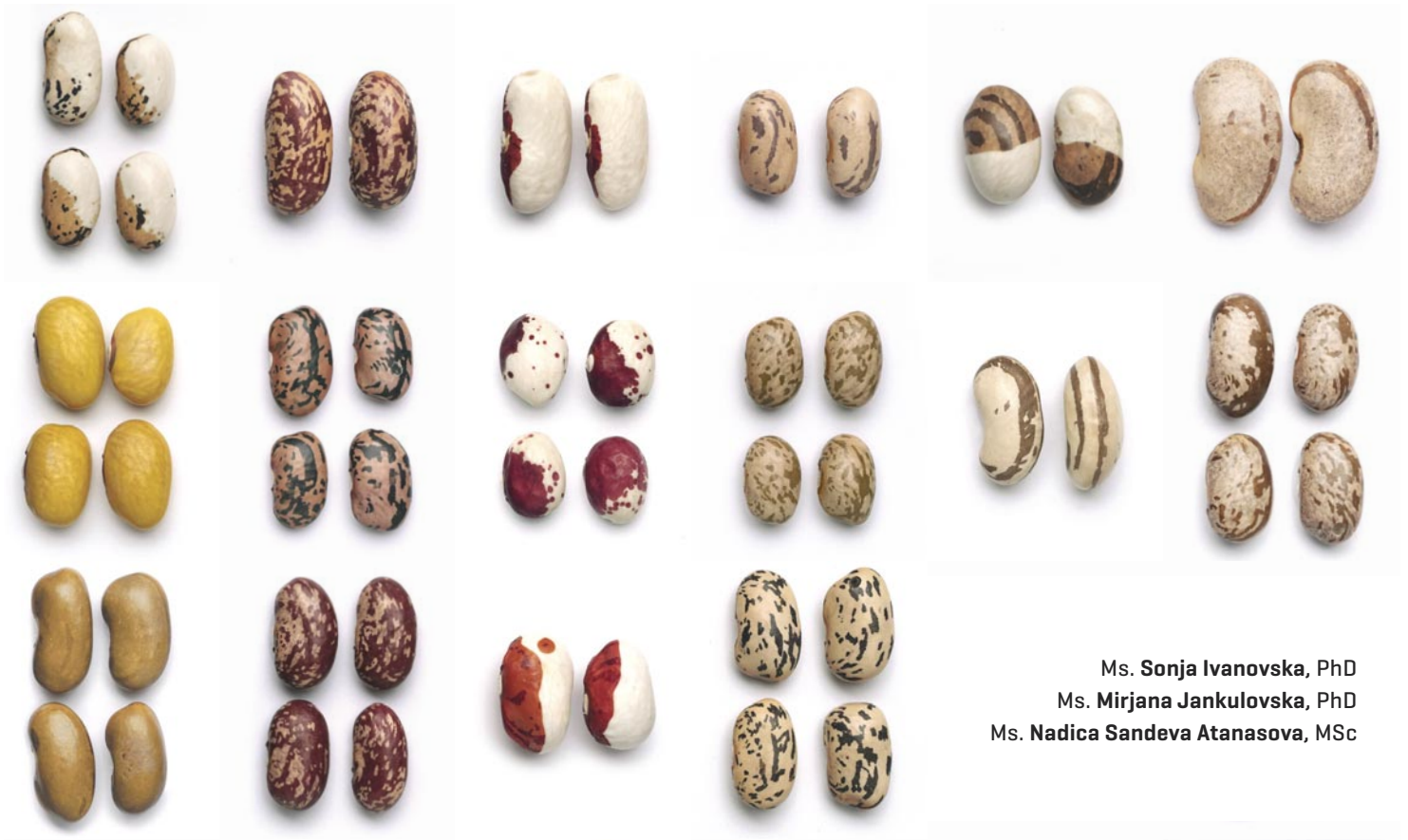

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MACEDONIAN PRICELESS HERITAGE

GENETIC DIVERSITY OF BEANS (*PHASEOLUS* SP.)

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2021

MACEDONIAN PRICELESS HERITAGE

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CATALOGUE

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The Macedonian Ecological Society (MES) is a civil society that has been striving to preserve nature and the environment for almost five decades by improving knowledge and communication with the public. We achieve our goals through numerous scientific research and applicative projects, organizing scientific and professional meetings, workshops and debates, scientific and popular publications, as well as media promotion in the field of ecology and protection of the environment and nature. We actively cooperate with local communities for sustainable use of natural resources, being inspired by nature and striving to promote sustainable economic development. Our efforts and activities have been translated into various long-term practices with a positive impact on nature and humans.

The result of our multi-year work, based on scientific principles, has contributed to MES becoming a national leader in the struggle for nature protection and preservation.

MES promotes environmental science and offers support to all those who want to expand their environmental knowledge. In addition to continuously strengthening its capacities through training, MES pays great attention to the establishment of young scientific staff qualified to be involved in the work of various relevant institutions, municipalities or protected areas. Our organization is old, but it is still evolving as a partner of many organizations in the country and the world because we believe in the power of community.

This publication is elaborated within the project "Valorization and promotion of agrobiodiversity through Macedonian local bean varieties". The project was implemented through the Agroecology Section at the Macedonian Ecological Society whose main goal is to preserve high nature value farming. One way to achieve this goal is to preserve the landscapes and traditional or extensive agriculture based on diverse old autochthonous species and varieties. Unfortunately, to achieve higher yields, agricultural production has been intensifying. The more intensive agroecosystems are, the greater the negative effects on the environment and nature, soil and groundwater contamination and loss of habitat, as well as plant and animal species are. In addition, natural ecosystems are degraded by the use of land for other purposes.

The Agroecology Section intensively focuses on scientific work and raising public awareness for the preservation of agrobiodiversity and tradition. This edition aims to contribute to the promotion, protection and sustainable use of diverse local bean varieties that are still grown in the rural areas of North Macedonia. We hope that this will be an incentive for all of us to turn to our gardens and learn to care for the old autochthonous varieties - our priceless treasure.

We express our gratitude to the authors who have translated their comprehensive scientific work into a popular edition for current and future generations.

Macedonian Ecological Society

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FOREWORD

"Look closely at nature. Every species is a masterpiece, exquisitely adapted to the particular environment in which it has survived. Who are we to destroy or even diminish biodiversity?"

"We should preserve every scrap of biodiversity as priceless while we learn to use it and come to understand what it means to humanity"

Edward Osborne Wilson,

American biologist, naturalist and writer

The concept of agriculture and nutrition is entirely changing In the face of climate, social and health changes that have been dominating the world in recent years. Extensive farming with traditional practices is being reintroduced, local varieties are replacing modern ones. Local varieties adapt better to specific environments and possess a reservoir of unique genes, especially ones that determine taste and quality. Therefore, developed countries invest a lot of resources into collecting and preserving local varieties.

Inspired by this example, in 2014 we started collecting seeds from old local varieties to discover and assess the extent of diversity of crop genetic resources maintained in North Macedonia. We visited over 300 settlements in the following years and a new surprise awaited us on each journey. We have compiled a huge collection of seed samples from over 50 crops. Impressions from our field travel and the results of our endeavours are shared in the first part of this edition.

However, the variety of different bean seeds impressed us the most. As the collection of seeds increased, we became aware that our country has different treasured and priceless local bean varieties. Unfortunately, it also became clear that soon many of these local varieties would disappear along with the older population that still maintains them.

There is no data in foreign literature about the diversity and distinctiveness of Macedonian bean varieties because they have not been examined so far. Moreover, we believe that our fellow citizens are well acquainted only with the Tetovo beans and do not know that varieties in a huge range of seed colours and patterns are grown in Macedonian villages. Although beans primarily originate from America, our collection proves the fact that the Balkans are a secondary centre of its origin.

Since we did not receive any support for the research and storage of the collection, we took photos of all different seeds to preserve the memory of them, at the very least.

Macedonian Ecological Society's proposal to publish a catalogue with photos of the seeds aimed to promote bean use and preserve their genetic diversity brought us joy and encouragement to share our knowledge with the public and write the manuscript for this edition.

The most difficult task was to identify the very information that would be interesting to each reader. We briefly present the story of the crop that has been our source of food for over 10,000 years. We describe

the origin of beans, some specific properties of plants and several different types of beans to help you easily distinguish between them.

The catalogue also contains information on bean collections stored in various gene banks around the world. We hope that this will encourage responsible people in the institutions to support similar activities in our country.

When writing the text, we tried to present the data in a popular and understandable style and to avoid using scientific terms as much as possible. We were guided by one goal - to provoke your new way of thinking. First of all, we will all become aware that the inherited bean varieties are a major centuries-old treasure, inextricably intertwined through our tradition and customs.

At the same time, our generation has a huge legacy demand - to preserve the varieties for future generations. Nature cannot talk to us, it only nurtures us. We need to hear her cry. Otherwise, we will cause the extinction of the varieties with no possible way to revive them. Therefore, our goal is to motivate you to grow and consume beans as much as possible. This is the only proven path that leads to their long-term conservation and sustainable use.

Beans can be grown in backyards or even in pots on balconies. We compiled a short step by step guide for cultivation in small areas and examples of the nutritional value of the seeds, along with their positive effects on human health. We are ambitious that they will become the foundation of your new diet based on bean grains rich in proteins. We also suggest several recipes for non-traditional bean dishes that you can include in your new daily menu.

The reputation of beans in developed countries has been changing over the past several years – it went from "poor man's meal" to healthy food, worthy to replace meat in every way. Beans are a staple food in many countries with a long-lived population. Native Americans rebuilt their "health and identity" through beans.

Let the photographs and text in this Catalogue essentially motivate us to mutually preserve the Macedonian identity and priceless heritage portrayed in the colours and patterns of the bean seeds.

The authors

BIODIVERSITY OF CROPS IN NORTH MACEDONIA

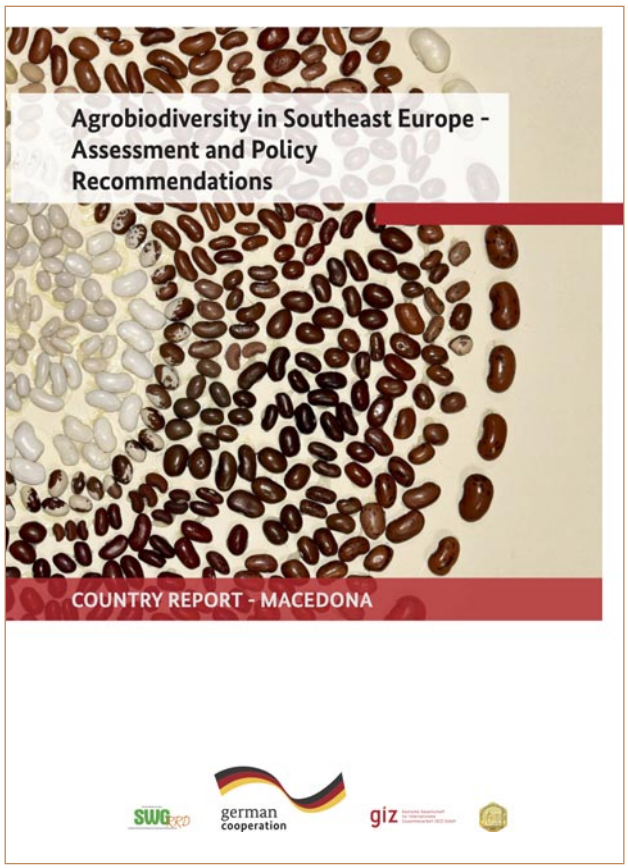
In North Macedonia, only registered varieties are grown in intensive agriculture areas, most of which are foreign. The obtained products enter your kitchen through the green markets and shops. You, on the other hand, strive to consume healthier and better-quality food, preferably organically produced. You often do not have much to choose from and you rarely think about the diversity and taste of the products.

On the green markets, you may sometimes find fruit or seeds that sellers have grown themselves. Many of them are either a forgotten crop or a landrace and are more often found on green markets in rural areas. After providing for their own food needs, locals sell the surplus of products at the market.

Every rule has its exceptions. Thus, some varieties of horticultural crops are locally grown for sale in smaller areas. Surely you are familiar with at least some of the landrace names of the ***pepper*** – 'Skopski Kavardzik', 'Kozji Rog', 'Kurtovska Kapija', 'Molinka', 'Bukovka', 'Prespanska green' or 'Ohridska green', 'Prilepska Banana' and 'Tetovska Turshijarka', or of the ***tomato*** – pink or red 'Jabuchar', 'Cuculest', 'Domashen'... Everyone who has tried these tomato and pepper varieties has noticed quite a difference in the salad taste.

Then, you can find ***onion*** – 'Brazdanski Pogachar', 'Skopski Srebrenik' and 'Buchinska' or 'Gostivarska arshlama'. You will often buy 'Kumanovski', 'Vasilevski' or 'Zrnovski' ***leek***. Many other varieties do not have a specific name. The sellers will only tell you that they come from the "old seeds", or they may have a common name, such as 'Embroidered pepper', 'Dzinki', 'Gambi', without distinguishing the varieties.

Products of some varieties, such as colourful bean, scarlet runner bean seeds, various winter and autumn watermelons and melons, coloured popcorn seeds and forgotten crops (pearl millet, ervil, sorghum, poppy) are not found on the markets at all. But they are still grown in rural gardens.



More details about agrobiodiversity and its conservation in North Macedonia are available in a 2018 study by GIZ

The most noticeable exception to the rule is beans. The landrace 'Tetovski' beans is grown in large areas and is immediately sold due to its proven quality. It is famous in our neighbouring countries, and even wider than that. In Serbia, there are registered varieties named 'Tetovac'. 'Tetovski' bean is protected by the State Office of Industrial Property with a designated origin, and by the World Intellectual Property Organization (WIPO) under the name '***The bean of Tetovo***'. This means that only producers of the Tetovo region have the right to sell it under that name.

Among the proof of the quality and taste of Tetovo beans lies a rather strange and interesting fact. There is an archaeological site named 'Hisar' with remains of a multi-layered settlement near Leskovec, Serbia. In 2005, charred grains from the XII century BC layer were analysed and they were proven to be peas (Pisum sativum) and ervil (Vicia ervilia). The results are published in a paper starting with the title: "Pisum & ervilia Tetovac ....", in which the term 'Tetovac' is used as a synonym for the extremely tasty and delicious dish made of 'Tetovac' beans.

The 'Kocanski' rice is protected with the same label, but the key difference between them is that the label of the rice only refers to the region of production. The varieties grown are foreign. It would be a similar case if the 'Berovski' or 'Krivopalanechki' potatoes were protected. In the case of 'Tetovski' beans, the place of origin also implies that the locals created a specific landrace in the agri-climatic conditions of that region over several decades, or maybe centuries.

The beans and the well-known dish 'Gravche tavche' (Baked beans) are presented in the cookbook "Food Beyond Borders" published by GIZ in 2020. In this edition, embroidered pepper, 'Zrnovski' leek, 'Brazdanski Pogachar' onion, 'Karakachanska' and 'Ovchepolska' sheep are presented through traditional dishes. Breeds, landraces and dishes from Albania, Bosnia and Herzegovina, Kosovo, Serbia and Montenegro are presented similarly.

HOW DID GREEN MARKETS LOOK IN THE PAST?

Macedonian markets were once colourful and overflowing with products. This fact is recorded in numerous documents, and we confirmed it during the collecting expeditions. Older residents nostalgically said that only 5 or 6 decades ago they were growing wheat, corn, rice, barley, rye, oats, millet, ervil, alfalfa, clover, vetches, sugar beet, oilseed rape, hop, cotton, hemp, castor, sunflower, peanut, flax, sesame, tobacco, poppy, turnip, broad bean, beans, green beans, peas, chickpeas, lentils, soybean, pumpkin, watermelon, melon, tomato, pepper, eggplant, cucumber, onion, garlic, leek, cabbage, okra and other vegetables. Fruit trees lined the landscape of the meadows along the roads and cast shade on their yards so that they could take rest from their hard work.

Then agriculture was modernized - foreign high-yielding varieties and hybrids were introduced. At the same time, the population colossally migrated to the cities. The villages were abandoned and the landraces were lost forever. Even more tragically, many crops have been completely lost as well. Today, almost no one grows millet, ervil, cotton, sugar beet, hemp, hop and castor. Sesame, flax, peanuts, soybeans, chickpeas and poppy are grown only on a negligible number of parcels. Seeds of these landraces can rarely be found. Often the inhabitants do not even sow the seeds, but rather, they keep them as a precious heritage.

Unfortunately, this priceless treasure is no longer available to us. What we need to do is to conserve today's landraces for future generations. We can only hope that this catalogue motivates you to share our goal and help give children the most valuable thing of all - the taste and colours of Macedonian fruits.

MACEDONIAN 'BLACK GOLD' THE TREASURE WE HAVE LOST

Poppy was first cultivated in our country in 1835 near the city of Stip. It was probably brought from the province of Afyon in Turkey, after which it got its name. The locals started cultivating it and they got semi-dry opium by cutting its non-matured capsules. At the end of the 19th century, 28% of the total opium production in the Ottoman Empire came from the Macedonian poppy. According to the crude morphine content level (14-16%), the Macedonian poppy ranked highest in the world.

