

RESEARCH ARTICLE

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The correlation between some leaves indicators with arbutin content in uva ursi populations (*Arctostaphylos uva ursi* (L) Spreng) on Korabi Mountain

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Abstract

Uva ursi (*Arctostaphylos uva ursi* (L) Spreng) is a shrubby plant, not very widespread in Albania. It is mainly located on Korabi Mountain. The study of the correlation of the leaves indicators with content of arbutine is an important aspect, in addition to other morphological, biological and chemical studies. The correlations between the leaf indicators with the arbutine are the object of this study because they show the influence that leaf indices have on the content of arbutin, the main component that gives the medicinal values to this plant. From the study carried out, it has a positive correlation with the leaves tail and the normal color of the leaves. Specifically, the leaflet has a coefficient of 0.59, which means that the content of the arbutin depends significantly on the length of the leaves tails. Meanwhile, with the fresh and dry weight of a plant there are also correlations, respectively 0.36 and 0.42, indicating a good influence. As far as the leaf color is concerned, it has a positive relationship only with the normal color, 0.31, which indicates that when the leaf becomes older (dark color), the content of the arbutine decreases.

Keywords: *Uva ursi*, chemical composition, plant organs, curative, samples, arbutin.

1. Introduction

Arctostaphylos Uva-ursi (L.) Spreng is one of the species of the Ericaceae family, common subalpine bushes in meadows, forests and mountains up to a height of 2000-2500 meters. It is a plant with a small height, about 30 cm (maximum 150 cm), with evergreen leaves, living for three years [1,2,3,4,7]. The leaves are oval, spatulate, alternating on the stalk. The flowers are white in light pink in the form of bells collected in small **racemes**. Lulet janë të bardha në rozë të çelët në formë këmbanëze të mbledhura në **raceme** të vogla. After flowering the green fruits are formed and when they ripen, they get red and have a spherical shape. The fruits are not very enjoyable. Her leaves contain a series of herbs, some of them curative [5,6,10,11,12]. Among the main components are:

- hydroquinone glucosides (arbutoside or arbutine, methyl-arbutine);
- hydrolysed tannins;
- glycoside iridoid (monotropein)
- flavonoid (mycetin);
- terpenoid (alpha-beta betaine, uveol, acid urethra)

Uva ursi is used as a diuretic, urinary disinfectant, and as an astringent. Its antibacterial effect comes from the arbutin. Thanks to the antibacterial and diuretic properties of *uva ursi*, it is commonly used as a remedy for inflammation, cystitis, urethritis and urinary tract infections in prostatitis. It is used as an urinary antiseptic thanks to the active arbutinous ingredient (which in the body becomes hydroquinone), which fights bacterial adhesions, urotelic walls and facilitates their removal from urine. Hydrinkinone has shown excellent anti-inflammatory properties.

These are the precious properties of this plant that make it necessary to study, experiment and carry out chemical analysis.

According to Parejo 2008 uva ursi populations present a variation of the content of the active arbutin substances. Based on genetic criteria, the variation can be studied on several levels. In this study, we focus on the population variation of the Korab Mountain based on some leaf indications and their correlations with the content of the arbutin for which this plant is used.

2. Material and Methods

The object of the study was to identify the links between some leaf indicators and arbutin content, based on the calculation of the correlation coefficient. Knowing these, practical opportunities can be created in their improvement [8,9]. For this purpose, the places where the samples would be taken were first determined. Previously there was a preparatory work by collecting data on the characteristic places where there are sources of uva ursi in which samples were taken.

