REPUBLIC OF AZERBAIJAN

On the rights of the manuscript

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

INTRODUCTION, BIOECOLOGICAL CHARACTERISTICS AND PHYTOCHEMICAL STUDY OF SOME SPECIES OF THE GENUS *PASSIFLORA* L. IN ABSHERON

Speciality: 2417.01 – Botany

Field of science: Biological science

Applicant: **Vusala Nariman Badalova**

Baku – 2024

The dissertation work was performed at the Institute of Dendrology of the Ministry of Science and Education of the Republic of Azerbaijan.

Supervisor: Doctor of Pharmaceutical sciences, professor
Tahir Abbasali Suleymanov

Doctor of Biological sciences, professor
Zumrud Aman Mammadova

Official opponents: Doctor of Biological sciences, professor
Aydın Musa Askerov

Doctor of Biological sciences, professor
Elman Osman Isgandar

Doctor of Philosophy in Biology,
Associate Professor
Nargiz Habib Mammadova

Dissertation council of ED 1.26 Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the Institute of Botany, MSE RA.

Chairman of the
Dissertation council: Doctor of Biological sciences,
professor
Sayyara Jamshid Ibadullayeva

Scientific secretary of the
Dissertation council: Doctor of philosophy in biology
Nuri Vagif Movsumova

Chairman of the scientific
seminar: Doctor of Biological sciences,
Associate Professor
Naiba Pirverdi Mehdiyeva

INTRODUCTION

Relevance and the degree of development of the topic. The creation of more effective herbal medicines is one of the most important and current problem of our time. Currently, more than 60 medicinal plants are grown on an industrial scale in the CIS countries[1]. Adaptation of new medicinal plants for cultivation (introduction) is considered a long-term and labor-intensive task. In recent years, a sharp increase in interest in technical and medicinal plants has turned the effective use of wild medicinal plant raw materials, the introduction of medicinal plants that do not distributed in our country, and their adaptation to local conditions into a very pressing issue. The growth in demand for medicinal plants with a particularly calming effect was more pronounced in the post-pandemic and post-war period. Stress and stress-related diseases: panic attacks, insomnia, depression, memory loss and other diseases will intensify and worsen by 2030. Many health organizations around the world have sounded the alarm and prepared an action plan in this direction[2].

It should be noted that medicines with a sedative effect, including "Alora", "Passilor", "Novo-Passit", "Persen Forte" and others made on the basis of raw materials of some species belonging to the genus *Passiflora* L., especially *P.incarnata* L. , are successfully used in medical practice. These raw materials and preparations are imported to our republic from foreign countries at high prices. Therefore, during planning the thesis, along with studying the possibilities of introduction of passionflower species in Azerbaijan, as a result of the phytochemical analysis of raw materials, such a direction as replacing imported raw materials at a cheap price was also relevant.

---

[1] Süleymanov, T. Farmakoqnoziya (praktikum) / T.Süleymanov, Y.Kərimov, C.İsayev, – Bakı: Elm, – 2017. – s.22.

[2] Koh, H.K. Flourishing after a pandemic: Healthy People 2030 / H.K.Koh, C.Blakey, E.Ochiai // J Public Health Manag Pract., – 2021, 27(6), – p. 215-217.

Currently, the use of compounds obtained from plant extracts is increasing rapidly, especially in the pharmaceutical industry.

In modern times, the search for new therapeutic antimicrobial agents against pathogenic bacteria showing resistance to existing drugs and the evaluation of their efficiency are among the urgent problems of modern times. In this regard, the study of the antioxidant activities of extracts obtained from some species of the Passiflora genus, the study of antifungal, antimicrobial, anticancer effects with modern methods reflects the relevance of the topic.

Based on the above, the introduction of promising species of the genus *Passiflora* L. in Absheron, the fruits, flowers and leaves of which contain biologically active substances and are a source of raw materials for the purchase of medicinal products and are widely used in landscaping and the food industry, the study of their bioecological characteristics, assessment of criteria for resistance to environmental factors, selection of promising species, and use in various fields of medicine and the food industry are very important and relevant.

The object and subject of the research. The object of the research work was the species *Passiflora incarnata* L., *Passiflora edulis* L., *Passiflora caerulea* L., *Passiflora ligularis* L., which are first introduced to Absheron, belonging to the genus *Passiflora* L. and the family *Passifloraceae*, and the subject of the research was the study of adaptability, morphological, bioecological features and phytochemical composition of these species.

The purpose and objectives of research. The purpose of research was to study the introduction, acclimatization and bioecological characteristics of some promising species belonging to the genus *Passiflora* L. in the dry subtropical climate of Absheron, assessment of their prospects, phytochemical study of the studied species, microbiological analysis, detection of their macro- and microelements and some biologically active substances, application in food industry, medicine and greening.

The following tasks have been set for this purpose:

- Determination of morphological features of seedlings obtained from seeds at the initial stage of development of species belonging to the genus *Passiflora* L.;

- Study of the dynamics of growth and development of aerial and underground organs of 1-3-year-old plants;
- Study of phenological stages of development of passionflower species;
- Determination of biological indicators of flowers and fruits;
- Study of morphological features of fruits and seeds;
- Study of methods of seed and vegetative propagation of *Passiflora* L. species;
- Agricultural technology of the studied species, resistance to some environmental factors, determination of diseases and pests;
- Phytochemical analysis of extracts obtained from raw materials of the aerial parts of the studied species;
- Determination of the amount of macro- and microelements in fruits;
- Study of the antimicrobial activity of raw material extracts against gram-negative and gram-positive bacteria;
- Evaluation of the possibilities and prospects for the introduction of species of the genus *Passiflora* L., study of their use in the food industry, medicine, landscape architecture, greening.

Research methods. Classical and modern methods were used in the research work. Various biological and ecological methods were used to study the bioecological characteristics of the introduced species. Spectrophotometry and chromatography methods were used in phytochemical analysis, DPPH, ABTS, CUPRAC, FRAB and other methods were used to determine antioxidants.

The main provisions submitted for the defence:

1. The suitability of 4 introduced species of the genus *Passiflora* L. to the dry subtropical climate of Absheron, the criteria for the success of their introduction and the economic efficiency of evergreen perennial shrubs provide the use of 1-3-year-old seedlings in landscape architecture and greening;

2. The study of the studied species, the discovery for the first time of flavonoids, which are biologically active substances, proves high antioxidant properties.

3. High nutritional value, as well as macro- and microelements of the fruits of *P. edulis* L. (passion) and *P. ligularis* L. (granadilla), grown in Absheron conditions, testify that the fruits are suitable for use in dietetics and nutrition.

4. As a result of the in vitro analysis of the secondary metabolites of the studied 4 species, high activity against pathogenic microbes and fungi ensures the development of new antimicrobial drugs.

The scientific novelty of the research. For the first time, *Passiflora incarnata* L., *Passiflora edulis* L., *Passiflora caerulea* L., *Passiflora ligularis* L. species imported from different countries of the world were introduced to Absheron and propagated by seeds, their development rhythm, phenological stages and their climatic factors, disease and pest resistance, fruit and seed productivity were studied.

Quantitative and qualitative indicators of the component composition of biologically active substances in the extracts obtained from the aerial parts of the studied species were investigated. The comparative study of the antimicrobial activity and anticancer properties of the obtained substances was carried out in the modern laboratories of Mugla Sitki Kochman University of the Republic of Turkiye and studied on scientific basis.

As a result of the bioecological and pharmacognostic study of 4 species belonging to the genus *Passiflora* L., which were introduced for the first time, promising species with sufficient raw material reserves and a complex of biologically active substances were selected in terms of the preparation of new medicinal drugs.