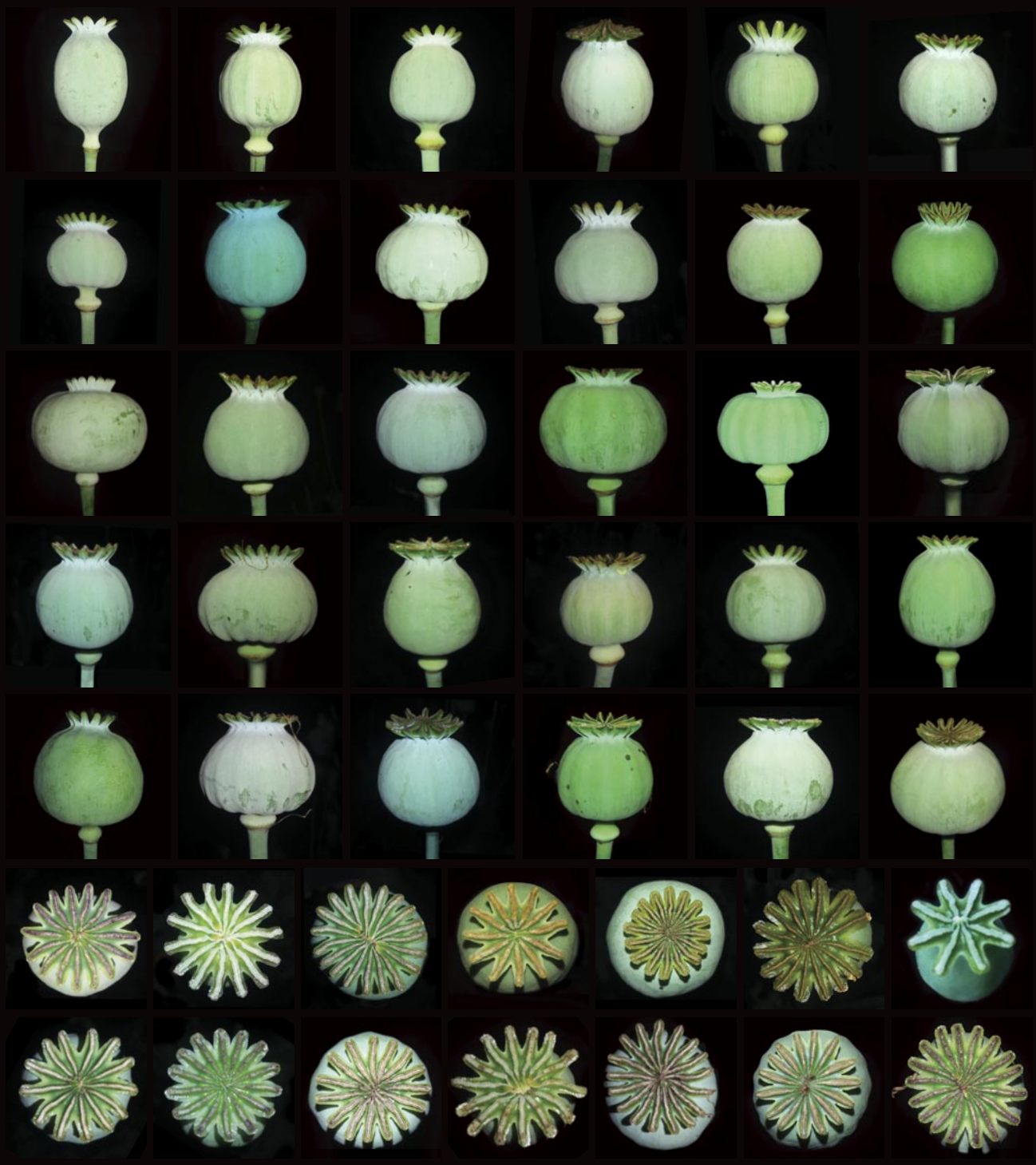
Macedonian local varieties in the 1800s probably originated from a cross between white-seeded and grey-seeded poppy. A 1949 CIA report states that "... there are two varieties of poppy in Macedonia, one with a white flower, a white seed and a closed capsule, and another with a purple flower, black seed and a shattering capsule when ripe. The white one is grown more and it contains more morphine ...". This document also states that the Kavadarci opium is the best in the world.

It was grown all over the country, but the best quality was observed in the regions of Kavadarci, Strumica and Veles. In 1927, 95% of Yugoslav production consisted of Macedonian poppy. This amount was enough to satisfy 43% of the needs of the processing factories in the world during the period between the two world wars. For various reasons, production decreased from 14,110 ha in 1930 to 4,009 ha in 1932. It is stated in data from the 1960s that the most typical feature of the Macedonian poppy is that it has a constant proportion between the content of thebaine and papaverine and therefore this opium belongs to the papaverine type, unlike Asian types.

Poppy was locally known as black gold and it was the incentive for the founding of the Alkaloid factory in 1936. During the war, when money lost its value, opium was kept as a "gold reserve" and a means of payment. When daughters got married, they were given an opium pie as dowry. This tradition lasted until the 1950s and significantly contributed to the conservation of local varieties at that time. This part of the culture is illustrated on the coat of arms of North Macedonia and the 500 denars bill as a symbol of Macedonian quality.

Unfortunately, production almost stopped in 1991. A few years ago, Alkaloid resumed production in agreement with small-scale farmers, giving them seeds of the variety 'Alkaloid 1' and then buying their capsules. This variety has light purple flowers and blue-grey seeds. So, production expanded from 90 ha in 2012 to 180 ha in 2017. However, current production meets only about 30% of domestic needs.

We collected several accessions of landraces from residents in rural villages who each grow 5-6 plants, only so that they don't lose the seeds. Some also keep the varieties for the preparation of the traditional spice 'K'cana' salt. In these photos, you can notice a great diversity of flowers, pods and seeds from the varieties, but of course, these accessions do not reflect the resources that North Macedonia once had, which were unsurpassed in the world. Therefore, our 'black gold' is a typical example of the loss of heritage and quality of the past.



MACEDONIAN EMBROIDERED PEPPER TREASURE WE NEED TO CONSERVE

Pepper was domesticated in Native America. It was brought to Europe at the end of the 15th century. It rapidly spread to the Mediterranean countries, and only then to Africa, India and China. It is believed to have been brought to the Balkans by Turkey in the 16th century. Evliya Çelebi describes that it was already offered on the Macedonian markets by the 17th century. The inhabitants kept selecting their preferred special fruits for seeds and that's how they unconsciously performed breeding. The varieties have adapted to different conditions, probably crossing with each other. And so, a whole range of the most diverse fruits and flavours that define our salads, dishes, winter preserves and spices was formed.

Therefore, North Macedonia, as part of the southern European region, was designated as a secondary pepper diversity centre. The greatest proof of this is the kingdom of peppers in each of our gardens and tables, and on the throne sits Her Majesty - the ***Embroidered pepper.*** This unique fruit is grown only in North Macedonia. It is also found in some areas around the borders with our neighbouring countries where Macedonians had gravitated. It was developed and maintained in North Macedonia because it represents our identity - a house without strings of embroidered peppers is not a Macedonian house.

Why are the Embroidered peppers so special? At first glance, they may not look keen on the eye, because they have striations. But every gourmet that has travelled the world, has described them as especially delicious and unique with a specific aroma. They contain more dry mass and sugar than other peppers. When fresh, theit flesh is crispy and juicy. When roasted, their hotness decreases and they become milder. The names residents have given them are embroidered, striated or something along those lines. A special name – 'Badjanaci' was given only to the short fruits that are very hot. We use them fresh or dry, we preserve them as 'Pechi-gmechi'. We bake and grind them in a unique spice. In recent years we have even made 'Ajvar' with it.

The cities only know of the long embroidered pepper. But in the villages, the inhabitants also maintain varieties with short peppers, embroidered 'Gambi' and 'Feferoni', with thin or thicker flesh, with red or burgundy colour. There are peppers with few or many, horizontal or vertical and thinner or thicker striations. There are sugary sweet, mild, hot, extremely hot and a special type - mild, but with the smell and aroma of hot pepper. No one knows how this type of pepper got its striations. No one has studied its genes yet.

There are about 800 accessions of peppers in our collection, and a quarter of them are embroidered. The inhabitants claim that they inherited them from their ancestors, and following the generational calculations, that would mean that they originated at least 2 centuries ago. They can be found throughout our country, and this is why embroidered pepper is a product that should be protected with the adjective Macedonian.

PLANT GENETIC RESOURCES CONSERVATION

Activities for conserving biodiversity have been taken all around the world for a long time now. Special attention and funds are allocated to the genetic resources used for food and agriculture. Accessions from different settlements are collected, described, evaluated and used in breeding programs to create new and better varieties. Conservation of resources can be done:

- **in situ**, or at the very place these varieties have been created and grown. In this case, contracts are made with the local population.
- **ex situ,** or away from the area they're grown on, in gene banks.

Seed-propagated crops are conserved in seed gene banks. Many countries have their own seed collections stored on their territory or in other countries. Fruit crops and Vitis, which are vegetatively propagated, are preserved in ***field gene banks***.

For over 50 years FAO has been the organization responsible for conservation of plant genetic resources for food and agriculture globally. It has organized many activities, as early as in the 1960s. The main idea was that resources are a legacy of humanity and should therefore be available for exchange in order to promote agriculture and food production.

The Convention of Biological Diversity, adopted in Rio de Janeiro a year earlier, came into effect in 1993. It is the responsibility of each Member State to conserve biodiversity in its territory and to use it sustainably. Subsequently, the conditions for free access to resources became more complicated. Diverse resources, especially landraces, are maintained in developing countries. On the other hand, those resources are mostly used by developed countries, very often by private breeding companies that create new modern varieties and make a profit out of selling the seeds.

After many years of negotiations, an international agreement was reached - the Nagoya Protocol, which entered into force in 2014. According to it, access to resources and their use must be based on a fair and equitable share of benefits. However, proving how large the profit is and how much of it is due to the resources used is quite complicated, and thus this idea is not realized in practice.

Meanwhile, activities carried out by gene banks in the world have intensified. Collections were described and evaluated to increase the potential for their use. International centres for preserving global collections from a specific crop have been established. Online platforms with information about plant genetic resources have been set up by various gene banks. These databases contain passport data on the name, status and origin of the accessions, characterization data, and photographs of the seeds and fruits or from the herbarium specimens of the plants. More detailed data on yield, nutritional composition, disease resistance, and even molecular characterization of the accessions can also be found in some gene banks.

GENESYS

Established in 2008, is the biggest plant genetic resources platform in the world. It contains information on over 4 million accessions from 450 gene banks, and this is estimated to be only about half of the total conserved resources in the world.

EURISCO (EUROPEAN SEARCH CATALOGUE FOR PLANT GENETIC RESOURCES)

Established in 2003, is a catalogue of European collections. It contains information on over 2 million accessions from 404 institutions that are part of Genesys. North Macedonia has uploaded passport data for only 1,086 accessions.

PLANT AGROBIODIVERSITY CONSERVATION ACTIVITIES IN NORTH MACEDONIA

North Macedonia is a signatory to the Convention on Biological Diversity and has an abundance of different landraces. The conservation of agrobiodiversity falls under the Ministry of Agriculture, Forestry and Water Economy, more specifically under the Directorate for Seeds and Seedlings, which has a Department for Gene Banks. However, to date, this institution has provided very insignificant support for the conservation of plant diversity, which has not been available at all in the last ten years.

Unfortunately, we do not have a system for organized conservation of resources with institutional set-up and regular financing of activities. Some individual efforts of institutions and researchers occasionally result in collections and research that end up permanently lost after some time. It is clear that this way, our country has little chance to promote its wealth around the world, to offer its own resources to users and to benefit from it.

There are 4 gene banks for plant genetic resources conservation in North Macedonia, which are integrated into the following institutions:

Institute of Agriculture, Skopje. Maintains a seed collection, with available information on only 721 accessions in the base collection (stored at -18°C). About half of them are landraces. The condition of the active collection (at 4°C) is unknown due to a lack of information and means of maintenance. The data in EURISCO have been uploaded by this institution.

Faculty of Agriculture, Shtip. Maintains a base seed collection of 152 accessions and an active collection of 8 local varieties.

Scientific Tobacco Institute, Prilep. Maintains a seed collection of 163 tobacco samples. Most of them are commercial varieties and breeding material.

Faculty of Agricultural Sciences and Food, Skopje. In 2014, the ownership of the field collection of fruit crops at the Institute of Agriculture was transferred to the Faculty. It consisted of around 400 accessions in critical condition. Some of them are currently in the phase of revitalization. In the meantime, a new collection of 52 old and domesticated varieties of 4 fruit crops located in Skopje and Resen was established. In addition, the Faculty has an inventory seed collection of field and vegetable landraces, as described in this text.

None of these collections have safety duplicate accessions in another gene bank. Except for a few fruit trees that are preserved at the original locations, in situ conservation of landraces has not been established in North Macedonia.

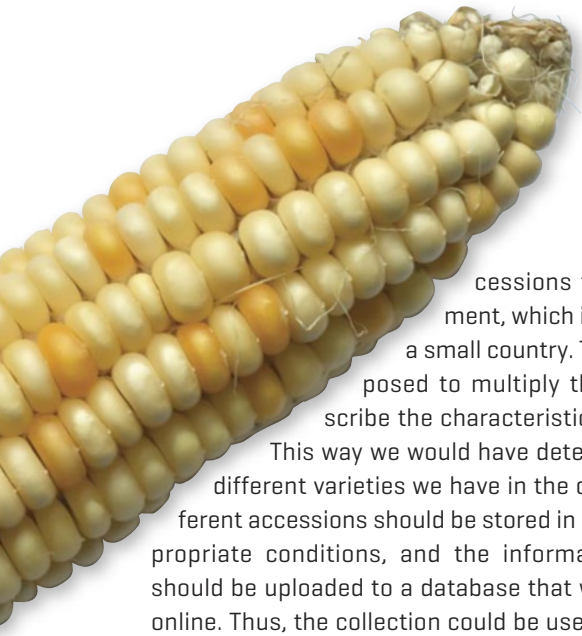
From a historical point of view, numerous activities for collecting landraces have been carried out in North Macedonia. In the period from 1969 to 1973, an extensive collection project, funded by the USA, was implemented in North Macedonia. Vegetables were collected by Prof. Lazar Aladzhajkov (1918-2009), and field crops were collected by Prof. Lazar Babamov (1906-1976), both professors at the Faculty of Agricultural Sciences and Food in Skopje. Collected accessions are still stored in various gene banks in the USA. Information about them, including details about the country of origin and the collector, is available in databases.

Then a project for inventorying agrobiodiversity supported by GIZ was implemented in 2003. Seeds of 782 landraces from 76 households were collected in 13 settlements in the Maleshevo Region. The collected samples were stored in the gene bank at the Agricultural Institute in Skopje, and the data were published in a brochure in 2004.

From 2004 to 2010, there were activities carried out within the regional project SEEDNet, funded by the Swedish agency Sida. During this period, the gene bank was equipped and the collection at the Agricultural Institute in Skopje was renewed. The condition of the collection was presented in a catalogue in 2009.

Then, as members of the Department of Genetics and Plant Breeding at the Faculty of Agricultural Sciences and Food, Ss Cyril and Methodius University in Skopje, we started a new collection of landraces in 2014. The field visits were supported by projects implemented through the Macedonian Ecological Society in Skopje. We collected samples from settlements along the river Bregalnica in 2014 and 2015 and the Osogovo Region in 2018. All other activities and field visits to many villages were carried out exclusively with our voluntary work and with our own finances.

Our goal was to determine the diversity of landraces and to establish an inventory collection as a basis for scientific research. Because the inhabitants kept a very small number of seeds from the local varieties, they could only set aside a few of them for the collection. It currently consists of more than 6,300 accessions from over 60 crops, originating from 440 settlements across the country. The idea was to keep going and collect ac-



cessions from each settlement, which is easily feasible in a small country. Then we were supposed to multiply the seeds and describe the characteristics of the varieties. This way we would have determined how many different varieties we have in the collection. The different accessions should be stored in a gene bank at appropriate conditions, and the information about them should be uploaded to a database that would be available online. Thus, the collection could be used by all interested parties.

Unfortunately, we have not implemented the latter steps to date due to a lack of financial support.

OUR IMPRESSIONS FROM THE FIELD EXPEDITIONS

We passed many villages in search of seeds from old varieties. We saw beautiful landscapes interwoven with forests and green fields, but also old stone houses decorated with strings of tobacco leaves and strings of peppers, onions and garlic. We visited large and inhabited, but also small abandoned villages and scattered settlements with only 1-2 inhabitants each. An interesting story awaited us in every village. In the small villages, we were asked to help the villagers find housewives because all girls were moving to the city. Some boasted that they had managed to find a bride from Albania. We came across an old lady, and we asked her: How many people live in the village? And she answered: Until yesterday, there was six of us, today we are five. We wondered how the few inhabitants around Makedonska Kamenica survive. How does an ambulance come to those inaccessible roads? How do they get together for coffee at such a distance? Their children rarely visit them or they might not even be in the country. We admired the landscapes in Konche, as nature was precisely painted out. We met a young mother of two who keeps cows, drives a tractor and produces leeks for sale, and she was even considering crossing cabbage varieties to create her own the way she'd like it to be. During the day we heard out their stories, and in the evening, we classified and packed the seeds and lived part of their lives.

Some villages did not have water, but they did not give up on their gardens. Sometimes men discouraged us and laughed at us, convincing us that the old seeds no longer existed. But their wives standing behind them secretly gestured us to approach them. And then they prepared a feast for our eyes - boxes with numerous sachets of different seeds neatly packed and marked. There were houses where the men valued the wealth as well, so they kept them together with their wives. We came across collectors of old fruits and residents who apply interesting and unique cultivation practices. One old man still sowed wheat and rye mixed together, claiming that that's how he was getting a higher yield. Elsewhere, a woman pierced the base of a tomato stem with copper wire, so that the plants would be resistant to diseases. They planted gourd for purposes of decoration, the making of decorative items or as a remedy for sinusitis. Some also used it for grafting watermelons because that's how the fruits had no strings and were sweeter. They had several ervil plants for medicine for better circulation, and sorghum plants to make brooms out of. The yellow tomato was grown for religious holidays during which red food is not to be eaten, and the chickpea was grown to prepare bread named 'Nautlija' - a disappearing tradition. We were told that winter watermelons are stored in a cold room until Christmas, and they could even last until the next crop. The villagers planted special varieties of watermelons and pumpkins for sweet relish.

