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The study of the chemical properties of gray tereskenes ceratoides latens

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Abstract. Today, perennial plants of the natural flora are a raw material resource for the production of drought-resistant and heat-resistant feeds, among which Eurotia ceratoides occupies a special place.

In this work, the chemical properties of Eurotia ceratoides latens (J.F. Gmel) were studied, and the humus content in the soil was determined. The chemical and physico-chemical properties of the light gray soil (humus, water, carbonate ions and nitrogen) were revealed. The humus content was determined based on the oxidation of organic carbon with chromic acid to carbon dioxide.

The chemical composition of Eurotia ceratoides latens was analyzed to determine the content of nutrients (protein, fiber, fat, nitrogen-free extractables, ash) and water-soluble substances (C, CO_2, Ca, Mg) in the plant. The study revealed that the ash content in the plants remained relatively constant throughout the growth cycle, with minimal variation across different age groups. The ash content ranged from 9.11% to 10.05%, while the calcium content was found to be within the range of 3.67% to 4.90%. The content of crude fiber was determined using the Soxhlet apparatus, while the calcium cation content in the soil was evaluated by the complexometric method. The Kjeldahl method was employed to determine crude protein, and crude fat was assessed via ether extraction. Nitrogen-free extractives in ash were quantified by precipitation with a saturated solution of ammonium oxalate, and phosphorus was determined using the colorimetric method. These analyses have elucidated the nutritional value of Eurotia ceratoides latens.

Keywords: Teresken, Eurotia ceratoides latens, Eurotia semi-bush, chemical properties, the soil, the Kjeldahl method, the Soxhlet apparatus, the Mohr's salt, the complexometric method, alkalinity, carbonate.

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Introduction

Valuable plants are abundant in the flora of Kazakhstan and Central Asia. The disorganized use of natural pastures led to desertification in the Republic steppe and desert pastures. Among the plants suitable for improving desert and semi-desert pastures, *Eurotia ceratoides,* a perennial forage plant, occupies a special place in terms of practical significance.

This plant is resistant to drought and sulfate salinization, less resistant to sulfate-chloride, and there are tight constraints on chloride salinization: when NaCl concentration is higher than 0,2%, its effect is extremely devastating.

By photosynthetic reaction, eurotia belongs to group C4 of the plants with very low water consumption and high photosynthetic yield by the photosynthetic reaction. Nevertheless, the plants grow rapidly in spring and accumulate valuable protein-rich forage for livestock breeding.

Eurotia ceratoides latens (Figure 1) and *Eurotia eversmanniana-Kracheninnikovi ceratoides* (L.) (Figure 2).

Figure 1. Eurotia ceratoides latens

Figure 2. Eurotia eversmanniana

Eurotia has been characterized by enhanced productivity and excellent feed quality, which makes it possible to consider *Eurotia ceratoides* latens as a perspective species to be domesticated as a pasture feeding plant (Abdraimov and Yeskaraev, 1992; Abdraimov and Taichibekov, 2010; Shamsutdinov et al., 2009; Arkincheev and Shamsutdinov, 2013; Arkincheev and Shamsutdinov, 2015). In connection with the above, the chemical properties of the semi-shrub *Eurotia ceratoides latens* were studied in the work.

Hence, examination of the chemical and physical-chemical properties of this plant is of vital importance in the judicious cultivation and use of *Eurotia.* The chemical and instrumental methods of analysis were employed to determine these properties. The experiments were conducted to identify the chemical and physical-chemical properties of light sierozem on virgin land, plowed land, and under *Eurotia ceratoides latens.* The Kjeldahl titration-based method was used in the paper to examine the content of nitrogen in plants. The chemical composition of Eurotia and the content of various nutrients and water-soluble substances (C, CO_2, Ca, Mg) in the plant were analyzed. The "crude" fiber and "crude" fat content were determined using the Soxhlet apparatus, and the presence of calcium cations in the soil was estimated by the complexometric method. The chemical composition and nutritional value of *the Eurotia ceratoides latens* were established (Paramonov, 2001; Zhanaliyeva R.N., 2018; Tarasova, 2012).

The literature review has shown that the chemical composition of *Eurotia* can vary depending on the upgrowth location and other factors (Shamsutdinov and Shamsutdinov, 2012; Arkincheev, 2016). In the conditions of the desert zone in Southern Kazakhstan, the composition and nutrient density of *Eurotia* are studied poorly.

