



Ethnobotanical study on the use of *Sideritis scardica* Griseb. in North Macedonia

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ABSTRACT

About 350 wild medicinal species that exist in the territory of North Macedonia are used in traditional medicine. Apart from medicinal purposes, medicinal plants are also used for culinary and recreational purposes. Among the medicinal plant species, the endemic species *Sideritis scardica* Griseb., whose presence has been recorded in the Balkans, has a special place. History, tradition and oral transmission of medicinal recipes speak for the daily use of this plant since ancient times. Wanting to preserve the traditional knowledge of *S. scardica* Griseb. from oblivion, the purpose of this research is to document its use in everyday life, especially its traditional use. As part of this research, an ethnobotanical survey was conducted in the period from June to September 2024 in North Macedonia. One hundred respondents were included in the research, and the obtained results showed that the respondents are well acquainted with this plant. The folk name Mountain tea is the most commonly used in our country. This plant is mostly used in the form of tea for recreational purposes (80%), while only 20% for medicinal reasons. Percentage-wise, Mountain tea is mostly used for the treatment of colds, followed by urinary, digestive and respiratory problems. In our country, people prefer buying the plant to collecting it in nature. This research provides data on the traditional use of *S. scardica* Griseb. in North Macedonia, and hence suggests that, in order to avoid the loss of traditional knowledge, greater efforts are needed to preserve and record the knowledge of use, not only for this plant but also for other medicinal plants.

Keywords: *Sideritis scardica* Griseb., medicinal plants, ethnobotanical research, traditional use

ИЗВОД

Око 350 дивљих лековитих биљних врста које постоје на територији Северне Македоније користе се у традиционалној медицини. Поред лековитих својстава, лековите биљке се користе и у кулинарске и рекреативне сврхе. Међу лековитим биљкама посебно место заузима ендемска врста *Sideritis scardica* Griseb., чије је присуство забележено на Балкану. Историја, традиција и усмена предаја лековитих рецепата говоре о свакодневној употреби ове биљке још од давнина. У жељи да се традиционално знање о *S. scardica* Griseb. сачува од заборавља, циљ овог истраживања је документовање њене свакодневне, а нарочито традиционалне употребе. Као део истраживања, у периоду од јуна до септембра 2024. године, спроведена је етноботаничка анкета у Северној Македонији. У истраживању је учествовало 100 испитаника, а добијени резултати показали су да су испитаници добро упознати са овом биљком. Народни назив “планински чај” најчешће се користи у нашој земљи. Ова биљка се углавном користи у облику чаја у рекреативне сврхе (80%), док се само 20% користи из медицинских разлога. Када је у питању медицинска употреба, планински чај се највише користи за лечење прехлада, затим уринарних проблема, дигестивних и респираторних тегоба, и слично. У нашој земљи, људи више воле да купују ову биљку него да је сами сакупљају у природи. Ово истраживање пружа податке о традиционалној употреби *S. scardica* Griseb. у Северној Македонији. Може се закључити да је, како би се избегао губитак традиционалног знања, потребно уложити веће напоре у очување и бележење знања о употреби, не само ове биљке, већ и других лековитих биљака.

Кључне речи: *Sideritis scardica* Griseb., лековито биље, етноботаничко истраживање, традиционална употреба

1. Introduction

The species *Sideritis scardica* Griseb. belongs to the *Lamiaceae* family. It is a perennial herbaceous plant with a well-developed root system. The stem of this plant reaches a height of 15–40 cm, and it can be branched and/or unbranched and woody at the base. The leaves are opposite from each other, covered with characteristic gray hairs. The flowers are yellow colored, arranged in racemes. Generally, the plant reproduces by seeds; also, in cultivation, vegetative reproduction is possible by rhizome division, but there

is no evidence of spontaneous vegetative reproduction (Assenov and Ganchev, 1978; Evstatieva et al., 1990; Evstatieva, 2006; Evstatieva, 2011). Specifically, this species belongs to the section *Empedoclia* (Rafin.) Benth., and it is an endemic plant of the Balkans. It is commonly found in the central and western regions of the Republic of North Macedonia, Serbia, the southwestern parts of Albania, the southern parts of Bulgaria, the northeastern parts of Greece and the European part of Turkey (Heywood, 1972; Petrova and Vladimirov, 2010). This species is drought tolerant and occurs in open, dry, stony places, on calcareous and