In each garden, the locals had planted different varieties of vegetables for their own needs. Eager to talk, they kindly offered us a taste of the fruits and served us homemade relish, juice or compote. And this is how we discovered the taste of the sun, relayed into fully ripe colourful fruits.

They nostalgically reminisced the large fields of hemp and poppy, the rice fields located where one never would have guessed that rice had once grown, the semi-nomadic lifestyle of shepherds, the tradition, and a time when life was quite difficult, but in a way more simple and calm, in harmony with nature.

Some knew the exact origin of the seeds - where their parents had brought them from. Some only said that they had owned the seeds ever since they could walk. Some had stopped sowing them, but they took them out of their cellars where they had been keeping them for many years. That's how we came across poppy seeds from 15 years ago and an old lady who was more than happy to pull out a bag of cotton seeds from 50 years ago for us.

Almost everyone proudly exclaimed that they kept the seeds they had inherited as dowry from their mother or mother-in-law. And then they would whisper sadly: And now I have no one to leave it to...

MORE INFORMATION ABOUT BEANS

Green beans and dry beans are the same crop - beans. Common beans are usually grown for green beans in Europe even though green pods can be harvested from any type of bean when the pods are immature. Maybe you do not know that, because the specific name for green pods in Macedonian is 'boranija', while the beans are called 'grav'. In addition, the terms french beans, string beans, snap beans, and haricot (French) are also used for green beans.

Beans belong to the genus *Phaseolus* in the subfamily of plants with papilionaceous flowers Faboideae or Papilionoideae, which are part of the family of leguminous plants Fabaceae or Leguminosae. It is estimated that there are over 150 species in the genus *Phaseolus*, only about 70-80 of which are described, and only five of them are cultivated:

- *Phaseolus vulgaris* L. - common bean;
- *Phaseolus lunatus* L. - lima bean;
- *Phaseolus acutifolius* A. Gray - tepary bean;
- *Phaseolus coccineus* L. - scarlet runner bean;
- *Phaseolus dumosus* Macfady - year-long bean.

Common beans are the most used and widely grown out of these five species and therefore they abound in different types and varieties. In some classifications, the varieties are grouped into subvarieties whose Latin names reflect the shape, colour, and pattern of the seeds, the colour of the flowers, or the plant architecture.

ORIGIN OF BEANS

Plenty of evidence suggests that beans originated in the New World. Wild beans are found across a large geographical area, from northern Mexico, through Central America and the Andes to north-western Argentina.

Common beans have long been thought to originate from wild populations in Peru and Ecuador, as only their seeds contain the phaseolin type I protein in the seeds, which is found in common beans. From this core area, they were dispersed to the north (Colombia, Central America, Mexico), resulting in the Mesoamerican gene pool, and also to the south (south Peru, Bolivia, and Argentina), resulting in the Andean gene pool. These two independent domestication events created the two large groups of today's varieties.

The plants from both gene pools differ in many morphological and biochemical characteristics. Consequently, they are partially reproductively isolated. This means that they cannot cross with each other, which is observed in both wild and domesticated populations. Isolation confirms that at least two domestication events have occurred - on both hemispheres, independent of each other. This scenario, with two geographically isolated evolutionary lineages ancestral to domesticated beans, is unique among crops.

For the domesticated populations, only these two basic gene pools are known. The structure of the wild populations is even more complex, as they have an additional gene pool located between Peru and Ecuador, while the Colombian populations are considered as intermediate forms.

Recent research works show that common beans originated from the Mesoamerican gene pool in Mexico. Then it spread to the southern hemisphere and formed the gene pool in Peru and Ecuador and the wild Andean gene pool.

DOMESTICATION OF BEANS

Wild beans are thought to have been cultivated 8,000 years ago. Man has always kept seeds from plants with better and more desirable properties for sowing. This selection increased the adaptability of the plants for cultivation and the possibility to use them for different purposes.

Thus, the pod dehiscence and the photoperiodic sensitivity gradually decreased in the domesticated populations. Plants started to flower earlier and got a more compact architecture, with fewer branches and leaves. Pod and grain yields increased, seed colours and patterns modified and seed germination became easier.

Later, the primitive varieties spread to other regions where wild populations already existed. Common beans are self-pollinating; however, around 2-3% of cross-pollination can occur. Therefore, the varieties spontaneously crossed with the wild populations growing nearby. Since the beginning of modern agriculture, breeders also performed crossbreeding to create new varieties. All these processes have resulted in a huge diversity of bean varieties with very distinctive features. Due to this, different races have been further identified in the gene pools.

RACES OF MESOAMERICA GENE POOL

- Durango (prostrate bush types, with medium-sized seeds, from the arid highlands of Mexico);
- Jalisco (tall climbing beans from the humid highlands of central Mexico);
- Mesoamerica (mostly bush types, with small seeds, from the lowlands of Central America and Mexico).

RACES OF THE ANDEAN GENE POOL

- Peru (dominated by tall mountain bean type);
- Nueva Granada (mostly bush types, adapted to medium-high altitudes);
- Chile (prostrate bush types or semi-climbing, from higher altitudes).

INTRODUCTION OF BEANS TO EUROPE

It is believed that on several occasions over five centuries, beans were introduced to Europe from different places. Sailors and traders probably took variously coloured seeds from America out of curiosity. Primarily, beans were transported from Central America to the Iberian Peninsula in 1506, and only after 1532 from the southern Andes. They quickly spread over different regions, especially in Mediterranean countries. The first description of beans in Europe dates back to 1542 as a vining plant with white or red flowers and red or cream seeds with black dots, dark red with or without a pattern, snow-white, white-grey or yellow. Later on, additional colours and patterns of bean seeds were described. There are no records of bush beans before 1542.

After they were introduced, bean plants naturally increased their survival ability. They became more tolerant to different daylength and more resistant to biotic and abiotic stress. Man, on the other hand, directed his selection to the phenotypic appearance of seeds and plants and their resistance to diseases and pests. In that period, he did not select plants for higher yields. If he needed more seeds, he planted more plants.

After the Ottoman Empire conquested the Balkans, many crops were brought from America. Corn, peppers and beans were some of them and they were quickly accepted by the local population. Beans were introduced to Serbia at the end of the 17th century, and in the 1930s they had already become the most important vegetable. Such wide cultivation in the Balkans and Mediterranean countries contributed to a great diversity of local varieties. Thereby, this region, including North Macedonia, is identified as a **secondary centre of bean diversity.**

So far, only one characterization with molecular markers has been performed on 28 Macedonian local varieties of common beans, including varieties from Slovenia, Croatia, Bosnia and Herzegovina and Serbia. We are familiar with the origin of the analysed Macedonian varieties; their diversity was much lower than the diversity of the seeds in our collection today. The analysis showed that they are clearly separate from the collections of other countries. Most of them belonged to the Mesoamerican gene pool, while the largest amount of the varieties from other countries belonged to the Andean gene pool. This grouping of Macedonian accessions to different gene pool indicates that beans in North Macedonia were mainly introduced from Turkey, Bulgaria and Greece.

Scarlet runner bean was brought to Spain in the 16th century. Then it spread to Italy and later to other European countries. It was primarily grown only as an ornamental plant, and the seeds were later used for food. Two years ago, 64 samples from our collection were analyzed with molecular markers, along with samples from Slovenia, Bosnia and Herzegovina, Serbia and Romania. Similarly to the common beans, this analysis showed that about 2/3 of the Macedonian samples belonged to a separate group that contain no samples from other countries, i.e. they completely differ from other bean samples in the region. This means that the Macedonian inhabitants had been selecting similar types of varieties in the past, mostly with white seeds, which are traditionally used in our cuisine.

Many other factors contributed to the diversity and uniqueness of the Macedonian landraces. North Macedonia is a geographical crossroad between the east and the west where different nations have passed through and settled in. Residents from former Yugoslavia migrated to all republics. As did the nations, religions, customs, and foods mix, so did the bean varieties. The specific micro-locations, interwoven within the mountains and lowlands, shaped the plants' characteristics. And all of them, to this day, have been preserved thanks to the custodians of our heritage - the rural inhabitants.

DESCRIPTION OF THE BEAN PLANT

In the tropics, all cultivated beans can grow as annuals or short-lived perennials, with a lifespan of up to 4 years. In the regions with temperate climates, they are annual crops because they are not resistant to frost. There are perennial forms only of *P. dumosus* and they have a vegetative growth period from 2 to 4 years. Hence its former Latin name – *P. polyanthus*. However, in dry conditions, it also grows like an annual crop. More recently, it has been discovered that this species is a natural hybrid that originated from a cross between common and scarlet runner beans.

ROOT ARCHITECTURE

The bean root system is composed of a tap root, many fine lateral roots and root hairs around 10 cm long near their tips. It can sometimes be fibrous, so the main root is indistinguishable. The root system is distributed up to 20 cm deep in the surface soil layer. In favourable soil conditions, it can reach more than 1 m in length.

Only the roots of scarlet runner beans are tuberous, spindle-shaped and rich in starch. Vegetative buds, which can be used for propagating plants, emerge in the root neck zone of its roots. P. dumosus, as a hybrid between the common and runner beans, has a semi-tuberous root.

PLANT ARCHITECTURE

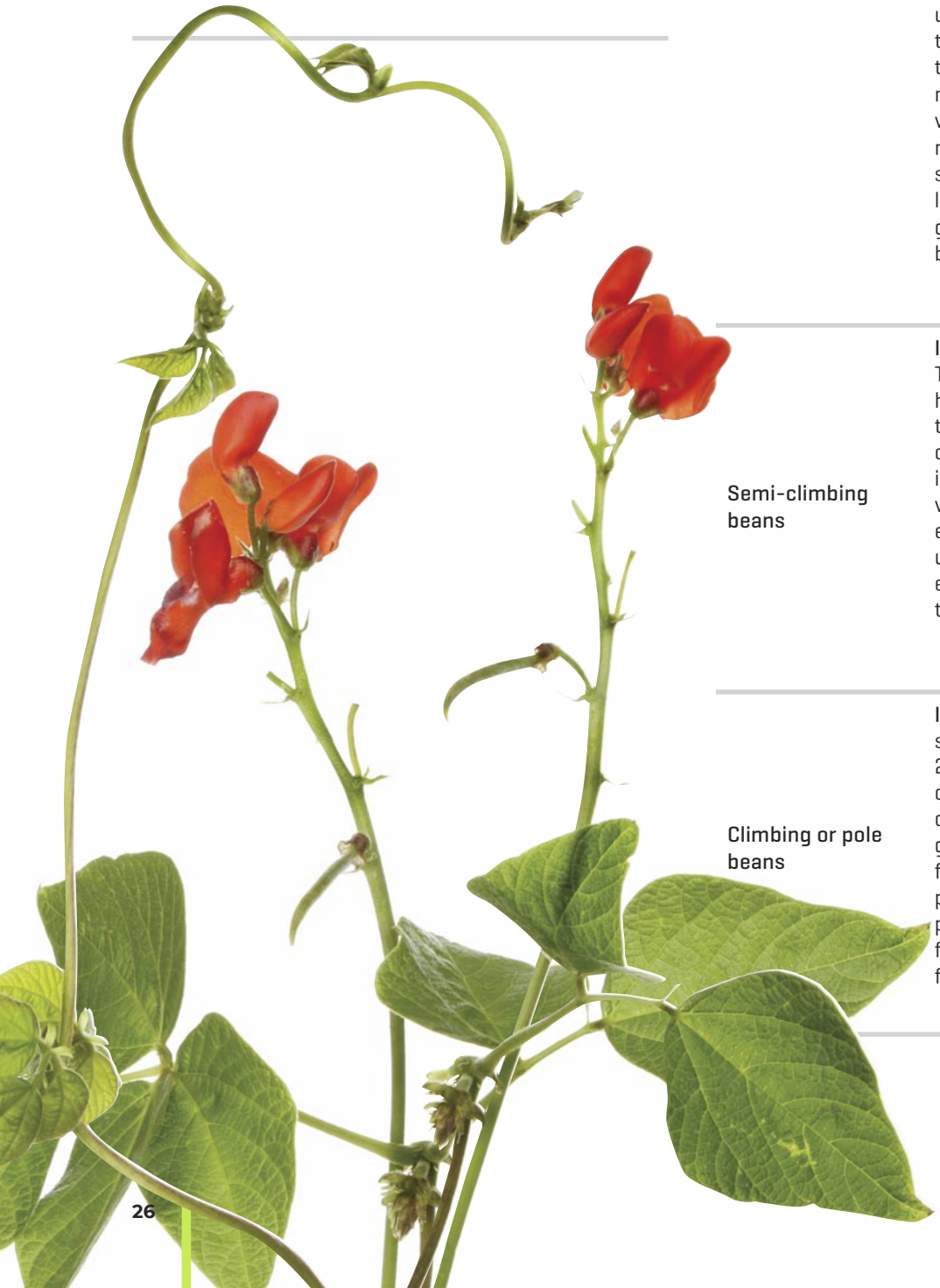
The stem of all bean species is herbaceous and tends to grow vertically. It consists of nodes - sections from which leaves emerge, and internodes between the nodes. Usually, the stem has a green colour, but some varieties have purple pigmentation on certain sections. Younger parts of the stem always have short hooked hairs protecting the plant from insects. The stem develops many lateral branches which increase the number of flowers. Branching is less pronounced in the upper parts of the plants or in the shoots that will start flowering. Leaves emerge from each node on the stem. Three buds appear in the leaf axils that will develop in vegetative branches or inflorescences.

BEANS ARE A USEFUL CROP – THEY IMPROVE SOIL FERTILITY

*Bean roots are inhabited by soil bacteria of the genus **Rhizobium**. They form globular nodules on the root surface and feed on plant metabolites. In turn, the bacteria fix the atmospheric nitrogen and transform it into ammonia, which is used by the bean plants. Therefore, when growing beans, fewer nitrogen fertilizers have to be applied and the available nitrogen remains in the soil for the next crop. This process of nitrogen fixation reduces under adverse soil conditions. Also, some pesticides and fungicides are toxic to **Rhizobium** bacteria.*

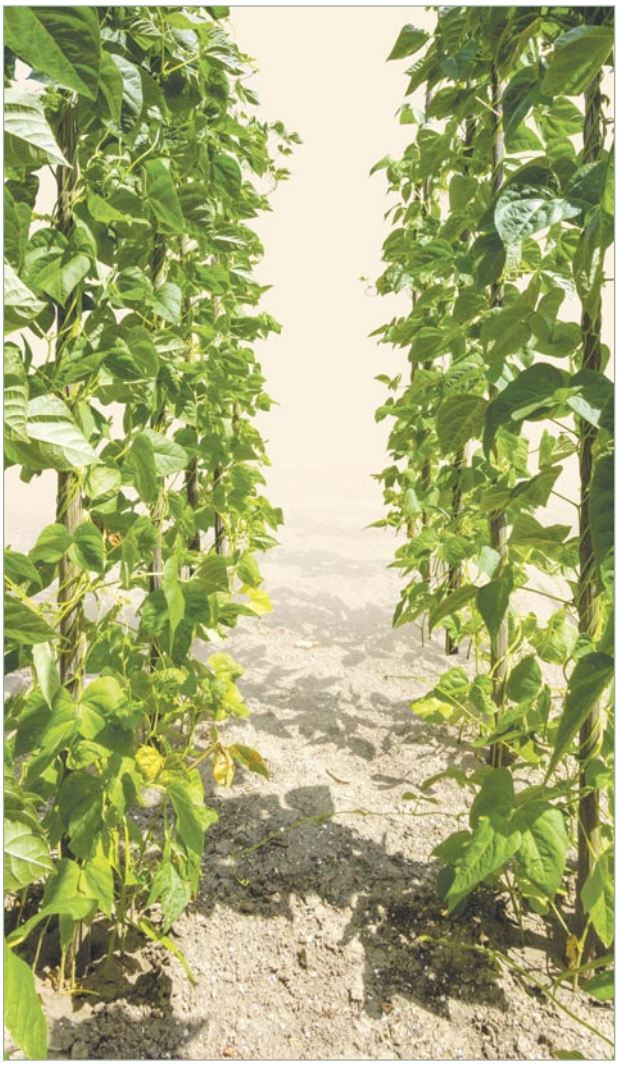
Based on the growth habit, two types of bean plants can be distinguished

Determinate	The growth of the main stem stops with an appearance of an inflorescence. Flowering takes place from the top to the base of the plants.
Indeterminate	The stem continues to grow even in the flowering stage. That is why they have a longer, climbing stem that twines around the support. Flowering takes place from the base to the top of the plants.



Based on the plant architecture, three types of bean varieties can be distinguished

Bush beans	**Determinate bush.** The stem and the branches end with a terminal flower raceme. When they appear, the plant stops growing. The main stem is thicker and consists of 5 to 10 short internodes. The plants are 30 to 50 cm high, but there are also dwarf varieties (15-25 cm). Flowering lasts a short time. All of the pods ripen almost simultaneously.
	Indeterminate bush. The stem is upright, without the ability for twinning and climbing, even though it ends with a short terminal vine. The branches have no vines. The main stem has many nodes (often more than 12). The stem and the branches are longer because they continue to grow even in the flowering stage, but with lower intensity.
Semi-climbing beans	**Indeterminate prostrate vine.** The main stem is twining and it has a lot of nodes and longer internodes. The stem can reach over 80 cm in length, and all of its branches end in terminal vines. Some plants prostrate in early growth stages. Some grow upright like a bush until the flowering stage and then they prostrate or climb when supported.
Climbing or pole beans	**Indeterminate climber.** The main stem is a typical climber with 20-30 nodes. When supported it can reach over 3 m in length. It is characterized by strong apical growth, therefore producing fewer branches. The flowering period lasts much longer and the plants simultaneously produce flowers and pods until the first frost.



