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# Feed Quality of New Sudan Grass Varieties

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## ABSTRACT

The present investigation was conducted to determine the feed quality of New Sudan grass varieties. On average, the highest plant height was found in Sudan grass variety Nika (274 cm) in 2019-2020. These rates in Sputnitsa and Aleksandrina were loer by 23 and 30 cm, respectevely. The yield of green matter after two cuts in the new variety Nika was 41.0 t $ha^{-1}$ and 9.59 t $ha^{-1}$ of hay. These rates in the recognized varieties varied in the range of 35.0-36.0 t $ha^{-1}$ and 7.98-8.28 t $ha^{-1}$. The maximum protein content for varieties Nika, Sputnitsa standard and Aleksandrina were 13.72%, 11.33%, and 11.72%, respectevely. The fiber content in the air-dry matter was 25.20% in Nika, 26.01% in Sputnitsa and 26.03% in Aleksandrina. When determining the presence of metabolizable energy in sheep feed, it was found that the variety Nika contained 2.03 MJ, Aleksandrina – 1.96 MJ, Sputnitsa – 1.90 MJ in 1 kg of green matter. The new variety Nika also had similar maximum rate in 1 kg of hay and amounted to 8.79 MJ. Among the studied varieties of Sudan grass, the most significant amino acid content was also obtained in the variety Nika. The maximum rate of asparagine and glutamic acids in the air-dry matter of this variety was 1.84% and 1.38%, respectively. The dry matter of the variety Nika contains high level (0.5-1.0%) of the amino acids proline, glycine, alanine, valine, leucine, phenylalanine, and lysine. A significant amount of threonine, serine, isoleucine, tyrosine, and arginine amino acids (0.3-0.5%) was obtained in the air-dry matter of Sudan grass. The content of methionine and histidine amino acids in hay was low (less than 0.27%).

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# Yeni Sudan Otu Çeşitlerinin Yem Kalitesi

## ÖZET

Bu araştırma Yeni Sudan otu çeşitlerinin yem kalitesini belirlemek için yapılmıştır. Ortalama olarak en yüksek bitki boyu 2019-2020 yıllarında Sudan otu çeşidi Nika'da (274 cm) bulunmuştur. Sputnitsa ve Aleksandrina'daki bu oranlar 23 ve 30 cm daha düşük bulunmuştur. Yeni Nika çeşidinde iki kesimden sonra yeşil madde verimi 41.0 t $ha^{-1}$ ve saman miktarı 9.59 t $ha^{-1}$ bukunuştur. Tanınan çeşitlerdeki bu oranlar, 35.0-36.0 t $ha^{-1}$ ve 7.98-8.28 t $ha^{-1}$ aralığında değişmiştir. Maksimum protein içeriği Nika çeşidinde (% 13.72), Sputnitsa standardında (% 11.33) ve Aleksandrina çeşidinde (% 11.72) bulunmuştur. Hava-kuru maddedeki lif içeriği Nika'da% 25.20, Sputnitsa'da% 26.01 ve Aleksandrina'da% 26.03 gözlenmiştir. Koyun yeminde metabolize edilebilir enerjinin varlığını bakıldığında, Nika çeşidinin 1 kg yeşil madde içinde 2.03 MJ, Aleksandrina - 1.96 MJ, Sputnitsa - 1.90 MJ içerdiği bulunmuştur. Yeni Nika çeşidin de benzer olarak 1 kg samanda maksimum 8.79 MJ içeriği elde edilmiştir. İncelenen Sudan çim çeşitleri arasında en belirgin amino asit içeriği Nika çeşidinde elde edilmiştir. Bu çeşidin hava-kuru maddesindeki maksimum asparagin ve glutamik asit oranı sırasıyla % 1.84 ve% 1.38 olmuştur. Nika çeşidinin kuru maddesi yüksek

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Azot içermeyen özüt
Metabolize edilebilir enerji
Amino asitler

seviyede (% 0.5-1.0) amino asit prolin, glisin, alanin, valin, lösin, fenilalanin ve lizin içerdiği bulunmuştur. Sudan çiminin havada kuru maddesinde önemli miktarda treonin, serin, izolösin, tirozin ve arginin amino asitleri (% 0,3-0,5) elde edilmiştir. Saman içindeki metiyonin ve histidin amino asit içeriği ise düşük (% 0.27'den az) bulunmuştur.

