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Chemical Analysis of Localized Indigoferaa Plant

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Abstract : Key purposes of the article is about The history of the spread of the wild plant “Indigoferaa tinctoria”, Chemical analysis of a localized Indigofera plant, Results of experiments carried out in the educational farm, Indigofera green biomass Chemical and Biological Constituents.

Key words: “Indigoferaa tinctoria”, Chemical analysis of a localized Indigofera plant, Results of experiments, green biomass Chemical and Biological Constituents.

Today, the development of science and technology is developing rapidly. The geographic political structure of the world is changing. In this context, the problem of achieving a balance in the relationship between man and nature is becoming more and more urgent, combining human interaction with the regulation of impact on the earth with social development and preservation of a favorable natural environment.

The risk associated with limited land and its quality composition, low productivity is constantly increasing. At the same time, land is not only a huge wealth, but also a factor that determines the future of the country. This is especially noticeable in Uzbekistan. Due to agrotechnical measures, erosion by wind and water adversely affects soil fertility. Thus, more than two million hectares of irrigated land throughout the country are under the threat of degradation. Therefore, in the coastal regions, in particular in Khorezm, for soil and climatic conditions, it was decided to acclimatize Indigofera plants to obtain natural dyes - this is one of the urgent tasks of our time.

With the help of nodule bacteria that grow at the root of the Indigoferaa plant, it assimilates atmospheric nitrogen, increases the amount of nutrients in the soil and helps to improve the agro-ecological properties of saline degraded soils. In addition, the Indigofera plant is currently grown in India, China, Japan, Afghanistan, Mali, Ghana and El Salvador, and in England, Germany and the United States, the indigo dye is obtained by chemical synthesis.

Based on this, the "O'ZINDIGO" project was founded in 2005 at the initiative of "UNESCO" in Uzbekistan. Within the framework of this project, experiments on planting and growing indigo were carried out in Karakalpakstan, Khorezm, Syrdarya and Tashkent regions. A number of scientific studies have also been carried out to improve the simple methods of extracting the dye powder from it.

Purpose of the study: Acclimatization of the Indogafer in Uzbekistan, including in the soil conditions of the Aral regions that have lost their fertility, the development of their agricultural technology in local conditions. And also a number of measures are being taken to improve the methods of obtaining natural dyes from it and create local stocks of raw materials, as well as to restore soil fertility and improve agro-ecological properties.

The history of the spread of the wild plant “Indigoferaa tinctoria”

There is a general assumption that the sources are spread from the east. However, recent studies by paleobathanists indicate that the Indigofera species actually spread eastward from Africa in the form of weeds mixed with cotton grains and other plant seeds from Arabia and India. The indigo-colored plants belong to the third largest family of butterflies in the genus Indigoferaa, with nearly 800 plant species. Plants belonging to the Indigofera genus can grow up to 1630 m above sea level.

Among all the indigo plants are Indigoferaa tinctorial and Lsumatran Caetn, which are widely used in tropical countries. These plants are single and multi-stemmed shrubs.

In the seventeenth century, chemists worked hard to obtain indigo from the leaves of the dye plant, and also achieved a certain consistency, although thanks to French experiments they came close to finding a solution on a large scale. The French found that the dye plant should be soaked in boiling water, unlike other indigo plants. Recently, scientists have found that the leaves of a dye plant need to be soaked not only for 10 minutes at 80 ° C, but also so that the liquid quickly remains.

Chemical analysis of a localized Indigofera plant

In addition to water and nutrients in the soil, which is a very complex property of soil, fertility also depends on conditions such as a certain amount of heat, a sufficient amount of air, a reaction that is close to neutral, and the absence of compounds harmful to plants. Consequently, fertility depends on chemical, physicochemical and biological processes in the soil.

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Indigofera is found in several parts of the world and is more common than other plant species from which other natural dyes are derived.

Results of experiments carried out in the educational farm

In 2006-2010. The observations were carried out according to a pilot scheme established by the ZEF / UNESCO Office in Uzbekistan.