Wild beans have only indeterminate stems, while bush beans are man-created by breeding. Pole beans are more resistant to diseases and have a higher yield. In humid tropical conditions, some varieties of climbing beans are very vigorous, so the stems of runner and lima beans can reach up to 5 m in length, and those of year-long beans can reach over 10 m.

BEAN LEAVES

Beans have simple unifoliolate leaves and compound trifoliate leaves that develop on nodes. The two cotyledon leaves on the first node and the two primary leaves (prophylls) on the second node are simple. They have only one leaflet and are oppositely arranged. Cotyledon leaves on all bean species grow above the soil during germination and fall off after two weeks. Only the cotyledons of scarlet runner beans remain underground. Tepary beans can be distinguished according to their primary leaves that have no stalks and are sessile to the stem.

The compound leaves are alternately placed on the stem. They have three leaflets with short stalks, two of which are lateral and one is central and terminal. The leaf edges are smooth, the surface may be glabrous or hairy and they have branched venation. At sunset, the leaflets bend inward and downward, and in the morning, they unfold and turn to the sun. Their shape varies, but they are usually heart-shaped with a pointed tip, 8-15 cm long and 5-10 cm wide.

Lima beans are different because of their smaller and thinner glabrous leaves with uneven and wavy edges. Tepary beans, on the other hand, have more elongated and acute leaves, indicated in their Latin name *P. acutifolius*.

BEAN FLOWERS

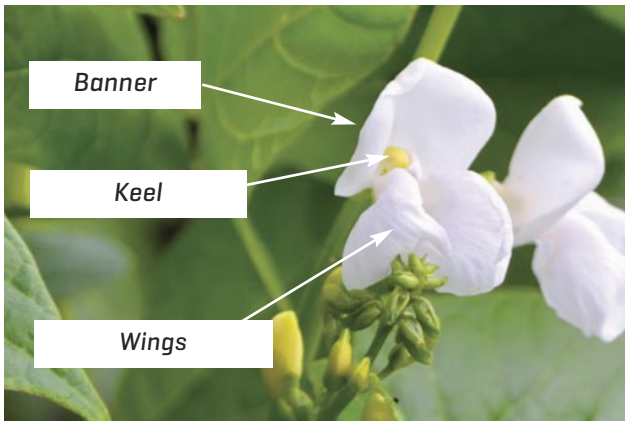
Bean inflorescences develop axillary in the leaf axils or terminally at the shoot apexes. They can have only one flower or racemes with clustered flowers. The first two flowers of the inflorescence develop pods before the rest of the flowers. Therefore, the distanced parts of the inflorescence age prematurely and about half to 80% of the pods may fall off.

Scarlet runner beans have the longest (up to 50 cm) branched inflorescences with up to 25 flowers, hence their former Latin name - *P. multiflorus*. Additionally, the inflorescences of year-long beans have the appearance of a spike.

The flower has a distinctive papilionaceous or butterfly-like shape and is consisted of five petals. The largest petal is vertically situated and it is known as a banner or standard. It can be white, green, pink or purple. The outer side of the standard base often has purple or pink stripes, or it can also be smooth and greenish. After fertilization, the white standards turn yellow.

The two horizontal petals are known as wings. They may come in shades of white, pink or purple, darker than the other petals. Some white wings also have pink or purple stripes or spots.

The remaining two petals are partially or completely fused in a tightly closed spiral, forming a boat-like "keel". The keel is placed below the wings and completely covers the stamens and the pistil.



Lima and tepary beans have smaller flowers, while the flowers of scarlet runner beans are large with long pedicels. They are usually red, scarlet or white, but some varieties may have bicoloured flowers with white wings and a scarlet standard.

Scarlet runner bean flowers

Both the stamens and the pistil are located in the same flower. They mature simultaneously, so the pollination occurs before the flower is fully open. That's why the bean is a self-pollinating crop, even though there is always some incidence of outcrossing. It can be eliminated when different varieties are grown at a 3 to 10 m distance.

Only scarlet runner beans are a cross-fertilized crop. Because of this, if different varieties are grown in one location, they should be sown with a larger isolation distance between them.

DECORATE YOUR APIARY WITH SCARLET RUNNER BEANS

Scarlet runner beans have numerous large flowers in a magnificent red colour producing large amounts of nectar. They are allogamous, pollinated by insects, and attract many bumblebees and honeybees. Accordingly, this species belongs to the melliferous plants.

BEAN PODS

The bean fruit is a single-carpelled pod, consisted of two valves fused by two sutures. Pods are usually glabrous or semi-hairy, with a straight, curved or double-curved shape and a prominent beak marginally or centrally between the sutures. Some varieties have pods with waxy epidermis. The pods are usually green or have red or purple stripes. Most often, white-seeded varieties have white or light-coloured flowers and green pods, while the varieties with darker and coloured seeds have coloured flowers and pods.

Common bean pods are 1-2 cm wide and 8-20 cm long. They usually have up to 6 seeds, but some varieties can produce up to 12 seeds. Other bean species have shorter pods, except for some varieties of scarlet runner beans whose pods can reach up to 40 cm in length.

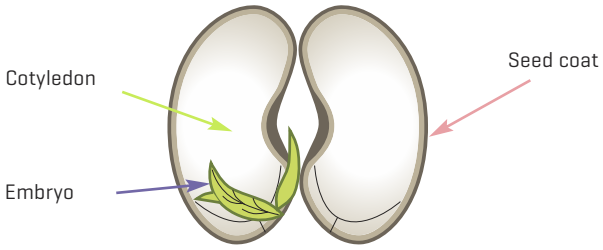
When fully mature, pods dehisce along the sutures and valves detach. In lima beans the valves twist into a spiral shape while opening. Due to breeding efforts, many modern varieties have fully indehiscent pods. There are three types of pods depending on their texture and dehiscence.

Strongly dehiscent	Pods have a fibrous texture. The varieties are grown only for the consumption of dry seeds.
Partially dehiscent	Pods are leathery with two slightly, but not completely separated valves. The varieties are grown for the consumption of green pods or dry seeds.
Indehiscent	Pods are fleshy and do not split. The varieties are grown for the consumption of green pods.

BEAN SEEDS

Bean seeds have a seed coat, embryo and cotyledons. Fleshy food-storing cotyledons nourish the embryo; therefore, the seeds have no endosperm. The embryo is located in the space between the cotyledons. The seed coat has a hilum or scar with two tiny openings on both sides of it. Wild beans and some varieties have a very hard seed coat that is partially permeable to water. That is why seeds in the soil can germinate even after two years.

The shape and the size of the bean seeds vary greatly and depend on seed dimensions. The most obvious differences between various varieties are due to the colours and patterns of the seed coat, which can also be very glossy or dull. You can easily notice these variations in the diverse bean types and species presented in this section, as well as in the photos of the seeds from our collection.



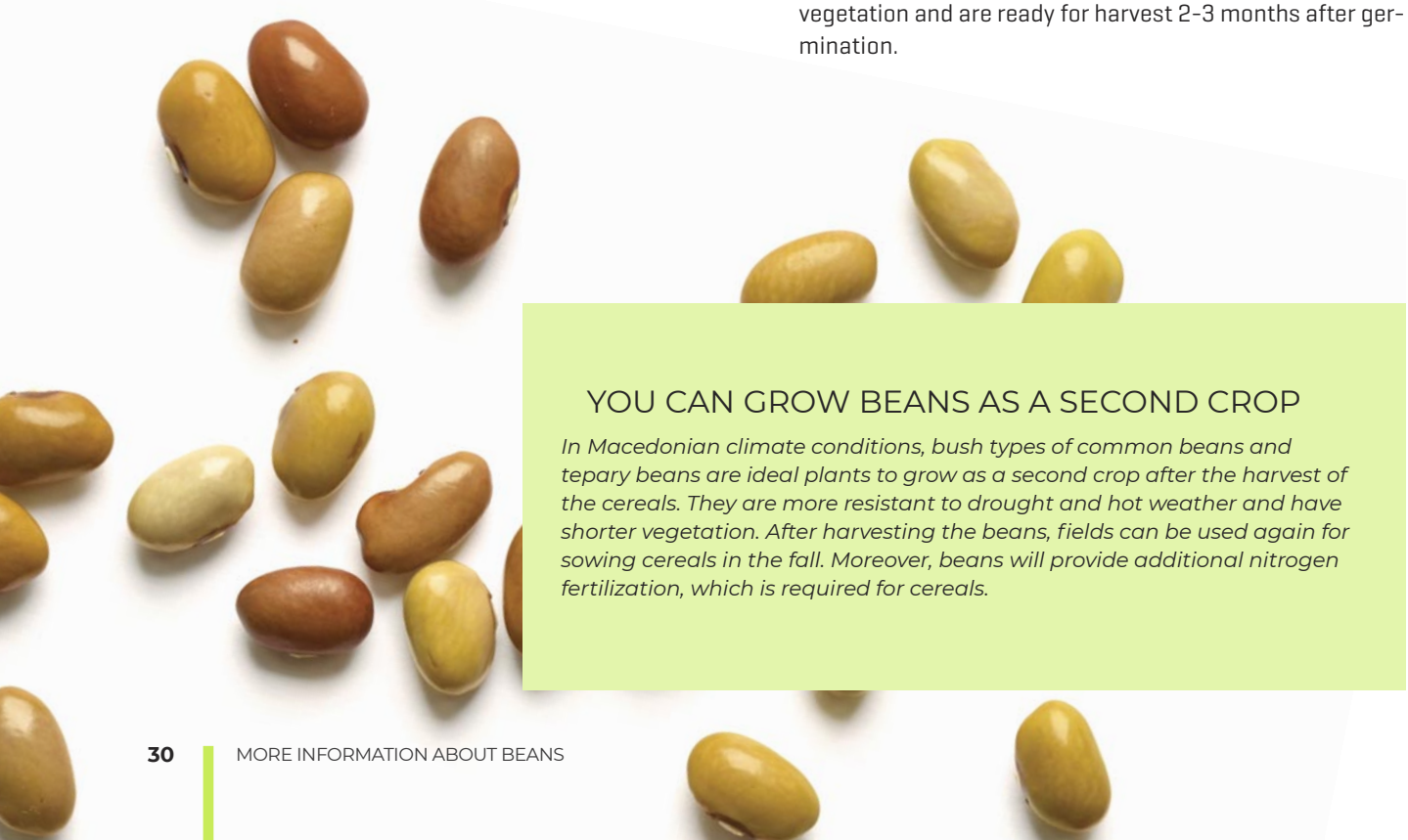
OPTIMAL CONDITIONS FOR BEAN DEVELOPMENT

Beans are a warm-season crop, but the optimal temperature for their development ranges from 10 to 27°C. It is sensitive to lower and higher temperatures and excessive humidity. During a period of several successive days with heavy rain or very high temperatures, the flowers and pods may fall off and the yield may be significantly reduced. Flowering begins around 30 days after sowing and the pods need another month to mature.

Scarlet runner beans and year-long beans are more suitable for colder and humid locations at higher altitudes. Scarlet runner bean plants start flowering around 50 days after sowing, and 3 months later they produce green pods. It takes about 4 to 5 months for the seeds to fully mature, depending on the variety.

On the contrary, lima beans are drought resistant and highly adaptable. One month after sowing, the plants will have remarkable vigour. They will produce flowers after 1 to 2 months, and it takes another 1 to 2 months for the pods to mature. Therefore, they are more suitable for lower altitudes and warmer locations.

Tepary beans are a typical desert species, providing the best harvest in dry and hot conditions. They have a short vegetation and are ready for harvest 2-3 months after germination.



YOU CAN GROW BEANS AS A SECOND CROP

In Macedonian climate conditions, bush types of common beans and tepary beans are ideal plants to grow as a second crop after the harvest of the cereals. They are more resistant to drought and hot weather and have shorter vegetation. After harvesting the beans, fields can be used again for sowing cereals in the fall. Moreover, beans will provide additional nitrogen fertilization, which is required for cereals.

MOST USED TYPES OF COMMON BEANS (*PHASEOLUS VULGARIS*)

Phaseolus vulgaris is known as **common bean**. In addition to this name, different types of seeds have other specific names. Some of them are also used as market classes in the United States. Seed size greatly varies between different common bean types, so 100 seeds can weigh from 15 to 90 g.

Cannellini beans
Phaseolus vulgaris
Other names:
White kidney beans

Large white kidney-shaped seeds with a creamy texture and nutty taste. They hold their shape during cooking and are fleshier than the great northern beans.

Great Northern beans
Phaseolus vulgaris

Large, kidney-shaped and oval white or cream seeds with a delicate nutty flavour. They have a grainy and less dense texture and absorb the flavour of other ingredients when cooked.

Navy beans
Phaseolus vulgaris
Other names:
Pea beans,
Haricot beans

White ovate or oval seeds with a powdery creamy texture that absorbs the flavour of other ingredients. They hold their shape when soft and taste similar to the great northern beans. This type was a staple food of the US Navy.

Black beans
Phaseolus vulgaris
Other names:
Turtle bean

Oval seeds with an intense black seed coat and creamy flesh. They have a velvety-smooth texture and a mild flavour.

Dark red kidney beans
Phaseolus vulgaris

Large kidney-shaped seeds with an intensely ruby-coloured seed coat. They are flavourful with a soft texture and hold their shape well during cooking.

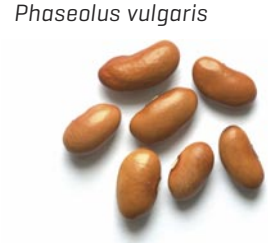
Red kidney beans
Phaseolus vulgaris

Kidney-shaped seeds in shades of red or reddish-brown. They are flavourful with a soft texture, holding their shape during cooking.

Small red beans
Phaseolus vulgaris

Medium-sized, oval or ovate dark red seeds, sometimes with squared ends. They look like black beans in their shape, but they have a rich nutty flavour and hold their shape during cooking.

Pink beans
Phaseolus vulgaris



Medium-sized, oval, light brown to pink seeds with a rich flavour and a slightly powdery texture that turn brownish when cooked. They are similar in shape to the pinto and great northern beans, but smaller and rounder.

Peruvian beans
Phaseolus vulgaris
Other names:
Canary beans, Mayocoba beans, Mexican yellow beans

Medium-sized oval and elongated seeds with a light yellow to cream colour, sometimes greenish or sulphur-yellow. They have a thin coat, a rich buttery flavour and a creamy texture similar to that of pinto beans. They cause fewer digestive problems.

Yellow kidney beans
Phaseolus vulgaris
Other names:
African yellow beans

Medium-sized oval and elongated seeds in shades of green or yellow with a dark ring around the hilum. Some varieties also have an intense yellow-brown seed. The colour fades when cooked. They have a flavour similar to pinto beans. This bean is known as green bean in North Macedonia (referring to its colour), and it is registered as an old variety in Slavonia, a region in Croatia.

Pinto beans
Phaseolus vulgaris

Oval or elongated cream seeds with brown speckles. The word pinto actually means painted and it is sometimes used for cranberry beans as well. They have a soft texture and a mild bean flavour.

Cranberry beans
Phaseolus vulgaris
Other names:
Borlotti beans

Oval elongated seeds in a light pink or cream colour, striped and speckled in red or dark red. Darker colours disappear during cooking and the seeds turn light brown. They have a thin coat, creamy texture and nutty flavour.

Caparron beans
Phaseolus vulgaris

Ovate seeds with a white seed coat that is mainly covered with coloured areas and spots. The colour is usually dark red or red with dark red patterns, but there are brown or black combinations as well. There are always some almost completely coloured seeds. They have a simple mild taste and a firmer texture.

Anasazi beans
Phaseolus vulgaris
Other names:
Aztec beans, Cave beans

Kidney-shaped or oval elongated seeds with a white or cream coat that is covered in areas and spots in intensely ruby/purple, red or brown colour. When cooked, they become light cream or pink. They have a mild slightly nutty taste and a firmer texture.

Appaloosa beans
Phaseolus vulgaris

Elongated kidney-shaped seeds with a white seed coat that is approximately half brown with black stripes, or orange-brown or brown. The patterns partially fade when cooked, but they are still visible and this is why they are used in salads. They have a mild taste and a firmer texture.

Vaquero beans
Phaseolus vulgaris
Other names:
Orca beans

Oval and oblong seeds, some have squared ends. They are similar to black beans. The seed coat is white with areas and spots in black. They have a light flavour and hold their shape well when cooked. The water darkens in colour during cooking.

SCARLET RUNNER BEAN
(PHASEOLUS COCCINEUS)

The English name of this species indicates the intense orange-red (scarlet) colour of the flowers and the long climbing stem (runner). The weight of 100 seeds ranges from 80 to 300 g.

Scarlet runner bean
Phaseolus coccineus

Wide and flattened, oval or kidney-shaped seeds, some have squared ends. The seed coat can be white, black or coloured with a dark pattern. Freshly harvested coloured seeds have a cream or light lilac colour with brown or dark lilac speckles, which gradually darken when stored. They have a soft and creamy texture with a buttery or chestnut flavour.

TEPARY BEAN
(PHASEOLUS ACUTIFOLIUS)

It is believed that the name tepary comes from the word 't'pawi' which means beans in the language of Native Americans. The weight of 100 grains ranges from 10 to 20 g.