For the first time, the antioxidant activity of methanol extracts of P. edulis and P. ligularis introduced in Absheron was investigated. As a result of experimental studies, methanol extracts of fruits of *P. edulis* and *P. ligularis* have cytotoxic effect on lung cancer (A549) and colon cancer (HT-29) cells in vitro.

Theoretical and practical significance of research. The bioecological characteristics and decorative characteristics of some species introduced to Absheron for the first time have been studied, which has allowed us to identify highly resistant and decorative

species. Biologically active substances in its composition have been studied using modern methods of physicochemical analysis, antioxidant activity and the total amount of flavonoids have been determined in vitro, antimicrobial and antifungal properties have been studied by conducting microbiological analysis. Projects have been developed for the use of aqueous and ethanol extracts of fruits and leaves in medicine, and it is recommended to grow passionflower plants on large areas.

On the basis of the positive results of analyzes of gram-negative and gram-positive bacteria, proposals for the preparation of new medicinal products are proposed.

As a result of the cytotoxic effect of methanolic extracts of *P. edulis* L. and *P. ligularis* L. fruits on some cancer cells, it is advisable to use them in medical practice in the future.

Since the species *Passiflora caerulea* L. is distinguished by its high decorativeness and evergreenness, compositions of different shapes were created on the collection territory of the Institute of Dendrology, Binagadi, Khazar district, Lankaran.

Scientific works, compiled on the basis of positive results of research work, will create conditions for the enrichment of small research materials in the direction of recognition of species belonging to the genus Passiflora, and will serve as sources for bachelor, master and PhD students in this direction in the future.

Approbation and application. Results of the study were presented at the international symposium "SEAB 2015: Biodiversity in Eurasia" (Baku, 2015), at the international conference "Current problems of modern chemistry and biology", at the conference dedicated to the 93rd anniversary of the national leader H. Aliyev (Ganja, 2016), Symposium on EuroAsian Biodiversity (Antalya, Turkey, 2016), At the conference of Institute of Botany of ANAS and Society of Azerbaijani Botanists dedicated to the 90th anniversary of Academician V.C. Hajiyev (Baku, 2018), at the International scientific conference dedicated to the 95th anniversary of the national leader H. Aliyev (Ganja, 2018), at "Innovative approaches to modern biology: VIII international scientific conference" (Baku, 2018) dedicated to the 75th anniversary of

ANAS, "Multidisciplinary approach in solving modern problems of fundamental and applied sciences" (Baku, 2020), International Asian congress on contemporary sciences - IV (Baku, 2020), IV International "Communication In The New World" Congress" (Tokyo, Japan, 2021), diversity, land and water resources of Karabakh: past, present and future (Baku, 2021), dedicated to the 90th anniversary of the establishment of the Azerbaijan Medical University, dedicated to the 80th anniversaries of higher pharmaceutical education in Azerbaijan "Modern Pharmacy problems" V International Scientific Congress (Baku, 2021), International Health Sciences and Innovation Congress (Baku, 2021), The 5th Symposium on EuroAsian Biodiversity (SEAB-2021) (Almata, Kazakhstan, Muğla, Turkey, 2021), 1st International Conference on Experimental Sciences and Biotechnology (Mugla, Turkey, 2021), BIO Web of Conferences (Almaty, 2024), New Challenges in Ensuring Biodiversity Sustainability (COP-29) (Nakhchivan, 2024), 7th symposium on Eurasian biodiversity (Turkey, 2024), plant pests and their management in conditions of global climate change (Ganja, 2024).

It was published 24 scientific works on the topic of dissertation.4 of them were published in journals indexed in international databases.

The name of the institution where the dissertation work was performed. The research work was carried out at the Institute of Dendrology of the Ministry of Science and Education of the Republic of Azerbaijan, phytochemical and microbiological studies were carried out in biochemistry, biotechnology and microbiology laboratories of Mugla Sitki Kochman University of the Republic of Türkiye.

Structure and scope of dissertation work. The dissertation consits of table of contents (2017 marks), introduction (13675 characters), 6 chapters (Chapter I- 34600, Chapter II-17776, Chapter III-77366, Chapter IV-23735, Chapter V-37390, Chapter VI-47497, results - 2755, practical recommendations - 1269 characters) and 245 sources, covering 224 computerized pages (258080 characters). The dissertation contains 36 tables, 65 pictures and 1 diagram.

THE MAIN CONTENT OF THE DISSERTATION

CHAPTER I
LITERATURE REVIEW

This chapter is based on materials from domestic and foreign literature. The review presents information about the history of passionflower, the plant's homeland, the species' range in the world, the features of its adaptive potential and its use in medicine.

CHAPTER II
OBJECT, METHODOLOGY AND CONDITIONS OF THE RESEARCH

2.1. The object of the study. The research was conducted in 2018-2023. The object of the study were 4 species belonging to the genus *Passiflora* L. from the family *Passifloraceae: P.incarnata* L., *P.edulis* L., *P.caerulea* L., *P. ligularis* L. It was investigated the introduction of some species belonging to the genus Passiflora L. in the dry subtropical climate of Absheron, bioecological characteristics, breeding, agrotechnics, evaluation of medicinal, food and decorative qualities, application of promising species in medicine and food industry.

2.2. The methodology of research. Classical and modern botanical research methods were used to solve the set goals and tasks.

The taxonomic composition and botanical description of some species belonging to the genus Passiflora are given. The name of the species is determined by the system "The plant list". The methods of V. Zukareli et al.[3], M. K. Firsova[4] used for seed propagation. Seed sowing was carried out in a chamber laboratory (Memmer device) and the seeds were stratified and scarified on a specially prepared field. The influence of light, darkness and

[3] Zucareli, V., Ono, O. E., Henrique, L.A.V. Influence of light and temperature on the germination of *Passiflora incarnata* L. seeds // Journal of Seed Science, – 2015, 37(2), – p. 162-167.

[4] Фирсова, М.К. Методы исследования и оценки качества семян / М.К.Фирсова. – Москва: Сельхозгиз, – 1955. – 376 с.

temperature on the germination of seeds is studied, the morphology of the sprouts is described. Annual growth in height was measured every 10 days from the beginning to the end of vegetation, in 3 repetitions, and the dynamics of plant growth was recorded during the months.

In vegetative propagation, the method of F. Uzunoglu and K. Mavi[5] was used, old specimens and lignified cuttings were used, the effect of organic growth substances on root attachment in cuttings was studied.

The morphology and development of the root system was carried out in 1-3-year-old plants using the method of V.A. Kolesnikov[6].

Fruit and seed productivity is determined by the "unit of fruit mass" of a medium-sized bush[7]. That end, fruits were collected and weighed from selected bushes of each species, the yield of fruits and seeds of each species, the weight of 100 fruits and 1000 seeds were determined.

The method of I.A. Ivanova and N.M. Dudik[8] was used for studying the morphological features of fruits and seeds, the color of fruits and seeds was determined according to the scale of A.S. Bondartsev[9], morphological indicators of the leaf were determined. The heterophyly and polymorphism of leaves were studied with a portable laser leaf area meter CI-202 (CID bio-science) by using the

---

[5] Uzunoğlu, F., Mavi, K. Farklı indol bütirik asit uyğulamalarının Çarkifelek (*Passiflora caerulea* L.) türünde fidan kalitesi üzerine etkisi // Bahçe 46 (Özel Sayı 1:V.Uluslararası Katılımlı Üzümsü Meyveler Sempozyumu). – 2017, – s. 183-187.

[6] Колесников, В.А. Методы изучения корневой системы древесных растений / В.А.Колесников, – 2-е изд., испр. и доп. – Москва: Лесная пром-сть, – 1972. – 152 с.