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## INTRODUCTION

The creation of a solid forage reserve for animal husbandry in the North Caucasus region is closely related to the cultivation of forage crops that would ensure high and sustainable yields at minimal cost. It is important to expand the sowing of drought-tolerant, high-yielding, high-afterfeed forage crops (Kapustin et al., 2018; Kapustin et al., 2019). One of which is Sudan grass. Sudan grass has a strong root system, and is resistant to soil and atmospheric droughts. İn dry years it is superior in the yield of green matter to not only corn, but also annual and perennial grasses (Kapustin et al., 2020). In the Stavropol Territory, up to 70% of the cultivated area of annual forage crops is occupied by Sudan grass. The possibility of sowing in several terms, the ability to produce high yields of green matter and afterfeed before autumn frost make it a good component of the green forage chain (Mut et al., 2017; Kuznetsov et al., 2018).

Published studies (Goulart-Machado et al., 2018; Vasin et al., 2018) state that pure sowing of Sudan grass has insufficient protein content. The use of fertilizers increases the content of amino acids, Ca, K, P and Mg in the forage. The percentage of protein in plants positively correlates with the amount of nitrogen in the soil (Wynd et al., 1947; Tang et al., 2015; Kosogova et al., 2020).

In dry years, mixed sowing of Sudan grass with corn and legumes is highly effective (Stojanovic B et al., 2020). The expansion of the crops under study required the creation of new varieties adapted to the local edaphoclimatic conditions. The breeding center North Caucasus Federal Agrarian Research Centre developed a program and identified the main areas of breeding work for the creation of new varieties of Sudan grass. As a rule, the growth and development of the crop take place in the conditions of drought and acceleration. The preemergent period was 5-7 days. The crop emergence was reduced to 60-70%.

All those things affect the yield of green matter and the subsequent regrowth of plants. Using hybridization on a sterile and fertile basis, as well as the method of selection with following self-pollination, new varieties of Sudanese grass Zemlyachka, Sputnitsa, Nika, adapted to the conditions of the local arid climate, were obtained from the hybrid population.

Along with the improvement of the variety assortment of sorghum crops, the elements of agricultural cultivation techniques and the qualitative composition of the green and dry matter of new varieties were updated (Sonmez et al., 2016; Cole et al., 2017; Baranovsky et al., 2019; Baranovsky et al., 2020). Due to the significant differences in the content of the main nutrients in fodder production, chemical feed analysis is carried out, which allows to evaluate nutrient density chemically. Reliable methods for evaluation of nutrient density have been developed. They make it possible to organize feeding in such a way that minimum feed consumption gives the maximum amount of animal products (Volgin et al., 2008).

This research was conducted to evaluate determine the content of protein, fat, fiber, metabolizable energy of the fodder and the level of amino acids in the raw material and air-dry matter.

## MATERIALS and METHOD

The identification of indicators of chemical analysis and the amino acid content of green matter and hay was performed in the certified scientific laboratory “Feed and Metabolism” at the Stavropol State Agrarian University. The content of 16 out of 22 amino acids was determined (Volgin et al., 2008).

The studies on the quality of fodder in new varieties of Sudan grass were carried out using field and laboratory experiments at the experimental field of North Caucasus Federal Agrarian Research Centre in 2019-2020. The soil cover of the field was typical chernozem. The depth of humus horizons was 120 cm, the humus level in the plow layer was 3.2%. The level of active forms of mineral nutrition in the soil was average. Insufficient precipitation, combined with high air and soil temperatures in late summer, contributed to the manifestation of drought in the years of the experiments.

In the competitive test, three varieties of Sudan grass were sown, of which two varieties were developed by breeders of North Caucasus Federal Agrarian Research Centre – Sputnitsa (standard) and new variety Nika, which is undergoing state testing of new varieties. The variety Aleksandrina was developed in the Agricultural Research Center “Donskoy”. The area of the registration plot was 25 $m^2$, the number of replications was 4, the width of space between rows

was 70 cm, and the sowing time was May 12. During observations and records, "Methodology of the state testing of new varieties of agricultural plants" was used (Fedin, 1985).

The statistical analysis of the experimental results was carried out by analysis of variance according to the method of B.A. Dospekhov (Dospekhov, 1985). Harvesting of Sudanese grass plants was carried out in the phase of the beginning of the appearance of panicles. Mineral fertilizing and watering were not carried out in the experiment. The experimental scheme did not provide for the use of aphids and bacteria.