Tepary bean
Phaseolus acutifolius
Other names:
Papago beans, Pavi

Small seeds with a flattened oval-rectangular shape. They can be white, black, in shades of cream, yellow, green, pink, lilac, red and brown or speckled in darker colours. They have a sweet nutty flavour which is not typical for beans.

LIMA BEANS
(PHASEOLUS LUNATUS)

The name of these beans comes from the Peruvian capital Lima, referring to their origin where they have been grown even before corn has. There are varieties with smaller seeds - baby lima and with larger seeds - large lima beans. The weight of 100 seeds ranges from 20 to 70 g.

Lima beans
Phaseolus lunatus
Other names:
Butter beans, Rangoon beans, Burma beans, Madagascar beans, Sieva beans, Caroline beans, Civet

Flattened, broad, white and creamy seeds, often slightly triangular with a buttery flavour. Baby lima beans are softer, milder and less starchy than the large lima beans which have an earthier flavour.

YEAR-LONG BEAN
(PHASEOLUS DUMOSUS)

The name year-long probably refers to the fact that only perennials are known from this species. The weight of 100 seeds ranges from 70 to 100 g.

Year-long beans
Phaseolus dumosus
Other names:
Year bean

Large oval seeds, usually brown, orange or yellow. Seeds in shades of dark red, navy blue, black and creamy white are found as well.

BEANS OF GENUS *VIGNA*

These species originate from Southeast Asia. They are adapted to warm climates and are drought-resistant, their growing season lasts 3 to 4 months. They are sown later and can be grown as a second crop after the cereals are harvested. Cultivation of *Vigna* beans is similar to that of common beans and if produced in optimal conditions the seed yield can reach over 2.5 t/ha.

Adzuki bean
Vigna angularis

Other names:
Red mung bean

Small cylindrical seeds, usually reddish-brown. Other colours of the seed coat can also be found, from cream, green to dark brown. They have a sweet taste and are used for cakes and various processed products. The weight of 100 seeds ranges from 5 to 20 g.

Black gram
Vigna mungo
Other names:
Urad, Urd bean

Small oval cylindrical black seeds that look a lot like mung beans, but the white hilum of black gram protrudes from the seeds. The weight of 100 seeds ranges from 1.5-6 g.

Mung bean
Vigna radiata

Other names:
Golden gram,
Green gram

Ovate seeds, usually green, but may also be yellow, olive, brown, reddish-brown or black. They can be glossy or dull, with spots and/or rough. They look like black gram, but the plants are different. The weight of 100 seeds ranges from 3 to 5.5 g.

Moth bean
Vigna aconitifolia

Other names:
Mat bean
Turkish gram

Ovate seeds, usually green, but may also be yellow, olive, brown, reddish-brown or black. They can be glossy or dull, with spots and/or rough. They look like black gram, but the plants are different. The weight of 100 seeds ranges from 3 to 5.5 g.

Rice bean
Vigna umbellate

Small seeds resembling larger rice seeds, rectangular or cylindrical with a white-greenish or yellow to brown colour, often variegated. The weight of 100 seeds ranges from 1 to 3.5 g.

COWPEA

Cowpea (*Vigna unguiculata*) originated in Africa, and its seeds resemble those of the Vigna bean species. It is also known as black-eyed pea or beans, sometimes referred to as field peas, crowder peas and cream peas. It is drought-resistant and has a vegetation season of 3 months. Their immature pods can be used like green beans and the seed yield reaches over 3 t/ha.

The seeds are ovoid and come in many colour variations. They are named black-eyed because of the dark colour around the hilum. They are aromatic with a creamy texture and a sweet distinctive taste. Grains with darker colours darken the water during cooking. They are cooked quickly and there is no need to soak them. The weight of 100 seeds ranges from 6 to 30 g.

BEAN GENETIC RESOURCES COLLECTIONS

Bean collections are stored in many gene banks around the world. The largest platform, Genesys, contains data on 117,000 accessions of the genus *Phaseolus*. Most of them belong to common beans (86%). The remaining samples consist of lima (6%), scarlet runner (4%), tepary (1%) and year-long beans (0.5%). About two-thirds of the accessions are local varieties.

The EURISCO catalogue contains data on 48,149 samples of common beans, 53 of which are Macedonian local varieties - 30 accessions of dry beans and 23 of green beans. Information on these accessions, containing only passport data, is uploaded by the Agricultural Institute in Skopje.

The largest and the most diverse collection of beans in the world is safeguarded by the seed gene bank of CIAT - International Center for Tropical Agriculture, based in Cali, Colombia. Samples of the stored germplasm in CIAT may be requested for distribution and used for scientific research. CIAT preserves 37,938 accessions of the genus *Phaseolus* of 44 taxa with origin from 112 countries. Out of these, 32,359 are common beans and 958 are scarlet runner beans samples. Most of the collection comes from the beans' countries of origin, but CIAT also preserves germplasm from Europe and Africa, and to a lesser extent from Asia. For security reasons, safety duplicates of almost all accessions are stored in the Svalbard gene bank and, in addition, approximately 3/4 of all accessions are stored in the CIMMYT gene bank in Mexico.

The second-largest collection of beans is maintained by the USDA-ARS, US Department of Agriculture, Agricultural Research Service. The collection of nearly 18,000 *Phaseolus* accessions is housed at the gene bank in Pullman, Washington. Macedonian bean samples, which are preserved in CIAT as well collected by Aladzajkov, preserved in CIAT as well, are included in this germplasm.

The third-largest bean collection is housed by the gene bank at the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gathersleben, Germany. This gene bank preserves 9,004 *Phaseolus* accessions, 8,453 of which are common beans and 458 are scarlet runner beans.

The gene bank of the National Plant Genetic Resources Center in Spain maintains over 3,000 samples of common beans. The Iberian Peninsula is considered a secondary centre of bean diversity due to the developed abundant diversity after bean introduction from America. A core collection of 202 samples was established for a specific study, representing the variability of all samples collected in Spain.

BEAN COLLECTION AT CIAT - AN EXAMPLE OF EFFICIENT USE OF ACCESSIONS

The cost of maintaining collections in gene banks is high, but it is justified when samples are actively used. The CIAT collection is used as breeding material for developing new improved bean varieties. This way, the breeders have successfully developed varieties that contain 60% more iron and 50% more zinc. They also created varieties that can tolerate higher temperatures and increased the yield from 0.7 t/ha to 1.1 t/ha.

The justification for maintaining genetic resources in gene banks is probably obvious in the following example. Seeds stocks of local bean varieties were lost in the flood caused by Hurricane Mitch. They were re-introduced by using germplasm accessions preserved at CIAT's genebank.

COLLECTIONS OF BEAN GENETIC RESOURCES IN NORTH MACEDONIA

Bean collections are preserved in two gene banks. The Agricultural Institute in Skopje has only 7 accessions registered as green beans in the base collection. There are probably more bean accessions in the active collection, at least those that are listed in the EURISCO catalogue, but no data is available on them. The Faculty of Agriculture in Shtip preserves 13 samples registered as green beans and 50 samples registered as dry beans. All of them have the status of local varieties, yet no characterization or origin data are available.

BEANS INVENTORY COLLECTION AT THE FACULTY OF AGRICULTURAL SCIENCES AND FOOD IN SKOPJE

Our collection contains 1,667 accessions of the genus *Phaseolus* that originate from different locations in the country. The varieties grown for green beans are listed separately, but a lot of varieties grown for dry beans are also used for green beans.

		COLLECTED FROM	
	Number of accessions	Settlements	Municipalities
Dry beans	1,373	274	58
Green beans	184	113	38
Runner beans	110	62	29

LOCAL NAMES OF BEAN LANDRACES

Beans are called 'bob' in eastern North Macedonia, 'fasul' in the Gevgelija region, and 'sochio' in the Polog region. The rural inhabitants have specific names for some of their varieties and sometimes they just call them old or domestic seeds.

Climbing beans are named pritkar (pritka means stick) or 'mumuruzar'/ 'pchenkaren' (two words referring to corn) because corn is often planted together as support for beans. Because of this, locals still preserve old corn landraces with incomparably tastier grains when cooked and roasted than those from modern hybrids. Climbing beans require more watering, therefore they are planted in gardens and are often referred to as 'bavchandziski' (garden) or 'voden' (water) beans.

The bush beans are called 'peshak', 'pozemat' or 'legach' (all names mean laying on the ground). They are cultivated at field plots near the houses. Because these beans do not require regular watering, they are often named 'suv', 'sushen', 'suar' or 'susholovec' (referring to dry).

Some names are given according to the stem characteristics, such as 'vitkach' (twiner), 'polzavec' (creeper), 'lozar' (vining) or 'shut' (vineless). They are often combined with seed description: 'prugav' (striped), 'tochkast' or 'prskan' (speckled) beans; then 'ploskach' (compressed), 'dolg' (elongated), 'topchest' (round), 'valavka' (roller), 'bobici' (berries) or 'biser' (pearl), kidney-shaped, 'srpchinja' (sickled) or 'krivki' (curved), and the name 'cacar'. In the Digital Macedonian dictionary, the word 'cacar' is defined as small rounded bean seeds, but we concluded that the locals use this word for small oval seeds instead, while round seeds are named 'valavka'.

Some varieties have specific names (a few cannot be translated), for example, 'kordar' ('korda' means pod), 'stolisnik' (with 100 leaves), 'brzak' (early-maturing), 'krski', 'bostandziski' (like melons), 'sobra', 'lovdziski' (hunters'), 'oroz', 'logavec', 'kokar', 'krshach' (breakable) or 'pesok' (sand). Others just indicate the origin, such as 'Tetovo beans'. Names often combine several words – 'zholt peshak' (yellow bush bean), 'bel ploskach' (white compressed), etc.

Green bean varieties are named in the same manner as dry beans, or according to the pod characteristics – 'zlatna' (golden), 'zelena' (green), 'bela' (white), 'puter' (butter), 'makaronka' (macaroni), 'korupchava' (crusty) or 'bezzhilnjak' (stringless). Scarlet runner beans are also listed in the literature as multi-flowered beans, due to their former Latin name *P. multiflorus*. In the eastern part of the country, they are known as 'bivolar' (buffalo's) because of their large seeds.

DISTRIBUTION OF BEAN LANDRACES IN DIFFERENT SEED SHAPES AND COLOURS

Two or three different bean landraces were planted in many gardens, usually one white-seeded and one with coloured seeds. Therefore, most of the collected samples have white seeds. White, coloured and patterned seeds are almost equally present in the green beans collection because they were selected based on the appearance or taste of the green pods. Thus, a lot of the samples have white or black, narrow cylindrical seeds that fit well in thin pods, but there are also samples with wide oval coloured seeds.

More than half of the white-seeded samples are kidney-shaped and vary in size. Among them is the Tetovo bean with large white flattened kidney seeds, which is very popular and grown all over the country. Seeds in oval and round shapes are the most distributed among the rest of the white-seeded samples, while the samples with narrow cylindrical seeds are the rarest.

A large share of the coloured bean samples belongs to landraces with light green oval seeds and light or dark yellow kidney seeds, which are often cultivated by the inhabitants who claim that these types of seeds do not cause digestion problems. Landraces with cream kidney and light or dark brown oval seeds are often grown as well, while those in a black and dark red colour are the rarest because beans are not traditionally used for salad in North Macedonia.

The most appealing seeds to us were those similar to anasazi, appaloosa and caparron beans. We call them bicoloured because one area of the seed coat is white and the rest is black, dark red, lilac, brown, orange, or patterned in several colours. There are usually coloured patches on the white areas as well. The coloured areas may be small, sometimes only near the hilum, or they may cover half or larger area of the seed, positioned horizontally or vertically. Most bicoloured seeds are oval or round, while elongated kidney seeds are much rarer.

There are samples of patterned seeds with different combinations of colours, patterns and shapes. The most popular ones are cranberry (cream or pink with dark red stripes) and pinto beans (cream with brown stripes and speckles). Samples with seeds in shades of brown or grey with wide dark stripes are less common. Seeds in one primary colour, speckled with a second darker colour and striped in a third darkest colour are the rarest.

Since a table containing all possible combinations would be too large, we presented the distribution of the samples in four groups according to seed colour.

Distribution of samples in different colours at the bean collection preserved by the Faculty of Agricultural Sciences and Food

Species		NUMBER OF ACCESSIONS WITH				
		White seeds	Coloured seeds	Bicoloured seeds	Patterned seeds	Total
Phaseolus vulgaris	Dry beans	672	172	37	492	1,373
	Green beans	62	54	12	56	184
Phaseolus coccineus	Runner beans	45	1	-	64	110

Patterned scarlet runner bean seeds either have a dark cream/brown or purple base colour, while the pattern is dark brown or black. Two pattern types are equally distributed: seeds with sparse speckles and seeds with dense speckles fading to a dark colour at the tip of the seed. These been seeds are in a kidney or oval shape, flattened or ovoid.

We did not group the landraces according to growth habit because this descriptor should be precisely determined in a field experiment. However, according to data given by the inhabitants, we concluded that climbing and bush beans are both equally grown.

In some households, different bean seeds are not separated when they were stored for the next sowing season. The inhabitants plant the mixed seeds and after the harvest, they separate the one type of seeds that they will use for cooking. Seeds in a different colour or pattern can very often be harvested from the same landrace. Since the colour is inherited only from the mother, this is an indication that different landraces were cross-fertilized in the previous years. So, if you sow patterned seeds, they will produce some seeds that are all in only one of the pattern's colours, and vice versa, coloured seeds may produce patterned seeds. Therefore, these landraces or local varieties are in fact populations and are not pure homogenous varieties. If you want to grow a "pure" or uniform variety, then you need to separate and sow only one type of seed that you prefer for several successive years, with no other varieties sown nearby. Even in such conditions, some divergent seeds will be produced due to the beans' genetics.

A SMALL-SCALE COMPARISON OF BEAN COLLECTIONS' DIVERSITY

We also roughly compare the genetic variability present in our bean collection with the diversity of varieties collected by Aladzhajkov from the entire territory of North Macedonia five decades ago. They are preserved at CIAT and can be looked up at https://genebank.ciat.cgiar.org/genebank/bsearchparam2.do.

This collection of Macedonian local varieties is comprised of 424 accessions, 406 of which are common bean, 17 scarlet runner bean and only 1 accession is a year-long bean. Seed and pod photographs, collection site, and some characterization data are available for these accessions. We had a look at this collection and concluded that half a century ago, the inhabitants used to grow both bush and climbing beans, mostly white-seeded. At that time, landraces with yellow and black seeds were grown more often, while landraces with patterned seeds were rarer than today.

It is obvious that diversity in our present collection is much higher. If we had succeeded to collect samples from all inhabited sites in the country, surely it would have been even higher. In addition, we did not analyse the accessions in an experimental trial for their characterization. Only samples with different seed shapes, colours and patterns are presented in this catalogue. However, landraces may have identical or similar seeds but can be different regarding many other characteristics. For example, they may be two different climbing and bush varieties and yet, they may have identical seeds. Until experimentally analysed, the extent of Macedonian bean landraces diversity will remain a mystery to us.

Finally, many of the seeds in our collection are the same as or similar to the seeds of different bean types collected by seed-saving organizations trying to preserve the old landraces. These landraces are promoted as **heirloom varieties**. Some organizations also sell small quantities of the seeds. Most of the varieties originate from America and are noted as extremely rare, but some varieties originate from Italy, Spain and France as well. Web sites of some of the organizations are listed in the literature references of this publication.

Variability of bean seed coat colours in the collection of Macedonian landraces preserved at CIAT

	Common beans	Green beans	Runner beans	Year-long bean	Total
White	232	20	10	-	262
Coloured	28	60	4	1	93
Bicoloured	9	25	-	-	34
Patterned	16	16	3	-	35
Total	285	121	17	1	424

CATALOGUE

NOW YOU MAY TAKE A LOOK AT THE PHOTOS OF OUR BEAN COLLECTION AND DELIGHT IN THE COLOURS AND PATTERNS OF OUR HERITAGE AND PRICELESS TREASURE.

YOU WILL IMMEDIATELY NOTICE THE REASON WHY NORTH MACEDONIA IS A SECONDARY CENTRE OF BEAN DIVERSITY.

BEANS (*PHASEOLUS VULGARIS* L.)