[7] Заборовский, Е.П. Лесные культуры и мелиорация / Е.П.Заборовский, С.С.Лисин, С.С.Соболев. – Москва: Лесная промыш., – 1972. – 311 с.

[8] Иванова, И.А. К методике описания морфологических признаков семян. Составление определений растений по плодам и семенам / И.А. Иванова, Н.М. Дудик. – Киев: Наукова думка, – 1974. – с. 43-54.

[9] Бондарцев, А.С. Шкала цветов / А.С. Бондарцев. – Москва-Ленинград.: изд-во Наука, – 1954. – 27 с.

method of Z. Gumbatov[10].

Pollen morphology and viability were studied using a Nikon eclipse E100 microscope and AmScope User Guide XSZ-N117A. Necessary agrotechnical plant care was performed, and since the liana has a stem, a trellis and a T-shaped wire system were built for support.

Mathematical-statistical calculations of the results of studies carried out according to the method of G.N. Zaychev[11], phytochemical analyzes carried out by the methods of DPPH[12], CUPRAC, FRAP, ABTS, β-carotene[13], during the study, the study of antibacterial and antifungal properties was determined according to the criteria of CLSI "Clinical and Laboratory Standards Institute" by the diffusion method[14].

The ICP-OES method[15] (inductively coupled argon-plasma-optical emission spectrometer) was used for the analysis of macro- and microelements in passion fruit. To determine the total amount of nitrogen, the results were recorded using the "Kjeldal" device.

The MTT test[16] was used to determine the effect of methanolic extracts of *P.ligularis* L. and *P.edulis* L. fruits on cell viability.

---

[10] Hümbətov, Z.İ. Bitki morfologiyası və anotomiyası (dərslik) / Z.İ.Hümbətov. – Bakı: Apostroff, – 2017. – 692 s

[11] Зайцев, Г.Н. Математика в экспериментальной ботанике / Г.Н.Зайцев. – Москва: Наука, – 1990. – 294 с.

[12] Turan, M., Mammadov, R. Antioxidant, antimicrobial, cytotoxic, larvicidal and antihelmintic activities and phenolic contents of *Cyclamen alpinum* // Pharmacology and Pharmacy, – 2018, 9, – p. 100-116.

[13] Shohretoglu, D., Genc, Y., Harput, Sh. Comparative evaluation of phenolic profile, antioxidative and cytotoxic activities of different *Geranium* species // İran J. Pharm. Res., – 2017. №16, – p.178-187.

[14] Lalitha, M.K. Manual on Antimicrobial Susceptibility Testing. – 2012.

[15] Kaçar, B. Bitki ve Toprağın Kimyasal Analizleri // Ankara Üniversitesi Ziraat Fakültesi Yayınları, – 1984, 2, – p. 55-59.

[16] Mossman, T. Rapid Colorimetric Assay for Cellular Growth and Survival: Application to Proliferation and Cytotoxicity Assays // Journal of Immunological Methods, – 1983, 65, – p. 55-63.

2.3. Soil and climate conditions of the Absheron peninsula where the research was conducted. The land cover of Absheron consists of gray-brown, saline or semi-desert soils. The amount of humus is low in the upper layers of these soils. Institute of Dendrology of the MSE RA where the research was conducted, is located in the northeastern part of the Absheron peninsula, in Mardakan settlement. The area of the institute consists of 12.5 hectares and is located 800 m above sea level. The places near the sea are 80-85% limestone and sandy soils. The composition of the soil in the high places away from the sea is mixed with medium sand and heavy clay, the thickness reaches 0.5-1.5 m. Its area of limestone and herringbone layers is located on the first seaside terrace. The mechanical composition is sandy and gray gravelly, alkaline (pH=8-9) soil layer is 0.6-2 cm. The amount of clay in the experimental area, which is mainly irrigated gray-brown soil type, varies between 4.2-7.2%.

CHAPTER III
BIOECOLOGICAL FEAUTURES OF SPECIES BELONGING TO THE GENUS PASSIFLORA L. IN ABSHERON CONDITIONS

3.1. Botanical description of the studied species. This chapter reflects the biological characteristics of species belonging to the genus *Passiflora* L., the results of studies of leaf morphology (heterophily).

The species *P.incarnata* L., cultivated in open ground in the conditions of Absheron, is a perennial plant of the liana type with a powerful root system reaching 9-10 meters in height.

The flowers are 5-membered, two-petaled, fragrant, purple in color, 7-8 cm wide, located singly in the leaf axil. The corolla consists of 5 sepals and 5 petals. The leaves are lanceolate, with a thorn-like protrusion at the tip. Since the flower buds have extrafloral nectar glands that attract ants, a large number of ants are

found on the stem when the first buds appear[17]. The ovary is superior, unilocular, sessile, with 5 filaments. It has an edible fruit consisting of a light green berry with a lemon flavor, which falls off when ripe. The fruits of *P.incarnata* L. are known worldwide as "Maypop". The fruits are green and do not change color even after ripening. The inside of the fruit consists of a jelly-like part covered with a white shell and 25-60 seeds located inside. The seeds are black, covered with a hard shell and a bumpy surface.

The collected seed samples were subjected to morphometric analysis, the length of the seed was measured using measuring paper and a device called a "coliper" (with an accuracy of 0.1 cm), the length of the seed was 0.6 cm, the width was 0.5 cm. The weight of the seeds was measured with electronic scales (EK-61.OI) (with an accuracy of 0.01 g). The weight of one seed varies from 0.05 to 0.07 grams. The weight of 1000 seeds is 50-60 grams. Its fruits ripen in the conditions of Absheron from the third decade of September to the second decade of October. The fruits are spherical, 6-12 cm long, light green, the berries are sour, they remain on the bush for a long time. Unlike other species, in *P.incarnata* after the ripening of the fruits, the above-ground part is completely destroyed at the end of autumn, and in the spring the above-ground part grows again from the underground rhizome. *P. edulis* L. is an evergreen plant that grows up to 8-10 m in Absheron both in open and closed conditions. Since *P.edulis* L. is a perennial climbing plant, it does not require a large area to grow these plants, as other plants do. *P.edulis* L. grows well in well-drained, moist soils with a pH of 6.5-7.5 and plenty of sunlight.

The leaves are bright, dark green, deeply tripartite, 10-25 cm long. Starting from the first true leaf, the plant remains whole until the 10th leaf. The 11th leaf changes its shape and develops from the

[17] Badalova, V. Nectar glands of Passiflora species growing in Absheron and relation with ants / Z.Mammadova, S.Maharramov, Kh.Alibeyli [et al.] // BIO Web of Conferences, – Almaty, March 27-28, – 2024, 100, 04003

leaf axil together with the first tendril[18]. Its flowers have a morphological structure similar to *P.incarnata* and differ in color (Fig. 1-2). The flowers are bisexual, self-pollinated and pollinated by insects. In the course of our research, it was established that the hypocotyl width of *P.edulis* L. is 1-2 mm, and the length is 2.5-4.5 cm. Two oval leaves are green, hairless. Length 1.6 cm, width 1.3 cm, handle length 0.4 cm. The hypocotyl is yellowish-green, 4-5 cm long, 0.3 cm in diameter. The duration of the leaves varies within 115-125 days. The weight of the fruit varies between 40-75 grams. The seeds are black and sunken. There are up to 250-400 seeds in 1 fruit. Since the length of the seed is 5-7.5 mm, the width is 3.5-4 mm and it is covered with a hard shell, germination occurs late. The weight of one seed varies from 0.06 to 0.07 grams. The weight of 1000 seeds are 55-65 grams.

Figure 1. *Passiflora incarnata* L. in flowering stage

Figure 2. Flowers of *Passiflora edulis* L.