shallow, eroded soils. It grows in subalpine and alpine vegetation zones and rocky slopes at an altitude of 1,000 to 2,200 meters (Todorova and Trendafilova, 2014; Evstatieva et al., 2014). *S. scardica* Griseb. is a very popular plant species that is also known by other different terms which usually come from the mountain where they are collected. In Macedonia this plant is also called "*Sharplaninski čaj*", in Bulgaria "*Pirin tea*", "*Mursal tea*" or "*Alibotushki tea*", in Greece "*Greek mountain tea*" (Todorova and Trendafilova, 2014).

Plant species that belong to the genus *Sideritis* are rich in many different chemical compounds, bioactive secondary metabolites: terpenes, flavonoids, essential oils, iridoids, coumarins, lignans and sterols (Yankova-Tsvetkova et al., 2013). The pharmacognostic analysis of this plant has been done by many different authors (Janeska et al., 2007; Kostadinova et al., 2007; Alipieva et al., 2010; Yankova-Tsvetkova et al., 2013; Todorova and Trendafilova, 2014). Essential oils, tanins, small amounts of mucilaginous substances and phenolic compounds have been detected in the upper parts of the stems, leaves and flowers (Janeska et al., 2007). The pharmacological activity of the species of this genus, especially the species *S. scardica* Griseb., is due to the presence of flavonoids and phenols (Alipieva et al., 2010; Yankova-Tsvetkova et al., 2013). Literature data indicate the fact that the essential oil of *Sideritis scardica* Griseb. contains over 100 compounds in variable amounts belonging to the group of monoterpenes, sesquiterpenes, diterpenes, and aliphatic and aromatic compounds (Todorova and Trendafilova, 2014). There are also literature data in which the presence of not only bitter substances but also minerals such as iron, copper, zinc, calcium, potassium, magnesium, sodium, cobalt and selenium have been determined (Kostadinova et al., 2007).

The plant *S. scardica* Griseb. has a long history of collection in nature and exploitation due to its aromatic properties that make it suitable for use in local cuisines. It is used as a tea for recreational purposes, but also for the treatment of certain diseases. This species works favorably in the treatment of diseases of the respiratory tract (asthma, cough, bronchitis, pulmonary emphysema) and gastrointestinal tract, as well as for immunomodulatory and diuretic effects. In addition, ethanol extracts of mountain tea have traditionally been used as an antiseptic for the oral cavity (Feistel et al., 2018). The aerial parts of mountain tea are traditionally known for their anti-inflammatory, antimicrobial, antibacterial, antirheumatic and gastroprotective properties (Tadić et al., 2012). So far, there have been no registered or authorized medicinal products in the European Union containing the plant species *S. scardica* Griseb. as an active ingredient (EMA, 2015; EMA, 2015). The plant extract containing monoterpenes, sesquiterpenes, diterpenes, triterpenes, sterols, flavones, coumarins and phenylpropanoids has only been reported (Fraga, 2012; Petreska Stanoeva and Stefova, 2013).

Unfortunately, all these data are not sufficient to provide a complete picture of this plant species. Further research is needed regarding the potential positive effects and mechanisms of action of the bioactive compounds of *S. scardica* Griseb., as well as ethnobotanical research on its traditional use. Hence, the aim of this study is to give an overview of the use of *S. scardica* Griseb. in everyday life, with special

emphasis on its traditional use in the Republic of North Macedonia.

2. Materials and methods

In this research, an online survey was conducted in the period from June to September 2024 in the territory of Republic of North Macedonia. One hundred respondents from North Macedonia were interviewed, using a structurally designed questionnaire consisting of 11 questions ("*What is your gender?*", "*How old are you?*", "*What is your level of education?*", "*What is your nationality?*", "*Where is your place of residence?*", "*Do you use Mountain tea?*", "*What are the folk names you use for Mountain tea?*", "*Do you prefer to use this tea for enjoyment or to treat some health problems?*", "*Specify the health problem for the treatment of which you use this tea*", "*Give a recipe for a medicinal solution prepared from Mountain tea*" and "*Do you buy or collect this tea?*"). The criterion used for selecting respondents was to be over 50 years old because older people have greater experience and knowledge regarding this issue. During the interview, informants shared their knowledge and experience about using *S. scardica* Griseb. The Microsoft Excel program was used to summarize and process the obtained data and present the obtained results in analytical and graphic form. Further analysis was carried out to compare the obtained data with the ethnobotanical literature.

