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Black Locust (*Robinia pseudoacacia* L.) as a medicinal plant with antibacterial activities

Abstract

Of the two species of the genus *Robinia* L., which are native to North America and introduced in Polesie, Black Locust (*Robinia pseudoacacia* L.) is traditionally used as a medicinal, technical and food plant. One of the least covered aspects of using Black Locust is making jam from the flowers of this plant. The aim of our study is to report the modern Black Locust use to make jam by local residents of Polesie. Sociological survey of the 250 adult local inhabitants on the use of *Robinia pseudoacacia* was conducted. The Black Locust syrup in Polesie is used as an effective antispasmodic, expectorant, diuretic, choleretic, sedative, hemostatic, antipyretic, laxative, hypotensive, anti-inflammatory and healing agent. The Black Locust flowers is perfect as an antipyretic, and also for the prevention of diseases of the lungs and bronchi, and also as an effective antispasmodic, that is, for spasms of internal organs or muscles.

The article presents recipes of the Polesie local residents for making the Black Locust flowers jams, namely: Black Locust jam with apple juice, Black Locust jam with grape juice, Black Locust jam with honey, transparent Black Locust jam with white wine. Black Locust jams are not only tasty national products, but also have beneficial properties for human health. The claims of the Polesie local residents about the Black Locust flower products antibacterial action are not unfounded: scientific publications provide facts about the bactericidal effect of *Robinia pseudoacacia* flower extracts.

The conducted research encourages further research into the properties of Black Locust as a potential raw material for use in the production of food products, as well as cosmetology and medical use.

Keywords: antibacterial properties, black locust flowers, green infrastructure, Polesie, *Robinia pseudoacacia* L., jam

Volume 12 Issue 2 - 2024

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Received: August 30, 2024 | **Published:** September 09, 2024

Introduction

Polesie is a physical-geographical province of the mixed forest zone of Europe. The well-known peculiar features of the nature of Polesie are the predominance of lowland relief, wide participation of sandy deposits, the presence of a large number of rivers with low banks, large areas of forests and a large number of swamps. Natural complexes, without occupying large areas, often change each other, which is a characteristic feature of this region.[1] Black locust (*Robinia pseudoacacia* L.) as an invasive species, which are native to North America, is actively spreading into the green infrastructure of the villages, towns, cities and of Polesie.

In the historical localities of Polesie, not only the traditions of the conservative lifestyle have been preserved up to the present day, but also the use of the natural resources, namely plants. Black locust is a medium sized, melliferous tree which grows upto 6 metres commonly distributed in sandy and rocky soils. Leaves are pinnately compound, bluish green on top, pale underneath. They have a pair of short thorns at the base. Leaflets are oval shaped. Bark is light grey and deeply furred. Flowers are small, pear shaped, formed in droppy clusture. Flowering period occurs in late spring, from May to June. Black locust an invasive tree in Europe, commonly known for its negative impact on biodiversity, is a rich source of phenolic compounds recognized in traditional medicine.[2] The plant is used as an antispasmodium, febrifuge, antioxidant; diuretic, emollient, antitumor etc. The present study was carried out to screen different solvent extracts of the *Robinia pseudoacacia* phytochemically for the presence of active constituents like Alkaloids, Flavonoids Saponins, Tannins, and Phenols. However, the positive results for the detection of Flavonoids, Tannins and phenols were obtained. The maximum yield of ethyl acetate extract of plant leaves 38.23% was obtained by Kaloo et al,.[2]

Robinia pseudoacacia leaf extract has been reported to contain flavonoids, including acacetin, apigenin, diosmetin, luteolin, and quercetin.[3] The black locust flower (BLF), which has been used as a food additive and traditional medicine, is considered very important as the main raw material for honey harvesting. The BLF has been known to have diuretic, sedative and anti-inflammatory effects. The BLF contains a lot of ascorbic acid and phenolics, which have excellent antioxidant effects, and also has a relatively high content of free sugars and minerals.[4]

The metabolite profile depends on the environment and climate, this study aimed to provide the first LC-MS phytochemical screening of the black locust from the Istria region (Croatia). The compounds were extracted from leaves and flowers with 70% ethanol and 80% methanol. Total phenolics (TP) and flavonoids (TF), as well as antioxidant capacity (AC) measured by ABTS (17.49-146.41 mg TE/g DW), DPPH (24.67-118.49 mg TE/g DW), and FRAP (7.38-77.53 mg TE/g DW) assays, were higher in leaf than in flower extracts. Higher TP and total non-flavonoid (TNF) values were displayed in ethanolic than in methanolic extracts. In total, 64 compounds were identified, of which flavonols (20) and hydroxycinnamic acid derivatives (15) were the most represented. Flavanols such as catechin dominated in leaf extracts, followed by flavonols, with kaempferol glucuronyl rhamnosyl hexosides as the main compound, respectively. Flower

extracts had the highest share of flavones, followed by ellagitannins, with luteolin dirhamnosyl hexosides and vescalagin, respectively, being predominant. The extracts had good quorum sensing, biofilm formation prevention, and eradicating capacity. The results provided new insights into the phytochemical properties of R. pseudoacacia as the first step toward its potential pharmaceutical use.[5]

