

Biodiversitital, Morphological and Biochemical Evaluation of Wild Herb Plants species at different Regions of Agra (U.P.) INDIA

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ABSTRACT

Medicinal plants have been explored and used in traditional medical practices for thousands of years, dating back to prehistoric times. Plants produce many chemicals and biochemical compounds to perform many functions, including defence against herbivorous insects, vertebrates, fungi, and diseases. This diversity must be maintained for the mutual survival and survival of species. Biodiversity is disappearing due to habitat loss and destruction, overexploitation of resources, unprecedented climate change, pollution, disease, crop displacement, wildlife poaching, etc. As humans reap all the benefits of biodiversity, they must be concerned about the conservation of biodiversity in all its forms and the good health and safety of future generations. Fresh leaf samples of selected herbal (medicinal) plants were collected from four locations in the Agra region: a total of 4 samples of wild plants.

Figures : 05

References : 16

Tables : 07

KEY WORDS : Biochemical compound, Biodiversity, Medicinal plants, Traditional medicine, Wild plants.

Introduction

Medicinal plants have been widely prescribed to treat a variety of medical conditions and diseases in traditional herbal medicine systems around the world for thousands of years⁵. Traces of their use can be found in all ancient civilizations and on all continents. Thus, despite advances in pharmacology, even today, the

medicinal use of plants is still very widespread in some countries, especially in developing countries. The World Health Organization (WHO) estimates that 80% of people in developed and developing countries are highly dependent on traditional medicine, especially herbal medicine, as their primary health care¹⁶. Plants are an important source of human food, spices, medicine,

TABLE-1 : The Menhinick's Index Value at Four Selected sites

S. No	Species Name	Bharatpur Value	Dhoulpur Value	Hathras Value	Farah Value
1	<i>Datura metel</i>	3.6015	4.5962	3.6015	3.6015
2	<i>Daturas stramonium</i>	4.116	4.2426	4.6305	4.459
3	<i>Solanum nigrum</i>	3.6015	4.773	4.116	4.459
4	<i>Withania somnifera</i>	4.6305	4.2426	4.459	4.116

TABLE-2 : The Margalef's Index Value at Four Selected sites

S. No.	Species Name	Bharpur site Value	Dholpur site Value	Hathras site Value	Farah site Value
1	<i>Datura metel</i>	5.6716	7.2135	5.6716	5.6716
2	<i>Daturas stramonium</i>	6.5223	6.6364	7.373	7.0895
3	<i>Solanum nigrum</i>	5.6716	7.502	6.5223	7.0895
4	<i>Withania somnifera</i>	7.373	6.6364	7.0895	6.5223

shelter, fuel and animal feed, as well as for livestock, pollinators and wildlife, and provide a variety of additional ecological and cultural services of value to humanity^{8,14,15}. Unfortunately, many beneficial plants are at risk from destruction and habitat degradation. Invasive plant species are vulnerable to climate change, pollution, and overexploitation^{3,9,12,13} and are poorly tolerated in ex-pat conservation areas. Ethiopia is home to a wide variety of landscapes and diversity; however, many species are threatened by habitat alteration. Threats overuse of natural resources and climate change climate change and pollution, displacement of the poor lack of knowledge and cooperation. Like most living organisms, they are organized at different levels, from animal systems to genetics. However, it involves a wide diversity of species, ecosystems, genes, and related factors¹.

Material and Methods

Plant material and Reagents

Fresh Leaf samples of selected Herbal (Medicinal) Plants were Collected from four selected sites of Agra Region. Total 5 samples of Wild Herbal Plants. All the chemicals used for DNA isolation and PCR were of

molecular biology grade.

Experimental Plants

Leaves of *Datura metel*, *Solanum nigrum*, *Datura stramonium*, *Withania somnifera*, used in the research were obtained from different areas of Agra Region (U.P.) India.

Selected Sites for the Study at Nearby Agra Region

For the study of biodiversity and biochemical evaluation herbal plant species these areas are characterized by low human activities and minimum biotic pressure.

The basic criteria for the selection of a site for the study were a distance of 50 km, at four different directions to get better biodiversity analysis.

Servery of Plant Species

Taxonomic survey of existing plant species conducted by Quadrante method. This has also been helpful in studying the diversity richness of wild plants of medicinal importance. In this method, quadrante of a prescribed size (generally, 1 sq. m) is randomly thrown at different locations in a given area.