The species *P.caerulea* L. differs from other species of the Passiflora genus by its rapid growth. It can reach 15-20 meters in Absheron conditions. It is a cold-resistant plant and tolerates frosts up to -5˚C.

[18] Badalova, V. Abşeron bölgesinde yetiştirilen *Passiflora edulis* L. türünün yapraklarının morfometrik parametrelerinin değişimi // Atatürk Bahçe Kültürleri Merkez Araştırma Dergisi Bahçe, – 2022, 51(2), – p. 103-108.

The leaves are dark green in color, have 5-7 finger deep sections and are joined to the stem. The flowers come out from the axils of the leaves singly, and the petals are white, pink, blue, and consist of a double 5-membered flower side. The diameter of the flower is 7-9 cm, the number of petals is 5-10. The green branches are hairless. It blooms regularly from May to November. It is propagated by seeds and cuttings, it is an evergreen perennial plant, and it is attractive for its decorativeness. Since *P.caerulea* L. has a creeping stem, it does not require a large area for its cultivation. The length of the annual stem of *P. caerulea* L. is 1.5-1.8 m. Starting from February of the second year of vegetation, the height of the plant grows rapidly, and after a while flower buds are formed on the young branches (Fig. 3). *P. caerulea* species is not demanding on land.

Figure 3. Passiflora caerulea L. in flowering stage

Figure 4. Appearance of flowers of *Passiflora ligularis* L. species

P.ligularis L. grows best in well-drained soils with a pH of 6.0-6.5 and plenty of sunlight. The stem of the plant is grayish, the leaves are simple, heart-shaped, arranged alternately, covered with small hairs below. Unlike other species, the leaf petiole is short (1.8-2.5 cm), with 4-6 soft spiny trichomes located on it. The length of the leaves is 8-11 cm, the width is 6-8 cm. The distance between the leaves is small. The leaves of the plant are located face down,

opposite the stem. The flowering period is 17-20 days. The length of the flower is 10 cm, the length of the peduncle is 3-4 cm, 5 stamens, 3 female stamens, the style is long, the mouth is concave-protruding (Fig. 4). The fruits (granadilla) are orange, weighing 65-75 g, have a sour taste. The fruit is attached directly to the stalk and falls off together with the stalk when ripe. The length of the seed is 6-8 mm. One fruit contains 250-350 seeds. 1 kg contains 12-14 granadilla fruits or 3000 seeds. The weight of 1 seed is 0.07-0.09 g, the weight of 1000 seeds is 82-86 g. Propagated by seeds and cuttings.

3.2. Morphology of sprouts. Observations have shown that seedlings usually appear 25-31 days after sowing depending on the species, and in scarified and stratified seeds - in 6-9 days (Fig. 5). In simultaneous sowings of seeds, germination was observed earlier in *P. edulis* L., and later in other species, with an interval of 2-4 days.

Figure 5. 3-20-day-old seedlings of *P.caerulea* L species

The process of seed germination and the development of sprouts are similar in the studied species. The type of seed germination is terrestrial, hypocotyl. The hypocotol is developed and the petals are two. The lifespan of the leaves of the passiflora species we studied varies between 55±3 and 73±3 days.

3.3. Growth and development of aerial parts of studied species. Passiflora species are characterized by relatively weak height growth in the 1st vegetation year. Rapid growth (increase in

height) occurs in the II vegetation period. In the first period, intensive height growth is observed from the third decade of May to the end of August. At this time, the air temperature and relative humidity fully ensure the normal growth of sprouts (28-320C and 70-80%). During that period, the height growth in open conditions is 60-70% of the total growth during the vegetation period. High temperatures (38-400C) from mid-July to mid-August slow down the development of 1-year-old seedlings. II growth is observed starting from the middle of August and continues until the I or II decade of October, depending on the species. At the end of the 1st vegetation year, high height growth of *P.caerulea* L. (1.3±2.1 m), *P.edulis* L. (4.0±5.5 m) and *P.incarnata* L. (1.2±1 ,5 m) species, and a relatively small height increase was recorded in *P.ligularis* L. (72.0±80.0 cm).

3.4. Growth and development of the root system of 1-3-year seedlings. The conducted study showed that in Absheron conditions the first year *P.caerulea* L. (53 cm), *P.edulis* L. (24.5 cm) and *P.incarnata* L. (24.0 cm), P.ligularis L. (18 ,2 cm) species have a well-developed spindle root. The main root forms a large number of absorbent threads and spreads by branching mainly at the depth of 18-25 cm of the soil. The diameter of the main root is 0.2-2.1 cm 3-5 cm below the root throat for the studied species. The length of first-order lateral roots reaches 6.0-2.0 cm.

3.5. Seasonal growth rhythm of Passiflora species. As a result of the conducted research and observations in the collection field, the first flowering of the studied species in the conditions of Absheron was recorded in the second year of vegetation for all species. Since some of the studied species (*P.caerulea* L., *P.edulis* L.) are evergreen, the time of change in leaf color and the absence of formation of new leaves and tendrils was estimated as the end of vegetation. The end of vegetation was taken as the time of yellowing of *P.incarnata* L. leaves and mass wilting of more than 70% of the aboveground part in the II-III decade of November.

3.6. Pollen viability in studied passiflora species. The viability of pollen in the studied passiflora species was studied by aceto-carmine and iodine staining. For this purpose, live and dry pollens of the flower were visually observed by means of "Nikon

eclipse E-100" and "AmScope" microscope (with 10, 25 and 40 times magnification lens). The undyed part of the pollen is colorless, and depending on the species, most of it is dark. Unstained pollen is sterile, and dark colored pollen is fertile. Since starch does not accumulate in sterile pollen, they are light in color and have no fertilizing properties. The highest result was observed in *P. caerulea* L. species[19]. Since there is a large amount of starch in fertile pollen, their fertilization ability is also much higher. For this reason, the studied species bloom and bear fruit until the end of autumn.

3.7. Biological characteristics of flowers and fruits of Passiflora species. It has been established that the climatic and soil conditions of Absheron determine the early phases of flowering and fruiting of the studied species. In April-May, the air temperature is not so high (18-200C), which increases the flowering period of some species. In June-July, as the air temperature rises (28-320C), the flowering period increases and the plant continues to bloom until the end of autumn. The color of the fruits varies from light green to orange and purple-brown. The color of the fruits of P. incarnata L. is light green, P. edulis L. is purple-brown, P. caerulea L. is orange, and P. ligularis L. is yellowish-orange. The shape of the fruits is oblong-ovoid (P.caerulea L.) or ovoid (P.incarnata L.), depending on the species. The length of the fruit varies from 3.1-5.0 to 5.2-7.5 cm depending on the species. In Passiflora species, the weight of 1 fruit varies from 4-5 grams (P. caerulea L.) to 60-80 grams (P. ligularis L.). The weight of 100 fruits varies from 400 to 8000 grams (the smallest and largest fruits). A study of the flowering and fruiting characteristics of the studied species shows that these species normally spend the periods of budding, flowering, fruiting and sowing of the generative stage.

[19] Badalova, V., Mammadova, Z. Morphological structure and germination capacity of pollen of some species belonging to the *Passiflora* L. genus // 7th symposium on euroasian biodiversity, – Turkiye: August 22-24, – 2024, – p. 014.

CHAPTER IV
METHODS OF PROPAGATION OF SPECIES OF THE GENUS *PASSIFLORA* L.