In the experiments, the influence of the Indigofera plant on the soil environment in various soil conditions was regularly observed. For this, soil samples were taken and the periodic changes in the amount of salts in them were studied. The influence of crops on the ecological properties of the soil was observed annually in spring and autumn based on a comparison of the conditions of soil fertility with the soils of the control fields.

In the experiments of 2006-2010. The crop irrigation regime was regulated according to the established plan. In 2006, simple methods were developed to extract the dye from the biomass of Indigofera grown in experimental plots.

In 2008-2009, a number of scientific observations were carried out on the methods of obtaining dyes from the Indigofera plant. At the same time, experiments were carried out on the dyeing of silk and cotton yarn with dyes from plant biomass. A number of works have been carried out to create the Indigofera variety "Feruz", adapted to local soil and climatic conditions, the collection of plant seeds on the basis of individual selection. Growing Indigo as a secondary crop after autumn wheat. The cultivation of two crops of plant biomass during the growing season and other similar properties is studied.

The yield of green biomass in the area sown with Indigofera is that when the seed pods are fully ripe, the buds of the bush are collected when they turn 70-80% brown and dried in the open air. Completely dried plant samples are crushed and the pods are separated from the stem and leaf biomass.

When analyzing the yield of dry seeds and leaf and stem biomass of plants in the field of practical experiments, 58-60% of the surface dry biomass of a plant were seed pods and 40-42% of the biomass of the stem and stem biomass.

For the cultivation of indigo in order to obtain light or leaf biomass, high yields of biomass can be grown in areas with light or medium sandy soils, with a high level of groundwater (1.3–1.5 m).

Indigofera green biomass

The main biomass of the Indigofera plant is formed in the upper part of the earth. Its roots do not penetrate deeply into the soil, and lateral roots make up a very small part of the total plant biomass due to their absence.

Plant growth and development continues until late autumn. The formation and development of the root system is also very different from other plants, that is, when true leaves appear, the root system grows 2 times faster than the surface one. Later, only lateral roots are formed, which stop growing. In the laboratory, plant parts are measured separately by drying at 70 * for 48 hours. However, it has been observed that the main moisture in the plant's body is mainly stored in the leaves and body.

Using Indigoferaa to improve soil fertility

The following conclusions can be drawn by analyzing the results of four-year field experiments conducted to study biological methods for increasing soil fertility.

1. Biological methods for increasing soil fertility. It is advisable to plant legumes that enrich the soil with humus and nutrients, especially the recently acclimatized Indigofera culture in our region.
2. The activity of nodule bacteria in the roots of Indigofera cultures and the addition of root and root residues to the soil improves its physical and mechanical properties. The bulk density in the soil ensures that the soil is grainy, humic, porous in a layer of 0–20 cm above the crop during the 4th harvest.
3. Due to the activity of bacteria in the roots of plants and root residues, the amount of humus in the soil increased by an average of 0.15-0.20%.
4. Rhizobacteria in the roots of Indigofera crops enrich the soil with nutrients by absorbing atmospheric nitrogen. Planting an indigo plant for 4 years increases the total nitrogen content in the soil from 0.043% to 0.075%. A decrease in the amount of free phosphorus is observed. This is evidenced by the fact that the plant consumes a lot of phosphorus. In general, all legumes consume more phosphorus. Potassium levels increase from an average of 80 to 105 mg / kg.

Based on the above, it is possible to recommend the cultivation of indigo to restore the fertility of degraded land in

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farms.

The demand for dyes is growing rapidly today. This, in turn, requires the search for natural, convenient and, most importantly, inexpensive resources. Naturally, research on bioactive substances offers not only advances in this area, but also a number of innovations in the chemistry of natural compounds. Identification of indoxyl-containing plants, development of effective methods for their isolation, study of the chemical structure and biological effects of indoxyls and the creation of drugs based on them, separation of natural dyes and development of new methods for their bioorganic separation. is an important and relevant function of chemistry. The Indigofera plant has long been used for dyeing, henna and basma for women. One of the methods for obtaining synthetic indigo is the addition of potassium hydroxide to the iron compound N-phenylglycine, which is formed by the interaction of aniline and monochloric acetic acid in the presence of iron (II) hydroxide. the sodium compound of indoxyl, obtained by the action of a mixture of sodium amide, potassium and sodium alkalis, is oxidized by atmospheric oxygen.

