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CHEMICAL COMPOSITION AND NUTRITIONAL VALUE OF THE FODDER GROWN IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

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Abstract

The chemical composition and nutritive value of fodder depends on many factors, the most important of which are the conditions for plant growth (climate, soil, fertilizers, agricultural machinery), species, stage of plant development, the way of harvesting, storage conditions. The aim of the research was to study the differences in the chemical composition of the fodder grown in different zones of the Republic of Moldova, the identification and comparative analysis of their actual nutritional value, analysis and comparison with the data given in specialty literature. The laboratory studies of the local fodder in Moldova, selected at the farms of the State Enterprise 'Moldsuinhibrid' (Orhei) and E.T.S. (Maximovka) revealed differences in chemical composition and general nutritive value that depends on the area of cultivation, as well as in comparison with the data used in calculating the recipes of fodder mixtures and combined fodder for animals and poultry. Differences in chemical composition and general nutritive value were observed in almost all fodder in the Republic of Moldova, selected from different places, as well as in comparison with the data used in the country to balance the diets of cattle and poultry.

Key words: *chemical composition, fodder, nutrition, breeding zone.*

INTRODUCTION

Livestock production largely depends on the high-grade feeding of animals. According to the World Health Organization (WHO), 52-55% of the nation's health is determined by the food quality. One of the causes of people′s health deterioration is the catastrophic shortage of micronutrients: vitamins, minerals and other biologically active substances. In parallel to this problem, in the conditions of increased human impact on the biosphere, the production of ecologically pure crop and livestock production is particularly acute.

Numerous studies have established that in many regions, depending on the ecological state of the animal habitats and the exposure of the animals to toxicants, the concentration of heavy metals in animals and animal products, is usually several times higher than their content in the soil and fodder, and that it exceeds the maximum allowable rate (Talanov and Chmielewski, 1991; Kashtanov et al., 1999; Bokova et al., 2000; Ermacov and Tyutikov, 2008).

Due to the deficiency of protein, vitamins and minerals in fodder, the metabolism in animals is disturbed, the animals often suffer from various diseases, the productivity is reduced, and the nutritional value of the livestock products is also low.

The rational use of the forage reserve involves carrying out an analysis of fodder by pedo climatic zones and obtaining of large amounts of low-cost fodder rich in nutrients. Nutrient content in fodder depends on fodder composition, stage of vegetation, soil fertility, etc., and the concentration of minerals varies in accordance with the phase of vegetation of cereals and the species of animals, including technological age groups (Voynar, 1960; Babenco et al., 1980).

In this context, the study of the chemical composition and nutritive value of fodder produced in Moldova and the determination of their quality become essential.

The level of crude protein, the essential amino acids and metabolisable energy in the recipes for livestock and poultry has a significant impact on productivity and depends on the breed, genetic potential, nutrition and maintenance technology (Pop et al., 2006; Stepurin and Vrancean, 2008; Caisin, 2010).

MATERIALS AND METHODS

In order to conduct the research, in the period of March-July 2011, samples of fodder were collected at the mixed fodder factory of the Stat Enterprise for pigs breeding 'Moldsuinhibrid' (Orhei town) and at the Technical and Experimental Station (village of Maximovka, the Republic of Moldova), which afterwards were tested on the content of moisture, crude and digestible protein, crude cellulose, fat, ash and nitrogen-free extractives. Conventional methods of zootechnical analysis were used (Petukhova et al., 1989).

The analysis of the fodder was carried out in the laboratory of the Department of General Animal Husbandry of the State Agrarian University of Moldova and the Laboratory of Nutrition and Fodder Technology of the Research and Practical Institute of Biotechnology in Animal Breeding and Veterinary Medicine. The determination of amino acids was conducted by the Institute of Physiology and Sanocreatology, and the determination of macro-and micro minerals was carried out by the Institute of Chemistry, Academy of Sciences of Moldova.

The estimation of the actual general nutrient value of the fodder was performed by calculation according to the data of the chemical composition of fodder, the digestibility of its nutrients using the energy equivalent of the conversion of digestible nutrients into energy.

RESULTS AND DISCUSSIONS

According to the results of the chemical analysis of the fodder and recycling wastes it was established that the dry matter content varied considerably in the fodder grown in different zones of Moldova, as well as in comparison with literature data (Kalashnikov, 2003) (Table 1, 2).