Materials and methods

Description of experiments

The study of the effect of the granulometric composition of the soil on the germination of seeds was carried out under laboratory conditions (GOST 25100-2011, 2015). The granulometric composition of the soil dramatically influences soil formation and agricultural use of soils. It determines water-physical, physical-mechanical, air, thermal properties, absorption capacity, accumulation of humus, the content of ash elements, and nitrogen in the soil.

The mechanical and chemical composition of the soil was determined in the soil laboratory of the Southwest Research Institute of Animal Husbandry and Crop Production.

The content of crude protein was determined by the Kjeldahl method, crude fat by ether extraction in a Soxhlet apparatus, and crude fiber by the Gonneberg and Stomann methods. Nitrogen-free extractives were determined by the difference in ash after precipitating with a saturated ammonium oxalate solution, and phosphorus was analyzed by colorimetry. All calculations for chemical composition were done on an absolute dry weight basis.

A method to determine the content of humus in the soil

Following the I.V. Tyurin method (GOST 26213-91, 1989), the humus was oxidized by the chromic-sulfuric acid mixture. The $K_2Cr_2O_7$ solution at the 0,067 mol/dm^3 concentration served as an oxidizer. The acid reaction occurred as follows:

$$2K_2Cr_2O_7 + 8H_2SO_4 \rightarrow 2K_2SO_4 + 2Cr_2(SO_4)_3 + 8H_2O + 3O_2; \quad \text{(Eq. 1)}$$

$$3C + 3O_2 = 3CO_2 \quad \text{(Eq. 2)}$$

The chromic acid that remained after oxidizing was titrated by the Mohr's salt $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$ as per the reaction

$$6FeSO_4 \cdot (NH_4)_2SO_4 + K_2Cr_2O_7 + 7H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + \\ + 3Fe_2(SO_4)_3 + 6(NH_4)_2SO_4 + 7H_2O \quad \text{(Eq. 3)}$$

The analysis procedure. 0,2 g of the air-dry mixture was placed into a cone flask, 10,0 ml of 0,4 n-chromic anhydride in sulfuric acid was added from a burette, and 0,1 g of catalyst $AgNO_3$ was added with further mixing. The mixture was heated until it reached boiling point and boiled for about 5 minutes. After the mixture had grown cold, it was transferred to a glass with 200 ml of water. The flask was flushed out several times. Finally, the flushing water was transferred to the glass with the mixture. At this point, the water volume was approximately 300 ml. Next, 8 drops of diphenylamine were added to this solution, and then the chromic acid, which remained after humus oxidation, was titrated by the 0,2 n-Mohr's salt solution until the solution hue changed from blue to greenish.

Determination of water content in the soil

Soil moisture under ceratoides latens (teresken) crops was determined by taking soil samples in 3-4 replications from the following range: 0-5; 5-10; 10-20; 20-40; 40-60; 60-80 and 80-100 cm.

The sequence of procedures: A 20g batch was placed into a pre-weighted container to determine soil moisture. The selected samples were dried in drying cabinets at the temperature of 1050 ^{0}C until they reached a constant weight. Calculation:

$$\% \text{ water} = (m_1 - m_2) / m_{batch} \cdot 100\% \quad \text{(Eq. 4)}$$

The Kjeldahl titration-based method of estimating the content of nitrogen

1g of the analyzed substance and 2g of catalyst (powder of 10 weight parts of cupric sulfate, 100 weight parts of potassium sulfate, and two weight parts of selenium) were added to the Kjeldahl flask, pouring in 10 cm^3 of concentrated sulfuric acid. The flask contents were well stirred and heated. After decoloring the liquid, heating continued for 30 minutes. After cooling, this mineralized liquid was transferred to the distillation flask. The Kjeldahl flask was rinsed with distilled water. 20 cm^3 of 4% boric acid and 5 drops from mixed indicators (0,20 g of methyl red and 0,10 g of methyl blue dissolved in 100 cm^3 of a 96% solution of ethyl alcohol) were poured into the conical flask of about 300 cm^3 capacity. The distillation flask was connected to the apparatus for ammonia distillation, and sodium hydroxide solution was carefully poured into the flask containing mineralized liquid through a dropping funnel. At least 3,5 cm of the sodium hydroxide solution with a weight content of 33% was to be added per cubic centimeter of sulfuric acid, remaining after the mineralization process had finished. With normal boiling, 20-30 min later, the volume of the solution in the receiving flask usually amounts to 150-200 cm^3. Red litmus paper can help detect if the distillation process has been completed. To do it, litmus paper had to be placed under the flowing drops of distillate. If litmus did not turn blue, the distillation of ammonia was finished.