TABEL-3 (A) : The Similarity Index of species at four natural sites

S. No.	Species Name	Different sites of Agra Region			
		Bharatpur	Dholpur	Hathras	Farah
1	<i>Datura metel</i>	+	+	+	+
2	<i>Daturas stramonium</i>	+	+	+	+
3	<i>Solanum nigrum</i>	+	+	+	+
4	<i>Withania somnifera</i>	+	+	+	+

TABEL-3 (B) : The Similarity Index of species at four natural sites

S.No.	Selected sites	Similarity Index
1.	Bharatpur— Dholpur Sites	86.76
2.	Bharatpur — Hathras	89.70
3.	Bharatpur – Farah	88.05
4.	Dholpur – Farah	82.80
5.	Dholpur — Hathras	83.20
6.	Farah – Hathras	81.60

Evaluation of Biodiversity Index

Following formulas were applied for evaluation of biodiversity:

i. Menhinick’s Index (1964)

Such index, having a linear relationship with S, is Menhinick’s Index (D_b). It is given this;

$$D_b = \frac{S}{\sqrt{n}}$$

Where, S = No. of species

n = No. of Individuals

ii. Margalef’s Index (1968)

Margalef’s Index is a simple species diversity index emphasizing species richness developed by the spanish ecologist **Ramon Margalef**.

$$D_m = \frac{S-1}{\log n(n)}$$

Where, S = No. of species

n= No. of individuals

iii. Similarity Index (by Zechanovaski’s)

The Similarity index determines the inter-specific association between the species of plant Communities.

$$S = 100 \times \frac{2C}{(a+b)}$$

Where a= No. of species here in 1 site

b= No. of species here in 2 sites

C= No. of species here in both sites.

Morphological and biochemical parameters Analysis:

Study of morphological characterization of wild herbal plants, having high biodiversity index for the following parameters:

- Morphological parameters – shoot, root length, fresh and dry weight of shoot and root, leaf surface area etc.

TABLE-4 : Moisture content (%) in seeds at 4 selected sites

S. No.	Species Name	Moisture content (%)In seeds of 4 Selected sites			
		Bharatpur	Dhaulpur	Hathras	Farah
1	<i>Datura metel</i>	4.42	7.40	5.10	7.56
2	<i>Datura stramonium</i>	6.80	6.81	6.79	6.90
3	<i>Solanum nigrum</i>	7.41	7.42	7.36	7.48
4	<i>Withania somnifera</i>	6.20	6.21	6.19	6.23

TABLE-5 : Oil content (%) in seeds at 4 selected sites

S. No.	Species Name	Oilcontent (%)In seeds of 4 Selected sites			
		Bharatpur	Dholpur	Hathras	Farah
1	<i>Datura metel</i>	7.42	4.01	6.10	6.56
2	<i>Datura stramonium</i>	6.68	5.21	6.72	6.90
3	<i>Solanum nigrum</i>	18.59	18.31	18.75	18.48
4	<i>Withania somnifera</i>	4.20	4.61	5.19	4.23

- Seed shape, colour, seed weight were recorded. Seeds collected from clean, healthy and dried seed lot will be counted and their values were recorded with the help of digital top loading balance.

Study of Floral Characterization of Wild Herbal Plants, For the Following Parameters:

- Inflorescence type
- Flowers: Bisexual/ unisexual, complete/ incomplete, bracteate/ ebracteate, actinomorphic/ zygomorphic.
- Epicalyx: Present/ Absent
- Androecium: Number of stamens, free or fused, type of attachment with respect to anther, mode of dehiscence.

Biochemical Analysis

Biodiversity studies were also based upon the biochemical variations in wild herbal plants found in four selected sites.

- Percentage of moisture content in seeds at four selected sites** – Were determined the % of moisture in the seeds by drying them to perpetual weight at a temperature of 105°C.

$$\text{Moisture \% by weight} = \frac{100 \times w}{W}$$

Where, w = Loss in weight g of the seeds upon drying and

W = Weight in g of the seeds taken for the test.

- Percent of oil content in seeds collected from four selected sites**—Percentage of oil content in seeds were analysed by oil extraction with a petroleum hydrocarbon solvent.

$$\text{Oil percentage by weight} = \frac{w \times 100}{W}$$

Where, w= weight of the oil extract (in gram);

W= weight of the sample taken for the test (in g)

Plant collection and morphological identification:

Four distinct places of Agra region, worth of naturally occurring herbal plants were gathered and brought to the lab for additional examination and identification.