Table 1. The content of dry matter and water in the natural fodder of Moldova,%

Fodder	SE 'Moldsuinhibrid'		E.T.S. Maximovka		Variations in dry matter content in the fodder of different zones in comparison with literature data
	total moisture	dry matter	total moisture	dry matter	
Corn grain	13.65	86.35	18.64	81.36	-3.64 - +1.35
Barley grain	13.17	86.83	13.42	86.58	+1.58 - +1.83
Wheat grain	14.19	85.81	15.06	84.94	-0.06 - +0.81
Oat grain	12.07	87.93	14.65	85.35	+0.35 - +2.93
Soybean grain	11.38	88.62	15.06	84.94	-0.06 - +3.62
Pea grain	12.97	87.03	12.60	87.40	+2.03 -+ 2.40

According to the results of the analysis, in the tested fodder the level of crude protein (Table 3) differed from the data in reference literature. Significant differences in the content of this substance were found depending on the zones of cultivation of forage crops; thus, according to the chemical analysis the quantity of crude protein in the corn grain was of 68.08-70.80 g, in reference literature this amount is equal to 92.0 g, so that the difference in the content of crude protein is 21.20-23.92 g, or 23.04-26.00%.

A lower quantity of crude protein in the local fodder in comparison with literature data was observed in the wheat grain-16.10 g, in oat grain-12.91 g, in pea grain-6.01, and in sunflower seed cake and meal-25.70 g; a bigger amount of crude protein, g/kg protein in comparison with literature was observed only in the barley grain (by 11.09 and 23.80 g), in wheat bran and alfalfa grass meal.

Table 2. The content of dry matter and water in the plant based raw material,%

Fodder	SE 'Moldsuinhibrid'		E.T.S. Maximovka		Variations in dry matter content in the fodder of different zones in comparison with literature data
	total moisture	dry matter	total moisture	dry matter	
Extruded corn	8.43	91.57	-	-	-
Extruded peas	8.35	91.65	-	-	-
Extruded barley	7.66	92.34	-	-	-
Extruded wheat	7.90	92.10	-	-	-
Extruded soybean	10.31	89.69	-	-	-
Sunflower oilcake	5.70	94.30	10.98	89.02	+4.02-+9.30
Sunflower seed meal	10.22	89.78	-	-	-0.22
Soybean meal	10.31	89.69	11.94	88.06	+3.06-+4.69
Wheat bran	14.51	85.49	-	-	+0.49
Alfalfa grass meal	8.30	91.70	13.67	86.33	+1.33

Table 3. Content of crude protein in the fodder in the Republic of Moldova, g/kg

Fodder	SE 'Moldsuinhibrid'	E.T.S. Maximovka	Variation in the content of crude protein in fodder in comparison with literature data
Corn grain	68.08	70.80	-23.92 -21.20
Barley grain	96.09	108.80	+11.09 +23.80
Wheat grain	133.62	116.90	+0.62 -16.10
Oat grain	95.09	116.90	-12.91 +8.90
Soybean grain	323.83	-	+4.83 -
Pea grain	211.99	192.30	-6.01 -25.70

Actually significant differences in the content of major nutrients were observed in all kinds of fodder and waste products from the processing of plant based raw materials, depending on the location of fodder sampling, as well as in comparison with literature data (Table 4, 5, 6).

These data indicate that the balancing of fodder rations for cattle and poultry on the basis of literature data, versus the basis of an actual fodder analysis results in significant differences with respect to the required level of their needs for nutrients.

The importance of mineral substances in animal feeding is extremely high, even though they have no energy value (Table 7, 8, 9). Depending on the zone of the country the macro-and micronutrients varies.

Table 4. The content of crude fat in fodder in Moldova, g/kg

Fodder	SE 'Moldsuinhibrid'	E.T.S. Maximovka	Content of crude fat in comparison with literature data
Corn grain	42.39	40.10	-2.90 -0.61
Barley grain	19.95	23.10	-2.05 +1.10
Wheat grain	11.19	13.50	-8.81 -16.50
Oat grain	44.03	38.60	+4.03 -1.40
Soybean grain	184.12	-	+38.12 -
Pea grain	13.06	17.90	-5.94 -1.10