Chemical Constituents

Compounds 1-65 are the known chemical constituents isolated from the genus Indigoferaa. They are commonly flavonoids, especially, flavonoids glycosides. Many lignin and a few of other constituents including alkaloids, steroids, fatty acids containing amino group.

Compounds isolated from the species of the genus *Indigoferaa*

S. No.	Compound Name	Source	Ref
Flavonoidal compounds			
1	(+)-5″-deacetylpurpurin	*I. spicata*	[20]
2	(+)-5-methoxypurpurin	*I. spicata*	[20,21]
3	(+)-purpurin	*I. spicata*	[22, 23]
4	(2S)-2,3-dihydrotephroapollin C	*I. spicata*	[20]
5	(2S)-2,3-dihydrotephroglabrin	*I. spicata*	[20]
6	(2S)-7-methoxy-8-(3-methoxy-3- methylbut-1-enyl) flavanone	*I. spicata*	[42]
7	Kaempferitrin	*I. arrecta*	[24]
8	Kaempferol 3,7diarabinoside	*I. hebepetala*	[25]
9	Kaempferol 7-alloside	*I. hebepetala*	[25]
10	Triflin;2´´-O-β-L-ramnopyranosyl,7-O-β-L arabinofuranoside	*I. hebepetala*	[26]
11	Triflin;6´´-O-β-L-ramnopyranosyl,7-O-β-L arabinofuranoside	*I. hebepetala*	[26]
12	Formononetin	*I. pseudotinctoria*	[20]
13	Afromosin	*I. pseudotinctoria*	[20]
14	Genistein	*I. pseudotinctoria*	[20]
15	Rutin	*I. kirilowi*	[27]
16	7,4'-Dihydroxy-3'-methoxy isoflavone	*I. pseudotinctoria*	[20]
17	Formononetin-7-O-β-D-glucoside	*I. pseudotinctoria*	[20]
18	Kaempferol-3-O-rutinoside	*I. kirilowi*	[27]
19	Quercetin-3-O-glucosidase	*I. kirilowi*	[27]
20	Louisfieserone	*I. suffruticosa*	[67]
21	Hetranthin A	*I. hetrantha*Wall.	[28]
22	Hetranthin B	*I. hetrantha*Wall.	[28]
23	Glabretephrin	*I. tinctoria*	[29]
24	Semiglabrin	*I. tinctoria*	[29]
25	Pseudosemiglabrin	*I. tinctoria*	[29]
26	Flavonol glycoside	*I. tinctoria,* *I. zollingeriana*. *I. hebepetala* Benth. Ex Baker	[30,31]
27	Quercetin	*I. aspalathoides Vahl ex DC.*	[32]
28	Kaempferol	*I. aspalathoides Vahl ex DC.*	[32]