- Morphological parameters** – shoot, root length, fresh and dry weight of shoot and root, leaf surface area etc.
- Seed quality**- Seed shape, colour, seed weight were recorded. Seeds collected from clean, healthy and dried seed lot were counted and their values were recorded with the help of digital top loading balance.
- Floral classification**- Inflorescence type, Flowers position, presence and absence of Epicalyx, Androecium number and gynaecium, Pollination were analyzed.

Observation

Survey and Preliminary Observations:

Extending between 27° 10' 36.0120" North Latitude and 78° 0' 29.0592" East longitude and covering an area of 4,041.5 sq. kms; the Agra district guards the South – Western gate of Uttar Pradesh. It is bounded on the west, by Bharatpur on the South by Dhaulpur to the North by Mathura and Etah and to East Manipuri and Etawah.

Evaluation of Biodiversity index

The plant species have been collected randomly from the four natural sites of Agra district (Table- 1). For the study of species richness (diversity) put the four formulae which showed the maximum and minimum diversity of species at its natural sites.

The Menhinick's Index (Db) was analysed for four natural sites. This index showed diversity of each

TABLE-6 :

S. No	Parameters	<i>Datura metel</i>	<i>Solanum nigrum</i>	<i>Datura stramonium</i>	<i>Withania somnifera</i>
1	Type of root	Tap root	Tap root, branched	Tap root	Tap root,
2	Length of root (cm)	50-100 cm	40-80 cm	40-100 cm	40-60 cm
3	Length of shoot (cm)	50-200 cm	40-100 cm	60-140 cm	50-150 cm
4	Type of stem and mode of branching	Herbaceous, erect branched, densely covered woody below, number of branches on main shoot = 15-20	Herbaceous, erect, cylindrical slightly ridged, branched, glaucous, number of branches on main shoot= 7-30	Herbaceous erect, branched, densely covered woody below number of branches on main shoot = 20-40	Herbaceous above, branched woody below, densely covered with fine stellate hair, number of branches on main shoot= 15-24
5	Root / shoot ratio (cm)	3/5 cm	6/7 cm	7/10 cm	½ cm
6	Leaf: Type	Simple, alternate petiolate, bracteate, ovate, dentate, acute, uncostate and reticulate ventation, ex-stipulate	Simple, alternate opposite, petiolate, bracteate, ovate dentate acute, and reticulate venation, ex- stipulate	Simple, alternate opposite, petiolate, ovate, dentate, acute, uncostate and reticulate venation, ex-stipulate	Alternate or in unequal pairs, ovate or ovate lanceolate, entire, acute petiolate, reticulate venation, ex-stipulate
7	Seed: (Shape, colour, 1000 seed weight) (in g)	Seeds sub-reniform, smooth light brown in colour. Wt. of 1000 seeds- 12-15 g	Seed sub- reniform wrinkled, pale brown. Wt. of 1000- seeds = 2.3- 2.5 g	Seeds reniform, dark brown in colour, smooth. Wt. of 1000 seeds = 14-16 g	Seeds sub reniform wrinkled, pale brown. Wt. of 1000 seeds= 2.9- 3.2 g

