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CHEMICAL COMPOSITION OF THE PERENNIAL PLANT SORGHUM AND FODDER PREPARED AND HAY

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Abstract

It has been investigated the non-traditional perennial fodder plant sorghum (Sorghum almum) for its use in feed for farm animals, fresh and preserved through the preparation of fodder. The content of nutrients in the green mass of the sorghum perennial plant: Moisture-78.25%, crude protein in absolutely dry substance -10.16%, crude fat-3.0, crude cellulose-38.95%, nutritive units-0,18, metabolic energy-8.59 Mj/kg. Organic acids had been formed in the process of green mass fermentation, which has helped to maintain the quality of the green mass and obtaining a high quality fodder. The nutrient content of the perennial herbal plant sorghum is close to the corresponding indices of the initial green mass. The green mass of the perennial plant sorghum is well suited to the preparation of fodder. Fodder is yellowish green, pleasantly smelled of pickled fruit and is well consumed by farm animals.

Key words*: animals, nutrients, green mass, organic acids, chewing.*

INTRODUCTION

In order to diversify the spectrum of fodder crops and to insure farm animals from R. Moldova with rough and juicy qualitative fodder we started research on the non-traditional perennial fodder plant sorghum (*Sorghum almum*). According to the publications of several authors (Cucu et al., 2004; Teleuta, 2010; Teleuta et al., 2015; Petukhov et al., 1989; Marin et al., 2016; Titei et al., 2018), this plant has increased resistance to drought, pests and various diseases, is relatively tolerant to soil quality, has a high regenerative capacity and growth after mowing, is adapted to traditional crop cultivation, harvesting and preparation technologies. The plant is multiannual and can be exploited on the same site for a long time (5-6 years). The green mass of the plant harvested in different phases of vegetation can be used in animal feed both fresh and preserved by the preparation of hay, fooder. During the green season it is possible to be harvested 2-3 times, in high humidity years it grows constantly and can be harvested every 30-35 days.

MATERIALS AND METHODS

The experimental researches of the perennial plant sorghum (*Sorgum almum*) (Figure 1) werecarried out in the central area of the Republic of Moldova in climatic conditions characteristic to the geographical area. The green mass of the perennial plant sorghum was harvested for the chemical analysis and determination of the nutritional value of theparcels sown in the current year and in the previous years.

Figure 1. The perennial plant sorghum (*Sorgum almum)*

Laboratory analyzes were performed to determine the following indices: Initial and Hydroscopic Humidity, Nitrogen and Crude Protein, Gross Fat, Gross Pulp, Crude Ash, Unsaturated Extractives, Carotene. In laboratory and semi-production conditions, the green mass of this plant was preserved by preparing the hay. Subsequently, the chemical composition of the hay was determined according to the hints shown above and other parameters characterizing the preserved fodder

by fermentation: pH index, organic acid content - lactic, acetic, butyric. The quality of the hay by organoleptic indices was also assessed: smell, color, consistency. Analyzes were performed according to classical methods (Petukhov et al., 1989.) Fodder humidity estimation was performed by drying the samples at 60-65°C, hydroscopic humidity at 100-105°C for 2.5-3 hours. Nitrogen (for crude protein determination) was evaluated using the Kjeldahl method, Gross fat content according to S. V. Ruşkovski's method. The method is based on the excretion of fats with organic diluents. Gross cellulose was evaluated according to the modified Henneberg and Stohmann method. Non-nitrogen extractive substances were calculated by subtracting from 100%: moisture indices, crude protein ash, raw pulp, crude fat, expressed as a percentage. The crude ash was evaluated by burning samples in stoves at 450-500°C. Organic acids content was determined by Lepper-Flig methods.

RESULTS AND DISCUSSIONS

After harvesting the green mass of the perennial plant sorghum, it was left in the furrows to wipe off to reduce the moisture, then chopped and crushed into 100-150 kg barrels. After a storage period necessary to complete the fermentation processes, the barrels were opened and hay analyzed. After the organoleptic analysis of the hay, it was found that its color deviated from green to yellow, yellow-grey with a pleasant smell of pickled vegetables and fruits and the consistency was identical to the initial green mass prior to preservation.