4.1. Seed propagation. The seeds used for planting were obtained from ripe fruits received from foreign botanical gardens by exchange. During the study, the seeds were planted in two variants (normal) control and stratified, scarified form in closed conditions and the effect of temperature and light on the germination of passionflower seeds was studied. For this purpose, the seeds were planted under conditions of different temperatures (20°C, 25°C, 30°C, 35°C constant, 25-35°C variable). Two environments (constant light and constant darkness) were adopted as the illumination factor. At the end of the experiments, the percentage of seed germination, germination rate and germination energy were calculated. An increase in temperature had a positive effect on the germination of *P.edulis* L., *P.ilgularis* L., *P.caerulea* L., and *P.incarnata* L. seeds, increasing germination and reducing germination time. As a result, seeds planted at a temperature of 20˚C germinated in 14±3 days, whereas at a constant temperature of 35˚, the seeds of *P.ligularis*, *P.edulis*, and *P.incarnata* germinated in 6±2 days; the temperature had a positive effect on seed germination. However, the germination of *P.edulis* L., *P. ligularis* L. was higher at a temperature of 30–35°C and in constant darkness. *P.incarnata* L. was high at a temperature of 25–30°C and in constant darkness[20].

It was found that 10 g of seeds should be used per 1 m^2 of sowing rate. The germination percentage is higher when sowing seeds at a depth of 3 cm (Table 1).

[20] Bədəlova, V.N., Məmmadova, Z.Ə. *Passiflora incarnata* L. növün Abşeronda *ex-situ* şəraitdə introduksiyası // Azərbaycan Tibb Universitetinin yaradılmasının 90, Azərbaycanda ali əczaçılıq təhsilinin 80 illik yubileylərinə həsr edilmiş "Əczaçılığın müasir problemləri" mövzusunda V Benəlxalq Elmi Konqresin materialları. – Bakı, – 2021, – s. 164-168.

During the study, self-formed shoots were observed around old passionflower plants. Only *P. ligularis* L. does not have the ability to naturally regenerate around this species.

Table 1

Effect of sowing and depth rate on germination percentage of Passiflora seeds

Species	Sowing depth, cm			Amount of seed sown per 1m^2 area, gr
	1,0	**2,0**	**3,0**	
P. caerulea L.	12,9	48,4	75,0	11,0
P. edulis L.	8,0	27,3	72,3	9,5
P.ligularis L.	5,2	17,4	64,5	15,0
P.incarnata L.	6,3	26,0	66,7	10,0

4.2. Vegetative propagation. Three-year-old woody cuttings of the species *P.incarnata* L., *P.edulis* L., *P.ligularis* L. and *P.caerulea* L. 10-12 cm long and 4-5 mm in diameter were used as plant material; 30 cuttings were cut for each species. After 55 days, the cuttings were removed and the rooting percentage (in %), number of roots (number), and root diameter (cm) were calculated, and it was determined that the use of the IBA solution had a positive effect on increasing these indicators.

CHAPTER V
AGRICULTURAL TECHNOLOGY, RESISTANCE TO ENVIRONMENTAL FACTORS, DISEASES AND PESTS OF THE SPECIES OF PASSIFLORA L. GENUS

5.1. Agricultural technology of the studied species. As a result of research conducted in 2018-2023, based on agricultural rules, cultivation, watering, fertilizing, pruning, etc. of introduced passionflower species in local soil and climatic conditions were studied and it was found that one of the important problems is the preparation of soil for growing climbing passionflower species, in

addition, it largely depends on soil fertility, climatic conditions and biological characteristics of the cultivated plant. It is advisable to give perlite to retain moisture. The plant should be planted in heavy soil with drainage, since it belongs to the liana type, it is important to create a support system.

5.2. Resistance of passiflora species to some ecological environmental factors. The studied species were more light-demanding because of belonging to tropical countries. A high degree of adaptability to different soil and climate conditions has led to the spread of the plant from subtropical zones to zones with dry climates.

5.3. Identification of pathogens and insect pests spreading in passionflower species in Absheron conditions and measures to combat them. The following phytophagous pests were identified in the passionflower species studied by us: spider mite (*Tetranychus urticae* Koch.), grape snail (*Helix pomatia* Lin.) and bacterial leaf spot (*Pseudomonas syringae*) (Tab.2). Necessary preventive measures have been taken against these pests. The use of a 0.1% solution of the Hekplan preparation in pest control gave a biological efficiency of 80-85%.

Table 2

Frequency of diseases and pests in Passiflora species

Type of pest or disease agent	Found in plant organs				Frequency of occurrence
	Leaf	Sprout	Branch	Stem	
Greenhouse mosquitoes	+	-	-	-	+
Thrips	+	-	-	-	+
Common spider mite	+	-	-	-	+
Grape snail	+	+	-	+	+ +
Bacterial leaf spot					+

Note: "+" - weak infection, "++" - moderate infection, "+++" strong infection, „-"not infected

CHAPTER VI
PHYTOCHEMICAL STUDY, MEDICINAL AND NUTRITIONAL IMPORTANCE OF SPECIES OF THE GENUS *PASSIFLORA* L.

6.1. Determination of biologically active substances in the raw materials of the studied species and obtaining extracts. In order to determine biologically active substances in plant raw materials, extracts were taken, dried using a rotary evaporator and lyophilizer, stored at a low temperature, and the resulting extracts were used in the following experiment.

6.2. Obtaining and chromatographic analysis of the sum of flavonoids from plant raw materials. In order to extract flavonoid compounds from plant raw materials, selective extraction was used taking into account the characteristics of the raw materials, lipophilic substances were washed, and then the raw materials were extracted with ethanol or methanol of various concentrations. The qualitative composition of flavonoids was studied using thin-layer chromatography. Rutin and hyperoside were detected as a result of chromatographic analysis.

6.2.1. Determination and chromatographic analysis of alkaloids in raw materials. In order to determine alkaloids in *P. incarnata* species, a characteristic, general (precipitating) reaction was used. The Rf indicator of the spot obtained on the chromatographic plate was determined to be the same as the Rf indicator of harmine alkaloid, which is a witness sample.

6.3. Quantitative determination of flavonoids, total phenolic substances and tannin in the studied raw material samples. In vitro biochemical analysis of ethanol extracts of leaves and fruits was carried out using modern methods and the total amount of secondary metabolites was determined[21].

[21] Badalova, V.N. Phytochemical analysis of some species belonging to the Passifloraceae family / V.N.Badalova, Z.A.Mammadova, T.A.Suleymanov [et al.] // Plant biology and horticulture: Theory, innovation, – 2023. № 1(166), – pp. 25-32.

The amount of total phenol in passionflower extracts ranges from 0.96±0.05 to 3.16±0.18 mgGAE/g[22]. The highest phenol content was recorded in *P.aerulea* L. leaf extracts (3.16±0.21 mgGAE/g). The weakest result in terms of the amount of total phenol was determined in ethanol extracts of P. caerulea L. fruits (0.96±0.05 mgGAE/g).

Total flavonoid content ranged from 0.65±0.07 to 12.52±1.85 mgGE/g. 1 mg/ml *P.caerulea* L. leaf extract (12.52±1.85QE/g) had the highest total flavonoid content. Total tannin content ranged from 0.22±0.13 to 4.33±0.16 mgGE/g. The highest tannin content was found in *P.caerulea* L. fruit extract (4.33±0.16 mgGE/g). The lowest tannin content was found in *P. edulis* L. fruit extract (0.22±0.13 mg) and P. ligularis L. fruit extract (0.20±0.15). The sum of phenolic substances varied from 3.16±0.21 to 0.96±0.05 mgGAE/g[23]. Thus, the highest content of total phenol was observed in the extract of *P. caerulea* L. leaves - 3.16±0.21 mgGAE/g, and the lowest result was determined in the extract of *P. caerulea* L. fruits - 0.96±0.05 mgGAE/g.

6.4. The study of the macro- and microelement composition of passion fruit species Passiflora edulis L. In the course of our studies, macro- and microelements were analyzed in the fruits of the variety *P. edulis* called "passionate", as a result, the fruits of the variety *P. edulis* L. contained Mg (0,20%), Fe (115.93%), K (3.53%), it was found that it is rich in such important elements as Zn (20.88%), Mn (35.83%), N (0.25%).