Table 5. Content of crude cellulose in the fodder in Moldova, g/kg

Fodder	SE 'Moldsuinhibrid'	E.T.S. Maximovka	Content of crude cellulose in comparison with literature data
Corn grain	20.88	11.70	-22.12 -31.30
Barley grain	51.98	66.70	+2.98 +17.70
Wheat grain	25.71	9.90	+8.71 -7.10
Oat grain	129.07	53.40	+32.07 -43.60
Soybean grain	74.81	-	+4.81 -
Pea grain	70.81	95.40	+16.81 +41.40

Table 6. The content of major nutrients in the raw waste products from the industrial processing of plant based raw material, g/kg

Fodder	SE 'Moldsuinhibrid'			E.T.S. Maximovka			By A. Kalashnikov, 2003		
	Crude protein	Crude fat	Crude cellulose	Crude protein	Crude fat	Crude cellulose	Crude protein	Crude fat	Crude cellulose
Extruded corn	75.13	27.03	27.32	-	-	-	-	-	-
Extruded peas	204.51	6.22	107.31	-	-	-	-	-	-
Extruded barley	103.90	18.27	52.77	-	-	-	-	-	-
Extruded wheat	142.89	19.80	46.48	-	-	-	-	-	-
Extruded soybean	358.62	125.59	85.27	368.60	9.50	130.8	-	-	-
Sunflower oilcake	260.44	231.39	233.94	231.20	196.9	130.8	405.0	77.0	129.0
Sunflower seed meal	331.65	12.17	201.76	-	-	-	429.0	37.0	144.0
Soybean meal	126.64	45.13	87.91	-	-	-	151.0	41.0	88.0
Wheat bran	613.77	127.70	23.96	-	-	-	535.0	108.0	-
Alfalfa grass meal	-	-	-	199.90	12.10	142.0	189.0	29.0	211.0

Table 7. The content of macronutrients in the fodder in Moldova, g/kg

Fodder	Ca		P		K		Na	
	*	**	*	**	*	**	*	**
Corn grain	0.067	0.5	3.10	5.2	3.81	5.2	0.021	1.3
Barley corn	0.712	2.0	4.39	3.9	6.68	5.0	0.054	0.8
Wheat grain	0.561	0.8	2.87	3.6	3.79	3.4	0.033	0.1
Oat grain	0.799	1.5	3.08	3.4	4.35	5.4	0.059	1.8
Soybean grain	1.601	4.8	4.98	7.1	17.21	21.7	0.040	3.4
Pea grain	0.476	2.0	3.28	4.3	8.75	10.7	0.016	0.3

Table 8. Content of macronutrients in the waste products from the industrial processing of plant based raw material, g/kg

Fodder	Ca		P		K		Na	
	*	**	*	**	*	**	*	**
Extruded corn	0.137	-	2.51	-	3.60	-	0.014	-
Extruded peas	0.857	-	4.56	-	8.48	-	0.038	-
Extruded barley	0.397	-	3.59	-	5.01		0.045	-
Extruded wheat	0.612	-	4.08	-	5.24	-	0.025	-
Extruded soybean	2.113	-	6.27	-	17.15	-	0.029	-
Sunflower oilcake	2.699	5.9	9.39	12.9	14.87	9.5	0.046	1.3
Sunflower seed meal	4.038	3.6	14.36	12.2	16.00	8.0	0.040	0.9
Soybean meal	0.617	2.0	6.50	9.6	8.34	10.9	0.026	0.9
Wheat bran	24.623	27.0	8.30	18.0	4.01	6.9	2.875	12.2

Plants that grow in soils containing an insufficient amount of nutrients are responsible for fodder which does not possess full value or quality.

The analysis of local fodder on the content of amino acids showed that both the content of lysine and methionine is significantly lower than the average data referred to in literature (Table 10).

Table 9. Content of micronutrients in the fodder and waste products from the industrial processing of plant based raw material, g/kg