A method to estimate crude fiber

2g of *ceratoides latens (teresken)* were weighted in a test tube using analytical scales, then placed in a 500-ml glass. Next, 100 ml of a 4% sulfuric acid solution were poured into the glass container while being stirred. The contents of the glass were then boiled on a stove for 10 minutes, with regular mixing and the addition of hot distilled water, until the liquid reached the desired level. The glass was further cooled, and 25 ml of 30% sodium hydroxide was added to the solution. Boiling continued for 10 min, stirring and pouring in hot distilled water to the mark at regular intervals.

Then, about 200 ml of hot distilled water was added to the glass contents, letting the fiber stand to settle and pumping out the most liquid using a water injection pump. The sediment was rinsed out 2-3 times more until the alkali was completely removed (a test for red litmus). The sediment from the glass was brought to the filter, which was 10-12 cm in diameter. The filter was previously placed into containers, dried for 1-2 hours at a temperature of 100-1050 ^{0}C, and weighed after cooling in the exicator. The sediment in the filter was rinsed out 2-3 times with hot distilled water, alcohol, and ether. The washed residue with the filter was placed in the same container, where an empty filter was dried. Ether was left to evaporate in the fume cupboard, followed by drying in the drying cabinet at 100-105 ^{0}C until its weight became constant.

The weight of crude fiber in the air-dry substance was determined by the difference in the weights of a container with a filter and fiber and a container with an empty filter.

Estimation of crude fat in the Soxhlet apparatus

The product batch of 2g in weight was brought to the dry porcelain mortar and ground with 6g of anhydrous sodium sulfate to a smooth powder. The groundmass was placed into a filter paper package and wrapped as a powder product in a drugstore. It was weighted using analytical scales and transferred to the Soxhlet apparatus extractor. Ether was poured into the receiving flask to 1/3 of its capacity, connecting it with the extractor. It was then connected to the fridge using a ground-glass neck and put into a cold water bath. Small bags with the material stood to infuse for 3-4 hours, turning on heating afterward. Ether vapors from the receiving flask entered the fridge through a wide tube, were condensed, and flowed down to the extractor, removing the fat from the material. As soon as the ether level reached the upper edge of a siphon tube, it would immediately start to overflow into the receiving flask. Fat was extracted in 5-6 hours. Then the small packages with the defatted material were withdrawn from the extractor, dried on the glass in the fume cupboard to let ether evaporate, and dried in the weighted containers at 100 to 105 ^{0}C until their weight became constant. The fat content (expressed in percentage concerning dried substance) was calculated knowing the weight of the small package before and after extraction and the weight of the empty package.

Estimation of calcium cation using the complexometric method

The primary stage of complexometric soil analysis is the titration of calcium with trilon B (disodium salt of ethylenediaminetetraacetic acid). Murexide ($C_8H_8N_6O_6H_2O$) serves as the indicator.

Soil extract preparation. A 50g batch was taken from the ground, sieved with air-dry soil, and placed into the flask (1L). Then, 500 ml of boiled distilled water was poured into it, plugged with a stopper, and shaken up for 3-5 min. The obtained suspension was filtered.

25 ml of water extract was placed into a 100 ml conical flask, and 2-5 ml of a 10% solution of NaOH and a grain of powder-like murexide indicator were added. The extract was titrated with 0,05 mol/l trilon B until a transition from pale-crimson to pale-lilac was reached. Then, the calcium ions were calculated according to Equation 5.

$$Ca^2+ = (a \cdot 0.05 \cdot 100\ К): C \text{ (mg-equiv. of calcium per 100 g of soil)} \qquad \text{(Eq.5)}$$

where a is the amount of Trilon B used for titration, in milliliters;

0,05 is the normality of the Trilon solution;

K is the correction factor for the Trilon titrant;

C is the soil sample weight corresponding to the amount of extract used for titration, in grams;

Estimation of the presence of carbonate-ions in the soil

A little soil was placed into a porcelain cup, and several drops of 10% solution of hydrochloric acid were added with a pipette. Carbon oxide (IV) CO_2, formed in the course of the reaction, was released as bubbles (soil «fizzes»). The intensity of their release could infer a fairly high content of carbonates.