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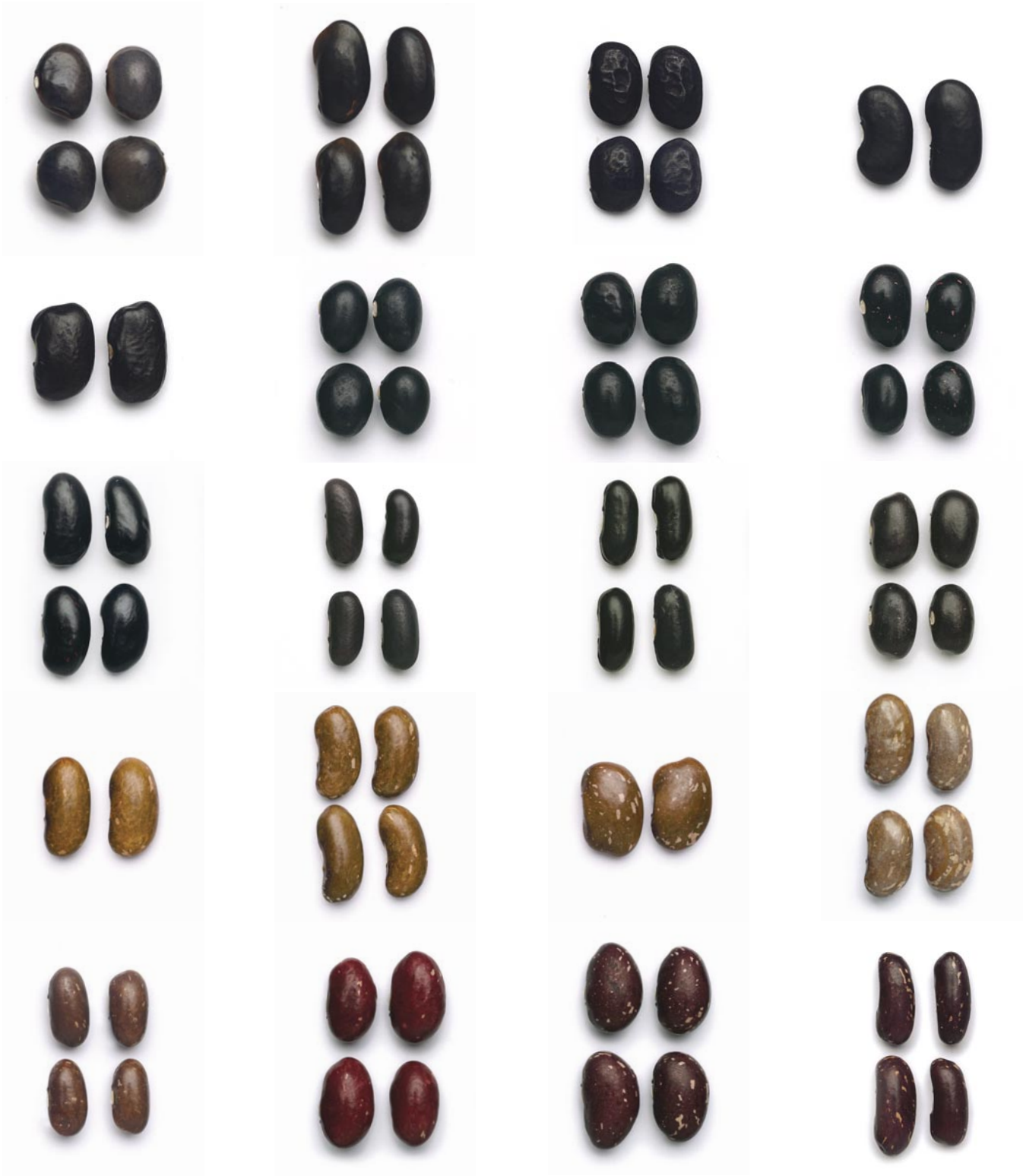

Beans (*Phaseolus vulgaris* L.)

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Beans (*Phaseolus vulgaris* L.)

Beans (*Phaseolus vulgaris* L.)

GREEN BEANS (*PHASEOLUS VULGARIS* L.)

Green beans (*Phaseolus vulgaris* L.)

SCARLET RUNNER BEANS (*PHASEOLUS COCCINEUS* L.)

BEAN PRODUCTION IN OUR COUNTRY AND THE WORLD

Common beans are the most grown in North Macedonia. This table presents data from the State Statistical Office on the harvested area and production of beans as a single crop and as intercrop when grown with corn.

The total harvested area with beans averaged 21,572 ha between 1985-1994. The harvested area has been continuously decreasing in almost all of the following years, but the decrease is way more significant for the intercrop production area which has been reduced by half. On the other hand, the average yield has increased, and many years it has reached over 1 t/ha when grown as single crop. Agricultural areas for many crops have been decreasing in North Macedonia and this trend does not only apply specifically to beans. On the contrary, the demand for beans and their price have been increasing in recent years.

Beans production in North Macedonia in the period 1985–2019

	SINGLE CROP			INTERCROP			Total area (ha)	Total production (t)
	Harvested area (ha)	Production (t)	Yield kg/ha	Harvested area (ha)	Production (t)	Yield kg/ha		
1985 – 1994	6,022	4,593	763	15,550	7,222	464	21,572	11,815
1995 – 2004	6,570	6,179	944	10,309	7,239	719	16,879	13,418
2005 – 2014	4,841	5,759	1,189	8,942	6,881	769	13,783	12,640
2015	4,783	5,569	1,164	8,795	7,789	886	13,578	13,358
2016	4,817	6,251	1,298	8,663	6,709	774	13,480	12,960
2017	4,703	4,867	1,035	8,472	5,095	601	13,175	9,962
2018	4,577	4,992	1,091	8,545	7,256	849	13,122	12,248
2019	4,504	4,886	1,085	8,511	5,933	697	13,015	10,819

According to FAO data, Myanmar and India dominate among the world bean producers with over 5 million tons in 2019. Brazil produced almost half of that, followed by Tanzania and China with over 1 million tons. Yield varies greatly depending on the species and varieties used in production because their genetic yield potential is very different regardless of what conditions they were grown in.

Largest bean producers in the world (in '000 tons)

	1961-2015		2016		2017		2018		2019	
	t	kg/ha	t	kg/ha	t	kg/ha	t	kg/ha	t	kg/ha
Myanmar	1,105	763	5,084	1,648	5,338	1,707	5,592	1,767	5,847	1,826
India	2,955	351	5,890	415	6,340	417	6,220	418	5,310	418
Brazil	2,583	652	2,621	1,013	3,046	1,087	2,916	1,028	2,907	1,113
Tanzania	395	666	1,192	1,145	1,428	1,276	1,097	1,223	1,197	1,340
China	1,675	1,173	1,206	1,644	1,334	1,756	1,338	1,776	1,310	1,741
Uganda	387	790	810	1,670	1,012	1,685	940	1,761	980	1,816
USA	1,056	1,675	1,302	2,065	1,291	2,307	1,108	2,377	932	1,980
Mexico	1,019	597	1,089	691	1,184	728	1,196	749	879	728
Kenya	294	535	728	622	846	821	837	711	747	640
Burundi	261	977	376	639	371	646	393	656	619	630

POTENTIALS TO EXPORT BEANS IN EUROPE

India, Myanmar and Brazil are the major bean consumers, contributing to about 1/3 of world consumption. They are followed by several African countries and Mexico. China has had the largest increase in consumption in recent years. Yearly, per capita, the biggest amount of beans is consumed in Niger (111 kg), Myanmar (72 kg) and Burkina Faso (35 kg). Keeping up with the increasing demand for beans in the world, consumption is expected to increase by about 2% by 2030, i.e., production will have to increase to 48 million tons.

Domestic bean production in Europe does not satisfy the demand needs and therefore the imports range from 450 to 500 thousand tons. In recent years, developing countries have exported a smaller quantity of beans to the EU. China, as one of the major exporters, is directing production to domestic needs. This is the reason why Europe is interested in locating new sources for bean imports, especially for organically produced beans. Italy is the largest importer and leader in the production of canned beans, whose largest consumer is England. Red kidney beans and white beans are the most sought after in England.

For many years now, healthy food has been promoted in Europe and the consumption of plant proteins has been stimulated. Beans are an important source of proteins for vegans, vegetarians and flexitarians (people who only occasionally eat meat). The further promotion has great potential because the consumption of beans is currently lower (0.8 kg/capita) than in other regions of the world.

In Europe, beans are sold as dry grains for cooking or as various processed foods: canned boiled beans or as an ingredient in various prepared dishes, salads and soups. Recently, flour and extracts, obtained mostly from white seeded beans, have been very popular. The flour is used for bread for sandwiches and snacks, while white, coloured and patterned seeds are used in prepared meals. Every year many new bean products are launched in the EU.

Although North Macedonia is a small country and cannot produce a large quantity to satisfy EU needs, targeted government policy and support can promote and encourage bean production. The support should primarily be directed to the Tetovo bean, which is well-known in the region and beyond due to its special taste and quality. It fully meets the visual and taste criteria of the most sought-after type of bean in Europe. Additionally, other varieties grown in the villages with white, coloured and patterned seeds should be promoted. Many of them are bush bean types, so growing without plant support would be much easier and cheaper. They could be exported as exotic or as processed traditional products, and large quantities of them would not have to be provided.

START A NEW HOBBY – GROW BEANS IN YOUR GARDENS

To start your new hobby, first, get acquainted with the beans by growing only a few plants in your garden. Pole bean is an ornamental plant that produces many leaves and flowers, especially scarlet runner beans that were brought to Europe solely for that purpose. Place it next to the railings that will support it and relish in its colours. You will have fresh green beans all summer, and you will collect dry seeds in the fall. Experiment with different varieties and determine your tastes. In addition to providing healthy food for yourself, you will also contribute to the conservation of Macedonian genetic resources.

In this section, we present the practices for growing beans in small areas and even in pots.

If you grow pole beans, you must provide support - a fence or pricks, or you can apply the Native American method "Three sisters". It is a combined crop of beans, corn and pumpkin, in which each crop benefits from the others. The corn supports the beans, large pumpkin leaves retain soil moisture and the beans fertilize the soil with nitrogen. Bush bean plots can be placed anywhere since they have a shorter vegetation and you will replace them with other plants after they dry. The yield varies depending on the variety, but growing 4-8 pole bean plants or 10-15 bush bean plants for each member of your family should be enough.

CHOOSE A GOOD LOCATION

It is best to sow the beans in a spot that's entirely covered with sunlight and protected from the wind, on which you have not grown beans in the previous 2-3 years. Plant pathogens can survive in plant debris. If you have never grown beans on that location before, then you may treat the seeds with a Rhizobium inoculant to stimulate the yield.

The soil should be rich in organic matter and should preferably have a pH value of 6.0-6.8. The optimal temperature for plant development is 10-27°C, therefore you should adjust the entire growing season to that time of year. Pods may not set at higher temperatures.

Beans can grow in partial shade, on sandy, stony, and even clay soils, but will produce less yield.

Bush beans produce pods for about 1-2 weeks and then they dry. If you grow them for a continuous harvest of green pods, sow a succession crop every 10 days until mid-summer, so you have immature pods all summer long. The vegetation of pole beans ends when the first frost in fall comes. They produce pods for about 6-8 weeks, and immature pods can be harvested every 2-3 days. In a suitable indoor environment, they can produce pods until winter.

HOW TO SOW THE BEANS?

Make furrows 40-50 cm wide and 30 cm deep, add a 10 cm layer of manure or compost, cover it with 10 cm of soil and add another layer of manure. Fill the furrow with the remaining soil so that you get a slightly higher sowing row. The water will drain easier in rows and the soil will warm up faster in the spring so that the seeds can germinate. You will also get irrigation furrows between the rows.

You can sow the beans in spring after the possible threat of late frost has passed or when the soil temperature has reached at least 10°C. This usually coincides with the end of April or the beginning of May. Lima and scarlet runner bean prefer slightly warmer climates and therefore they are sown a bit later. Generally, they are sown after the holiday St. Jeremiah (May 1st) has passed. If you're striving for an earlier harvest, you can produce transplants. Place the seeds 3-4 weeks earlier

in biodegradable or paper containers and store them indoors at 18°C. The seedlings are then transplanted outdoor together with the pot so that their roots are not damaged.

It is best to use seeds up to two years old when sowing. Place the seeds 2-3 cm deep in the soil with the "eye" facing downward. For bush beans keep 30 to 60 cm distance between the rows and 10 to 30 cm within the rows, and for pole beans keep 70 to 90 cm between the rows and 10 to 15 cm within the rows. You can sow the pole beans in hills 1 m apart, with 5-6 seeds in the hill. Dense sowing always increases the possibility of diseases. Immediately place the support after sowing the seeds.

If you do not have a garden, start your new hobby on the balcony. You can grow bush beans in pots about 20 cm wide and 20-30 cm deep.

Do not soak the seeds with water before sowing and do not water them too much after sowing because they can crack and have difficulty germinating. The seeds will germinate after 8-10 days, or after 20 days at lower temperatures. Leave the seedlings dense so that they can support each other. After 6 days, both cotyledon leaves will rise above the ground, and after 10 days, both primary leaves will be formed. The cotyledons will fall off around 2 weeks after germination when the plants are about 10-12 cm tall. You can cut the weak plants, leaving only the strongest ones at a distance of 10 to 15 cm. Do not pull them, so as not to damage the roots of the ones that remain.

NURTURE THE PLANTS

Keep the soil moist up to a depth of 15 cm. Hoe carefully as the beans have shallow roots. When bean leaves overshadow the ground, they will suppress the weeds. You can also mulch the ground with a layer of hay, compost or plastic on the surface.

Wrap the first vines around the support, then the plants will start vining themselves. They will have 3-4 internodes and 3-4 trifoliate leaves about 1 month after sowing and they will start flowering a week later. Irrigate regularly, especially during flower and pod set growth stages. If the soil is dry or the temperature is very high during pollination, flowers may not set at all or they may fall off, and pods may not produce seeds. On the other hand, if there is too much water, the small pods may fall off and the plants may be more susceptible to diseases. Always irrigate early in the morning, between the rows. Do not sprinkle the plants with water and do not touch the wet leaves so that they do not get sick. If the leaves wilt in the afternoon, this does not mean that the plants have no water. If they are wilted in the morning, water immediately.

You do not have to additionally fertilize the bush beans. Pole beans can be fertilized when producing pods with a solution of compost or organic manure or with liquid manure containing potassium and phosphorus. Do not fertilize with nitrogen as the plants fix a portion of their nitrogen needs from the atmosphere.

The best way to prevent diseases is to take good care of the plants. However, if pests and diseases occur, treat the plants with appropriate pesticides according to the instructions. If signs of a viral disease appear, such as green and yellow mosaic leaves, it is best to remove those plants.

HARVEST THE FRUITS OF YOUR LABOUR

Harvest green beans when they are tender and immature. The more pods you pick from the plants, the more flowers and pods will set. If you let them mature, the plants will stop growing and they will dry out. Pole beans produce new pods until the first frost. Cut the pods with scissors or your fingers, do not pull them from the stem.

The seeds fill for 3-7 weeks, maturing when they reach around 50% moisture. Then you can pick green older pods with well-developed young seeds to use the seeds for cooking. You will be surprised by the unique taste of these seeds as it is completely different from the taste of dry seeds.

If you want to harvest dry seeds, you must wait for the pods to obtain a straw colour and the seeds to reach 15% moisture. Do not leave the plants to dry out completely, as the pods will crack and the seeds will shatter.

Physiological ripening of the seeds continues after the harvest. To allow the seeds to dry, you should leave the pods in a sheltered and dry space for a few days. Take the seeds out of the pods by hand or by pounding the pods. Remove the pod leftovers and any damaged or unhealthy grains. Seeds with a different colour or shape often appear in beans, you can separate them if you want to. Store them in canvas or paper bags in a cool and dry place to dry down to 11-12% moisture. You can mix them with ash or sand, or coat them with vegetable oil to prevent diseases. Seeds can be stored in suitable closed containers or a deep freezer. If kept in inappropriate conditions, they will change their colour, texture and taste. Do not mix seeds of different harvests and varieties.

INTERESTING FACTS ABOUT BEANS

- Beans have probably been part of the human diet since the beginning of manhood.
- Beans that were grown thousands of years ago are genetically very similar to the beans that are grown today.
- In the 1980s, bean seeds older than 1,500 years were found in New Mexico. They sprouted and grew.
- Beans were left in the tombs in ancient Egypt as food for the departed and their souls in the afterlife.
- The ancient Greek philosopher and mathematician Pythagoras strived to avoid eating meat and thus he is considered the father of vegetarianism. However, he hated beans with a passion. Not only did he avoid eating them, but was also afraid to touch them because he believed that the soul passed through the bean stems and roots on their way to the Underworld. His aversion eventually caused his own misfortune. According to legend, Pythagoras escaped from an enemy that was chasing him and came across a field of beans, but he refused to enter it to hide and was killed.
- In ancient Greece, public officials were elected by chance, using beans. They put 100 beans inside a wheel, all of them but one were black. The person who got the white seed was chosen.
- Legumes were highly appreciated in Ancient Rome. In fact, they were so precious, that four prestigious families took their names. Lentullus, Piso, Cicero, and Fabius come from the Latin names of lentils, peas, chickpea and broad bean, respectively.
- The world record for the biggest pot of baked beans (5,600 litres) in the Guinness Book of World Records is held by North Macedonia. It was prepared on 7 August 2012 in the village Sarchievo near Shtip.
- The Guinness world record is 14.1 m for the longest bean stem and 121.9 cm for the longest bean pod.

- Bean day is celebrated on October 26 in the Municipality of Tearce, North Macedonia.
- While the Senate is in session in the USA, the senators must be served bean soup every day, regardless of the weather. This resolution was implemented in 1907.
- Bean, as part of military strategy, is one of the symbols and fondest memories of the Yugoslav National Army in the former Yugoslavia. It has been served since 1805 and was mainly prepared without meat at the time. The secret taste is achieved with quantity when prepared for at least 500 servings.

WHAT ELSE IS THE BEAN PLANT USED FOR?

Plants are not only used for food but as animal feed or biofuel as well. They make quality hay or silage, especially in low production years when no pods have been produced and nutrients have remained in the stem and leaves.

Beans are often sown for green manure because they fertilize the soil with nitrogen.

FOLK BELIEFS ABOUT BEANS

- Beans are used to predict the future by throwing seeds and interpreting the position they land in. This practice is called favomancy. The term comes from the Latin name of the broad bean (Vicia faba). It is used by many people and it probably originated in the Middle East.
- Native American mythology includes a myth about a coyote that steals a bag of beans and scatters them through the sky, thus creating the Milky Way.
- According to Indo-Germanic beliefs, beans are a favoured food of the souls of the dead. Therefore, lean beans are served every Christmas Eve to make a symbolic connection to the ancestors.
- Newlyweds are given a bowl of beans as a symbol of good luck in Nicaragua.
- Magic bean seeds that protect from the evil eyes of the devil and help in childbirth are mentioned in English folklore.
- Turks have used beans for magic love rituals.