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## RESULTS and DISCUSSION

Sudan grass is suitable for use and making of green matter, silage, haylage, dry fodder, grass meal, and grazing. On average, the duration of the growing season from shoots to blooming period of panicles in the standard variety Sputnitsa was 60 days for 2019-2020. In the varieties Nika and Aleksandrinathis period was about 65-67 days. The duration of this period depended on the biological and morphological characteristics of the studied varieties.

The maximum energy of early growth on the 30th day of the growing season was in the variety Nika (93 cm). In the standard variety Sputnitsa, the same rate of growth was 86 cm, and the variety Aleksandrina had 82 cm. The records of the height of plants in the milky-waxy stage of ripeness show that the highest rate of this trait was also in Sudan grass Nika (274 cm). According to the rate, Sputnitsa and Aleksandrina were 23 and 30 cm lower. All of the studied varieties are highly resistant to lodging, aphid damage and bacteriosis.

After two cuts, the yield of green matter of the new variety Nika was 41.0 t $ha^{-1}$ and 9.59 t $ha^{-1}$ of hay. The yield of green matter of recognized varieties Sputnitsa and Aleksandrina was 5-6 t $ha^{-1}$ less and varied in the range of 35.0-36.0 t $ha^{-1}$. The hay yield of these varieties was 7.98-8.28 t $ha^{-1}$.

The experiment includes the quality evaluation of the green matter and hay of three varieties of Sudan grass. According to the data in Table 1, the quality indicators were determined in green matter (raw material) and hay (in the air-dry matter). Samples were taken from the clip of the first growth of Sudan grass and from the aftergrass.

Table 1. Chemical analysis of green matter and hay of Sudan grass (2019-2020)
*Çizelge 1. Yaş ve kuru Sudan otunun kimyasal analizi (2019-2020)*

| Sudan grass variety | Cuts | Total moisture, % | Crude protein, % | Crude fat, % | Crude fiber, % | Crude ash, % | NFE, % | Metabolizable energy, MJ $kg^{-1}$ |
|---|---|---|---|---|---|---|---|---|
| in the raw material | | | | | | | | |
| Sputnitsa, St | the first cut | 79.1 | 2.36 | 0.20 | 5.58 | 1.48 | 11.28 | 1.95 |
| | the second cut | 80.4 | 2.23 | 0.26 | 4.96 | 1.44 | 10.70 | 1.85 |
| Nika | the first cut | 78.4 | 2.93 | 0.23 | 5.18 | 1.44 | 11.82 | 2.10 |
| | the second cut | 79.5 | 2.84 | 0.27 | 5.42 | 1.39 | 10.58 | 1.96 |
| Aleksandrina | the first cut | 79.1 | 2.84 | 0.26 | 5.34 | 1.31 | 11.15 | 2.02 |
| | the second cut | 79.8 | 1.99 | 0.25 | 5.36 | 1.33 | 11.28 | 1.89 |
| **LSD $_{0.05}$** | | 3.17 | 0.11 | 0.01 | 0.21 | 0.05 | 0.45 | 0.08 |
| in the air-dry matter | | | | | | | | |
| Sputnitsa. St | the first cut | 7.58 | 11.27 | 0.96 | 26.70 | 7.10 | 46.39 | 8.28 |
| | the second cut | 6.92 | 11.38 | 1.35 | 25.32 | 7.35 | 47.68 | 8.51 |
| Nika | the first cut | 7.39 | 13.57 | 1.06 | 23.98 | 6.65 | 47.35 | 8.86 |
| | the second cut | 6.90 | 13.86 | 1.32 | 26.42 | 6.77 | 44.73 | 8.72 |
| Aleksandrina | the first cut | 7.63 | 13.58 | 1.26 | 25.55 | 6.25 | 45.73 | 8.75 |
| | the second cut | 6.58 | 9.86 | 1.23 | 26.51 | 6.58 | 49.24 | 8.35 |
| **LSD $_{0.05}$** | | 0.28 | 0.52 | 0.05 | 1.09 | 0.28 | 1.78 | 0.35 |

After the second cut, the total moisture content in the green matter was 0.7-1.3% more than after the first cut. However, the air-dry matter had the opposite results. After the second cut, the hay of all varieties had 0.49-1.05% less moisture than after the first cut due to the intense hot weather during the second half of the summer.