Table 1. Chemical composition and nutritive value of perennial plant sorghum depending on the vegetation phase

Indices			Green mass, plant growth phase, h = 60-80 cm	The green mass, the pre-emergence phase (the panicle out of the sheath)	Green mass, phase of panicle formation
Humidity ,%		first	85.70	76.62	76.13
		hygroscopic	5.30	6.58	6.52
		total	**86.46**	**78.16**	**77.69**
Dry Substance,%			13,54	21.84	22.31
Nitrogen,%	%	in DS	2.10	1.24	1.16
		in the absolutely dry substance	2.22	1.33	1.24
		with natural moisture	0.30	0.29	0.28
Crude protein	%	in DS	13.13	7.75	7.25
		in the absolutely dry substance	**13.86**	**8.30**	**7.76**
		with natural moisture	1.88	1.81	1,73
	g		18.77	18.12	17.31
Digestible protein, g/kg			12.96	12.50	11.94
Gross fat	%	in DS	4.32	2.48	1.99
		in the absolutely dry substance	**4.56**	**2.65**	**2.13**
		with natural moisture	0.62	0.58	0.48
	g		6.18	5.80	**4.75**
Cellulose brute	%	in DS	30.39	34.77	36.51
		in the absolutely dry substance	**32.09**	**37.22**	**39.06**
		with natural moisture	4.34	8.13	8.71
	g		*43.46*	81.29	87.15
Gross ash	%	in DS	11.19	6.40	6.23
		in the absolutely dry substance	**11.82**	**6.85**	**6.66**
		with natural moisture	1.60	1.50	1.49
NES (non-nitrogen extractive substances),%	%	in DS	35.68	42.02	41.50
		in the absolutely dry substance	**37.67**	**44.98**	**44,40**
		with natural moisture	5.10	9.82	9,91

UN (nutritonal units)	With natural humidity	**0.12**	**0.19**	**0.20**
ME (metabolisable energy), Mj/kg	in dry substance	**8.90**	**9.00**	**8.93**
	With natural humidity	1.27	2.10	**2.13**
Carotene, mg/kg		28.67	36,0	27.0
Calcium, %	in DS	0.56	0.35	0.36
Phosphorus, %	in DS	0.30	0.14	0.14

The study of dynamics and chemical composition of nutritive value for perennial plant sorghum in dependence on the vegetation phase revealed considerable changes (Table 1). Thus, for young plants, in the beginning of growing period humidity was 86.46% then the ones in the pre-mature phase decreased to 78.16% and the ones in the mature phase to 77.69%.

Respectively dry matter content increases from 13.54 to 22.31%. Instead, the crude protein content of the absolutely dry substance drops from 13.86% in the first case to 8.30 and 7.76%, respectively.

At the same time the digestible protein level in one kg of green mass with natural moisture changes, but less than 12.96 g in the growth period to 12.50 g in the pre-mature phase and 11.94 g in the mature period. With the aging of the plant, increases the level of crude cellulose (from 32.09 to 39.06%) and non-nitrogenous extractive substances (from 37.67 to 44.98%).

All these changes in the chemical composition also lead to a change in the nutritional value of the plants.

Table 2. Fodder and ratio of stalks and leaves mass to plant Sorg depending on the number of harvesters

Indices	Harvest I	Harvest II	Harvest III	Average
Plant height, cm	**196**	163	153	171
Fodder mass, green, t/ha total, t/ha	28.3 x	17.23 x	15.31 x	20.28 60.84
Stalks,g	23.2	16.4	8.5	16.0
Leaves, g	11.3	11.0	7.1	9.8
Total, g	34.5	27.4	15.6	25.8
Ratio, stalks/leaves%	67.3/ 32.7	59.9/ 40.1	54.5/ 45.5	62.1/ 37.9

For example, the energy value increases from 0.12 UN/kg in the plant growth period to 0.20 UN/kg in the matture phase. The data obtained further reveals that the differences between the chemical composition of the plants harvested in the pre-mature and mature phase are insignificant with only one important difference which needs to be taken into consideration when determining the harvesting period, this difference refers to digestible protein content to a nutritional unit. If during the period of plant growth this index is 108 g/UN, before mature phase - 66 g/UN, then drops to 54 g/UN or 18.2% during the mature period.

The technology is harvesting the plants and drying them in furrows up to 55-65% humidity (Figure 2). At this humidity stage the plants are gathered from the furrows, shredded and transported to storage capacities.

Figure 2. Perennial plant sorghum harvested in furrows

To determine the ratio of the stalk mass to the leaves of the perennial plant sorghum, the straw were separated from leaves, weighed and the correlation between them was calculated and presented (Table 2). This procedure has been applied to plants harvested from 3 times consecutive in a season.

As Table 2 shows, as plant is getting higher, the more fodder it gives per hectare. At a height of 196 cm, the fodder is 28.3 t/ha, and at the height of 153.0 cm, the fodder is only 15.31 t/ha. The ratio stalks / leaves averaged 62.1 / 37.9% of the weight of the fresh harvested plants (Table 3).

At the same time this ratio increases from the first to the second harvest from 67.3 / 32.7% to 59.9 / 40.1% and at the third harvest to the 54,5 / 45,5%, not taking into account that the harvest of

green mass decreases from 28.3 t / ha at first harvest to 17.23 at the second and go down to 15.31 at the third harvest.