At the same time, in the course of our scientific research, the content of starch, sugar, extractive substances, nitrate compounds

---

[22] Bədələova, V.N. Abşeronda introduksiya olunmuş *Passiflora* L. cinsinin bəzi növlərinin fitokimyəvi tədqiqi // Biomüxtəlifliyin dayanıqlığının təmin edilməsində yeni çağırışlar (COP-29), – Naxçıvan: 3-4 iyun, – 2024, – s. 150.

[23] Badalova, V.N. Determination of different biological activities of methanolic extracts of fruits of *Passiflora ligularis* Juss. and *Passiflora edulis* Sims. / V.N.Badalova, M.Ö.Atay, B.Ardil [et al.] // Natural Products and Biotechnology, – 2021.Vol. 1. No. 2, – p.86-95.

and dry matter was analyzed in the passion fruit plant[24]. As a result of the analysis, it was established that the amount of nitrate substances (29.13 mg/kg) and dry substances (21.35%) was high[25].

6.5. Study of antioxidant activity. As a result of the experiments, the free radical scavenging activity of the extracts varied from 1.36±0.05 to 2.43±25 IC50 mg/ml (DPPH experiment) and from 0.25±0.012 to 2.48±0.016 IC50 mg/ml (ABTS experiment). The extarct of *P.ligularis* L. showed the highest antioxidant activity. In the ß-carotene, linoleic acid experiment, the highest inhibitory activity in *Passiflora* L. species was found in ethanol extracts of *P. ligularis* L. fruit (88.17±1.86%), P. incarnata L. leaf (83±0.53%) and P. caerulea L. leaf (81±0.8%).

Among the extracts, the lowest inhibition value was observed in *P.caerulea* L., fruit 45±1.21% ethanol extracts. Copper (II) ion reducing power of extracts (CUPRAC) varied from 2.43±0.16 to 9.01±0.38 mgTE/g. The highest copper (II) ion reducing power was observed in *P.caerulea* L. leaf extracts (7.29±0.33mgTE/g), respectively. The weakest activity was found in fruit extracts of P. edulis L. (2.47±0.07mgTE/g).

6.6. Study of cytotoxic effect of methanol extracts of P. edulis L. and P. ligularis L. fruits on cancer cells. The anticancer potential of methanolic extracts of *P. edulis* L. and *P. ligularis* L. fruits against human colorectal cancer (HT-29) and human lung cancer cells (A549) was studied. During our experiments, positive results were obtained in both species (Fig. 6, 7).

---

[24] Bədəlova, V. *Passiflora edulis* L. növünün "Marakuya" meyvələrinin ölkəmizdə tanınması və qida potensialının araşdırılması / V.Bədəlova, Z.Məmmədova, N.Alışlı [et al.] // Qlobal iqlim dəyişkənliyi şəraitində bitkilərin zərərverən orqanizmləri və onların idarə edilməsi mövzusunda elmi-praktiki konfrans, – Gəncə: 24-25 sentyabr, – 2024, – p. 276-279.

[25] Badalova, V., Atay, M.Ö. Determination and pharmacological properties of phytochemical compounds in the ethnobotanical *Passiflora edulis* L., first cultivated in Azerbaijan // Proceedings The 2nd İnternational Congress on Cocoa Coffee and Tea Asia, – Baku: May 19-20, – 2022, – p. 24.

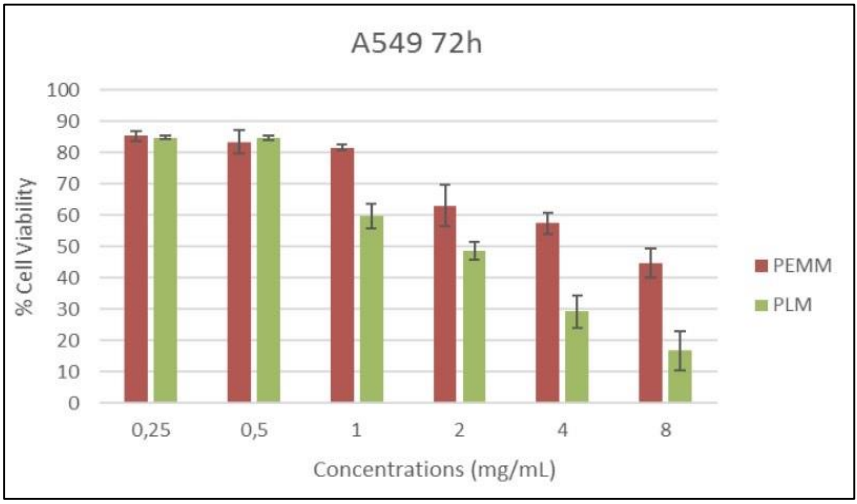

Figure 6. Effects of *P. edulis* (PEMM) and *P. ligularis* methanolic (PLM) extracts on HT-29 cell viability

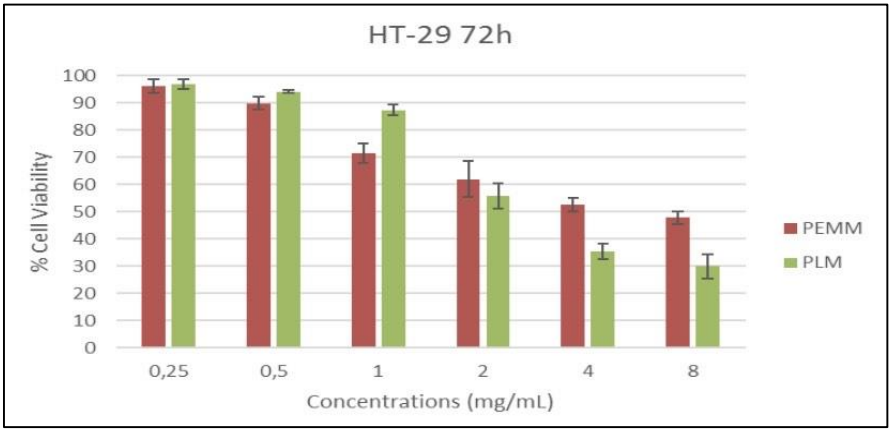

Figure 7. Effects of *P. edulis* (PEMM) and *P. ligularis* methanolic extracts (PLM) on A549 cell viability

However, the cytotoxic effect of *P. ligularis* L. species was stronger compared to methanol extracts of *P. edulis* L. species. Fruit-

methanol extracts of *P. edulis* L. and *P. ligularis* L. species reduced the viability of colon and lung cancer cells up to 50% [26,27].

6.7. Microbiological study of ethanol extracts of plants.

The results of our microbiological analyzes established that the antimicrobial activity of the tested plant extracts depends on the part of the plant used and the type of extract. In leaf extracts, the highest sensitivity was found in species *P. edulis* L., *P. aeruginosa* (16.7±0.1 mm), *L. monocytogenes* (15.±0.6 mm), and the weakest result - in gram-negative bacteria *E .coli*. (14 ±0.3 mm). In fruit extracts, the strongest effect on *Escherichia coli* was found in extracts of *P.caerulea* L. (13.2±0.5 mm), and the weakest - in ethanolic extracts of *P.edulis* L. And in the form of *B. subtilis* - 7.2 ±0.2 mm. As a result, the antifungal and antimicrobial action of passionflower extracts against pathogenic microbes and fungi gave positive results. Ethanolic leaf extracts showed higher antimicrobial activity than fruit extracts[28].

One-factor ANOVA test was used to perform dispersion analysis of the obtained results. The Minitab script was used to calculate the significant difference between the mean values of the variances, and *Tukey's pairwise* comparison criterion was estimated at $p<0.05$.