- A general belief in Bosnia and Herzegovina is that a person should not change their clothes before sowing beans because this will cause their flowers to fall off and that beans should be sown in the afternoon so that they are cooked faster.
- In the Kumanovo region, cooked beans were served on the day of Saint Varvara (December 4) to protect the crops from hail. In Bulgaria, on the other hand, beans and lentils are avoided on this day so that chickenpox wouldn't leave scars the size of bean seeds on people's skin.
- In the village of Orman near Skopje and its neighbouring villages, it was believed that in order to get married sooner, boys and girls should carry a bean that has been passed through the mouth of an excised snake's head.

BEANS & IDENTITY

Native Americans developed a catalogue of medical applications of different types of beans. Each tribe used different varieties to treat many diseases - from skincare to snake bites. They "restored health and identity" with beans.

IMPROVE YOUR HEALTH EAT BEANS

Legumes are an extremely healthy food because they increase life longevity and reduce the risk of diseases. To encourage their use, FAO has declared 2016 the International Year of the Legumes.

Other than eating fast food, a possible cause of various health problems is the disproportionate share of cereals and legumes in the human diet. This ratio should be 2:1, but it reaches up to 9:1 in modern-day diet. Let's reduce it together. In this section, we will introduce you to the nutrients of beans and their health benefits.

What don't you know about beans? Many of you mistakenly group them into starchy foods along with rice and pasta. But beans have a great nutritional value that will satisfy a significant part of the daily needs for almost all necessary nutrients. They are an excellent source of protein, fibre, carbohydrates, vitamins, minerals and antioxidants.

Therefore, they occupy two places in the food pyramid:

1. Dry seeds contain 20-30% crude proteins, more than other types of plant-based foods, especially vegetables. They are therefore grouped with meat, fish, eggs and nuts and present in various diets as a meat substitute. In terms of protein requirements, 100 g of cooked beans replace 50 g of lean meat.
2. Due to the high fibre and minerals content, they also belong to the group of vegetables.

We will try to describe the various effects of the bean nutrients on you. All of the following tables present the nutritional composition of different types of common beans and lima bean. The data are taken from the USDA FoodData Central database and refer to 100 g of mature seeds cooked in water without salt. *(https://fdc.nal.usda.gov/fdc-app.html#/?query=cooked%20beans*

		GREAT NORTHERN	NAVY	WHITE	GREAT LIMA	BABY LIMA	RED KIDNEY	PINK	CRANBERRY	PINTO	BLACK	YELLOW
Water	g	69.0	63.8	63.1	69.8	67.2	66.9	61.2	64.7	63.0	65.7	63.0
Energy	kcal	118	140	139	115	126	127	149	136	143	132	144
Proteins	g	8.33	8.23	9.73	7.80	8.04	8.67	9.06	9.34	9.01	8.86	9.16
Total lipid (fat)	g	0.45	0.62	0.35	0.38	0.38	0.50	0.49	0.46	0.65	0.54	1.08
Ash	g	1.14	1.30	1.75	1.15	1.12	1.09	1.34	1.09	1.17	1.15	1.50
Carbohydrate	g	21.1	26.1	25.1	20.9	23.3	22.8	27.9	24.5	26.2	23.7	25.3
Total fibre	g	7.0	10.5	6.3	7.0	7.7	7.4	5.3	8.6	9.0	8.7	10.4

PROTEINS

Beans contain 2-3 times more proteins than cereals. They are high-quality proteins, consisted of all essential amino acids, especially the lysine present in higher quantities. Only methionine and tryptophan are below the optimal level. These two amino acids are present in cereals, which in turn are deficient in lysine. Therefore, you should balance your diet by combining beans and cereals. Lysine has a key role in human metabolism and it is also a part of collagen structure. Our body cannot synthesize it, so we must obtain lysine from our diet.

Phaseolin is a major storage protein in beans, accounting for up to 50% of the total nitrogen in the seeds. Therefore, the nutritional quality and quantity of beans are determined by the phaseolin content. This protein inhibits the activation of the α-amylase enzyme

which breaks down carbohydrates. This means that the carbohydrates you have ingested through food will not be completely digested and absorbed by your body. In other words - eat beans and lose some extra weight.

Bean proteins are naturally gluten-free and are a great source of vegetable proteins for people with celiac disease.

CARBOHYDRATES

Carbohydrates make up 50-70% of the seeds' dry matter. They provide calories or energy to our diet. However, not all carbohydrates provide energy. Seeds contain simple sugars, such as glucose, which provides immediate energy. Starch is the major component of complex sugars (45%). It degrades more slowly and incompletely because it contains more amylose, unlike cereal starch. A lot of the starch, especially in black beans, is oligosaccharides and resistant starch. They do not break down in the stomach and small intestine due to a lack of enzymes in the human body. This means that they do not immediately convert into glucose, which would raise blood sugar levels. Therefore, beans have a low glycaemic index (GI 20), compared to baked potatoes (GI 85), bread (GI 77), and whole-grain

Amino acid content in various bean types (g)

AMINO ACIDS	GREAT NORTHERN	NAVY	WHITE	GREAT LIMA	BABY LIMA	RED KIDNEY	PINK	CRANBERRY	PINTO	BLACK	YELLOW
TRYPTOPHAN	0.1	0.1	0.12	0.09	0.1	0.1	0.11	0.11	0.11	0.11	0.11
THREONINE	0.35	0.29	0.41	0.34	0.35	0.37	0.38	0.39	0.33	0.37	0.39
ISOLEUCINE	0.37	0.39	0.43	0.41	0.42	0.38	0.4	0.41	0.43	0.39	0.41
LEUCINE	0.67	0.7	0.78	0.67	0.69	0.69	0.72	0.75	0.77	0.71	0.73
LYSINE	0.57	0.52	0.67	0.52	0.54	0.6	0.62	0.64	0.63	0.61	0.63
METHIONINE	0.13	0.11	0.15	0.1	0.1	0.13	0.14	0.14	0.12	0.13	0.14
CYSTINE	0.09	0.08	0.11	0.09	0.09	0.09	0.1	0.1	0.08	0.1	0.1
PHENYLALANINE	0.45	0.47	0.53	0.45	0.46	0.47	0.49	0.51	0.53	0.48	0.5
TYROSINE	0.24	0.2	0.27	0.28	0.28	0.24	0.26	0.26	0.21	0.25	0.26
VALINE	0.44	0.5	0.51	0.47	0.48	0.45	0.47	0.49	0.52	0.46	0.48
ARGININE	0.52	0.42	0.6	0.48	0.49	0.54	0.56	0.58	0.49	0.55	0.57
HISTIDINE	0.23	0.21	0.27	0.24	0.25	0.24	0.25	0.26	0.25	0.25	0.26
ALANINE	0.35	0.37	0.41	0.4	0.41	0.36	0.38	0.39	0.41	0.37	0.38
ASPARTIC ACID	1.01	1.06	1.18	1.01	1.04	1.05	1.1	1.13	1.13	1.07	1.11
GLUTAMIC ACID	1.27	1.26	1.48	1.1	1.14	1.32	1.38	1.42	1.45	1.35	1.4
GLYCINE	0.33	0.33	0.38	0.33	0.34	0.34	0.35	0.37	0.37	0.35	0.36
PROLINE	0.35	0.45	0.41	0.35	0.37	0.37	0.38	0.4	0.52	0.38	0.39
SERINE	0.45	0.48	0.53	0.52	0.54	0.47	0.49	0.51	0.57	0.48	0.5

rice (GI 50). In addition to this benefit, undigested starch passes into the colon where it ferments with the help of beneficial bacteria and acts as a prebiotic.

DIETARY FIBRE

Complex sugars in beans are composed of 18-20% of starch polysaccharides or dietary fibre, 2/3 of which are insoluble. This amount is much higher than in other grain crops. In addition to providing a feeling of satiety, fibre keeps our digestive tract healthy and functional. Soluble fibre trap cholesterol from food in the digestive tract and help prevent its absorption. They help lower blood cholesterol levels. Also, due to the slow digestion of the fibre, the sugar level is kept stable at all times, without sudden rises. That is why beans are an ideal food for people with diabetes.

Fibre, along with resistant starch and oligosaccharides, ferment in the colon. This creates gas, which is the reason why many people avoid eating beans. However, fermentation also provides the prevention of colon cancer. On the other hand, the gases are reduced by soaking the seeds in water before boiling them.

FATS

Like other plant foods, beans do not contain cholesterol. The seeds have a low-fat content (1.5-2%) and it is especially important that 60 to 75% of fats are unsaturated. Polyunsaturated fatty acids, especially omega fatty acids (linolenic and α-Linolenic acid), along with dietary fibre reduce the risk of coronary heart disease, metabolic syndrome, stroke, high blood pressure, diabetes, some gastrointestinal diseases and overweight. They also have a positive effect on chronic obstructive pulmonary diseases.

Fat content in different bean types (g)

FATTY ACIDS	GREAT NORTHERN	NAVY	WHITE	GREAT LIMA	BABY LIMA	RED KIDNEY	PINK	CRANBERRY	PINTO	BLACK	YELLOW
Total saturated	0.14	0.10	0.09	0.09	0.09	0.07	0.13	0.12	0.14	0.14	0.28
Total monounsaturated	0.02	0.14	0.03	0.03	0.03	0.04	0.04	0.04	0.13	0.05	0.09
Total polyunsaturated	0.19	0.49	0.15	0.17	0.17	0.28	0.21	0.20	0.24	0.23	0.47

VITAMINS AND MINERALS

No other food has the potential to provide us with as much protein, fibre and minerals at the same time as beans. Compared to other legumes and cereals, beans have the highest content of minerals and vitamins. It has been confirmed that 100 g replace 100 g of vegetables. Including beans in the regular diet is important for vegetarians and vegans because they contain 11% iron per 100 g serving. Grains are also rich in magnesium, calcium, phosphorus, copper, zinc, aluminium, manganese and selenium, and are naturally low in sodium. One serving of beans contains 300-400 mg of potassium, a quantity similar to that obtained from a glass of cow's milk.

Out of the vitamins, seeds have a high content of folates (vitamin B). With one serving of beans, we can satisfy up to 95% of our daily needs. They are necessary for the formation of red blood cells and the development of the embryo's nervous system in the early stages of pregnancy. They also reduce the levels of homocysteine, an amino acid that contributes to heart attack and stroke, peripheral vascular disease, osteoporosis, Parkinson's and Alzheimer's disease. More folate content is reduced by rapid soaking of the seeds than by prolonged soaking.

In addition, the seeds are a good source of B vitamins: thiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6) and folic acid (B9). Although beans are low in fat, they contain vitamins E and K. Vitamin E is a powerful antioxidant preventing infections, while vitamin K is important for bone health and reduces the risk of cancer.

Mineral and vitamin content in different types of beans

		GREAT NORTHERN	NAVY	WHITE	GREAT LIMA	BABY LIMA	RED KIDNEY	PINK	CRANBERRY	PINTO	BLACK	YELLOW
Calcium, Ca	mg	68	69	90	17	29	28	52	50	46	27	62
Iron, Fe	mg	2.13	2.36	3.70	2.39	2.40	2.94	2.30	2.09	2.09	2.10	2.48
Magnesium, Mg	mg	50	53	63	43	53	45	65	50	50	70	74
Phosphorus, P	mg	165	144	113	111	127	142	165	135	147	140	183
Potassium, K	mg	391	389	561	508	401	403	508	387	436	355	325
Sodium, Na	mg	2	0	6	2	3	2	2	1	1	1	5
Zinc, Zn	mg	0.88	1.03	1.38	0.95	1.03	1.07	0.96	1.14	0.98	1.12	1.06
Copper, Cu	mg	0.25	0.21	0.29	0.24	0.22	0.24	0.27	0.23	0.22	0.21	0.19
Manganese, Mn	mg	0.52	0.53	0.64	0.52	0.59	0.48	0.55	0.37	0.45	0.44	0.46
Selenium, Se	µg	4.1	2.9	1.3	4.5	4.9	1.2	1.4	1.3	6.2	1.2	1.3
Vitamin C	mg	1.3	0.9	-	-	-	1.2	-	-	0.8	-	1.8
Thiamine	mg	0.16	0.24	0.12	0.16	0.16	0.16	0.26	0.21	0.19	0.24	0.19
Riboflavin	mg	0.06	0.07	0.05	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.10
Niacin	mg	0.68	0.65	0.14	0.42	0.66	0.58	0.57	0.52	0.32	0.51	0.71
Pantothenic acid	mg	0.27	0.27	0.23	0.42	0.47	0.22	0.30	0.24	0.21	0.24	0.23
Vitamin B-6	mg	0.12	0.14	0.09	0.16	0.08	0.12	0.18	0.08	0.23	0.07	0.13
Folate, total	µg	102	140	81	83	150	130	168	207	172	149	81
Vitamin A	IU	1	-	-	-	-	-	-	-	-	6	2
Vitamin E	mg	-	0.01	0.94	0.18	-	0.03	0.98	-	0.94	0.87	0.94
Vitamin K	µg	-	0.6	3.5	2.0	-	8.4	3.7	-	3.5	3.3	3.5

Units: g - gram, mg - milligram, µg - microgram, UI – international units

POLYPHENOLS

Various bean seeds have different types and amounts of phenolic compounds with individual effects. Their content and type depend on the bean variety, but also the growing conditions because phenols are mostly produced when plants are under stress. They determine the pigments and contribute to the colour of the seed coat. Coloured seeds are especially rich in phenols.

Serving as natural antioxidants, phenols trap free radicals in our body that contribute to heart disease, cancer and ageing. In addition, they act in the prevention of breast, prostate and colon cancers, and they also reduce the amount of cholesterol and other fats in the blood.

Beans contain a variety of flavonoids, tannins and phenolic acids. Flavonoids are natural antioxidants and antimutagenic agents. The darker the colour of the seed coat, the higher the flavonoid content. Anthocyanins are one of the most active flavonoids. The content of anthocyanins in 100 g of black beans is 10 times higher than orange and similar to that of grapes, apples and cranberries.

Recent research has shown that some flavonoids block genes for enzymes that increase blood fat levels. On the other hand, they stimulate genes for enzymes that transport cholesterol from the body back to the liver, thereby lowering cholesterol blood levels. People who ingest higher quantities of phytoestrogens, such as bean isoflavones, have a 44-72% lower risk of developing lung cancer.

ANTINUTRIENTS

Beans contain protease inhibitors, lectins, phytates and oxalates that are classified as antinutrients. Protease inhibitors interfere with protein digestion by inhibiting digestive enzymes. Phytates bind to minerals, especially zinc and iron, a form in which they are less available to the human body. However, about 90% of the total iron in white seeds is soluble and resistant to phy-

tates. Oxalates have the same effect, but they primarily act only on calcium. That is why calcium from beans is less bioavailable than from dairy products.

However, there has been significant research in the last two decades that some antinutrients have antioxidant properties and are beneficial for our health.

Most lectins and protease inhibitors are inactivated after boiling the beans for 10 minutes. Seeds should not be eaten raw or uncooked, as they can cause poisoning, vomiting and diarrhoea. Phytates do not decompose with heat, their effect is reduced when the seeds are soaked in water before cooking.

Oligosaccharides, also classified as antinutrients, are broken down in the large intestine leading to the production of gases.

As scarlet runner beans (*P. coccineus*) are not included in the tables presented above, we used data from a scientific paper listed in the references for this type of bean. The data refer to varieties with white and red speckled seed coats cultivated in Nigeria.

* *Calculate metabolisable energy (protein x 17 + fat x 37 + carbohydrate x 17)*

Nutrient content in scarlet runner bean seeds flour (g in kg dry matter)

	RED SPECKLED SEED COAT	WHITE SEED COAT
Moisture	17.4	16.2
Energy MJ*	3,965	4,025
Crude protein	511.4	526.1
Crude fat	69.5	75.3
Ash	46.1	41.1
Carbohydrate	313.6	301.1
Crude fibre	44.0	40.2
Fatty acids**	55.6	60.2

** *Calculated fatty acids (0.8 x crude fat)*

Amino acid composition, g in kg crude proteins

	RED SPECKLED SEED COAT	WHITE SEED COAT
Threonine	32.3	25.3
Isoleucine	37.8	42.4
Leucine	66.3	72.4
Lysine	31.0	32.7
Methionine	19.1	19.8
Cystine	3.2	4.8
Phenylalanine	40.0	48.3
Tyrosine	33.2	36.0
Valine	32.6	35.4
Arginine	38.5	44.0
Histidine	20.0	24.0
Alanine	34.0	33.7
Aspartic acid	47.9	66.1
Glutamic acid	132.5	172.1
Glycine	29.1	34.4
Proline	29.5	42.4
Serine	30.6	35.6

OTHER HEALTH BENEFITS OF BEANS

Mineral content, g in kg scarlet runner bean seeds

	RED SPECKLED SEED COAT	WHITE SEED COAT
Calcium	595.0	605.0
Iron	103.3	115.1
Magnesium	644.0	665.1
Phosphorus	950.3	831.3
Potassium	377.3	366.5
Sodium	84.2	98.7
Zinc	73.5	82.6
Copper	3.3	1.4
Manganese	10.0	16.3

Additionally, scarlet runner beans contain coccicine peptide with exerted antifungal activity. It is proven that it also inhibits the proliferation of leukaemia cells and reduces the activity of an enzyme that enables the reproduction of HIV.

A decoction made of boiled scarlet runner beans root is used against malaria, as well as for the treatment of skin eczema. It is also applied to treat inflamed and swollen eyes.

Other than the medical effects of the seeds, dry or green pods from all types of beans are used for tea with potent diuretic properties, which prevents high cholesterol, diabetes, lung cancer, urinary tract infections and kidney and bladder stones.