The organic part of the feed consists of nitrogenous (protein) and nitrogen-free substances (fat, fiber, nitrogen-free extracts). Crude protein is the total amount of nitrogen-containing substances in the feed. It was determined by the Kjeldahl method. The maximum protein content was found in the new variety Nika at the average rate of 13.72% after two cuts, the standard Sputnitsa had 11.33%, and the variety Aleksandrina – 11.72%. After the second cut

of the varieties of Stavropol selection, the content of crude fat in the green matter was 0.04-0.06% more than after the first cut. The content of this indicator in hay was similar to the green matter. The differences varied in the range of 0.26-0.39%. As for the variety Aleksandrina, there were no significant differences in this trait depending on the time of cut.

The nutritional value of crude fiber depends on the cellulose content, the degree of lignification and vegetative stages of plants. The cellulose predominates in the cell wall among young plants. A certain regularity of crude fiber content depending on the cut time was not observed. It was found that, on average, the fiber content in the new variety of Sudan grass Nika in dried hay after two cuts was 25.20%, in the varieties Sputnitsa – 26.01, Aleksandrina – 26.03%. The decrease in the variety Nika in comparison with the standard was 0.81%.

The ash content in both methods of use did not depend on the cut period and was more significant in the variety Sputnitsa. The main representatives of nitrogen-free extracts (NFE) are amylum, sugars, and pentosans. The amylum content in plants is influenced by climate conditions, methods of feed preparation and storage. In our research, the presence of NFE did not depend on the cut period, and on average after two cuts air-dry matter of Nika variety contained 46.14%, Sputnitsa standard had 47.04%, and the maximum percentage was 47.49% in the variety Aleksandrina.

The metabolizable energy is a part of gross energy in the feed, which is necessary to ensure a certain level of vital activity, biosynthesis and deposition in the substances of the product. The determination of the presence of metabolizable energy in the feed for sheep was carried out. It was found that on average, for two cuts, 1 kg of green matter of the variety Nika contained 2.03 MJ, Aleksandrina – 1.96, Sputnitsa – 1.90 MJ. In 1 kg of hay, the presence of similar rates also turned out to be the maximum in the new variety Nika and amounted to 8.79 MJ, the standard Sputnitsa had 8.40, Aleksandrina – 8.55 MJ. There is an increasing tendency for metabolizable energy for sheep in the green matter and hay during the first cut, in comparison with the second cut.

The content of 16 amino acids, presented in Table 2, was determined in the samples of green matter and hay, which were taken during the second cut from three studied varieties of Sudan grass. All amino acids are the building blocks of proteins. After the protein digestion, the body receives specific amino acids. Some of them are replaceable, the body is able to produce them and irreplaceable (can only be obtained through nutrition).

The replaceable amino acids are serine, glutamic and aspartic acids, proline, glycine, alanine, tyrosine, and arginine. The irreplaceable are threonine, valine, methionine, isoleucine, leucine, lysine, phenylalanine, histidine. Although these amino acids are not produced by the body, but valine, isoleucine, threonine, which are needed for wound healing and immune system stimulation, are also necessary for the formation of hemoglobin, and regulation of neurological issues. Leucine, phenylalanine and histidine regulate blood sugar levels. They are the raw material for insulin, they prevent hypertension, atherosclerosis, heart attacks. Threonine, along with lysine, alanine and aspartic acid, activate the production of antibodies, which strengthens the immune system.

The highest percentage in the air-dry matter of Sudan grass had aspartic and glutamic acids (1.10-1.84%). Aspartic acid is a replaceable amino acid. It plays an important role for the proper functioning of the nervous and endocrine systems, provides the hormone production (testosterone, etc.). Glutamic amino acid can be found in the brain and spinal cord, plasma, and the fluid part of the muscles. It regulates the balance of alkali and acids, provides the production of new cells and prevents early aging.

Among three studied varieties of Sudan grass, the new variety Nika had the maximum content of these two amino acids (1.84% and 1.38%). Similar results were obtained in the green matter. As for the rest of the amino acids, their maximum content was also obtained in the new variety Nika.