6.8. Medicinal value of the studied Passiflora species. Flowers, fruits and leaves of the ethnobotanical passionflower species

[26] Badalova, V. Some antioxidant and quantitative studies on *Passiflora ligularis* methanol extracts / V. Badalova, B.Özçakır, M.Ö. Atay [et al.] // 1st International Conference on Experimental Sciences and Biotechnology, – Mugla: September 8-10, – 2021, – p.711.

[27] Badalova, V., Beria, Ö., Süleymanov, T. Quantification and Some Antioxidant Studies on *Passiflora caerulea* Methanol Extracts // The 5th Symposium on Euro Asian Biodiversity (SEAB-2021), – Almaty: July 1-3, – 2021, p. 289.

[28] Badalova, V. Determination of the antimicrobial activity of ethanolic exstracts of some *Passiflora* L. first introduced in Azerbaijan / V. Badalova, T.Suleymanov, R. Mammadov [et al.] // Bulletin of Science and Practice, – 2022, 8(5), – p .101.

are natural sedatives of health importance. Extracts obtained from the above-ground parts of the passionflower species studied by us can be used in the treatment of many diseases associated with insomnia, hypertension, muscle pain and stress. Our phytochemical and microbiological in vitro analyses prove the antibacterial, antioxidant, antiviral and immune-boosting effects of passionflower species and assess their medicinal value.

6.9. Application in landscaping and various areas of the food industry. Since the species we have studied are very decorative and resistant to external environmental factors, they can be used in landscape design for the following purposes:

- In various compositions together with perennial grasses (P. caerulea L.);
- In the construction of living fences (P. edulis L.) due to the rapid growth of the climbing stem, which forms an insurmountable barrier;
- On the roadsides for noise absorption;
- In small areas around recreation and health areas;
- In the design of topiaries - making different figures from one species and using them in compositions (passionflower species grow quickly, tolerate pruning well and take any shape);
- In the manufacture of various figures (animals, birds) since it has a liana-type body.

RESULTS

1. Bioecological features of *P. caerulea, P. edulis, P. incarnata* and *P. ligularis*, belonging to the genus *Passiflora* L., depending on the species, usually appear after 25-31 days after sowing. and after scarification and stratification of seeds - after 6-9 days. In the studied species, vegetation lasts 175-210 days, after a year there is an intensive growth in the height and diameter of the crown.

2. It is established that the temperature in the room of 30-35°C accelerates germination and shortens the time of germination during seed propagation. In open conditions, the best sowing time for seed

propagation is spring. During vegetative reproduction, the species *P. incarnata* L. used the method of root division, and in *P. caerulea* L. and *P. edulis* L., cutting cuttings was considered a more effective method.

3. As a result of qualitative reactions and chromatographic studies in ethanol extracts of the above-ground parts of 4 species belonging to the genus *Passiflora*, it was established that flavonoid compounds include rutin, hyperoside and alkaloids. The amount of flavonoids in the raw materials of P. caerulea, P. edulis, P. incarnata and *P. ligularis* was 12.52 ± 1.85, 9.56 ± 1.56, 8.57 ± 0.59, 9.70 ± 1.52 mgQE/g, respectively. The sum of total phenolic compounds 3.16±0.21, 2.42±0.35, 1.32±0.12, 2.35±0.23 mg GAE/g and 0.75±0.15, 0.65±0.031, 3.2±0.07, 1.55±0.030 of the total amount of tannin was determined as mgCE/g.

4. The highest inhibitory activity in the extracts of *Passiflora* L. was found in *P. ligularis* L. (fruits - 88.17±1.86%), *P.incarnata* L. (leaves - 83±0.53%) and *P.caerulea* L. (leaves - 81±0.8%) in ethanol extracts.

5. As a result of the analysis of macro- and microelements, it was found that the fruits of *P. edulis* L. are rich in such important elements as Mg (0.20%), Fe (115.93%), K (3.53%), Zn (20.88%), Mn (35.83%), N (0.25%).

6. For the first time, ethanol extracts of fruits and leaves of 4 species were used in the analysis of pathogenic microbes *Bacillus subtilis* (ATCC 6633), *Listeria monocytogenes* (ATCC 7644), *Staphylococcus aureus* (MTCC 554231), *Eshericia coli* (MTCC 423155), *Proteus vulgaris* (ATCC49132), *Pseudomonas aeruginosa* (ATCC 27853). Leaf extracts showed higher antimicrobial activity than fruits, the highest sensitivity was 15.2 ± 0.6 mm for gram-positive bacteria *L. monocytogenes* and 16.7 ± 0.1 mm for gram-negative bacteria *P. aeruginosa*. The strongest effect of fruit extracts was 13.2±0.5 mm on *P.caerulea* L. and *E.coli*, the weakest result was 7.2±0.2 for ethanol extracts of *P.edulis* L. on *B.subtilis*.

7. For the first time, methanol extracts of fruits of *P.edulis* L. and *P.ligularis* L. species were tested against colon (HT-29) and lung (A 549) cancer cells in various concentrations in vitro, and their

anticancer properties were studied, positive results were obtained for both species. Compared with methanol extracts of *P. edulis* L., the cytotoxic effect of *P. ligularis* L. species was stronger at a dose of 8 mg/ml, reducing cell viability to 50%.

PRACTICAL RECOMMENDATIONS

1. The study of bioecological characteristics and methods of reproduction of the studied species gives grounds to recommend the use of root division in *P.incarnata* L. and propagation by cuttings in *P.caerulea* L. and *P.edulis* L.

2. Considering that the root system of *P.caerulea* species is located close to the soil surface and is densely branched, it is recommended to use it in landscape architecture to prevent landslides in certain areas, as well as due to its evergreen color, beautiful decorative appearance and resistance to frosts down to -10 ° C. It is also advisable to plant *P. caerulea* L. in areas with increased radiation background and oil-polluted areas.

3. It is recommended to cultivate *P.caerulea* L., *P.incarnata* L. and *P.edulis* L. species in large farms, taking into account their adaptive capabilities, medicinal and food value.

4. Ethanol extracts of fruits and leaves of the studied species can be used in the manufacture of new antifungal drugs against *B. subtilis* (ATCC 6633), *L. monocytogenes* (ATCC 7644), S. aureus (MTCC 554231), *E. coli* (MTCC 423155), *P. vulgaris* (ATCC49132), *P. aeruginosa* (ATCC 27853), given the cytotoxic effect of methanol extracts obtained from the fruits of *P. edulis* L. and *P. ligularis* L. on intestinal cancer cells (HT-29) and lungs (A 549), it can be used as a new drug in the preparation of herbal anticancer drugs.