Microchemical analysis of the plant ash

Reactions to detect chemical elements of ash were carried out on the slides. First, a drop of the ash solution was placed on the glass slide with a blunt end of a glass rod and a drop of the appropriate reagent at the 4-5 mm distance. Next, these drops were connected with an arc-**shaped channel, a proper reaction occurred, and crystals were formed.**

Detection of potassium

The reagent a water solution of salt $Na_2PbCu(NO_2)_6$. The reaction with the formation of the lead-copper nitrate of potassium occurred according to the equation:

$$2KCl + Na_2PbCu(NO_2)_6 \rightarrow K_2PbCu(NO_2)_6\downarrow + 2NaCl \quad \text{(Eq. 6)}$$

If ash contained potassium, leaden-black and dark-brown crystals were formed.

Detection of phosphorus

The reagent a 1% solution of molybdenum-acid ammonium in the 15% solution of HNO_3. When this reagent was mixed with the ash extract, the following reaction occurred:

$$H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 \rightarrow 21NH_4NO_3 + \\ +(NH_4)_3PO_4 \cdot 12MoO_3 \cdot 6H_2O + 6H_2O \quad \text{(Eq. 7)}$$

Greenish-yellow crystalline sediment was formed as a result of the reaction.

Results and Discussion

Results

Study carried out determining the chemical and physicochemical properties of light sierozem. An idea of the content of humus and elements of mineral nutrition is given by the data in Table 1. As a result, it was found that the content of humus at a depth of 0-5 cm (0,62) was higher in virgin soil, and at a depth of 10-15 cm (0,69) it was on the plow.

Table 1. Chemical and physico-chemical properties of light sierozem on virgin land, on plowed land, and under Eurotia ceratoides latens, 2020

Sampling location	Sampling depth (cm)	Humus	Nitrogen content	$C0_2$ of carbonates	Absorbed bases		Labile forms		Absorption capacity
					Na	K	P_2O_5	K_2O	
					Mg-equiv. per 100g of soil				
Virgin land	0-5 10-15	0.62 0.30	0.06 0.04	3.75 4.48	0.10 0.09	0.28 0.21	2.74 1.10	22.23 23.40	3.84 3.89

Plowed land	0-5 10-15	0.32 0.69	0.04 0.06	5.04 4.59	0.01 0.09	0.23 0.24	2.64 1.20	30.42 26.91	4.04 5.31
Under *Eurotia* of the 2nd year of life	0-5 10-15	0,35 0,60	0.04 0.06	4.26 3.64	0.10 0.09	0.35 0.24	1.78 2.06	42.12 23.40	2.95 3.00
Under *Eurotia* of the 3th year of life	0-5 10-15	0.50 0.43	0.06 0.04	4.76 4.59	0.1 0.16	0.37 0.14	2.14 1.62	46.80 21.06	4.18 3.65

The biological usefulness of pasture plants is determined by the total content of nutrients and their ratio. A review of the literature showed that the chemical composition of teresken, depending on the place of growth and other factors, can be different (Shamsutdinov, Z. S.; Shamsutdinov, N. Z. (2012); Arkincheev, D.V. (2016).

Our biochemical studies of teresken gray have shown that plants contain 10,44-27,54 crude protein, 1,62-4,05 fat, 26, 48-60,01 fiber. In plants, the ash content almost does not change either in the phases of vegetation or with the age of the plants and ranges from 9,11-10,05%, respectively, and the calcium content was at the level of 3,67-4,90. In 2021, the protein content was high, especially in the seed maturation phase. The highest fiber content was noted at the beginning of winter – 60,01% (Table 2).

Table 2. Chemical composition of *Eurotia ceratoides latens* in various years

Life year	Accounting date	Water content	Protein	Fiber	Ash	Fat	NES (nitrogen-free extractable substances)	Mineral	
2020									
Second	19.V 30.VII 2.X	48.2 47.0 8.5	19.82 15.32 10.55	36.99 42.20 47.33	9.11 9.47 9.48	2,97 3,74 3,04	31.11 29.27 29.60	4.90 4.07 4.60	0.48 0.50 0.31
Fourth	19.V 30.VII 22.X	43.3 47.6 27.4	16.01 16.39 10.44	39.75 35.24 48.15	9.48 9.38 9.82	2.11 4.05 2.35	32.65 34.94 29.24	4.42 4.60 3.97	0.16 – 0.22
2021									
Second	28.V 15.VII 30.IX	42.0 26.0 3.30	20.51 19.37 22.32	38.79 47.34 44.99	9.52 9.88 9.85	2.51 2.64 1.87	28.67 20.77 20.97	3.90 4.30 3.43	0.26 0.51 –
Fourth	28.V 30.VII 2.X 25.XII	57.2 30.0 23.0 –	22.42 24.90 27.54 21.37	26.48 – 37.39 60.01	9.39 10.05 9.86 10.0	3.11 3.28 1.62 1.72	38.60 – 23.59 6.90	4.08 3.67 6.22 3.28	0.28 0.33 0.36 0.33