EAT BEANS MORE OFTEN - THERE ARE MANY WAYS TO PREPARE FOOD FROM BEANS

GROW YOUR OWN BEAN SPROUTS

Sprouts are young stems sprouted from germinated seeds. They can be obtained from many different crops and consumed raw. In recent years they have gained popularity because they are nutritious, fresh and crispy. Traditionally, sprouts are an integral part of Asian cuisine.

You can grow your bean sprouts in your own home, but **you should never eat them raw as you would eat the sprouts from other crops.** Raw seeds and fresh bean plants contain toxic substances. Only beans from the genus *Vigna* (mung, adzuki) may be used fresh. You can cook or stir fry them, this way you will avoid the danger of consuming unwanted bacteria that fresh sprouts can be contaminated with.

Sprouts and germinated seeds have a higher nutritional value than dry seeds. Use them cooked in a salad or for different dishes.

EQUIPMENT NEEDED:

A jar with a wider opening and a piece of cheesecloth.

HOW TO GROW SPROUTS

- Clean and wash the seeds thoroughly under running water several times.
- Fill 1/4 of the jar with seeds and pour clean cold water in the remaining 3/4 of the jar. Close it with a mesh lid or a cheesecloth secured with a rubber band. Let them soak for 8-12 hours at room temperature in a dark and cool place.
- Drain the water and rinse the seeds several times.
- If seeds at this stage are not enlarged and germinated, keep them in the jar for another 1 to 2 days. Store the jar horizontally, slightly tilted with the opening facing down so the excess water drains.
- Run fresh water and drain the seeds 3-4 times per day. If seeds sprout even a bit, their nutritional composition will change and improve.
- If not used immediately, store in a tightly closed container in a refrigerator for up to 7 days, depending on their appearance.

TIPS FOR BETTER SUCCESS:

- The older the seeds, the less likely they are to germinate. If possible, use seeds from this year's harvest.
- Do not use seeds that have been vacuum packed, as many of them will not be vital.
- Containers and cheesecloth must be clean to reduce the possibility of contamination.
- Remove diseased or damaged seeds. They can cause contamination and diminish the taste of healthy seeds.
- Seeds in stores or on the green markets are sometimes treated with fungicides and pesticides and are not suitable for sprouting. It is best to produce your own seeds or buy organically produced seeds.

WHY ARE SPROUTS USEFUL?

Dry seeds are vital, but all their physiological processes are kept at the bare minimum. The moment they get wet, intensive metabolic activities begin. Complex compounds are broken down into simpler ones needed to build new different compounds. The biggest transformation occurs in the amount of starch which decreases in order to increase the content of fibre, protein, essential amino acids, fats, minerals and vitamins. Sprouts are much richer in folate, iron, zinc, magnesium, vitamins A, E and C and B vitamins, especially when consumed fresh.

Antinutrients break down at the same time. That is why sprouts are easier to digest and they don't produce gases. As phytates are broken down, minerals in the sprouts also become more available to the human body.

GROW YOUR OWN BEAN MICROGREENS

Bean microgreens are very small plants that have developed their first cotyledon leaves. You can grow them any season at home in soil or hydroponically without soil. The soilless method is safer because the risk of contamination is lower. They have a higher nutritional value compared to sprouts. Because microgreens are used fresh for salad, we emphasize once again that you can consume fresh microgreens only from adzuki and mung beans, as well as from the scarlet runner beans (*Phaseolus coccineus*).

EQUIPMENT:

Any container with drain holes – mesh, colander or strainer that fits inside another container to drain water, preferably with a lid.

HOW TO GROW MICROGREENS

- Clean and wash seeds thoroughly. Soak them in water for 20 minutes and rinse 3 times.
- Soak in freshwater for at least 8 hours. After they swell, pour the water and rinse 3 times.
- Spread the seeds out on a sheet of paper for 30 minutes to drain excess water. This will prevent mould, while the seeds will remain wet.
- Scatter the seeds on mesh with larger holes for roots to pass through them. Place the mesh in a container to hold drained water and cover it with a lid.
- Spray the seeds with water twice a day and regularly remove the drained water from the container.
- After 3 to 7 days the seeds will sprout and develop larger roots under the mesh. The roots should reach the drained water in the container, but the stems that grow above the mesh should not.
- Keep the container covered or in the dark until small leaves appear. Then keep it uncovered next to a well-lit window avoiding direct sunlight.
- The two cotyledon leaves will fully develop after 5 to 7 days in sunlight when plants are about 7-10 cm tall. Then you can use the microgreens, just cut them with scissors above the mesh.

YOU CAN PREPARE VARIOUS BEAN DISHES

You can use completely mature and immature seeds and immature pods (green beans) to prepare various dishes, but they must be cooked. Dry seeds are also used to produce flour, which is mixed with cereal flour to make protein bread, pastries and snacks. This way, the products are not allergenic, they taste and look better and they absorb less oil. The flour is also added to fruit drinks and minced meat products. Some types of beans, especially in Asia and Africa, are used to prepare various desserts.

YOU MIGHT NOT KNOW

Many parts of the scarlet runner bean plant are edible and used in some regions of the world. Young stems and leaves, immature pods, inflorescences, and even the flowers can be eaten fresh as vegetables, boiled or fried. You can use the fresh flowers as a salad; they taste similar to beans. The roots are starchy tubers but may also contain some toxic substances. Therefore, first, they are soaked, then cut and boiled and after the water is removed you can eat them or chew them like candy.

HOW TO PROPERLY COOK BEANS?

Dry beans will retain their nutritional value and lose some of their antinutrients when soaked before cooking. Soaking will also reduce the cooking time and the amount of foam during boiling, and the cooked seeds will be more tender. There are three different soaking methods:

- **Cold soaking:** soak the beans with cold water for 8 hours or overnight;
- **Quick hot soaking:** cook the beans for 5 minutes and leave them in the cooking water for 1 hour;
- **Long hot soaking:** cook the beans for 5 minutes and leave them in the cooking water for 24 hours.

Soak the beans in plenty of water as they will expand and double the volume. Finally, drain the water and rinse them several times before cooking. The long hot soaking method reduces gas-producing compounds the most.

Do not mix beans of different varieties because they all have a different cooking time. Water should always cover the beans as they cook. Simmer gently on low heat to prevent split skins. Before you start cooking, add two tablespoons of oil to prevent foaming. You can add vegetables and spices in the beginning if desired, keeping in mind that the beans will absorb their taste. If you wish so, you may add salt and tomato sauce after the beans are cooked. The cooking time is longer if the water is hard or the beans are older or grown at higher altitudes. Fully-cooked beans are tender inside, but still firm, wittheir skin intact and they can be mashed easily.

Consumers favour varieties with more desirable culinary properties, such as tender seeds that do not split, seeds that easily absorb water and cook faster, beans that make thicker broth and have a delicious flavour and aroma, gentle texture, thin skin, and stable colour. The canning industry prefers seeds with a short cooking time that remain intact and retain their colour. Beans with a thinner seed coat usually have a shorter cooking time.

DIFFERENT BEAN TYPES HAVE DIFFERENT COOKING TIMES

90-120 minutes for navy, pinto, and red kidney beans

60-90 minutes for small red and black beans

60 minutes for pink beans

45-60 minutes for lima, cranberry and great northern beans

MAKE YOUR OWN CANNED GREEN BEANS, MATURE OR IMMATURE BEAN SEEDS

Immature bean pods and seeds taste delicious, but you can only use them for a short time. Soon after the harvest, immature seeds will dry out and change their flavour. On the other hand, dry beans always take a lot of time to cook. Canning these products in jars is one way to have them available and pre-prepared throughout the year. Preserve them in large jars if you use the seeds or green beans as your main dish and small jars if you use them as a salad.

Fill the jars with sliced green beans or with immature seeds and pour boiling brine over them. Boil the closed jars in a large pot with water for 30 minutes or use a pressure cooker to do the canning process. Soak the dried seeds in water for 8 to 12 hours before canning. You can also cook them before canning and use the broth instead of brine. If desired, you can add spices or tomato sauce.

IMMATURE BEAN SEEDS ARE A DELICACY

White kidney beans, when immature, have a pale green colour and creamy texture. When cooked at this maturation phase, they have a unique flavour and are highly valued as a delicacy. They are traditionally used in France, popular as flageolet beans. Many families that cultivate beans use immature seeds in our country, but they cannot be found on the markets.

SURPRISE YOUR FRIENDS WITH UNUSUAL BEAN RECIPES

In North Macedonia beans are traditionally prepared as a stew or a baked dish named 'Tavce Gravce'. Recipes for these dishes are published in many cookbooks and on various web pages. Compulsory ingredients in both dishes are oil, onion, garlic, dried and/or fresh peppers and spices. Roux is added at the very end of cooking, except during some religious holidays when beans are prepared without oil. The only difference between these dishes is that when preparing Tavce Gravce beans are boiled in less water and baked in the oven in the end. Both dishes can be prepared with or without meat, but beans are usually cooked with no meat, especially during religious holidays fasting.

The recipes for these two dishes are widely known in the region as well as the world. On the other hand, every Macedonian family has its own recipe that they have followed for many years. Therefore, we decided not to list these recipes in this section. Instead, we consider a few easy-to-make recipes not traditionally prepared in Macedonian cuisine, but adaptable to our preferred taste.

You can use any bean variety in all of the listed recipes. The bean's flavour goes very well with the flavour of fresh cabbage or sauerkraut. You can add it to bean stew or you can stuff cabbage leaves with beans (sarma). Additionally, you can also prepare bean dishes with spinach or other green vegetables.

The filling for the cookies or cakes is usually made of red beans because it is sweeter and the red colour makes it appear decorative. However, you can also use white bean paste and you can add food colouring to it. The taste of beans is not recognizable because it is very similar to the taste of chestnuts. We suggest that you surprise your friends with bean dessert. They will never guess which secret ingredient makes the cookies taste good.

CABBAGE ROLLS STUFFED WITH BEANS (SARMA)

INGREDIENTS

- 1 sauerkraut head
- 250 g white beans
- 3 onions
- 2 garlic cloves
- 1 tablespoon salt
- 1 teaspoon grounded black pepper
- 1 tablespoon ground red pepper
- 3-5 tablespoons oil

PREPARATION

Cook the beans and drain the broth, saving it for later. Separate the leaves from the cabbage, cut off the thick part without tearing the leaves. If the leaves are too large, split them in half. Chop the cabbage remains into small pieces, place them on the bottom of the pot and add some oil.

Chop the onions and fry them in oil in a separate pan until soft. You can use leeks instead of onions when making sarma, and you could also add fried chopped dried peppers and dried tomatoes to the filling. Add beans, salt and spices by taste to the onion and sauté for 5 minutes until the filling is well combined.

Add one spoonful of the filling on each cabbage leaf, roll them to make sarma and place them in the pot above the chopped cabbage. Pour some bean broth, or just a little bit of sauerkraut juice if you want to achieve a slightly sour flavour. Preheat the oven at 200°C and bake for 1 hour. Fry milled red pepper in oil to make the roux. When ready, pour the roux over the sarma and bake for another 5-10 minutes.

BEAN PÂTÉ

INGREDIENTS

- Boiled black bean seeds
- Scallions or onion and garlic
- Salt and spices

PREPARATION

You can make pâté from any common bean or scarlet runner bean seeds and thus you will get black, red or white pâté. Blend the well-drained seeds. The exact measures are not given because you can add garlic, onion, mustard or spices by taste. If you want a slightly smoother pâté, add a little bit of broth from the cooked beans. When mashing the pâté, or if you want to decorate it, you can add parsley, chives or other aromatic herbs. You can also top the pâté with grated white or yellow cheese.

BLACK OR RED BEAN PANCAKES

INGREDIENTS

100 g bean paste

Flour as needed

100 ml milk

50 ml sparkling water

1 egg

PREPARATION

Mix egg, milk, sparkling water and bean paste in a bowl until smooth. Gradually add flour to achieve the required consistency for pancakes. Bake in a preheated lightly oiled frying pan. One side of the pancakes will remain rough and darker due to the grainy structure of the beans, so use it as the outer side when filling as it is more decorative.

Don't add salt to the pancakes so that you can fill them with either sweet or savoury fillings. Black bean pancakes have a brown colour and look good when combined with a filling in another colour. You can prepare a savoury filling from crumbled white cheese or grated yellow cheese, sour cream, mayonnaise, pickled beetroot, fresh or pickled cucumbers, tomatoes, lettuce and other ingredients by choice.

BEAN CHIPS

INGREDIENTS

100 g black or red bean paste

2 tablespoons cooking oil

1 tablespoon salt

Water

PREPARATION

Blend the bean paste with oil and salt. Add water gradually, but make sure that the mixture remains thick and only spreads minimally on parchment paper. Scoop a teaspoon amount of the mixture into balls and place them on a pan lined with baking paper. Slightly flatten the balls with the back of a spoon into circles. They don't have to be identical in shape. Preheat the oven at 160°C and bake for 12 minutes.

Take the pan out of the oven, steadily peel the chips off from the paper with a spatula and flip them. Slightly press the top of each chip with a fork to form a crinkled top. Return the pan to the oven and bake for another 10 minutes. When baked completely, leave to cool and carefully detach them from the paper. Add garlic or spices to the mixture if you want to spice up the taste of the chips.

BEAN CAKE

INGREDIENTS

200 g white bean paste
130 g sugar
2 tablespoons bread crumbs
2 tablespoons flour
1/2 sachet of baking powder
4 eggs
Grated zest and juice from 1 lemon
2 sachets vanilla sugar (20 g)

FILLING

400 ml sweet whipped cream
2 tablespoons icing sugar

PREPARATION

Whisk the egg whites in a bowl until stiff peaks form. In a separate bowl, beat the egg yolks with sugar and 1 sachet of vanilla sugar. Add the grated lemon zest and lemon juice and mix. Add the bean paste and mix at low speed. Mixing with a spoon, gradually add flour, bread crumbs and baking powder. Finally, add the egg whites and mix. Once smooth, pour the mixture into a pan lined with baking paper.

Preheat the oven at 140°C and bake for 30-35 minutes. When checking to see if the cake is baked, keep in mind that it will be a bit softer and wetter than usual cakes. When cooled, cut the cake with a thread into two layers and leave it out to dry out a bit before filling. Coat the first layer with half of the filling and place the next layer. Coat the top and sides of the cake with the rest of the filling.

PREPARING THE FILLING

Whip the sweet cream until stiff peaks and add one sachet of vanilla sugar and 2 tablespoons of icing sugar. You can add coconut flakes, fresh fruit or forest fruit jam to the filling if you would like. You can also make chocolate or any other filling of your choice.

VANILLA SWEETS WITH RED BEANS

INGREDIENTS

- 100-150 g red bean paste
- 200 g wheat flour
- 100 ml plant oil
- 25-50 g icing sugar
- 1 sachet vanilla sugar (10 g)
- 50 ml white wine
- 1 teaspoon baking powder
- 1 egg

PREPARATION

Mix the oil and wine in a bowl, then gradually add baking powder and flour. Initially whisk to mix, and when the dough gets thicker knead it by hand.

To make the filling, mix the bean paste, vanilla and icing sugar in another bowl until a smooth and dough-like texture is achieved. Depending on the desired sweetness you can add 25 to 50 g of icing sugar for every 100 g of bean paste. Whisk the egg in a separate dish.

Divide the dough and the filling each into 4 parts and roll them into long logs. Press the logs into rectangles 12 x 8 cm big and 5 mm thick. Cut the edges off so that they are even and place the filling rolls in the middle of the rectangles. Fold and overlap the remaining dough of each log over the filling and roll them again. Cut the rolls into slices about 2 cm wide and place them on a tray lined with baking paper with the dough facing upwards. The dough won't rise while baked, so you don't need to place them far apart. Brush the dough surface with whisked egg and sprinkle with sesame seeds. Preheat the oven at 180°C and bake for about 15 to 20 minutes. The sweets are ready when their bottom is slightly golden.

BEAN COOKIES

INGREDIENTS

220 g wheat flour
2 teaspoons baking powder
1/4 teaspoon salt
130 g red bean paste
110 g butter
100 g sugar
100 g brown sugar
2 eggs

TOPPING INGREDIENTS

Granulated sugar
Icing sugar

PREPARATION

Add the flour, baking powder and salt to a bowl and whisk them together. In another bowl whisk the softened butter until creamy and white, then add the sugar and mix for about 2 minutes on medium speed. Add beaten eggs and the bean paste. After adding each ingredient, mix at medium speed. Finally, gradually add the flour mixture and mix until combined. The dough should be sticky and thick; add more flour if it is not. Wrap the dough in plastic wrap and refrigerate for 4 hours. Form balls about 1 cm large from the cold dough with oiled hands. Roll each one in granulated sugar, and then in icing sugar until well-coated. Place the balls on a tray lined with baking paper far apart from each other as they will rise.

Preheat the oven at 160°C and bake for about 10 to 13 minutes. If you opt for a shorter baking time, their texture will be softer and wetter on the inside. Take the cookies out of the oven when they still appear very soft, as they will harden up a bit when they cool down. If the baking time is longer, they will be crispier on the outside.

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https://fdc.nal.usda.gov/#:~:text=FoodData%20Central%20is%20an%20integrated,for%20viewing%20on%20mobile%20devices. https://ciat.cgiar.org/

WEBSITES WITH INFORMATION ON HEIRLOOM BEAN VARIETIES

Heritage Food Crops Research Trust
https://www.heritagefoodcrops.org.nz/heirloom-beans/

Baker Creek Heirloom Seeds. rareseeds™
https://www.rareseeds.com/store/vegetables/green-beans

Seed Savers Exchange
https://www.seedsavers.org/quick_find/beans-dry

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GENETIC DIVERSITY OF BEANS
(*PHASEOLUS* SP.)

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