LIST OF SCIENTIFIC WORKS PUBLISHED ON THE SUBJECT OF THE DISSERTATION

1. Məmmədova, Z.Ə, Bədəlova, V.N. *Passiflora incarnata* L. növünün Abşeron şəraitində introdüksiyası, morfobioloji xüsusiyyətləri // AMEA Botanika İnstitutu və Azərbaycan Botaniklər Cəmiyyətinin akademik Vahid Cəlal oğlu Hacıyevin 90 illiyinə həsr edilmiş konfransı, – Bakı: 20-21 iyun, – 2018, – s. 299-301.
2. Bədəlova, V. Abşeronda Passiflora növlərinin introduksiyası və ontogenetik strukturunun öyrənilməsi // Azərbaycan Aqrar Elmi Jurnalı, – 2019. №2, – s. 173-175.
3. Bədəlova, V., Məmmədova, Z. Tropik dərman bitkisi *Passiflora incarnata* L. növünün ilk dəfə Abşeronda introduksiyası bioekoloji və farmokoloji tədqiqi // Azərbaycan Texnologiya Universiteti "Elmi Xəbərlər məcmuəsi", – 2020. № 1 /32, – s. 38-43.
4. Bədəlova, V. Karantin rejimində insanlarda emosional gərginliyin artmasına *Passiflora incarnata* L. növünün sedativ təsiri // İnternational Asian congress on contemporary sciences-IV, – Baku: 26-28 iyun, – 2020, – 306-311 s.
5. Bədəlova, V., Şükürova, N. *P. edulis* növünün introduksiyası və bioekoloji xüsusiyyətləri // Gənc Alim və Mütəxəsislərin İkinci Beynəlxalq Elmi-konfransı. Fundamental və tətbiqi elmlərin müasir problemlərin həllində multidissiplinar yanaşma, – Bakı: 3-6 mart, – 2020, – s. 67-68.
6. Badalova, V.N. Məmmadova, Z.A. Introduction and bioecological characteristics of *P.ligularis* in Abşeron // IV International "Communication in the new World" congress, – Tokyo: February 19-21, – 2021, – p. 364-369.
7. Məmmədova, Z., Bədəlova, V. İşğaldan azad olunmuş ərazilərdə biomüxtəlifliyin bərpasında *Passiflora* L. cinsinə aid növlərin istifadəsi // "Qarabağın biomüxtəlifliyi, torpaq və su ehtiyatları: keçmişi, bu günü və gələcəyi" mövzusunda konfrans, – Bakı: – 20-21 may, – 2021, – s. 53.

8. Badalova, V.N., Məmmadova, Z.Ə. *Passiflora incarnata* L. növün Abşeronda *ex-situ* şəraitdə introduksiyası // Azərbaycan Tibb Universitetinin yaradılmasının 90, Azərbaycanda ali əczaçılıq təhsilinin 80 illik yubileylərinə həsr edilmiş "Əczaçılığın müasir problemləri" mövzusunda V Benəlxalq Elmi Konqresin materialları, – Bakı: 23-24 aprel, – 2021, – s. 164-168.
9. Bədəlova, V.N. Sedativ təsirli *P.incarnata* növünün stresin aradan qaldırılmasında rolu // Internatıonal Health Sciences and Innovation Congress, – Baku: July 5-6, – 2021, – p. 490.
10. Badalova, V. Some antioxidant and quantitative studies on *Passiflora ligularis* methanol extracts / V.Badalova, B.Özçakır, M.Ö.Atay [et al.] // 1st International Conference on Experimental Sciences and Biotechnology, – Mugla: September 8-10, – 2021, – p.711.
11. Badalova, V., Beria, Ö., Süleymanov, T. Quantification and Some Antioxidant Studies on *Passiflora caerulea* Methanol Extracts // The 5th Symposium on Euro Asian Biodiversity (SEAB-2021), – Almaty: July 1-3, – 2021, p. 289.
12. Badalova, V. Some antioxidant and quantitative studies on *Passiflora edulis* methanol extracts / V.Badalova, M.Ö.Atay, Z.Mammadova [et al.]// The 5th Symposium on Euro Asian Biodiversity (SEAB-2021), – Almaty: July 1-3, – 2021, p. 290.
13. Badalova, V. The effect of Methanol Extracts of *Passiflora caerulea* and *Passiflora foedita* on the viability of cells / V.Badalova, B.Özçakır, M.Ö.Atay [et al.] // Ith İnternotional Conference and Biotechnology, – Mugla: September 8-10, – 2021, – p. 68.
14. Badalova, V.N. Determination of different biological activities of methanolic extracts of fruits of *Passiflora ligularis* Juss. and *Passiflora edulis* Sims. / V.N.Badalova, M.Ö.Atay, B.Ardil [et al.] // Natural Products and Biotechnology, – 2021. Vol. 1. No. 2, – p.86-95.
15. Məmmədova, Z., Bədəlova, V. Etnobotaniki xüsusiyyətə malik sedative və anksiolitik təsirli *Passiflora incarnata* L.

növün tibbdə istifadəsində müasir yanaşmalar // “Alternativ Tibb Metodlarının Tətbiqi Məsələləri” Mövzusunda Respublika Elmi Konfransı, – Naxçıvan: 23 aprel, – 2021, s. 44-49.
16. Badalova, V. Determination of the antimicrobial activity of ethanolic exstracts of some *Passiflora* L. first introduced in Azerbaıjan / V. Badalova, T. Suleymanov, R. Mammadov [et al.] // Bulletin of Science and Practice, – 2022, № 8(5), – p. 101.
17. Badalova, V., Atay, M.Ö. Determination and pharmacological properties of phytochemical compounds in the ethnobotanical *Passiflora edulis* L., first cultivated in Azerbaijan // Proceedings The 2nd İnternational Congress on Cocoa Coffee and Tea Asia, – Baku: May 19-20, – 2022, – p. 24.
18. Badalova, V. Abşeron bölgesinde yetiştirilen *Passiflora edulis* L. türünün yapraklarının morfometrik parametrelerinin değişimi // Atatürk Bahçe Kültürleri Merkez Araştırma Dergisi Bahçe, – 2022, № 51(2), – p. 103-108.
19. Bədələva, V. *Passiflora edulis* L. növün bioekologiyası və çoxaldılma texnologiyası // Ümummilli Lider Heydər Əliyevin anadan olmasının 100 illiyinə həsr olunmuş “Müasir təbiət və iqtisad elimlərinin aktual problemləri” mövsusunda beynəlxalq elmi konfrans III-hissə, – Gəncə: 05-06 may, – 2023, – p. 36-38.
20. Badalova, V.N. Phytochemical analysis of some species belonging to the Passifloraceae family / V.N.Badalova, Z.A.Mammadova, T.A.Suleymanov [et al.] // Plant biology and horticulture: Theory, innovation, – 2023. № 1(166), – pp. 25-32.
21. Badalova, V. Nectar glands of Passiflora species growing in Absheron and relation with ants / V.Badalova, Z.Mammadova, S.Maharramov [et al.] // BIO Web of Conferences, – Almaty, March 27-28**,** – 2024, 100, 04003.
22. Bədələva, V.N. Abşeronda introduksiya olunmuş *Passiflora* L. cinsinin bəzi növlərinin fitokimyəvi tədqiqi // Biomüxtəlifliyin

dayanıqlığının təmin edilməsində yeni çağırışlar (COP-29), – Naxçıvan: 3-4 iyun, – 2024, – s. 150.

23. Badalova, V., Mammadova, Z. Morphological structure and germination capacity of pollen of some species belonging to the *Passiflora* L. genus // 7th symposium on euroasian biodiversity, – Turkiye: August 22-24, – 2024, – p. 014.
24. Bədəlova, V., Məmmədova, Z., Alışlı, N. *Passiflora edulis* L. növünün "Marakuya" meyvələrinin ölkəmizdə tanınması və qida potensialının araşdırılması // Qlobal iqlim dəyişkənliyi şəraitində bitkilərin zərərverən orqanizmləri və onların idarə edilməsi mövzusunda elmi-praktiki konfrans, – Gəncə: 24-25 sentyabr, – 2024, – p. 276-279.

The defence will be held on December 17, 2024 at 11^{00} the meeting of the Dissertation council ED 1.26 operating at the Institute of Botany of MSE RA

Adress: A. Abbaszade str., 1128 crossing, AZ1004, Baku, Azerbaijan

The dissertation is available at the library of the Institute of Botany of MSE RA.

The electron version of the dissertation and its abstract is available on the official website (https://botany.az/) of the Institute of Botany.

Abstract was sent to the required addresses on November 15, 2024.

Signed for print: 07.11.2024

Paper format: A5

Volume: 38010

Number of hard copies: 20