Section 1. Biology

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PROTEIN CONTENT OF SOME *RUMEX* SPECIES (*POLYGONACEAE*)

Abstract. The aim of this study is the comparative analysis of the quantitative composition of protein content of five *Rumex* species: *Rumex pamiricus* Rech. f., *Rumex conglomeratus* Murray., *Rumex confertus* Willd., *Rumex acetosa* L. and *Rumex aquaticus* L. growing in similar environmental conditions. Based on the results obtained, it was found that the protein content in the leaves was higher than in the roots and seeds of the existing plants. The protein content of *Rumex aquaticus* demonstrated the highest values than other species (Table 1). The total proteins content in the roots of *Rumex aquaticus* 9.25%, in the seeds 9.11%, in the leaves 19.75%. This amount is a high figure for the plant. As a result our research, we have found a new source rich in protein.

Keywords: *Polygonaceae* L., *Rumex pamiricus* Rech. f., *Rumex conglomeratus* Murray., *Rumex confertus* Willd., *Rumex acetosa* L., *Rumex aquaticus* L., sorrel, dock, protein, superfood

1. Introduction

The nutrients essential for life are proteins, fat and carbohydrates, all contribute to caloric content of the dietary, minerals including trace elements, vitamins and water. Numerous studies, including in man, have demonstrated clearly that life may be sustained by nutrient mixtures in which every component is definable chemically and soluble in water. Most of the countries of the world have been facing malnutrition problems. The deficiency of protein in human food and animal feed is well recognized. The need of the good quality of proteins has been increasing due to rapid growth of population. It has been reported that in Uzbekistan the protein gap would continue to increase unless well-planned measures are adopted to tackle the situation. It is therefore imperative to increase protein production by utilizing all the available ways and means.

The name of *Rumex* derived from the Latin word for dart, alluding to the shape of the leaves. It is the largest genus of family *Polygonaceae* [1]. Plants of the genus *Rumex* L. (dock, sorrel) are widely distributed in North America, Central and Eastern Europe, Kazakhstan, the Far East, and partly in the Caucasia, Russia, and East Asia [2; 3; 4; 5]. This genus includes more than 250 species distributed worldwide. 16 species grow in Uzbekistan. *Rumex pamiricus* Rech. f, *Rumex conglomeratus* Murray, *Rumex confertus* Willd, *Rumex acetosa* L. and *Rumex aquaticus* L. are the most common species among them [6; 7; 8]. Since ancient times *Rumex L.* species have been well known for their use in traditional medicine, due to therapeutic efficacy and various biological activities [9]. The consumption of wild edible plants has been an integral part of human nutrition and traditional medicine since ancient times [10; 11]. Wild plants are known to be a good source of primary nutritional compounds (proteins, fats, sugars, vitamins, and minerals) [12]. Wild plants contain various biologically active components that demonstrated health benefits effects (flavonoids, phenolic acids, anthocyanins, tannins, terpenoids, steroidal saponins, glucosinolates, and so on) [11]. This shows their potential as nutritional supplements, feed additives, and medicinal agents [11; 13]. Among wild plants, *Rumex* plants have a great potential. They are already widely used as food, fodder, melliferous, and medicinal plants [5; 14; 15]. In some countries, the leaves of *Rumex* plants (such as R. *vesicarius*, R. *acetosella*, R. *abyssinicus*, R. *crispus*, R. *induratus*, R. *sanguineus*, R. *obtusifolius*, R. *tuberosus*, R. *thyrsiflorus*, and R. *acetosa*) are used for food, mainly as salads [16; 17]. According to the literature informations, several *Rumex* species are included in the pharmacopoeias of various countries. For example, *Rumex crispus* is listed in the American Herbal Pharmacopoeia as a general detoxifier and an agent for skin treatment [18]. The State Pharmacopoeia of the Russian Federation includes the roots of *Rumex confertus* Willd. as a herbal medicine, which is used in the treatment of liver diseases, dysentery, pulmonary, and uterine bleeding, as well as a laxative [19; 20]. The aim of this research is to study and compare the amount of protein between of Some *Rumex* Species.

2. Materials and Methods

2.1. Plant Material

Plant leaves, roots and seeds of the following species were used as the objects of study: *Rumex pamiricus* Rech. f., *Rumex acetosa* L., *Rumex confertus* Willd, *Rumex conglomeratus* Murray and *Rumex aquaticus* L. (Figure 1). Leaf samples (during the flowering period on May 2021), seeds and roots (on July, September 2021) of the plants were collected from Botanic Garden, Tashkent, Uzbekistan.

