

Characterization of lettuce germplasm (*Lactuca sativa* L.) stored in the Genetic Bank of Albania

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Abstract: *Lettuce is an important leafy vegetable for Albanians. It is mostly used as a fresh salad. There are several forms (species) of lettuce that are cultivated in Albania, but Albanian farmers cultivate and market mostly the farmer's cultivars (landraces), which are cultivars adapted to the conditions of the country and to the farming practice of the farmer. The introduction of foreign lettuce species increases the risk of genetic erosion of the farmer's cultivars. Through various projects, cultivars of the salad farmer have been collected and their seeds are stored in the country's Genetic Bank. This study was undertaken to recognize the morphological characteristics, as well as to evaluate the genetic variation of these genotypes with the aim of increasing the effectiveness of their using in possible genetic improvement programs, as well as other studies. In the study, 10 accessions (farmer cultivars) collected in different areas of Albania and stored in the Genetic Bank were taken.*

Keywords: LETTUCE, LACTUCA SATIVA, FARMER'S CULTIVAR, LANDRACES, DESCRIPTOR, CHARACTERIZATION

1. Introduction

Lettuce (*Lactuca sativa*) is the most important vegetable crop in the group of leafy vegetables [2, 3, 5]. The origin of lettuce is Europe, but it spread and was rapidly cultivated throughout the world [1]. It is a well-known plant worldwide due to its use in the preparation of salads, soups, etc. This plant is one of the oldest known edible vegetables and has gained importance mainly due to its biological activities, including antioxidant activity, antimicrobial activity and neuroprotective activity [5]. Lettuce includes seven main groups of cultivars (including oilseed lettuce) that differ phenotypically, and are usually described as morphotypes (morphological types) [3]. It is considered an important source of plant nutrients. This vegetable is rich in mineral nutrients such as vitamins, calcium, iron, flavonoids, fiber, potassium and phosphorus. It is a valuable dietary source of vitamin K, E and C, as well as carotenoids [5]. The chemical composition of the plant revealed the presence of different classes of secondary metabolites, such as terpenoids, flavonoids and phenols, which should be responsible for its biological activities. The plant also contains essential elements, such as vitamins, minerals and organic substances. It is characterized by significant morphological and genetic variations [3, 4].

This leafy vegetable plant was first cultivated by the Egyptians. Today, lettuce is produced all over the world and this plant has excellent medicinal properties. It is used in forensic medicine for many diseases, including pain, stomach and inflammation problems, as well as urinary tract infections. Various studies have provided scientific evidence of its pharmacological potential, including antimicrobial, antioxidant, neuroprotective and hypnotic effects [4]. Some of the benefits that lettuce offers to the human organism: Removes headaches and eases sleep; for these benefits, the lettuce is soaked in warm water, some fresh mint leaves are added and the drinks are taken before bed. It prevents Alzheimer's disease. It dissolves fats and helps to reduce weight. Fights body toxins and poisons. Fights cancer cells and prevents aging. It facilitates blood circulation and protects the heart. Protects bone health and prevents osteoporosis. The selenium contained in lettuce helps to strengthen the immune system. It lowers the body temperature and refreshes it. It is diuretic and facilitates metabolism and waste elimination. Important nutrient for pregnant women and regenerator of milk. Lowers blood pressure. Alleviates disorders in the large intestine. Fights anemia, strengthens the body, removes body odor. Strengthens vision and fights eye infections. Removes skin rashes and itching. It brightens the skin and prevents hair loss, because it stimulates blood circulation [1].

Lettuce is cultivated worldwide and is one of the most consumed green leafy vegetables in fresh (raw) form for its taste and high nutritional value [4]. Lettuce is grown on all continents, but the largest consumers and producers are the USA (91,000 hectares, of which 60,000 ha are in California) and Europe (the total area of the countries of the European Economic Community 80,000 ha). Large areas of lettuce are also grown in southeastern Australia, Japan, China, Israel, northern Mexico, Chile, Argentina, Brazil, and Peru

[6]. Spain, China, USA, India, Japan and Italy are among the main producers in the world [2, 5]. China ranks first in the world for the cultivation of lettuce, followed by the USA and India. In Albania, it is also called green salad and is widely used in the kitchen [1]. Lettuce is very important as a commercial crop in North and Central America, Asia and Europe [5].