3. Results and discussion

About 350 wild medicinal species that exist in the territory of North Macedonia are used in traditional medicine (Rexhepi et al., 2013, 2014, 2018). Among the medicinal plant species, the Balkan endemic species *S. scardica* Griseb. has a special place. This research provides data on the traditional use of this plant in North Macedonia.

In order to obtain a more detailed statistical description of the participants, a sociodemographic characterization was made in this research, as an initial part of the survey. Here, the questions were aimed at determining the gender, age, level of education, nationality and place of residence of the participants.

Out of 100 respondents, 76 (76%) declared themselves as female, while 24 (24%) declared themselves to be male. In this research, the female gender was predominant (Figure 1).

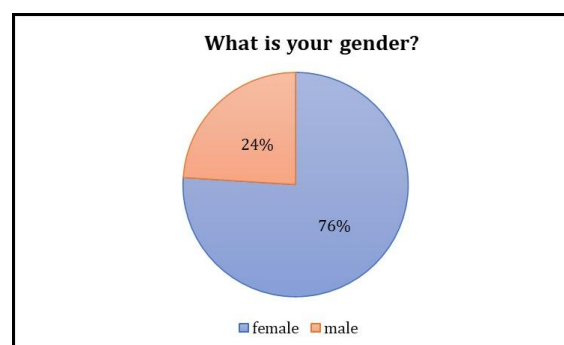


Figure 1. Graphic representation of the respondents' gender

During the selection of the surveyed people, the tendency was towards older people whose age limit exceeds 50 years. Namely, older people are expected to have greater experience and knowledge regarding this issue. In response to the question “How old are you?”, the largest number of participants, 50 (50%), answered that they are over 50 years old, 23 participants (23%) answered 30–50 years old, and 27 (27%) answered that they are between 18 and 35 years of age.

The received answers about the level of education showed that 60 respondents (60%) have completed secondary education (high school), 29 (29%) have completed university education (faculty), 9 (9%) have finished primary school, and only 2 (2%) have acquired higher education (Figure 2).

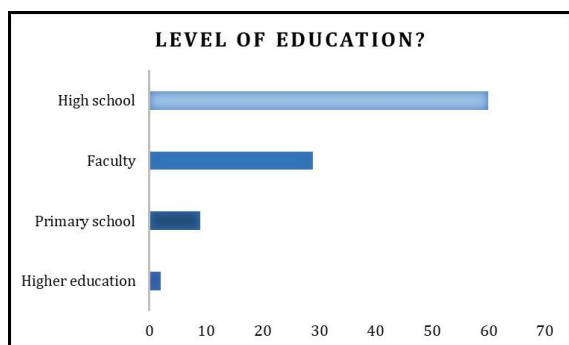


Figure 2. Presentation of the data obtained for the level of education

In response to the question “What is your nationality?”, out of the total number of respondents, 76 declared themselves to be of Macedonian nationality, 14 – Albanian nationality, and 10 – Serbian nationality.

The majority of the respondents, 84, are from the city of Kumanovo, followed by 11 from Skopje, 2 from Ohrid, 2 from Veles and only 1 from Strumica (Figure 3).

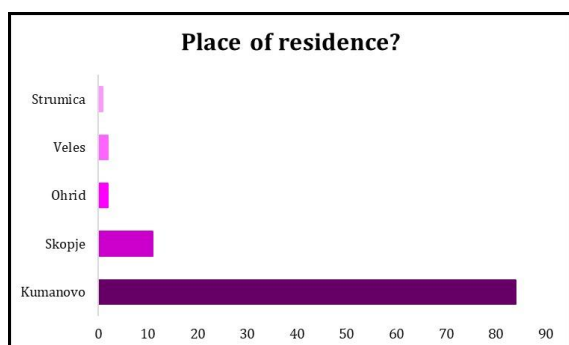


Figure 3. Data obtained on the respondents' place of residence

Regarding the use of *S. scardica* Griseb., the largest number of respondents (88) answered that they use mountain tea, while 12 gave a negative answer. Dragoeva et al. were the first to conduct research in Bulgaria on a targeted group of respondents on the traditional use of many plant species, including *S. scardica* Griseb. They reported that the respondents have a well-preserved and nurtured tradition of passing on the knowledge about the species (Dragoeva et al., 2021).