TABLE-7 : Oil content (%) in seeds at 4 selected sites

S. No	Parameters	<i>Datura metel</i>	<i>Solanum xanthocarpum</i>	<i>Solanum nigrum</i>	<i>Datura stramonium</i>	<i>Withania somnifera</i>
1	Inflorescence	Solitary axillary	Helicoid cyme	Extra-axillary helicoid cymes, extra axillary due to fusion	Solitary axillary	Axillary cyme
2	Flowers	Pedicellate Hermaphrodite, Completes bracteates, actinomorphic hypogynous	Hermaphrodite, complete, bracteate, hypogynous, actinomorphic pedicellate	Hypogynous, Hermaphrodite, Complete, ebracteate, actinomorphic pedicellate	Hermaphrodite, complete, bracteate, actinomorphic pedicellate	Hermaphrodite, complete, ebracteate, actinomorphic, pedicellate, hypogynous
3	Epicalyx	Absent	Absent	Absent	Present	Absent
4	Calyx	Septal 5, gamosepalous twisted aestivation, acuminate, green inferior	Septal 5, gamosepalous imbricate aestivation, green hairy inferior	Septal 5, gamosepalous valvate, aestivation, persistent, green hairy inferior	Septal 5, gamosepalous twisted aestivation, assumate, green, inferior	Septal 5, gamosepalous valvate aestivation, campanulate, green, hairy inferior
5	Corolla	Petal 5, gamopetalous, twisted aestivation, campanulate, inferior	Petal 5, gamopetalous, imbricate aestivation, infundibuliform, inferior	Petal 5, gamopetalous, valvate aestivation, corolla lobes inflexed, greenish yellow	Petal 5, gamopetalous, twisted aestivation, Corolla campanulate, violet outside, inferior	Petal 5, gamopetalous, valvate aestivation, Corolla lobes inflexed, greenish yellow
6	Androecium	Stamen 5, epipetalous, filaments long, anther basifixed, introre, dithecos, dehiscence by lateral side	Stamen 5, epipetalous, polyandrous, anther basifixed, introre, inferior dithecos, dehiscence by lateral side	Stamen 5, polyandro-usepipetalous, alterpetalous filaments equal in length, anthers long and conniving basifixed, introre, dithecos, dehiscence by apical pores	Stamen 5.epipetalous, alterpetalous filaments equal in length, anther, long and conniving basifixed, dithealous, dehiscence by ventral side	Stamen 5, epipetalous, filaments long, anther basifixed, introre, dithecos, dehiscence by lateral side
7	Gynoecium	Bicarpellary, syncarpous ovary superior, axel placement, style long, stigma bilobed	Bicarpellary, syncarpous ovary superior, bilocular, axel placement, style simple long, stigma bifid	Bicarpellary, syncarpous ovary superior, bilocular axel placement, style simple, stigma bifid	Bicarpellary, syncarpous ovary superior, axel placement, style simple, stigma bifid	Bicarpellary, syncarpous ovary superior, axel placement, style simple, stigma bifid
8	Pollination	Entomophilous, Anemophilous	Entomophilous	Entomophilous	Entomophilous	Entomophilous