This is reflected in the nutritional value of the forage mass in winter. It is of interest to determine the content of nutrients in various plant organs: the most nutritious are leaves and seeds. Thus, the protein content in the leaves in the flowering phase is 20,06%, fat: 2,80-3,55% in the stems is only 13,22%, fiber, respectively -31,51-38,87% and 65,66-62,47 %. *ceratoides latens (teresken)* seeds contain 27,85% protein, 45,22% fiber, 5,58% fat.

Table 3 shows the nutrient content in individual organs of the teresken.

Table 3. The content of nutrients in individual plant organs

Plant organs	Date and years of definition	Protein	Fiber	Ash	Fat	NES (nitrogen-free extractable substances)
Leaves	30.VII.2020 15.VII.2021	20.06 –	31.51 38.87	9.09 9.16	2.80 3.55	36.47 –
Stems	30.VII.2020 15.VII.2021	– 13.22	65.66 62.47	10.06 10.07	1.12 1.67	– 12.55
Seeds	3.X.2021	27.85	45.22	8.0	5.58	13.34

Discussion

One of the ways to preserve and increase the productivity of degraded pastures is to radically improve them by creating artificial phytocenoses, based on the scientific selection of species, taking into account the chemical, biological characteristics of plants in specific natural and climatic conditions of the improvement zone.

The vigor of the development of plant species roots and their specific distribution throughout soil somewhat affects physical, mechanical, and other soil properties (Shamsutdinova et al., 2019; Shagaipov, 2018; Arkincheev, 2016; Shamsutdinov et al., 2018; Callaway et al., 2000; Jakobs et al., 2004). Thus, the analyses of 0-5 and 10-15cm soil layers have demonstrated that the humus content decreases under Eurotia bushes compared to virgin land. Though the number of mobile potassium increases.

The latter is very good in the 0-5 cm layer (Table 4).

Table 4. Grain size composition of light sierozem on virgin land, on plowed land, and under Eurotia ceratoides latens bushes («Bukhtulen» experimental plot), 2021

Sampling location	Sampling depth (cm)	The content of the fraction in %						The amount
		1-0,12	0,25-0,05	0,05-0,01	0,01-0,001	0,0005-0,001	0,001	0,01-0,001
Virgin land	0-5 10-15	10.6 12.2	75.0 71.6	8.6 4.6	1.8 1.4	2.2 5.0	1.8 5.2	5.8 11.6
Plowed land	0-5 10-15	12.9 10.1	61.6 66.0	11.2 5.0	3.2 9.5	6.5 4.6	4.6 4.8	14.3 18.9

Under *Eurotia* of the 2nd year of life	0-5 10-15	15.3 12.5	67.5 69.6	8.8 10.9	1.8 0.4	4.4 5.2	2.2 1.4	8.4 7.0
Under *Eurotia* of the 3th year of life	0-5 10-15	11.8 12.6	67.7 65.8	9.9 12.4	2.8 2.0	4.8 4.8	3.0 2.4	10.6 9.2

Table 5 summarizes the values of water-soluble substances in the plant. An increase in dust fraction (0,01+0,001 sum) is most noticeable. Thus, on plowed land in the 10-15 cm layer, the 0,01-0,001 fraction sum was 18,9, and under bushes of Eurotia ceratoides latens, it was 7,0–9,2%. Table 1 presents light sierozem's chemical and physico-chemical properties on virgin land, plowed land, and Eurotia ceratoides latens.

In 2021, the protein content in all phases was high, particularly in the phase of seed ripening since Eurotia plants intensely bore fruit. The maximum fiber content was noted in early winter (25. XII)—60,01%. Ash amount has almost no changes, neither by vegetation phases nor with the age of plants, and varies within 9,11–10,05%, respectively, with the 3,67–4,90 calcium content. In early winter, the protein amount decreased to 21,37%, while the fiber increased to 60.01%. Therefore, it affects the nutrient density of forage mass in winter. Determining the content of nutrients in various organs of plants: leaves and seeds are the most nutrient-dense.