In general, the morphological and agronomic description of wild lettuce accessions is not complete. Even the status of some species related to cultivated lettuce is not detailed. In lettuce, morphological studies have been carried out in Slovenian and Swedish, Austrian and Italian, Brazilian, Philippine and Iranian genetic resources [5].

Genetic improvement of lettuce is mainly focused on different morphological characteristics and resistance to diseases and pests. Accurate lettuce germplasm descriptors provide useful basic information for breeders. The compilation of the list of lettuce descriptors has been stimulated by the international gene bank community [2]. This list consists of 55 descriptors with 15 of them illustrated with pictures. It provides the means for the detailed characterization and differentiation within intraspecific variation of *L. sativa*, for the verification of old varieties and for the identification of releases and putative gaps in germplasm collections. These descriptors, together with the descriptors of wild *Lactuca* species, provide the efficient analytical tool for studying the complex morphological variability of this genus and the relationships between species [3, 2]. Genetic improvement of lettuce is mainly focused on different morphological characteristics and resistance to diseases and pests. Accurate lettuce germplasm descriptors provide useful basic information for breeders. The compilation of the list of lettuce descriptors has been stimulated by the international gene bank community [2]. This list consists of 55 descriptors with 15 of them illustrated with pictures. It provides the means for the detailed characterization and differentiation within intraspecific variation of *L. sativa*, for the verification of old varieties and for the identification of releases and putative gaps in germplasm collections. These descriptors, together with the descriptors of wild *Lactuca* species, provide the efficient analytical tool for studying the complex morphological variability of this genus and the relationships between species [3, 2].

The Institute of Genetic Resources in Albania, within its mission, has collected preserves, regenerates, characterizes and evaluates the genetic material of the cultivated lettuce (*Lactuca sativa* L.) collection [2].

2. The purpose of the study

The purpose of the study was to know the morphological characteristics and qualitative features of the accessions of Albanian lettuce, which are stored in the Albanian Genetic Bank.

3. Objectives of the study

The objective of the study was the characterization of lettuce accessions, i.e. the evaluation, recording and recognition of morphological characteristics with the aim of highlighting the

morphological diversity among lettuce accessions, collected locally and stored in the Genetic Bank to enable their more efficient use effectiveness by researchers and crop genetic improvers.

4. Materials and methods

Materials used in the study

In the study, 10 accessions of lettuce (*Lactuca sativa* L.) representing the farmer's cultivars (landrace) were taken, which collected in 6 districts of the country, are stored in the Albanian Genetic Bank.

The study was conducted at the Experimental Base of the Genetic Bank near the EDE of the Agricultural University of Tirana, in Valias [longitude 19043'59.90"E; latitude 41024'04.30"N; altitude 39 m]. The establishment of the field trial was based on international standards (FAO, 2014. Genebank standards for leafy vegetables) and the assessments for the characterization of the genetic material were based on the minimal descriptors (ECPGR, 2009 and IBPGR Secretariat, Rome, 1996). The accessions used for the study are part of the germplasm collections kept in the Genetic Bank of Albania.

Table no. 1: Lettuce farmer's cultivars and collection points

No. of accession	Accession name	Site of collection
AGB3807	Sallatë marule e Piskovës	Përmet
AGB3878	Sallatë marule e Bulgarecit	Korçë
AGB4169	Sallatë marule e Mirasit	Korçë
AGB4170	Sallatë vendi e Lushnjës	Lushnjë
AGB4171	Sallatë marule e Korçës	Korçë
AGB4172	Sallatë vendi e Fierit	Fier
AGB4173	Sallatë e Berdicës	Shkodër
AGB4174	Sallatë Bari vendi	Përmet
AGB4175	Sallatë e Leshnicës	Përmet
AGB4180	Sallatë Allias-78	Tiranë

Planting was done on March 16, 2022 in polystyrene trays with 170 cells, with a cell diameter of 4.2 cm, filled with Flora Gard soil. Seeds germinated on March 24–26, 2022. Seedlings were planted in the field on April 21, 2022. The experimental design was randomized block with three replications. Each variant in the replicate was represented by 30 plants, planted in three rows of 4.0 m length, with 10 plants per row. The distance between rows was 60 cm and between plants in rows 40 cm. planting density was 4.16 plants/m². So, the variant in each replication had an area of 7.2 m².