Biological activities such as antioxidant, anticoagulant, and α-glucosidase inhibitory effects of 40% (v/v) ethanolic extract from black locust flower were investigated. The polyphenol content of the black locust flower extract was 39.8±0.5 mg gallic acid equivalents/g. The flower extract represented antioxidant effects such as free radical, cationic radical, and nitrite scavenging abilities as well as reducing power. Also, the flower extract inhibited α-glucosidase activity and common pathway in plasma coagulation system.[6]

Local residents of Polesie (Ukraine) have long used Black Locust as a medicinal, technical and food plant. One of the least covered aspects of using Black Locust is making jam from the flowers of this plant. So, the aim of our study is to report the modern Black Locust use to make jam by local residents of Polesie.

Methodology

Sociological survey of adult local inhabitants on the use of *Robinia pseudoacacia* was conducted. The local inhabitants of all households with a quota of 1 person per household were interviewed, regardless of whether the household is home to an extended family (consisting of several generations) or a nuclear family (consisting of parents and their unmarried children), as well as childless families and single people. The surveys were conducted by interviewing and recording the respondents' answers and stories. A total of 250 people took part in the sociological survey.

Results and discussion

Of the two species of the genus *Robinia*, which are introduced in Polesie, *Robinia pseudoacacia* is traditionally used when it blooms in late May – early June (Figure 1). Local residents of Polesie know the following the Black Locust uses. The Black Locust syrup in Polesie is used as an effective antispasmodic, expectorant, diuretic, choleretic, sedative, hemostatic, antipyretic, laxative, hypotensive, anti-inflammatory and healing agent. The flowers of *Robinia pseudoacacia* is perfect as an antipyretic, and also for the prevention of diseases of the lungs and bronchi, and also as an effective antispasmodic, that is, for spasms of internal organs or muscles. The healing properties of flowers: acacias improve blood clotting; dilate blood vessels and relieve spasms; increase sputum production during colds; reduce body temperature; increase sweat secretion; destroy pathogenic bacteria; have a diuretic effect; normalize blood pressure; stimulate the secretion of bile; reduce stomach acidity.

Out of 250 surveyed respondents, only 12% prepare or have once made Black Locust jam. Recipe for making jam at home in the Tupichev area. To make jam from black locust flowers, you need to collect acacia clusters in places far from the city (if possible). We cut off the whole bunches, rinse them lightly with water and dry them in the sun. We pick the flowers into a separate container; to make jam you will need 1 kg of white Black Locust flowers. Jam should be made only from white Black Locust flowers, as other varieties, such as purple acacia, are bitter. Place Black Locust flowers in a saucepan. Scald the lemons with boiling water, wash them and cut them into cubes along with the skin, removing only the seeds. Fill the flowers and lemons with water, put them on the stove, bring to a boil and simmer for 20 minutes over low heat. Cover the pan with a lid and leave the broth for 1 day. After a day, strain the decoction of flowers and lemon through a triple layer of gauze, squeeze well, put the pan on the stove and gradually add sugar. Cook the jam over low heat, skimming off the foam with a slotted spoon. If you want to get a syrup that can be added to tea and soaked into cake layers, cook for 20-30 minutes; if you want thicker jam, cook for 45-60 minutes. Pour the finished hot jam into clean sterilized jars, roll up and wrap until completely cooled. Yield: 2 liters of acacia honey.

Figure 1 The Black Locust (*Robinia pseudoacacia* L.) flowering (Chernihiv Polesie).

Black Locust jam with apple juice. Grind the acacia with a rolling pin or pass it through a meat grinder. You will need: 2 kg of Black Locust flowers, 2 kg of sugar, 250 ml of apple juice, 1 liter of water. Preparation: Black Locust flowers with 1 kg of sugar to a mushy state. Pour apple juice, boil for 10 minutes and put aside for 2 hours. Boil the syrup from water and the remaining sugar, pour it into the preparation with acacia and boil it all together for 30 minutes. Strain through cheesecloth, and squeeze the cake well. Boil the resulting jam for another 15-20 minutes, pour into jars and roll up.

Black Locust jam with grape juice. The finished jam can be served just like that, spread on bread, used to soak biscuits or added to tea. You will need: 1.5 kg of Black Locust flowers, 2 kg of sugar, 250 ml of grape juice, 1 liter of water. Preparation: Mix water with sugar and boil the syrup for 10 minutes. Pour in the prepared Black Locust flowers, boil for 20 minutes and remove the preparation for 2 hours. Then put the jam on the fire and boil for 25-30 minutes. Strain, pour grape juice and boil for another 40 minutes. Pour into clean, dry jars, enter and leave in a warm place for a day.