Table 5. Content of water-soluble substances in the plant

Sampling depth, cm	Alkalinity		CO_2	Ca	Mg	Total	NO_3
	Total HCO_3-	Carbonate CO_3					
0-18	0.037 0.60	None	0.005 0.11	0.007 0.35	0.001 0.10	0.068	0.002 0.03
18-43	0.037 0.60	None	0.007 0.15	0.006 0.30	0.001 0.10	0.069	0.002 0.03
43-80	0.029 0.48	None	0.006 0.12	0.006 0.40	0.002 0.15	0.058	0.004 0.06
80-120	0.037 0.60	None	0.013 0.28	0.011 0.55	0.004 0.30	0.098	None
120-138	0.024 0.40	None	0.202 4.20	0.015 1.20	0.016 1.30	0.469	None
138-220	0.037 0.60	None	0.145 7.25	0.145 7.25	0.015 1.25	1.211	None

Conclusion

1. The range has been refined, and the ecological, phytocenotic, and biomorphological features of the introduced into cultivation indigenous semi-shrub species, *ceratoides latens* (grey sagebrush), have been studied.

2. Low-productive desert pastures of arid communities, sometimes enriched with semi-shrubs (Artemisia seratina and Astragalus villosissimus), can be reconstructed by creating highly productive agro-phytocenoses using ceratoides latens.

3. *ceratoides latens* (grey sagebrush) is a xerophilous polymorphic semi-shrub, including elements of biomorphology similar to taxa described from arid regions of Central Asia and Kazakhstan. It is closely related to *ceratoides eversmanniana,* but differs in its less compact bush structure, branching mainly at the base, smaller size, and leaf shape. It has a wide range in Kazakhstan, forming mixed formations with numerous associations.

4. *ceratoides latens (grey sagebrush)* is among the valuable and promising forage plants for improving low-productive pastures in Southern Kazakhstan, distinguished by its unique biomorphological and eco-biological characteristics and economic value.

5. Laboratory germination of *ceratoides latens* seeds varies annually from 47 to 89%, while field germination ranges from 9.2 to 23.9%.

6. In the cultivation conditions of Kazakhstan's arid zone, *ceratoides latens* exhibits an accelerated pace of all ontogenetic stages. Its taproot intensively deepens into the soil in the first year of life, promoting better plant survival.

7. The vegetation period of *ceratoides latens* in the cultivation conditions of the arid zone of Southern Kazakhstan lasts from 196 to 216 days.

8. Hay yield in the 1st year of life is 5.0 tons/ha, and seed yield is 0.3 tons/ha. From the 2nd year onward, yields increase to 13.6-31.9 tons/ha and 1.2-2.5 tons/ha, respectively.

9. Establishing long-term, rich-pasture meadows for summer-autumn-winter use using the cultivated variety of *ceratoides latens* in the arid zone of Southern Kazakhstan is an economically advantageous measure, resulting in a 4-6 fold increase in productivity of ephemeral and wormwood forage lands.

Contributions of the Authors

Zhanaliyeva R.N. and **Imangaliyeva B.S.** developed the main concept of the study. **Zhanaliyeva R.N.** and **Torsykbaeva B.B.** designed the methodological approach for the research. **Zhanaliyeva R.N.** and **Torsykbaeva B.B.** verified and confirmed the accuracy of the data and results. **Zhanaliyeva R.N.** and **Yeskaraev N.M.** conducted the primary stages of the research. **Imangaliyeva B.S.** and **Ubaydullayeva N.A**. drafted and prepared the initial manuscript. **Ubaidulayeva N.A.** and **Sultanov N.A.** were responsible for translating the article into English and editing the review.

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References

1. Abdraimov A.S., Taichibekov A.U. Ecological problems of the Kazakhstan pastures arid forage production // Proceedings of International Scientific and Practical Conference. - Taraz, 2010. – P. 304–307.

2. Abdraimov S.A., Yeskaraev N.M. Influence of the seeding-down method on field germination rate, growth, and development of Eurotia. - Alma- Ata: Kainar, 1992.

3. Krascheninnikovia ceratoides (L.) Gueldenst [Plantarium. Plants and lichens of Russia and neighboring countries [Galleries and plant identification guide] https://www.plantarium.ru/lang/en/page/view/item/21760.html

4. Glinka N.L. General chemistry: manual for graduate students. Vol.3 - Almaty, 2018. –248 p.

5. John Pichtel Waste Management Practices: Municipal, Hazardous, and Industrial. – New York: Taylor & Francis Group, LLC, 2019. –676 p.