Table 1. The places where the samples were taken on which the study of leaf indications of uva ursi on the Korab Mountain

The country's name	Height above sea level	Geographic coordinates	
		ϕ	λ
Borovajku i Begjunecit	1377	41°40' 36,5''	20°28'34,2''
Gropat e Stane	1475	41°47'57,8''	20°26'39,4''
Mali i Vrenjtit	1526	41 °44' 35,1''	20 °26'48,2''
Llofkat e Sllatinës	1615	41°47'26,3''	20°27'44,1''
Livadhi i Gjatë	1655	41°47'08,7''	20° 28'07,3''
Kodrat e Bregut	1690	41°47'26,3''	20°27'19,2''
Përroi i Pasqyrës	1868	41°46'56,9''	20° 28'43,9''

- Consequently, the uva ursi populations bear the names of the countries where these populations are spread, each having specific characteristics such as height, exposure, soil composition, plant associations, etc. During the sampling, it was intended to get as far as possible the uva ursi variation on the Korab mountain, which from our explorations results that here are the most commonly uva ursi sites in Albania. Each site was taken from 50 plants in three points where the population is more complete and from this was analyzed an average sample of 30 plants on which the respective measurements and analyzes were made. The data collected from the samples were divided into groups according to their nature:
- First set of data: Indicators of the leaf and the content of arbutine
- Second set of data: Indicators of leaf colour and the content of arbutine
- Third set of data: Indicators of leaves weight and the content of arbutine
- The sample data was subjected to statistical correlation analysis. The correlation coefficient is calculated on the basis of the formula:

$$r = \frac{\text{Kovarianca (xy)}}{\sqrt{\text{Varianca (x)} \times \text{Varianca (y)}}$$

The correlation coefficient is an indicator of the links between two variables ranging from +1 to -1. The size of connections assessment was made by the correlation coefficient (Plascak, 1993). The collected samples were analyzed for the contents of the arbutin. The collected samples were analyzed for the contents of the arbutin.

2.1. The extraction parameters:

The protocol used for full extraction of arbutin is that optimized by Parejo, etc. (2001).

3. Results and Discussion

As will be seen, at the center of this study lies the content of the arbutin in relation to the other features of the leaf of the different populations of *uva ursi*, since this characteristic is related to the healing properties of this plant. Let's analyze the links that present the content of the arbutin with leaf indicators.

Table 2. The average data for the leaf indicators and arbutin content of *Arctostaphylos uva-ursi* (L) Spreng populations on the plateau of Korabi mountain.

Site	Length of leaves (cm)	Width of leaves (cm)	The length of the petiole (cm)	Number of leaves in branches	Content of arbutine
Gropat e Stane	2.16	0.77	0.70	14.73	9.6
Kodrat e Bregut	2.13	0.86	0.37	13.4	8.16
Llofkat e Sllatinës	2.17	0.79	0.44	14.3	8.46
Liv.Gjate	2.09	0.89	0.44	14.83	9.03
Perroi i Pasqyrës	2.01	0.94	0.44	15.0	8.38
Mali Vrenjtit	2.16	0.87	0.45	12.93	6.79
Bor.Begjunecit	1.93	0.70	0.41	13.73	8.02
Average	2.09	0.83	0.46	14.13	8.35

From the data we observe a visible variation for all the indicators in the seven studied sites, but more pronounced as seen from the table is for the length of the branches and the number of branches and the content of the arbutine. But what interests us in this case is to see how arbutin content stands in relation to leaf size indicators. For this we refer to the table data of correlation coefficients.

Table 3. The correlation coefficients of leaves indicators of *Uva Ursi* (*Arctostaphylos uva-ursi* L.) Spreng. and arbutin content on the plateau of Korabi mountain

Features	Length of leaves (cm)	Width of leaves (cm)	The length of the petiole (cm)	No of leaves on branche	Content of arbutine
Length of leaves (cm)	1				
Width of leaves (cm)	0.19	1			
The length of the petiole (cm)	0.35	-0.26	1		
Number of leaves on branche	-0.15	0.20	0.40	1	
Content of arbutine	0.06	-0.14	0.59	0.82	1

From the data of table 3 we note that the content of the arbutin has a very strong positive correlation with the number of leaves in the stems with the correlation coefficients 0.82, with the length of the leaf tail where the coefficient of correlation between them is 0.59. While its connection to the length and breadth of the leaf is not noticeable. Table 4 gives average data of **leaves colour** and arbutin content of **Arctostaphylos uva-ursi (L) Spreng** grain populations on the plateaus of Korab Mountain. An important indicator is the color of the leaves. In this case, our interest was to see if there is correlation between the leaves color and the content of the arbutin. For this we refer to the data in table 4.