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29	kaempferol 5-O-b D-glucopyranoside	*I. aspalathoides Vahl ex DC.*	[32]
Nitro group containing compounds			
30	Endecaphyllin A1	*I. linnaei*	[33]
31	Hiptagin	*I. endecaphylla*	[33]
32	3-Nitropropanoates;2,3,4,6-tetrkis-(3-nitropropanoyl)-β -D-glucopyranose	*I. suffruticosa* and *I. linnaei*	[33]
33	Endecaphyllin	*I. endecaphylla*	[33]
34	3-Nitropropanoic acid, Et ester	*I. endecaphylla*	[33]
Amide			
35	Indigoidin	*I. pseudomonas*	[34]
36	Indigotin	*I. tinctoria*	[35]
37	(S)-Indispicine	*I. spicata* and *I. endecaphylla*	[36]
Steroidal compounds			
38	β –Sitosterol	*I. pseudotinctoria*	[20]
39	Daucosterol	*I.pseudotinctoria*	[20]
40	Lupeol	*I. kirilowi*	[28]
41	5-[(E)-2-(4-hydroxyphenyl] benzene-1,3-diol	*Indigoferaalinnaei*, Ali	[37]
42	Gitoxin	*Indigoferaalinnaei*, Ali	[37]
Keto compounds			
43	12-Oleanen-3,11- dione	*I. pseudotinctoria*	[20]
44	12-Oleanen-3,11-dione	*I. pseudotinctoria*	[20]
45	3β-acetoxy-12-oleanen-11-one	*I. pseudotinctoria*	[20]
Keto flavonoids			
46	Louisfieserone	*I. suffruticosa*	[39]
Lignin			
47	Isoliquiritigenin	*I. pseudotinctoria*	[20]
48	Maackiain	*I. pseudotinctoria*	[20]
Alkaloids			
49	Indigo, 2,2′-bisindole alkaloid	*I.tinctoria*, *I.suffruticosa*and *I. truxillensis* Kunth.	[40-42] [43]
Terpenoids			
50	Indigoferaabietone	*I. longeracemosa*Boiv. ex. Baill.	[44]
51	Two monoterpene glycosides,	*I. hetrantha*	[45]
Miscellaneous compounds			
52	Indigin	*I. oblongifolia*Forssk.,	[46]

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53	Indigoferaic acid	*I. oblongifolia*Forssk.	[46]
Toxic constituents of I. spicata			
54	Indospicine	*I. spicata*	[28,47,48] [50,50]
55	Canavanine	*I. spicata*	[28-50]
56	3-nitropropanoic acid	*I. spicata*	[28-50]
Rotenoids			
57	cis-(6aβ,12aβ)-hydroxyrotenone	*I. spicata*	[51,52]
58	rotenone	*I. spicata*	[52,53]
59	Tephrosin	*I. spicata*	[52,54]
Chalcone			
60	(+)-tephropurpurin	*I. spicata*	[55]
Nitropropanoyl			
61	[2,3,4,6-tetra (3-nitropropanoyl) α-D glucopyranose]	*I.suffruticosa*	[56]
Benzofuran			
62	2-(2'-hydroy-4'-methoxypheyl)-3-methyl-6-methoxy benzo[b] furan	*I. microcorpa*	[57]
63	2-(2'-hydroy-4'-methoxypheyl)-3-methyl-5,6-dioxmethyl-ene-benzo[b] furan	*I. microcorpa*	[57]
Cerebroside			
64	Indigoferaamide-A	*I. heterantha*	[69]
Ester			
65	Indigoferaate	*I. heterantha*	[70]

Biological Activities

The genus Indigoferaa is known for the medicinal important due to a rich source of secondary metabolites such as flavonoids, triterpenoids, lignins and steroids. Based on structure activity relationship the biological activities of different class of compounds isolated from various species of the genus Indigoferaa are highlighted below. Indirubin isolated from I. suffruticosa proved to be excellent inhibitor in mice against lewis lung carcinoma and walker 256 carcinosarcoma. Indispicine isolated from both I. spicata and I. endecaphylla (Posses good hepatotoxic and teratogenic activity. While bovinocidin obtained from I. endecaphylla has showed moderate activity against mycobacterium tuberculosis. Louisfieserone isolated from I. suffruticosa has antibacterial stroke against vague gram-positive and gram-negative microorganisms. The isolated compound Hetranthin A displayed in vitro lipoxygenase inhibitory potential with an IC50 value of 2.1 µg/mL. Fat food treated with a mixture of semiglabrin and pseudosemiglabrin (20:80) keeps significant reductions in plasma triglycerides (60%), as well as completes cholesterol (19%), along with an upsurge in high density lipoprotein (8%) [29]. Indigo, a 2,2′-bisindole alkaloid is a main component of I. tinctoria, used as a blue dye. A 2,3′-isomer of indigo and insignificant component of I. tinctoria, indirubin, was documented as the active ingredient present.

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