignificant from the statistical point of view.

The higher content of Pb in the analysed samples from the ecological system could be explained by the fact

that the meadow from which samples were gathered is transited by the national road DN 282. The higher Cu concentration in the analysed samples from the ecological system could be explained by the reduced growth rate of the plants. The banning of the use of fertilisers based on phosphates (the main source of contamination with Cd) in the frame of the ecological production system could explain the lower rate of Cd in the samples from this system.

The established mean values for the Pb concentration of *green mass alfalfa* were below the limits presented in the literature of 0.198 mg Pb/kg DM and 0.433 mg Pb/kg SU (Li *et al.*, 2008), the statistical differences between the production systems being very significant in both research years.

The Cd concentration in the analysed samples of *green mass alfalfa* had mean values below the limit of 0.045 mg Cd/kg DM and 0.328 mg Cd/kg SU (Trincă *et al.*, 2008). The statistical differences between the two systems were very significant for both years of study. The lower concentration of organic fodder is due to the ban on the use of phosphate fertilisers in this production system.

For the Cu and Zn concentrations, the statistical differences between the two systems were very significant. The higher concentration of Cu for feed obtained in the conventional system is due to the accelerated production of biomass in this system.

The nitrates and nitrites content of *natural meadow* and ecological *alfalfa* recorded values that were

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significant, statistically speaking, and lower than the samples gathered from the conventional system.

The totality of the analysed samples, for both research years, for

the nitrites content of the two forages (Table 3) were situated below the maximum admissible limit of 15 ppm NO₂⁻ fodder with 12% moisture, as imposed by Regulation 575/2011.

Table 2 - The heavy metal content of analysed organic and conventional forages

Specification	n	Natural grassland				Green alfalfa				
		1st year		2nd year		1st year		2nd year		
		X±sx	V%	X±sx	V%	X±sx	V%	X±sx	V%	
Pb mg/kg at 12% moisture	Conv.	5	0.06±0.004 ^a	13.33	0.09±0.007 ^a	16.67	0.12±0.004 ^a	6.67	0.16±0.005 ^a	7.63
	Eco.	5	0.08±0.003 ^c	8.75	0.12±0.006 ^c	10.83	0.08±0.004 ^d	11.2	0.09±0.007 ^d	16.67
Cd mg/kg at 12% moisture	Conv.	5	0.018±0.001 ^a	11.11	0.012±0.001 ^a	13.33	0.019±0.001 ^a	8.95	0.02±0.001 ^a	11.50
	Eco.	5	0.007±0.0004 ^d	14.29	0.01±0.001 ^a	12.00	0.01±0.001 ^d	17.0	0.013±0.001 ^d	17.81
Cu mg/kg	Conv.	5	1.16±0.036 ^a	6.90	1.25±0.068 ^a	12.16	1.23±0.013 ^a	2.44	1.26±0.055 ^a	9.77
	Eco.	5	2.04±0.045 ^d	4.90	2.21±0.071 ^d	7.15	1.09±0.009 ^d	1.83	1.81±0.057 ^d	7.08
Zn mg/kg	Conv.	5	3.267±0.085 ^a	5.82	3.065±0.101 ^a	7.36	3.276±0.118 ^a	8.08	3.02±0.085 ^a	5.32
	Eco.	5	3.045±0.118 ^a	8.69	2.953±0.110 ^a	8.32	3.646±0.110 ^d	6.74	3.345±0.08 ^b	6.29

Different exponents for the same indicator and year, show significant differences for mono-factorial analysis of variance (ANOVA): p<0.05 for ^{ab}, p<0.01 for ^{ac}, p<0.001 for ^{ad}

Table 3 - Nitrate and nitrite content of studied organic and conventional forages

Specification	n	Natural grassland				Green alfalfa				
		1st year		2nd year		1st year		2nd year		
		X±sx	V%	X±sx	V%	X±sx	V%	X±sx	V%	
NO ₃ ⁻ ppm	Conv.	5	50.63±0.59 ^a	2.62	49.31±1.37 ^a	6.21	384.92±8.10 ^a	4.71	395.54±7.92 ^a	4.48
	Eco.	5	47.44±0.89 ^c	4.21	43.31±1.39 ^b	7.15	108.32±2.02 ^d	4.11	117.33±2.38 ^d	4.61
NO ₂ ⁻ ppm at 12% fodder moisture	Conv.	5	1.56±0.05 ^a	7.51	1.90±0.16 ^a	19.42	5.02±0.21 ^a	9.51	4.98±0.07 ^a	3.20
	Eco.	5	1.78±0.05 ^b	6.60	1.55±0.15 ^a	21.7	1.46±0.04 ^d	5.79	1.58±0.05 ^d	7.21

Different exponents for the same indicator and year, show significant differences for mono-factorial analysis of variance (ANOVA): p<0.05 for ^{ab}, p<0.01 for ^{ac}, p<0.001 for ^{ad}

The nitrites (NO_2^-) concentration of *natural meadow* had mean values between 1.56 and 1.90 mg/kg at 12% moisture for the conventional production system, and between 1.78 and 1.55 mg/kg for the ecological production system.

The nitrites (NO_2^-) content of *green mass alfalfa* had mean values between 5.02 and 4.98 mg/kg at 12% moisture for the conventional system and 1.46 - 1.58 mg/kg for the ecological one, the differences between systems being very significant.

The ban on the use of fertilisers based on nitrogen in the frame of ecological production systems could explain the lower rate of these compounds in the analysed natural meadow belonging to this system.

Gas chromatographic analysis of the concentration of organo-chlorinated and organo-phosphoric pesticides from samples of natural meadow and green mass alfalfa gathered from both systems, conventional and ecological, highlight the fact that the pesticides residuum was under the detection limit of 0.05 mg/kg DM for organo-chlorinated pesticides and 0.001 mg/kg for organo-phosphoric pesticides.

CONCLUSION

The crude chemical composition fluctuated more depending on the feed analysed and less depending on the field of production.

In the ecological system, the highest values for both feeds were for EE (with 0.25% for natural meadow and with 0.18% for alfalfa), for NFE

(with 7.98% for natural meadow and with 0.18% for alfalfa) and for Ca (with 0.2% for natural meadow and with 0.41% for alfalfa).

The highest values obtained in the conventional system were only for CP (with 2.90% for natural meadow and 1.76% for alfalfa).

Both feeds were safe in terms of heavy metal content. The maximum concentration for Cd was 50 times less than the maximum allowed limit (1 mg/kg), for Pb it was 187.5 times less than the maximum allowed limit (30 mg/kg) and for Cu it was 22.6 times less than the maximum permissible limit (50 mg/kg).

The maximum level of nitrites in the analysed feed was 2.98 times lower than the maximum allowed limit (15 mg/kg) for alfalfa obtained in a conventional system and with fertiliser.

No pesticide residues were detected in the analysed feed.

The most relevant indicators from the ecological point of view (content of heavy metals, pesticides, nitrites and nitrates) show that the studied forages for dairy cow feed to obtain ecological milk were within the quality parameters imposed with this system.

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