Among the respondents, the most commonly used folk name for this plant species is Mountain tea – 89 responses, followed by Sarplanin tea – 5 responses, and Macedonian tea and Russian tea – 3 responses each (Figure 4).

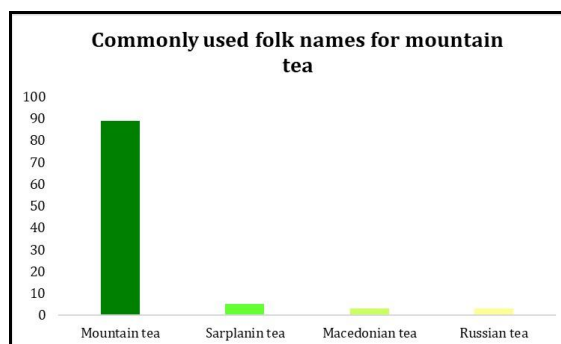


Figure 4. Graphic representation of the most commonly used folk names for mountain tea

A tea made from the plant species *S. scardica* Griseb. has been approved by the European Medicines Agency (EMA) as a traditionally used herbal medicinal product, based on its long-standing use to relieve coughs associated with colds and to relieve mild gastrointestinal discomfort (European Medicines Agency, 2015).

In our research, the respondents mostly use this tea for enjoyment (80% of the respondents) and less often for the treatment of some health problems (20% of the respondents).

As regards the question “Specify the health problem for the treatment of which you use this tea”, the surveyed people gave different answers. This tea is mostly used to treat colds, and less often for detoxification, treatment of urinary infections, stomach problems, gynecological problems, gastritis, and digestive and respiratory tract (Figure 5). In an ethnobotanical survey on the use of medicinal plants in Greece done by Tsioutsiou et al., it was determined that *S. scardica* Griseb. is commonly used to treat inflammation of the respiratory tract and cough (Tsioutsiou et al., 2019). The use of the *S. scardica* Griseb. tea in the southern parts of Kosovo was mostly for the treatment of bronchitis (Mustafa et al., 2020). The literature data have shown that regular consumption of mountain tea can result in a reduction in body mass and the prevention of insulin resistance by reducing the blood levels of glucose and triglycerides, as well as by increasing the content of glycogen in the liver. In addition, this tea also showed antioxidant properties and an increase in catalase activity in the liver (Jeremic et al., 2019). The genus *Sideritis* can also be used in the form of ethanol extracts locally on the skin, but also in the form of an antiseptic solution after tooth extraction (Todorova and Trendafilova, 2014). Literature data has also been found on the positive effects of this plant on memory and general cognitive abilities, especially in the elderly, and this most likely results from the increased cerebral blood flow and the increased content of oxygenated hemoglobin in the blood, especially in the prefrontal cortex. *S. scardica* Griseb. extract also acts as an inhibitor of monoamine neurotransmitters – serotonin, noradrenaline and dopamine, in vitro,

which may result in improved mood (Zhao et al., 2010; Knörle, 2012). Recently, promising results have been reported from studies performed on rats for the improvement of glucose tolerance and triglyceride levels, as well as antioxidant effects of a 70% aqueous/ethanolic extract of *S. scardica* Griseb., possibly mediated through the activation of AMPK (Jeremic et al., 2019).

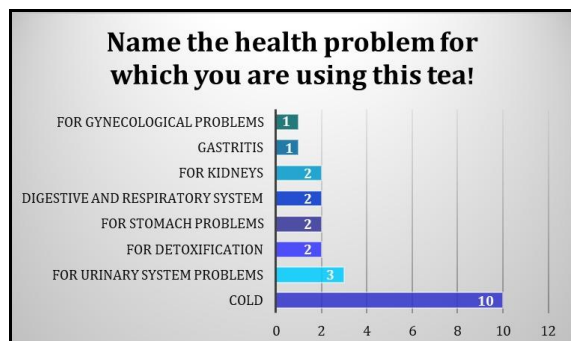


Figure 5. Display of the responses received for the health problem treated by the people