6. Chang N., Pires A. Sustainable Solid Waste Management: A Systems Engineering Approach. 1st ed. Wiley, - 2015. https://doi.org/10.1002/9781119035848.

7. Arkincheev D.V., Shamsutdinov N.Z. Intraspecific diversity of teresken gray (Eurotia ceratoides) // Scientific and production journal Fodder production. – 2015. – P. 38-43.

8. Arkincheev D.V., Shamsutdinov N.Z., Goldvarg B.A. A promising forage semi-shrub for creating long-term pastures for sheep in the Caspian semi-desert // International scientific and practical conference «Problems of rational use of natural resource complexes of zasushlivykh arid territories». - Volgograd, 2015. - P. 318-340.

9. Arkincheev D.V. Examination and evaluation of eurotia (eurotia ceratoides l. c.a. mey.) specimens to create the initial material with enhanced grazing capacity and seed yield for the semidesert zone of the Republic of Kalmykia. Extended Abstract of Cand. Sci. (Agr.) Dissertation. - Москва, 2015. – 171 p. [in Russian].

10. Arkincheev, D.V., Shamsutdinov, N.Z. Eurotia (Eurotia ceratoides) - an important feeding plant to restore the yield of arid pastures of the North-western Pre-Caspian // Zootekhnia. - 2013. - № 6 – P. 21-25.

11. Zhanalieva. R. Chemical and physicochemical methods of analysis. Study guide. - Astana: Foliot, 2018. – 248 p. [in Russian].

12. N.I. Dzyubenko, A.V. Bukhteeva, N.I. Vavilov Perennial and annual drought- and salt-tolerant forage plants in the Vavilov collection // Proceedings on applied botany, genetics and breeding. – 2017. - Vol. 178, № 1 – P. 5-23. DOI: 10.30901/2227-8834-2017-1-5-23. [in Russian].

13. GOST 25100-2011 (2015). Soils. Classification. Kachinsky method GOST. Collected GOSTs. - Moscow: Publishing house of Standards.

14. Shamsutdinova E.Z., Shamsutdinov N., Kaminov. Yu. B., Shamsutdinov Z.Sh. Species composition and productivity of improved phytocenoses with minimal disturbances of the natural vegetation // Multifunctional adaptive feed production. Federal Williams Research Center of Forage Production and Agroecology, - 2019. - P. 70–80. https://doi.org/10.33814/MAK-2019-21-69-70-80.

15. Shagaipov M.M. Scientific fundamentals of methods for restoring and enhancing yield of disturbed pasture ecosystems in arid regions of the North-Western Pre-Caspian: Extended Abstract of Dr. (Agr.) Dissertation - Volgograd, 2018 [in Russian].

16. Shamsutdinov Z.S., Kosolapov V.M. Shamsutdinova E.Z., Blagorazumova M.V., Shamsutdinov N.Z. About the concept of ecological niche and its role in design of adaptive arid pasture agroecosystems // Sel'skokhozyaistvennaya Biologiya. - 2018. - Vol. 53, № 2. - P. 270–281. https://doi.org/10.15389/agrobiology.2018.2.270eng.

17. Saginayev A., Dosmurzina E., Apendina A., Dossanova B., Imangaliyeva B. Development of individual approaches to the use of the gasoline fraction as a raw material for the process of hydrocatalytic isomerization // Materials Science for Energy Technologies. - 2023. - Vol. 6. - P. 158–165. https://doi.org/10.1016/j.mset.2022.12.008.
18. Rashmi Sanghi and Vandana Singh Green Chemistry for Environmental Remediation. - Massachusetts, 2012. – 800 p.
19. Nurlybaev G., Beketova G., Zhaumitova Sh. Karassayeva. Similarity of periods and periodicity in groups of periodic tables of chemical elements: Periodic law. // South African Journal of Chemistry. – 2024. - Vol. 78, № 1. - P.108-112.
20. Akhmetov N.S. General and inorganic chemistry. - Krasnodar, 2021. - 744p. [in Russian].
21. Goncharov E.G. and others. A short course in theoretical inorganic chemistry. - St. Petersburg, 2017. – 464 p. [in Russian].
22. B. Imangaliyeva, G. Rakhmetova, B. Dossanova, R. Zhanaliyeva. Technology of manufacturing soap from natural substances in domestic conditions // Reports of the National Academy of Sciences of the Republic of Kazakhstan. -2023. - Vol. 2 (346) – P. 94-107. https://doi.org/10.32014/2023.2518-1483.212; https://journals.nauka-nanrk.kz/reports-science/article/view/5556/3932. [in Kazakh].