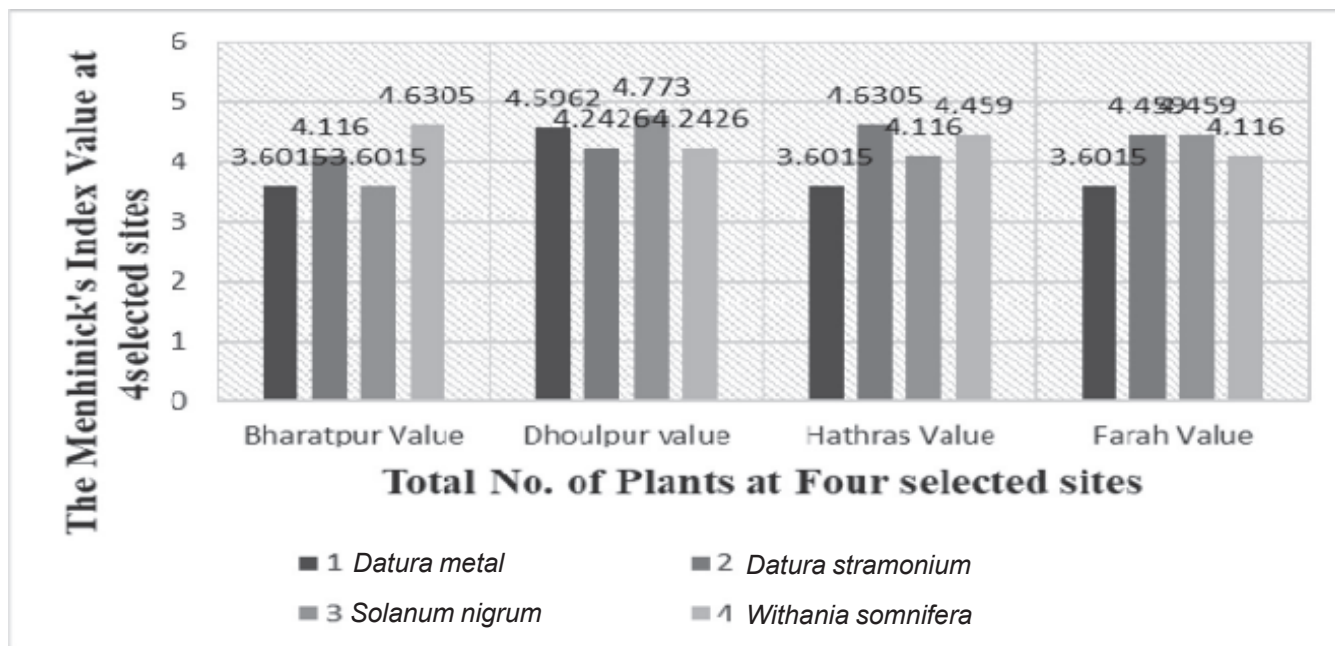


Fig. 1 : The Menhinick's Index Value at Bharatpur

individual at particular site- At Bharatpur site tota species were recorded (Table-2), which the maximum Menhinick's Index was shown by Withania Somnifera. At Dhaulpur site, total species were recorded which the maximum Menhinick's Index was shown by Solanum nigrum. At Hathras site, total species were recorded. Which the maximum Menhinick's index was shown by Datura stramonium. At Farah site, totalspecies were recorded. Which, the maximum menhinick's index was shown by Datura stramonium and Solanum nigrum.

For the determination of species diversity, Margalef's index [de] was also studied. According to

Margalef's index was different for four above natural sites. At Bharatpur site, total species were recorded (table-3), which maximum Margalef's index was shown by *Withania somnifera*. At Dhaulpur site, total species were recorded species (Table-3).which maximum Margalef's index was shown by ***Datura metel* (7.2135)**. At Hathras site, total species were recorded. maximum Margalef's index was shown by *Datura stramonium* (7.373). At Farah site, totalspecies were recorded. which, *Datura metel* and *Solanum nigrum*.

According to similarity index value [s], the species similarity of Bharatpur-Hathras sites showed maximum