Table 4. The average data of leaves colour and arbutin content of *Arctostaphylos uva-ursi* (L) Spreng. grain populations. on the plateaus of Korab mountain.

Site	Dark colour	Normal colour	Light colour	Content of arbutine %
Gropat e Stane	23.4	46.6	30.2	9.6
Kodrat e Bregut	40	36.6	23.3	8.16
Llofkat e Sllatinës	26.6	56.6	16.4	8.46
Livadhi i Gjatë	23.3	56.6	20.0	9.03

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Përroi i Pasqyrës	33.3	36.5	30.0	8.38
Mali Vrenjtit	30.0	43.3	26.6	6.79
Bor. Begjunecit	33.3	50.0	16.6	8.02
Average	30.0	46.6	23.3	8.35

From the data in table 5 it is noted that the content of the arbutin correlates negatively with the dark leaf color, that is, the dark colored populations have a lower content of the arbutin where the coefficient of correlation is -0.50. While it is characterized by a medium correlation with normal green color with a correlation coefficient of 0.31.

Table 5. The correlation coefficients between leaves color and arbutin content of *Arctostaphylos uva-ursi* (L) Sprengel populations. on the plateaus of Korabi mountain.

Feature	Dark colour	Normal colour	Light colour	Content of arbutine
Dark colour	1			
Normal colour	-0.73	1		
Light colour	0.0	-0.69	1	
Content of arbutine	-0.50	0.31	0.09	1

The last phenomenon was the study of the relationship between leaf weight and arbutin content. In this regard we studied the weight of leaves of all plants for fresh and dry plants as well as the weight of 100 fresh and dried leaves taken occasionally. The data for this indicator are presented in Table 6. From the data in this table, as well as for other indicators, there is a noticeable variation among population of different sites. This means that indicators such as height above sea level, exposure and soil composition have influenced on their variation in the Korab Mountain massif. In this regard, we studied in these populations uva ursi the links between leaf weight and arbutin content. The correlation coefficient data for these links is shown in Table 7.

Table 6. The average data of leaf weight and arbutin content of uva ursi populations *Arctostaphylos uva-ursi* (L.) Spreng on the plateaus of Korab mountain.

Site	Weight of leaves / plants (fresh)	Weight of leaves / plants (dry)	Weight of 100 leaves (fresh)	Weight of 100 leaves (dry)	Content of arbutine
Gropat e Stane	3.34	2.25	3.0	2.1	9.6
Kodrat e Bregut	3.47	2.65	4.4	3.3	8.16
Llofkat e Sllatinës	2.38	1.87	4.0	3.2	8.46
Livadhi i Gjatë	3.63	2.62	4.7	3.4	9.03
Përroi i Pasqyrës	4.97	3.54	4.5	3.1	8.38
Mali Vrenjtit	2.47	1.47	4.4	2.7	6.79
Bor. Begjunecit	1.99	1.41	3.1	2.2	8.02
Average	3.18	2.26	4.0	2.86	8.35

Table 6 shows that the content of the arbutin presents a medium positive correlation, respectively with the weight of the leaves of a fresh and dry plant, but no relation has been observed for the weight of 100 leaves.

Table 7. The correlation coefficients between leaf weight and arbutin content of uva ursi *Arctostaphylos uva-ursi* (L.) Spreng populations. on the plateaus of Korabi mountain.

	Weight of	Content				
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Feature	leaves / plants (fresh)	leaves / plants (dry)	100 leaves (fresh)	100 leaves (dry)	of arbutine
Weight of leaves / plants (fresh)	1				
Weight of leaves / plants (dry)	0.98	1			
Weight of 100 leaves (fresh)	0.48	0.49	1		
Weight of 100 leaves (dry)	0.41	0.51	0.89	1	
Content of arbutine	0.36	0.42	-0.30	-0.06	1

The content of the arbutin has a positive relation to the fresh and dry weight of a plant and the negative relation with the fresh and dry weight of 100 leaves.