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Ceratoides latens сұр терескендердің химиялық қасиеттерін зерттеу

Аңдатпа. Бүгінгі таңда табиғи флораның көпжылдық өсімдіктері құрғақшылыққа және ыстыққа төзімді жем өсімдіктерін өндіруге арналған шикізат ресурсы болып табылады, олардың арасында *Eurotia ceratoides* ерекше орын алады.

Бұл жұмыста *Eurotia ceratoides latens* (J.F. Gmel) тұқымының химиялық қасиеттері зерттеліп, топырақтағы қарашірік мөлшері, анықталды, ашық сұр топырақтың химиялық және физика-химиялық қасиеттері (қарашірік, су, карбонат иондары, азот мөлшері) анықталды. Қарашірік құрамы органикалық көміртектің хром қышқылы мен көмірқышқыл газына дейін тотығуы негізінде анықталды.

Eurotia ceratoides Latens химиялық құрамы өсімдіктегі қоректік заттардың (ақуыз, талшық, май, азотсыз экстракцияланатын заттар, күл) және суда еритін заттардың (C, CO_2, Ca, Mg) мөлшеріне талдау негізінде жасалды. Өсімдіктердегі күл мөлшері вегетациялық фазаларына сәйкес өзгермейтіні анықталды, ол өсімдіктердің жасына қарай 9,11-10,05% аралығында, ал сәйкесінше кальций мөлшері 3,67-4,90 деңгейінде болды. «Шикі» талшықтың құрамы Сокслет аппаратының көмегімен анықталды, топырақтағы кальций катиондарының құрамы комплексометриялық әдіспен бағаланды. Шикі ақуызды, шикі майды эфирлік экстракциялау әдісі арқылы анықтау үшін Кьельдал әдісі қолданылды және колориметриялық әдіспен аммоний оксалаты мен фосфордың қаныққан ерітіндісімен тұндыру арқылы күлдегі азотсыз экстракциялық заттар анықталды. Сонымен қатар, *Eurotia ceratoides latens*-тің тағамдық құндылығы айқындалды.

Түйін сөздер: терескен, *Eurotia ceratoides latens*, бұта Eurotia, химиялық қасиеттері, топырақ, Кьельдаль әдісі, Сокслет аппараты, Мор тұзы, комплексометриялық әдіс, сілтілік, карбонат.

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Изучение химических свойств серых терескенов ceratoides latens

Аннотация. Многолетние растения естественной флоры на сегодняшний день являются сырьевым ресурсом производства засухоустойчивых и термостойких кормов, среди которых особое место занимает *Eurotia ceratoides.*

В данной работе изучены химические свойства *Eurotia ceratoides latens* (J.F. Gmel) и проведено определение содержания гумуса в почве, выявлены химические и физико-химических свойства светлого серозема (содержание гумуса, воды, карбонат-ионов, азота). Содержание гумуса определяли на основе окисления органического углерода хромовой кислотой до диоксида углерода.

Химический состав *Eurotia ceratoides Latens* проанализирован на содержание в растении питательных веществ (белка, клетчатки, жира, безазотистых экстрагируемых веществ, золы) и водорастворимых веществ (C, CO2, Ca, Mg). Установлено, что в растениях содержание золы почти не меняется по фазам вегетации, с возрастом растений и колеблется в пределах 9,11-10,05% соответственно и содержания кальция было на уровне 3,67-4,90. Содержание «сырой» клетчатки определяли с помощью аппарата Сокслета, содержание катионов кальция в почве оценивали комплексонометрическим методом, методом Кьельдаля проведен анализ по определению сырого протеина, сырого жира методом эфирной экстракции, безазотистых экстрактивных веществ в золе путем осаждения ее насыщенным раствором оксалата аммония и фосфора колориметрическим методом. Выявлена пищевая ценность *Eurotia ceratoides latens.*

Ключевые слова: терескен, *Eurotia ceratoides latens,* полукустарник Eurotia, химические свойства, почва, метод Кьельдаля, аппарат Сокслета, соль Мора, комплексометрический метод, щелочность, карбонат.

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