During the growing season, all the agro technical services performed on the lettuce plant in production were carried out; care was taken to water once every 2–3 days until the flowering period and, later, during the flowering and fruit-setting period, the plants were watered every day. Field observations were made for the field trial condition and germination, flowering and ripening dates were recorded for each accession.

5. Results and discussion

The characterization of lettuce accessions was carried out through the descriptors of the morphological characteristics of the leaf, flower, head and achene of lettuce.

Let's first elaborate on the variation of lettuce accessions via leaf descriptors. Several leaf morphological characteristics were analyzed but 9 descriptors were recorded on which we are examining the variation among the lettuce accessions under study.

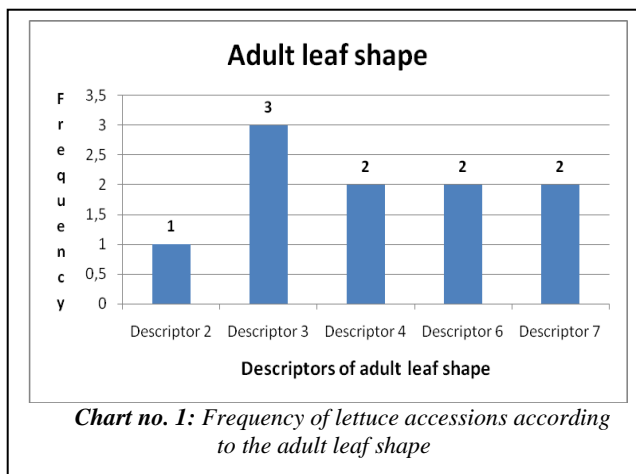
a. Genetic variation of lettuce accessions according to leaf morphological characteristics

The shape of the adult leaf showed wide variation, all 10 accessions in the study were divided into 5 groups, of which 3 accessions had broad elliptic leaves, 1 was elliptic, and the other 6 had leaves of other shapes (table no. 2).

The base of the leaf is expressed in two forms, from the three classes that this descriptor has in total; 6 accessions had the leaf with a short attenuate base, while the other 4 had a medium attenuate base, so this feature has good variation (table no. 2).

Table no. 2: Descriptors of lettuce accessions

Lettuce accessories		Number of accessions
Descriptor number and name	Status	
1.3.7.1 Outer adult leaf-entire-shape of blade in outline	2	1
	3	3
	4	2
	6	2
	7	2
1.3.10 Outer adult leaf-shape of blade base	1	6
	2	4
1.3.9 Outer adult leaf-shape of apex	1	2
	2	8
1.3.7.2 Outer adult leaf-entire-margin of blade	1	2
	3	8
1.3.5 Outer adult leaf-surface profile	1	9
	2	1
1.3.11 Outer adult leaf-blistering	0	1
	3	4
	5	5
1.3.1 Outer adult leaf-colour	1	2
	2	7
	5	1
1.3.2 Outer adult leaf-intensity of colour	5	9
	7	1
1.3.3.1 Outer adult leaf-anthocyanin-distribution	0	9
	1	1
1.6.1 Flower-colour of ligule	5	10
1.6.2.1 Flower-anthocyanin-distribution pattern on lower part of ligule	0	9
	2	1
1.4.1 Head-formation	0	1
	1	9
1.4.4.1 Head-shape in vertical section	3	5
	4	4
1.4.4.3 Head-firmness	5	9
1.4.4.2 Head-overlapping of leaves	3	5
	5	4
1.4.5 Leaf rosette position of leaves	1	1
	7	9
1.7.1 Achene-colour	2	7
	7	3