The content of proline, glycine, alanine, valine, leucine, phenylalanine, lysine amino acids had a high percentage (0.5-1.0%) in dry matter. A significant presence of amino acids (0.3-0.5%) in the air-dry matter of Sudan grass was obtained from: threonine, serine, isoleucine, tyrosine, arginine. Low content of amino acids (less than 0.25%) in hay was found in methionine and histidine.

## CONCLUSION

The varieties of Sudan grass which were identified in 2019-2020 in the seed field of competitive variety trial were well selected, had a complex of positive economically valuable characteristics, and were resistant to dry conditions. The Sudan grass variety Nika excelled in terms of the green matter yield, the early growth rate and the the plants height.

Chemical of green matter and hay showed that Nika was superior to the standard varieties in terms of protein content by 2.0-2.39% and sustained the best values of fiber and metabolizable energy.

Among the studied varieties of Sudan grass, the new variety Nika had the highest percentage of amino acids. The maximum presence of aspartic and glutamic amino acids in the air-dry matter of this variety was 1.84 and 1.38%, respectively.

Table 2. Amino acid content of green matter and hay of Sudan grass in 2019-2020
*Çizelge 2. Yaş ve kuru Sudan otunun amino asit içeriği (2019-2020)*

| Name of the Sudan grass | Amino acids, % | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Aspartic acids (Asp) | Threonine (Thr) | Serine (Ser) | Glutamic acid (GLu) | Proline (Pro) | Glycine (GLy) | Alanine (Ala) | Valine (Val) |
| in the raw material | | | | | | | | |
| Sputnitsa St | 0.22 | 0.08 | 0.09 | 0.23 | 0.15 | 0.10 | 0.13 | 0.11 |
| Nika | 0.38 | 0.10 | 0.11 | 0.28 | 0.21 | 0.11 | 0.14 | 0.14 |
| Aleksandrina | 0.24 | 0.07 | 0.08 | 0.22 | 0.01 | 0.09 | 0.11 | 0.10 |
| **LSD** $_{0.05}$ | 0.01 | 0.003 | 0.014 | 0.01 | 0.005 | 0.004 | 0.005 | 0.05 |
| in the air-dry matter | | | | | | | | |
| Sputnitsa St | 1.13 | 0.43 | 0.48 | 1.19 | 0.76 | 0.50 | 0.65 | 0.54 |
| Nika | 1.84 | 0.49 | 0.56 | 1.38 | 1.00 | 0.55 | 0.67 | 0.69 |
| Aleksandrina | 1.17 | 0.37 | 0.42 | 1.10 | 0.62 | 0.43 | 0.55 | 0.51 |
| **LSD** $_{0.05}$ | 0.056 | 0.02 | 0.021 | 0.053 | 0.036 | 0.021 | 0.031 | 0.026 |

| Name of the Sudan grass | Amino acids, % | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Methionine (Met) | Isoleucine (Lie) | Leucine (Leu) | Tyrosine (Tyr) | Phenylalanine (Phe) | Histidine (His) | Lysine (Lys) | Arginine (Arg) |
| in the raw material | | | | | | | | |
| Sputnitsa St | 0.03 | 0.08 | 0.16 | 0.08 | 0.10 | 0.05 | 0.11 | 0.10 |
| Nika | 0.03 | 0.09 | 0.17 | 0.09 | 0.12 | 0.05 | 0.13 | 0.11 |
| Aleksandrina | 0.03 | 0.08 | 0.15 | 0.07 | 0.09 | 0.04 | 0.10 | 0.08 |
| **LSD** $_{0.05}$ | 0.002 | 0.003 | 0.006 | 0.003 | 0.004 | 0.02 | 0.04 | 0.04 |
| in the air-dry matter | | | | | | | | |
| Sputnitsa St | 0.15 | 0.39 | 0.84 | 0.40 | 0.51 | 0.24 | 0.58 | 0.50 |
| Nika | 0.15 | 0.46 | 0.85 | 0.42 | 0.57 | 0.26 | 0.62 | 0.50 |
| Aleksandrina | 0.14 | 0.38 | 0.72 | 0.33 | 0.44 | 0.19 | 0.48 | 0.40 |
| **LSD** $_{0.05}$ | 0.007 | 0.02 | 0.04 | 0.017 | 0.025 | 0.011 | 0.025 | 0.023 |

## Statement of Conflict of Interest

Authors have declared no conflict of interest.

## Author's Contributions

The contribution of the authors is equal.

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