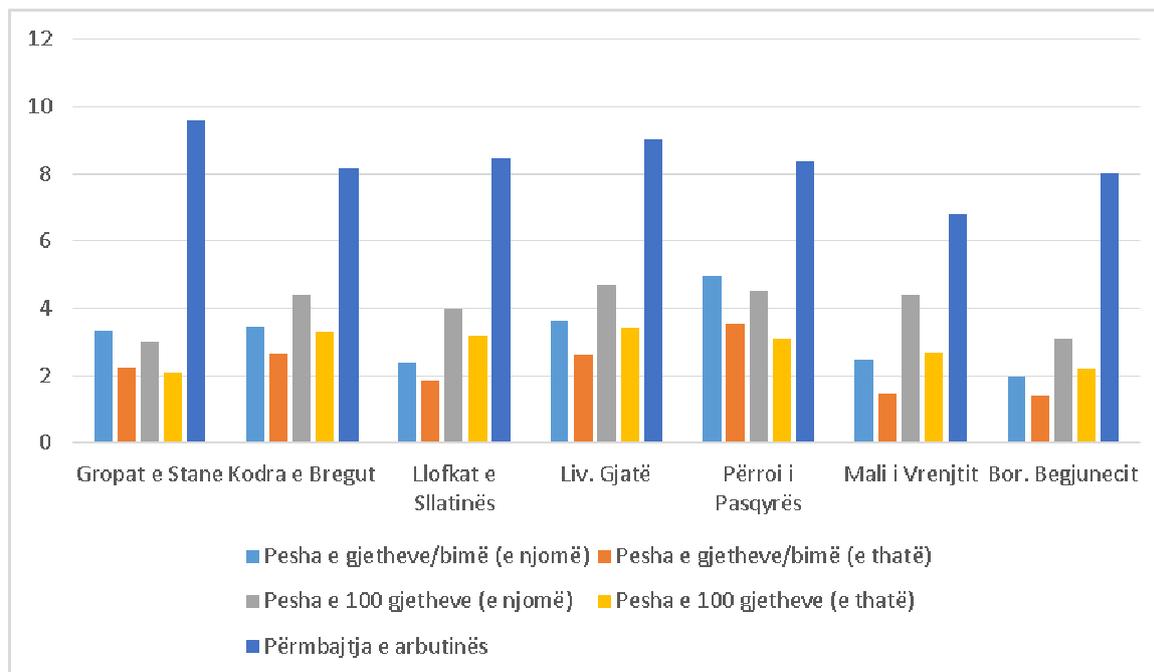


Figure 1. Graphic representation of the average data of leaf weight indicators and arbutin content of uva ursi *Arctostaphylos uva-ursi* (L.) Spreng populations on the plateaus of Korabi mountain.

4. Conclusions

By analyzing the data of leaves indicators and arbutin content we come up with some conclusions and give advice:

4.1. Conclusions

From the study of the variation of the main indicators of uva ursi *Arctostaphylos uva-ursi* (L.) Spreng. and the links between the contents of the arbutin and some leaves features we draw the following conclusions:

- For the links between leaves features and the arbutin content there is a strong positive correlation between the petiole length, but no relation is found to the length and width of the leaf.
- For leaf color and arbutin content, there is a medium negative correlation for dark color and poor correlation for green color
- For the weight of leaves of all the plants (fresh and dry) and the weight of 100 leaves, there is a weak and medium positive relation respectively for the weight of the leaves of the fresh and dry all the plant and the weak negative relation with the weight of 100 leaves
- Variation between the studied places is also observed for arbutin's contain. For Korab Mountain, this varies from 6.78% to the Mali i Vrenjtit population, to 9.61% to Gropat e Stane, with an average of 8.34%.

4.2. Advice

To influence positively in the rational utilization of the plant, the timing of harvesting and increase of incomes, we advise:

- The most qualitative part of the plant are the leaves of normal green (not dark) and long tail, which have higher arbutin content.
- The brown leaves should not be collected because they spoil the quality of the product due to the low content of the arbutin.
- The leaves should be cleaned well from foreign matter and the plant itself to enable the production with higher quality and higher percentage of arbutin.
- Importance should be given to drying as soon as possible, as this provides the leaves with the highest percentage of the arbutin.

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