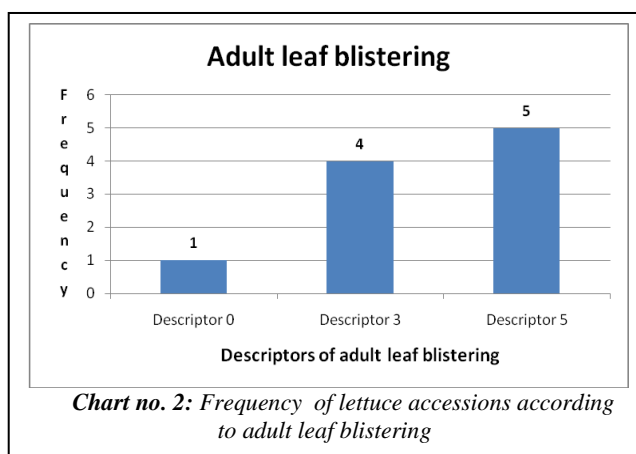


As for the shape of the apex of the leaves, the leaf with a rounded tip prevails, which includes 8 accessions; only two accessions have truncate leaf tips (table no. 2).

For the margin of the blade leaf, accessions with dentate sides predominate (8 accessions), while the other two have entire leaves. So even for this feature there is variation between accessions.

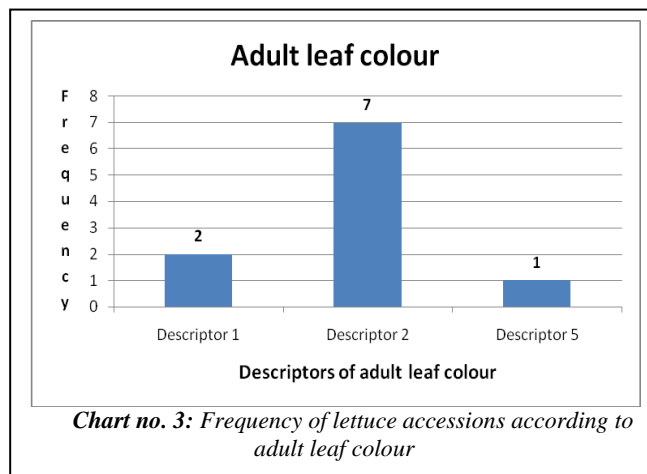
Farmer's cultivars of the lettuce also showed variation for the appearance of the leaf surface, for this feature the accessions with concave (spoon) leaves predominate where 9 accessions belong, only one accession had flat leaves.

Blisters can also form on lettuce leaves, which depend on the cultivar, so the appearance of blisters is controlled by genetic factors. For this feature, lettuce accessions are divided into 3 groups (table no. 2), out of 4 groups that this descriptor has in total; so this trait showed good variation. Thus, for example, 1 accession (Sallata e Bërdicës) has the surface of the outer adult leaf without any bubbles (grade 0), 4 accessions (Marule e Bulgarecit, Marule e Mirasit, Sallata e Lushnjes and Sallata e Fierit) had slight blistering (grade 3) and the other 5 accessions had moderate blistering (grade 5).



The green color (class 2) of the outer adult leaf-colour appeared in most accessions (7 accessions), 2 accessions and (Marule e Bulgarecit and Marule e Korçës) have green to yellow leaves (descriptor 1), while one accession "Sallata e Leshnicës" has red and green colored leaves (table no. 2).

Regarding the intensity of leaf color, the lettuce accessions in the study mostly showed moderate intensity of leaf color (class 5); while one accessory (Sallata marule e Mirasit) has an intense green color (grade 7).



The appearance of anthocyanin on the leaves is interesting. For this descriptor, most accessions (9 accessions) had no anthocyanin on the leaves, only one accession (Sallata e Leshnicës) had anthocyanin only on the veins (grade 1).

b. Genetic variation of lettuce accessions according to flower morphological characteristics.

The lettuce accessions did not show variation regarding the color of the flower crown, all 10 accessions formed flowers with a yellow crown (grade 5).