Black Locust jam with honey. You will need: 1.5 kg of Black Locust flowers, 500 g of sugar, juice of half a lemon, 500 g of honey, 1 liter of water. Preparation: Place the Black Locust flowers in a saucepan, cover with sugar and grind well to a mushy state. Pour water, boil for 40 minutes and strain. Mix the resulting liquid with lemon juice and honey. Boil the jam for another 20 minutes, pour into prepared jars and store for the winter.

Transparent Black Locust jam with white wine. You will need: 2 kg of Black Locust flowers, 250 ml of white wine, 2 kg of sugar, 0.5 tsp. citric acid, 1 liter of water. Preparation: boil water, add sugar and boil for 10 minutes. Pour in the Black Locust flowers, remove the preparation from the fire and insist under the lid for 2 hours. Then boil

Citation: Lukash O, Morskyi V, Kurhaluk N, et al. Black Locust (*Robinia pseudoacacia* L.) as a medicinal plant with antibacterial activities . *MOJ Food Process Technol.* 2024;12(2):152–154. DOI: 10.15406/mojfpt.2024.12.00312

for another 40 minutes, strain and squeeze the cake well. Mix the jam with wine and citric acid, boil for 20 minutes and close in a sterilized container.

In the Liubech area, local residents emphasize the specifics of syrup preparation: "The classic syrup was prepared – granulated sugar was dissolved in water, gradually heating it. When the sugar dissolved, pure flowers were poured in, stirring continuously, and boiled for 45 minutes. Then the petals were crushed in a blender, poured again in syrup, added the squeezed juice of one lemon and boiled for another 15 minutes. Turned off the heat and left to cool".

There are 85% of surveyed local residents of Polesie believe that Black Locust jam has antibacterial properties. And this statement is confirmed by P. Bhalla et al,.[4] scientific research. Their research investigates the chemical composition of flower essential oil of *Robinia pseudoacacia* (FEORP) by GC-MS analysis and reports its antimicrobial efficacy against selected foodborne pathogens. The GC-MS analysis of FEORP confirmed the presence of 27 compounds which represented 94.46 % of total oil. Further, FEORP (1000 µg/disc) exhibited significant antimicrobial effects against some of the selected foodborne pathogens such as *Staphylococcus aureus* KCTC 1621, *Bacillus subtilis* KCTC 3569, *Listeria monocytogenes* KCTC 3569, *Escherichia coli* O157:H7 and *Salmonella enterica* ATCC 4731 with diameters of the zones of inhibition (15.2 ± 0.3-17.3 ± 2.0 mm) as well as the MIC and MBC (250-1,000 µg/mL). Additionally, FEORP at MIC reduced cell viabilities of two selected foodborne pathogens, *B. subtilis* KCTC 3569 and E. coli O157:H7 (Bhalla & Bajpai, 2017). Extracts of flowers and seeds are efficient antibacterials for Gram positive cocci.[7]

S. Stankov et al,.[8] established that the *Robinia pseudoacacia* flowers were with high levels of phenolic compounds and minerals that have pronounced antioxidant properties. The aromatic substances and phenolic compounds passing through the extracts exhibit antimicrobial properties against foodborne pathogenic bacteria as *Salmonella, Escherichia coli* and *Listeria monocytogenes*. The Black Locust flowers extracts were efficient antibacterials for Gram positive cocci.[8] It is also known about the antibacterial potential of extracts of *Robinia pseudoacacia* and its different fractions, as well as some of its natural compounds against oral pathogens and a nonpathogenic reference bacteria, Escherichia coli, *Streptococcus mutans* and *Porphyromonas gingivalis*, which cause periodontal inflammatory diseases and dental caries.[9]

The conducted research encourages further research into the properties of Black Locust as a potential raw material for use in the production of food products, as well as cosmetology and medical use.

Conclusion

There are traditional ways for the Polesie region of using the *Robinia pseudoacacia* as a medicinal plant and for making jam. Ther are 12% from 250 respondences prepare or have once made Black Locust jam. The local residents of Polesie believe that acacia jam has not only a pleasant taste, but also some useful properties. The benefit of Black Locust jam is that it can positively affect a person's general well-being, has a calming effect on the nervous system, and also reduces the level of tension and stress. In addition, Black Locust contains flavonoids – they are antioxidants that protect the body from harmful effects and have anti-inflammatory and also bactericidal properties. Black Locust jam contains vitamin C and other nutrients that help strengthen the immune system, support healthy skin and improve digestion. However, Black Locust jam should be used sparingly, with caution. The main harm lies in the increased sugar content, which will negatively affect people prone to allergic reactions, diabetics and those who are overweight.

Acknowledgments

The authors are grateful to the International Visegrad Fund for supporting the research.

Conflicts of interest

Authors declare that there is no conflict of interest.

Funding

None.

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