The use of *S. scardica* Griseb. for medicinal purposes is due to its chemical composition. As a result of the high concentration of phenolic compounds, *S. scardica* Griseb. extracts show dose-dependent anti-inflammatory and gastroprotective activities. In addition, the high content of some phenolic compounds, especially certain flavonoids, can result in cytotoxic activity against cancer cells (Tadić et al., 2012). The samples of the genus *Sideritis* (*S. scardica* Griseb. and *S. raeseri* Boiss & Heldr) collected from Albania, Bulgaria and North Macedonia are similar in their chemical profiles (both phenolic compounds and diterpenes) and antioxidant activity; the found differences are not essential (Ibraliu et al., 2015).

The chemical profile of *S. scardica* Griseb. from North Macedonia revealed more than 90 compounds, with diterpenes and hydrocarbons predominating. Thirty-two mono and sesquiterpenes were registered in very small, trace amounts. The main sesquiterpenes detected in wild and cultivated species of *S. scardica* Griseb. are: transcaryophyllene, δ - cardinol, caryophyllene oxide and α -cadinol. α -cadinol was defined as the most dominant component of the essential oil (Kostadinova et al., 2007).

During the analysis of the essential oils of six different populations of *S. scardica* Griseb. from Bulgaria, 37 components were identified (α -pinene, β -pinene, oct-1-en-3-ol, phenylacetaldehyde, β -bisabolene, benzyl benzoate and m-camphor). A low content of oxygenated mono- and sesquiterpenes was registered as a specific difference for all tested samples (Kostadinova et al., 2008; Koc and Sari, 2009).

The quantitative analysis of *S. scardica* Griseb. revealed the highest flavonoid content in the full flowering stage (0.34%), while the lowest content in the seed ripening stage (0.02%) (Ignatov, 2017).

As regards the recipe for a medicinal solution prepared from mountain tea, 54 respondents from our research answered that they do not know, while 44 respondents answered that they prepare it as tea, and only one respondent answered that they prepare mountain tea in the form of tincture (Figure 6). The survey of Pieroni (2017) on the traditional use of

medicinal plants in Albania found that the plant species *S. scardica* Griseb. was most often used in the form of tea. Also, an ethnobotanical survey conducted in North Macedonia mentioned the use of *S. scardica* Griseb. as tea for medicinal purposes (Miskoska-Milevska et al., 2020). Kültür's ethnobotanical survey research showed that many different plant species are used not only for their medicinal properties, but also as food, tea, spices or for coloring. Moreover, in the study area, the whole plant of *S. scardica* Griseb. was used (Kültür, 2008). In their ethnobotanical research, Mustafa et al. (2020) reported that the most common parts used are the aerial parts of *S. scardica* Griseb., mostly in the form of tea. Unfortunately, the results obtained from the research of Žuna Pfeiffer et al. (2020) indicated that the valuable ethnobotanical knowledge in the investigated areas in north-eastern Croatia are disappearing.

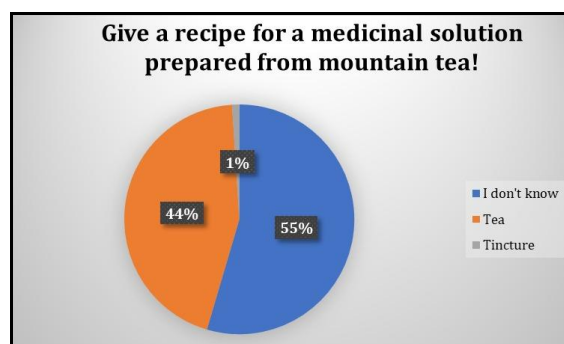


Figure 6. Graph showing the data obtained for the preparation of a medicinal solution

This tea can be found on the shelves in the markets, but also in the wide mountain meadows. The question "Do you buy or collect this tea?" gave the following responses: out of the 100 respondents, 75 buy it, 14 collect it, while 5 both buy and collect it; six people did not answer the question (Figure 7).