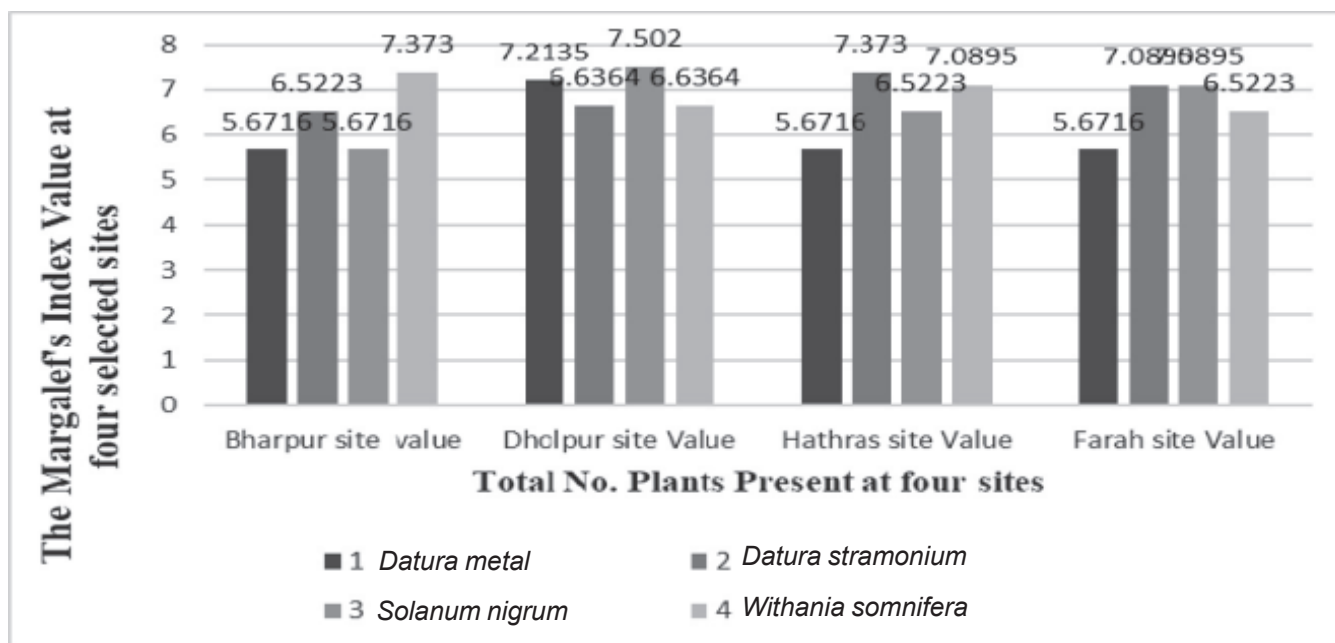


Fig. 2 : The Margalef's Index Value at selected 4 sites

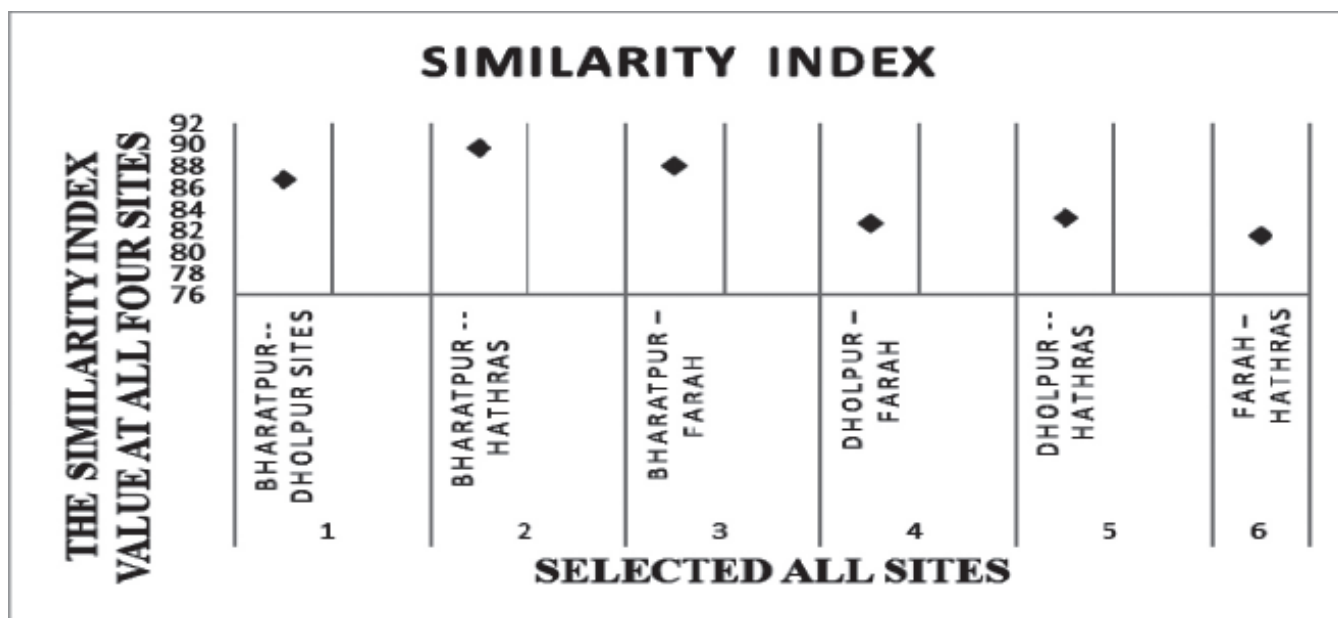


Fig. 3 : The Similarity Index Value at four natural sites

value was showed maximum value (89.70%) while the species similarity of Farah - Hathras sites was showed minimum value (81.6%) (Table-4).

Biodiversity was analysed on the basis of moisture content in seeds of four selected sites. The seeds of experimental herbs growing at Farah site showed maximum moisture content while the same growing at Bharatpur site showed minimum moisture content. (Table 5).

Biodiversity was also analysed on the basis of oil content in seeds of four selected sites. The seeds of experimental herbs growing at Bharatpur site showed maximum oil content while the seeds of experimental herbs growing at Dholpur site showed minimum oil content. (Table-6)

Results and Discussion

Species diversity of each plant was studied in *in-situ* with the help of four formula. 4 species of plants showed maximum diversity out of total species of plants. These plants species transplants in Botanical Garden, Agra. The name of these plants are given below:

1. *Datura metel*
2. *Datura stramonium*
3. *Solanum nigrum*
4. *Withania somnifera*

Morphological characterization

Evaluation of morphological and microscopic characteristics of plants with high biodiversity index at four selected sites.

All the selected growing herbs are classified into following families:

A. Family: Solanaceae

Plants: 1. *Datura metel* 2. *Solanum nigrum* 3. *Datura stramonium* 4. *Withania somnifera*.

Study of Floral Characterization of selected growing herbs at four selected sites.

All the natural growing herbs are transplanted in *ex-situ* sites at Farm house, Agra. All the natural growing herbs, The given parameters fixed for Characterization of individual plants species include:

I. Family: Solanaceae

Plants: 1. *Datura metel* 2. *Solanum nigrum* 3. *Datura stramonium* 4. *Withania somnifera*.

Biochemical Analysis

Biodiversity studied on the basis of Biochemical Analysis in Natural herbs on four selected sites.