Fodder	Fe		Cu		Zn		Mn		Co	
	*	**	*	**	*	**	*	**	*	**
Corn grain	42.93	303.0	3.07	2.9	22.69	29.6	22.69	3.9	0.91	0.06
Barley grain	860.19	50.0	6.86	4.2	30.11	35.1	30.11	13.5	0.92	0.26
Wheat grain	46.73	40.0	4.63	6.6	32.12	23.0	32.12	46.4	0.90	0.07
Oat grain	98.56	41	2.68	4.9	22.62	22.5	22.62	56.5	0.94	0.07
Soybean grain	156.63	125	9.12	14.2	36.84	33.0	36.84	27.3	0.94	0.09
Pea grain	61.75	60.0	7.71	7.70	38.35	26.7	38.35	20.2	0.91	0.18
Extruded corn	186.53	-	1.96	-	20.20	-	20.20	-	0.96	-
Extruded peas	98.37	-	5.56	-	37.48	-	37.48	-	0.97	-
Extruded barley	267.04	-	5.20	-	21.75	-	21.75	-	0.97	-
Extruded wheat	78.71	-	6.46	-	28.12	-	28.12	-	0.96	-
Extruded soybean	212.07	-	12.61	-	40.78	-	40.78	-	0.93	-
Sunflower seed meal	176.72	215	25.23	17.2	73.74	40.0	73.74	37.9	0.98	0.19
Soybean meal	208.96	332	36.59	24.1	85.25	40.8	85.25	48.5	0.94	0.416
Wheat bran	84.67	170	11.08	11.3	60.35	81.0	60.35	117.0	0.90	0.10

Table 10. The content of amino acids in grain, g/kg

Amino acids	Corn grain		Pea grain		Barley grain		Oat grain		Soybean grain	
	*	**	*	**	*	**	*	**	*	**
Lysine	3.00	2.1	20.48	14.2	5.06	4.1	5.31	3.6	18.71	21.1
Methionine	0.80	3.3	0.51	1.8	0.83	3.6	0.39	4,6	2.07	1.8
Cysteine	1.37	-	2.30	-	1.69	-	2.11	-	3.24	-
Threonine	2.06	-	5.27	-	2.46	-	2.08	-	5.69	-
Serine	3.18	-	9.68	-	4.45	-	4.19	-	11.40	-
Glutamic acid	13.64	-	54.83	-	35.08	-	26.75	-	63.37	-
Proline	5.05	-	10.21	-	11.93	-	5.17	-	13.44	-
Glycine	3.11	-	10.43	-	4.99	-	5.24	-	11.88	-
Alanine	4.39	-	10.53	-	4.90	-	5.26	-	11.97	-
Valine	3.09	-	10.37	-	5.34	-	4.52	-	9.85	-

*fodder selected at the SE „Moldsuinhibrid",Orhei; **literature data by A. Kalashnikov, 2003*

The calculations to determine the actual overall nutritional value of fodder in Moldova revealed that, in the analyzed fodder the content of the exchange energy for pigs and poultry (Table 11) differed depending on the location of sampling, as well as on the indicators listed in the normative literature; significant differences were observed in the data both on nutrition value of cereal crops and products of their processing.

Table 11. The nutritional value of fodder and waste products from the processing of plant based raw material in exchange energy, Mj

Fodder	SE 'Moldsuinhibrid'		E.T.S. Maximovka		by Kalashnikov (2003) for:	
		poultry	pigs	poultry	pigs	poultry
Corn grain		13.94	11.48	12.43	12.80	13.81
Barley grain		12.21	14.83	19.63	12.43	11.20
Wheat grain		13.22	11.25	11.02	13.60	12.34
Oat grain		13.85	10.40	10.76	10.80	10.75
Soybean grain		16.04	-	-	15.00	12.97
Pea grain		13.77	15.11	15.19	13.10	10.46
Extruded corn		14.49	-	-	-	
Extruded peas	14.20		-	-	-	-
Extruded barley	12.88		-	-	-	-
Extruded wheat	13.80		-	-	-	-
Extruded soybean	14.93		-	-	-	-
Sunflower oilcake	11.76		11.53	11.62	12.30	9.62
Sunflower seed meal		8.26	11.53	10.01	13.70	9.83
Soybean meal	-		12.81	12.33	14.50	11.09
Wheat bran	10.52		-	-	9.30	7.20
Alfalfa grass meal		-	8.55	8.35	7.20	5.86

CONCLUSIONS

The results of the chemical analysis of local fodder showed considerable differences on nutrient content in comparison with literature data. Large deviations were found in the content of crude fat: in oat grain by 4.03 g/kg and soya by 38.12 g/kg; the content of crude protein in corn grain was lower by 32.2-34.92 g/kg, in barley grain by 4.2-16.91 g/kg, in wheat grain by 16.1 g/kg, and in oat grain by 12.91 g/kg.

Overall nutritional value in metabolic energy of local fodder in Moldova varied depending on the location of sampling and compared with the data in specialty literature.

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