Regarding the distribution of anthocyanin on the flowers, 9 accessions did not have anthocyanin on the flowers (grade 0), only one accession (Sallata e Leshnicës) has anthocyanin on the margin of the flower (grade 2).

c. Genetic variation of lettuce accessions according to head morphological characteristics.

For morphological characteristics, we assessed and recorded 6 descriptors. Let's examine each of them in turn.

Regarding the formation of the head, the lettuce accessions are divided into two classes of the descriptor, but 9 of them formed a head, that is, they are var.capitata, the only exception was "Sallata e Bërdicës", which did not form a head (table no. 2). In terms of head shape in vertical section, five lettuce accessions form broad elliptic heads (grade 3), while the other four form orbicular heads (grade 4).

Regarding the firmness of the head, all 9 accessions that formed a head were evaluated with medium firmness of the head (grade 5).

Regarding the overlap of the head leaves, the lettuce accessions are divided into two groups, of which 5 accessions were assessed as partly covered (class 3) and 4 accessions with half-covered heads (grade 5)

For the position of the leaves, i.e. for the angle that the leaves of the rosette form with the horizontal plane, in 1 accession (Sallata e Bërdicës), which does not form a head, the position of the leaves of the rosette is very upright (grade 1). In other accessions, which form a head, the position of the leaves of the rosette with the horizontal plane is assessed as flat (grade 7).

d. Genetic variation of lettuce accessions according to seed morphological characteristics.

As for the color of the achene, it can be said that there is an interesting diversity: three accessions (Sallatë vendi e Lushnjes, Sallatë vendi e Fierit and Sallata e Bërdicës) have black colored achenes; all the others have white to gray color.

6. CONCLUSION

Based on the data of the study and their review and discussion, we draw some conclusions.

1. The germplasm of 10 accessions of country lettuce was characterized by wide variation for the outer adult leaf-shape of blade in outline, all 10 accessions were divided into 5 groups;
2. Even for the base of the leaf good variation was shown, the accessions were grouped into two classes out of the three that this descriptor has in total. Even for the outer adult leaf-shape of apex, lettuce accessions expressed variation;
3. For the color of the outer adult leaf, the farmers cultivars of the lettuce were divided into three classes in which the green color prevailed, which was in 70.0% of the accessions;
4. For the color of the flower, all the accessions had only the yellow color, so for this descriptor there was no variation;
5. For head formation, only one accession did not form a head, while the other 9 (90 %) did form a head;
6. For achene color, the lettuce accessions were divided into two groups, of which 3 accessions had black achene, while the other 7 had white to gray achene.
7. We consider the information obtained from this study to be useful for the genetic variation of lettuce stored in the Albanian Genetic Bank;
8. This variation in the characterization of lettuce accessions may also be important for use in genetic improvement programs of this plant.

7. REFERENCAT

1. Beta E. (2016). Konsumoni marule (sallatë jeshile)? Ja çfarë nuk dini për të! Healthyfood;
7. Jani S. (2022). Për studimin “Karakterizimi morfologjik dhe vlerësimin e disa acc të germplazmës së sallatës (*Lactuca sativa* L.)”, 2022. Raport. Instituti i Resurseve Gjenetike të Bimëve.
3. Křístková E., Doležalová I., Lebeda A., Vinter V., Novotná A. (2008). Description of morphological characters of lettuce (*Lactuca sativa* L.) genetic resources. Hort. Sci. (Prague), 35, 2008 (3): 113–129;
4. Kuete V. (2017). Medicinal Spices and Vegetables from Africa; therapeutic potencial against metabolic, inflamatore, infectious and systemic diseases. Amsterdam: Academic Press (2017);
5. Lallouche Bahia, Hadj Kouider Boubakr, Beloudah Asma, Ben Madani Reguia and Boutekrabt Ammar (2020). Phenotypic characterization of some lettuce cultivars (*Lactuca sativa* L.) cultivated in Algeria. Revue Agrobiologia (2020) 10(1): 1787-96;
6. Pink D.A.C., Keane Evan M. (1993). Genetic Improvement of Vegetable Crops. 40-Lettuce: *Lactuca sativa* L. Available online 2 December 2012.