So, the 10 species at four natural selected sites showed the different value of moisture content and showed diversity.

Summary and Conclusion

The plant species have been collected randomly from the four natural sites of Agra district (Table- 1). For the study of species richness (diversity) put the four formulae which showed the maximum and minimum diversity of species at its natural sites.

The Menhinick's Index (Db) was analysed for four natural sites. This index showed diversity of each individual at particular site- At Bharatpur site total species were recorded (Table-2), which the maximum Menhinick's Index was shown by *Withania Somnifera*. At Dhaulpur site, total species were recorded which the

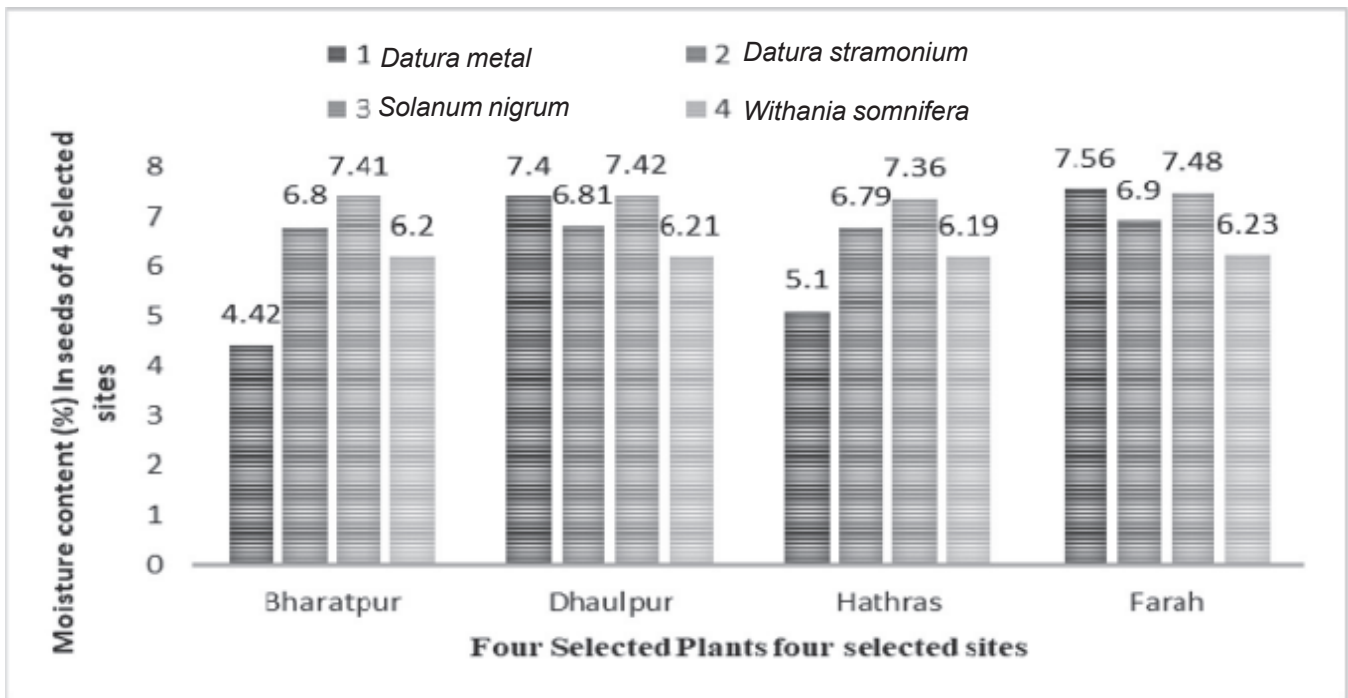


Fig. 4 : Moisture content (%) in seeds at 4 selected sites

maximum Menhinick’s Index was shown by *Solanum nigrum*. At Hathras site, total species were recorded. Which the maximum Menhinick’s index was shown by *Datura stramonium*. A Farah site, total species were recorded. Which, the maximum menhinick’s index was shown by *Datura stramonium*.