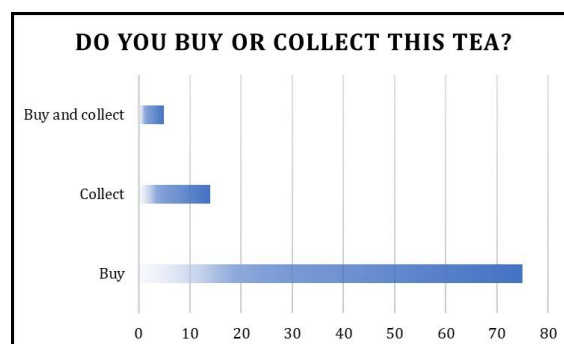


Figure 7. Graphical representation of the purchase or collection data

The collectors of the mountain tea, *S. scardica* Griseb., mentioned various collecting regions of the country. Some of them are: Kumanovo region, Kriva Palanka region, Veles region, Berovo region, as well as the mountain areas, especially on Galicica Mountain (Figure 8).

In the ethnobotanical research carried out by Mincheva et al., it was noted that *S. scardica* Griseb. is an endangered Balkan endemic plant species whose collection in nature for trade is strictly prohibited. The popularity of this species has increased in recent

decades in Bulgaria, resulting in greater vulnerability of the wild populations. Their research showed that there are many cultivated plots in the Central Rhodopes (e.g. Trigrad, Chepelare, Mugla, Momchilovci), as well as smaller plots in their own, home gardens, but also in larger plots for commercial purposes. The local people in these areas are interested in the cultivation of *S. scardica* Griseb., which could be considered as a good practice for the conservation of this plant species (Mincheva et al., 2022).

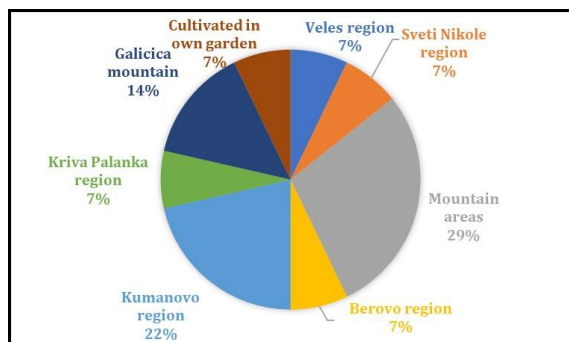


Figure 8. Graphical representation of the most common collecting regions for this tea

A recent ethnobotanical survey conducted in north-western part of Croatia showed that the local people still nurture the practice of cultivating and gathering plants. The informants also considered the herbal remedies as a very important part of their life (Krstin et al., 2024). Janačković et al. (2022) emphasized that smaller and specific Balkan areas can be an important reservoir of ethnobotanical knowledge on the traditional use of medicinal plant varieties. Their final results showed the great importance of wild edible plants in daily life, as well as in traditional medicine.



Figure 9. Collection of *S. scardica* Griseb. in rural areas of North Macedonia (photo by Elizabeta Miskoska-Milevska)

The final data of the present survey suggest that the plant species *Sideritis scardica* Griseb. is known among the Macedonian people. It is worth mentioning that it is used quite often for enjoyment by different population groups, but also for the treatment of various health conditions.

4. Conclusions

S. scardica Griseb., also known as Mountain tea, is an endemic plant species present in the Balkan Peninsula. Its biochemical composition abounds with essential oils, tannins, mucilaginous substances, flavonoids, polyphenolic compounds, iridoids, coumarins, lignans, sterols and mineral substances. The presence of all these important chemical compounds actually give Mountain tea its medicinal, nutritional and aromatic properties. Therefore, this tea is attractive to all populations, from the youngest to the oldest.

The ethnobotanical research on the knowledge and use of *S. scardica* Griseb. (Mountain tea) was conducted in the territory of the Republic of North Macedonia. The obtained results showed that the people in these areas are familiar with this plant species, as well as with its medicinal properties and ways of use. As for the most common form of consumption by the surveyed population, the recipe for preparing tea is listed, and most of the time the consumption is just for enjoyment rather than for medicinal purposes. Only 20% of the respondents use this plant species to treat certain health conditions. Percentage-wise, Mountain tea is mostly used for the treatment of colds, followed by urinary, digestive and respiratory problems. The knowledge we have today about the use of plants in food is mostly due to the transmission of information and experience from the old generations. Hence, in order to avoid the loss of traditional knowledge, greater efforts are needed to preserve and record the knowledge of use, not only for this plant but also for other medicinal plants.

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