Table 3. Chemical composition and nutritional value of the green mass and hay of perennial plant sorghum (*Sorgum almum*)

Indices	Green mass	Hay
Total humidity, %	78.25	59.74
Dry substances, %	21.75	40.26
	% in dry substances	
Nitrogen	1.63	1.3
Crude protein	10.16	8.1
Gross fat	3.0	2.81
Gross pulp	38.95	39.23
Gross ash	8.34	9.24
SEN	32.51	36.43
EM, Mj/kg	8.53	8.59
Ca	0.42	0.49
P	0.26	0.19
Carotene, mg/kg	53.67	32.25

Of course, here it has influenced when the plant was harvested, because the plants in the third harvest are finer and has more leaves as seen from the ratio of stalks/leaves of 54.5 / 45.5% in this harvest. So we lose in quantity, but we grow in quality because leaves are much more nutritious than the stalks, which contain predominantly cellulose. As a result, the fodder prepared from the third harvest will be much more qualitative than the one made from first harvest.

During storage, mucosities have not formed and mold has not developed (Figure 3).

Figure 3. The green table *Sorgum almum*

For the determination of the nutrient content and the appreciation of the nutritives values, chemical analysis of the green mass and the hay prepared from the perennial plant sorghum were carried out (Table 3).

The data obtained and presented in Table 3 demonstrate that in the growing stage, at the height of perennial plant sorghum (*Sorgum almum*) 60-120 cm, the total humidity constituted 78.25%, and hay prepared from it 59.74%. Analyzing the content of essential nutrients in the green mass and the hay made from it, we find a very small difference between these two fodders. Thus, the amount of nitrogen in the green mass is 1.63%, and in hay 1.3%, the corresponding crude protein 10.16% and 8.1%, the crude fat 3.0% and 2.81% and so on. The exception is the amount of carotene, which in the green mass is higher at 53.67 mg / Kg, and in hay is only 32.25 mg/kg. It is natural, that in the process of fermentation and storage some of the carotene is lost. The metabolic energy expressed in Mj/kg was practicaly identical, respectively, 8.53 and 8.59.

In order to determine how the fermentation processes were carried for fodder preparation, the chemical analysis of the finished product was performed. Thus the percentages of the basic organic acids (lactic, acetic and butyric) in the free and fixed state, the active acidity (pH index) in the prepared pellet were evaluated (Table 4).

Table 4. The content of free and fixed organic acids in the perennial plant sorghum (*Sorgum almum*

Indices	Fodder from plant Sorg
pH	4.52
Free: acetic ;%	0.45
butyric,%	0
lactic, %	1.0
Fixed: acetic, %	0.66
butyric,%	0
lactic,%	2.0
Total: acetic, %	1.1
butyric, %	0
lactic, %	3.0
Sum: % Lactic+butyric+acetic	4.16
Correlation of acids, in %	
Acetic	26.62
butyric	0
lactic	73.25

The data of Table 4 elucidates the amount of organic acids eliminated in the fermentation process, shows that predominantly lactic acid was produced in total of 3.0%, both in free (1.0%) and fixed (2.0%). Acetic acid wasproduced in moderate quantities, a total of1.1% and the butyric acid that is undesirable

infodder, basically did not produced. This amount of organic acids eliminated as a result of fermentation, but especially the share of 73.35% lactic acid provided a dominant acid-lactic fermentation of the green mass and contributed to the production of the fodder (Figure 4).

Figure 4. The hay of the perennial plant sorghum

As a result, the development of the fermentation process under favorable conditions of the development of the lactobacteria led to the achievement of a superior quality fodder.

CONCLUSIONS

1. The perennial plant sorghum (*Sorgum almum*) is in the state of research in the Republic of Moldova and is mainly cultivated on experimental parcels.
2. The green mass of the perennial plant sorghum (*Sorgum almum*) can be used freshly in animal feed and is well suited to preservation by preparing the fodder, thus offering the opportunity to expand the spectrum of feed used in farm animal rations.
3. The content of nutrients in the plant sorghum (*Sorgum almum*): total moisture - 73.77%, dry matter - 26.23%, crude protein - 10.57%, gross fat - 2.26%, raw pulp - 38.88%, SEN - 32.51%. Nutrient value in nutrient units averaged 0.20 UN/kg; in metabolisable energy 8.53 Mj/kg of dry matter. Average carotene content was 53.67 mg/kg; mineral substances - calcium 0.42%; phosphor - 0.26%. These indices fall within the average normative parameters of fodder plants used in animal feed.
4. Fodder prepared from perennial plant sorghum according to organoleptic characteristic has the greenish-yellow color, the pleasant smell of pickled vegetables or fruits, well conserved consistency of the original plants, without mold and mucus.
5. The content of fixed and free organic acids with a share of lactic acid up to 80-87% of the total amount of acids ensured a beneficial process of acid-lactic fermentation of the green mass, from the perennial plant sorghum, which led in obtaining a quality fodder.
6. Nutritional value and chemical composition of the fodder prepared from the non-traditional perennial plant sorghum (*Sorgum almum*) was close to the same indices of the initial vegetal mass.

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