For the determination of species diversity, Margalef’s index [de] was also studied. According to

Margalef’s index was different for four above natural sites. At Bharatpur site, total species were recorded (Table-3), which maximum Margalef’s index was shown by *Withania somnifera*. At Dhaultpur site, total species were recorded species (table-3). which maximum Margalef’s index was shown by ***Datura metel* (7.2135)**. At Hathras site, total species were recorded. Maximum Margalef’s index was shown by *Datura stramonium*

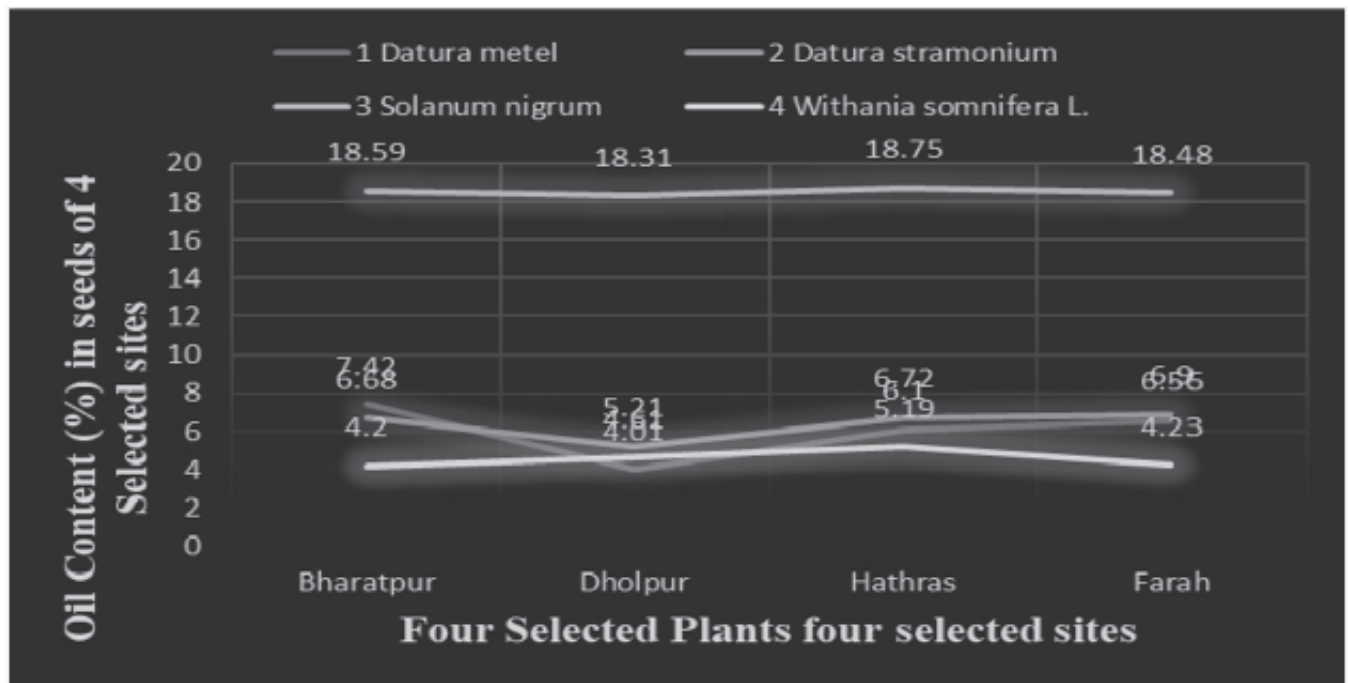


Fig. 5: Oil content (%) in seeds at 4 selected sites

(7.373). At Farah site, total species were recorded. Which, *Datura metel* and *Solanum nigrum*.

According to similarity index value [s], the species similarity of Bharatpur-Hathras sites showed maximum value was showed maximum value (89.70%) while the species similarity of Farah - Hathras sites was showed minimum value (81.6%) (Table-4).

Species diversity of each plant was studied in in-situ with the help of four formula. 4 species of plants show maximum diversity out of total 35 species of plants. These plants species transplants in Botanical Garden, Agra. The names of these plants are given below:

1. *Datura metel*
2. *Datura stramonium*
3. *Solanum nigrum*
4. *Withania somifera*

The parameters fixed for Morphological and Floral Characterization in natural growing herbs at four selected sites. The morphological and floral characterization was essential for the identification of these herbs.

Biodiversity studied on the basis of biochemical analysis in natural herbs at four selected sites. This was based on moisture content, oil content and of seed. The seeds of experimental plant growing at Farah sites, showed maximum moisture content while the same growing at Bharatpur site showed minimum moisture content (Table-5). Likewise, oil content maximum showed in Hathras site while minimum oil content in Bharatpur site in Table 6. This was directly related to moisture content ratio and oil content ratio. All this evident, the 4 species at four selected sites showed the different value of oil content, moisture content and showed diversity.

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