1 2 3 4 5

Figure 1. The leaves of *Rumex pamiricus* (1); the seeds of *Rumex acetosa* (2); the seeds of *Rumex confertus* (3); the roots of *Rumex conglomeratus* (4); the aerial part of *Rumex aquaticus* (5)

2.2. Determination of Total Protein Content

The Kjeldahl method was used to determine the amount of protein. This method was performed using Nessler reagent. To determine the amount of protein, 0.1 g (to the nearest 0.001 g) of crushed plant samples were placed inside the tubes. To them were added 5 ml of concentrated H_2SO_4 (r 1,84 g/cm^3), 0,5 ml of 30% H_2O_2 or 0,2 ml of concentrated perchlorotic acid ($HClO_4$). Place the flasks in a sand bath or on a temperature-controlled plate, set the temperature to 4000C, and heat carefully. After 20 minutes, another 0.5 ml of 30% peroxide or 0.2 ml of concentrated perchlorotic acid is added to the flask to accelerate mineralization. The solution was heated until completely white (for 1 hour). The flasks were then kept on the plate for another 15–20 minutes and cooled. 10 ml of distilled water was added to the cooled flasks, the required amount of solution was transferred to 50 cm^3 flasks, distilled water was added and mixed. After mineralization, 0.3 ml of aliquot solution was added to 25cm^3 flasks, and distilled water was added to the 25cm^3 mark. 10% NaOH was added to the solution. To eliminate opalescence of the solution, 0.5 ml of 50% Segnet salt solution was first added to the tubes and then 1 ml of Nessler reagent. The solutions were then filled with distilled water to the mark of 50 cm^3 and mixed. In this case, the solutions must be clean. If the solutions are turbid, this indicates that the mineralization has not completely passed or that the reagents used are not clean. If the amount of protein in the samples is low, the color of the solution will be yellow, if large – the color will be orange. After 15 min, the optical density of the solutions was measured at a wavelength of l= 400 nm. The amount of protein in the studied samples was determined according to the following formula:

$$C = \frac{V * 100 * 5,7 * C_1}{H * A * 1000}$$

C – protein content,%

H – protein etalon content, g

V – volume, after sample division, ml

A – is the volume of the aliquot taken for colorimetry;

C – is the percentage of nitrogen in the aliquot section determined using a measurement chart, mg

1000 – copying coefficient, mg.

100 – copying coefficient,%.

6.25 – coefficient.

3. Results

In the protein content study of *Rumex aquaticus* demonstrated the highest values (Table 1). The total proteins content in the roots of *Rumex aquaticus* 9.25%, in the seeds 9.11%, in the leaves 19.75%. This is a high figure for a plant.

Table 1.– Protein content of some *Rumex* species in the leaves, seeds and roots

№	Plant name	Total protein content,%		
		Root	Seed	Leaf
1.	Rumex pamiricus Rech. f.	5.22	7.56	13.87
2.	Rumex confertus Willd	2.87	4.22	15.16
3.	Rumexconglomeratus Murray	6.02	5.16	17.14
4.	Rumex acetosa L.	5.10	7. 23	16.12
5.	Rumex aquaticus L.	9.25	9.11	19.75

Based on the results obtained, the protein content in the leaves was found to be higher than in the roots and seeds of the existing species. It was studied at the Institute of the Chemistry of Plant Substances named after Acad. S. Yu. Yunusov AS of Uzbekistan, Laboratory of Chemistry of high-molecular plant substances. The quantitative protein index of plants was determined at 400 nm on a spectrophotometer device using an improved Nessler reagent of the Kjeldahl method.

4. Discussion

Plants of the genus *Rumex* have traditionally been used as edible or medicinal plants in various regions of the world. However, today, their biotechnological potential is becoming evident, and these species can act as a resource of biologically active substances. The *Rumex* plants are abundant, undemanding, gain phytomass easily, and have a short vegetative cycle (and, as a consequence, can reproduce frequently throughout the year), thus they have a real advantage among wild plants of the temperate zone. It should also be noted that *Rumex* species have a high potential for regrowth after injury [20; 21; 22]. Aerial parts of many species (for example, *R. confertus*, *R. acetosella*, *R. acetosa* and *R. crispus*) are widely used for food. Plants are collected mainly in spring and are used as vegetables [14; 23; 24]. Moreover, the accumulated amount of research allows us to define the plants of this genus as a «superfood». Currently, «superfood» is defined as foods high in nutritional or biologically active phytochemicals beneficial to human health [25]. The results of our studies prove that plants of the genus *Rumex* can occupy a niche in the food industry and act as a functional food product.

5. Conclusion

The aim of this study is the comparative analysis of the quantitative composition of protein content of five *Rumex* species: *R. pamiricus*, *R. acetosa*, *R. confertus*, *R. conglomeratus* and *Rumex aquaticus* growing in similar environmental conditions. As we can see in Table 1, we have found a new source rich in protein. This suggests that *Rumex*-based foods can be rich sources of protein, and that *Rumex* species can be a solution to the problem of protein deficiency with their protein-rich content. The results of the study will allow to identify the most promising species for pharmaceutical and food use.

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