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Diversity and uses of Solanaceous plants in Sivasagar District of Assam, India

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Abstract

Solanaceae is an economically important angiospermic plant family. Present paper recorded the occurrence of 22 species under 8 genera of Solanaceae growing wild, in home gardens, roadsides and from cultivated areas from the Sivasagar district of Assam. 10 (45%) species belongs to *Solanum*, 4 (18 %) species to *Capsicum*, 2 (9 %) species each to *Cestrum* and *Datura* and 1 (5 %) species to each *Brugmansia*, *Nicotiana*, *Petunia* and *Physalis*. Among those 7 species, including 4 species of *Capsicum*, *Solanum tuberosum*, *Solanum lycopersicum* and *Solanum melangona* are very important major cash crop species in the study area, 3 species *i.e. Brugmansia suaveolens*, *Cestrum nocturnum* and *Petunia x hybrida* are grown as ornamental in gardens. 12 species have medicinal values, 14 species are used as vegetables, 4 species ornamental, 2 species used in rituals and 1 species is used for playing children in the district.

Key words: Solanaceae, Diversity, Uses, Crop plants, Sivasagar district, Assam

INTRODUCTION

Floristically, ethnobotanically and ornamentally Solanaceae is the third most important plant family of flowering plants in the world (Olmstead & Palmer 1992; Daunay *et al*. 2007). Economically too, in terms of vegetable crops, agricultural utility, as it include the tuber-bearing potato (*Solanum tuberosum*), tomato (*Solanum lycopersicum*), eggplant (*Solanum melongena*) and chili (*Capsicum* spp.) the family is almost equally important with Gramineae. These plants are distributed throughout the tropical to temperate regions of the world, with centers of diversity in Central and South America and Australia (Edmonds 1978; D'Arcy 1991). It is believed that the family has originated in South America (Hunziker 1979).

Members of the Solanaceae are herbs, shrubs, trees, vines, lianas, and rarely epiphytes and can be annuals, biennials and perennials. They have regular flowers with five fused petals and sepals, alternate leaves, five epipetalous stamens, persistent calyx and superior ovary containing many yellowish discoid seeds (http://theseedsite.co.uk/solanaceae.html). Solanaceae members are also known for the presence of various types of secondary metabolites, such as alkaloids, flavonoids and terpenes of commercial importance (Evans 1986).

From time to time different workers have shown interest in Solanaceae in terms of diversity, ethnic uses, taxonomy, floral morphology, nutrition, pharmacology, medicine, pollen morphology, foliar epidermal features (like stomata and trichomes), seed characteristics, genetics, cytology, breeding, molecular systematic and phylogeny of different members of the family. These studies have contributed a lot to the researchers of the world in understanding the family more precisely (Sharma 1974; Haegi 1976; Kung *et al*. 1982; Mcleod *et al*. 1983; Armstrong 1986; El-Ghazaly 1993, 1999; Martinez *et al*. 1995; Al-Wadei 2000; Bohs & Olmstead 2001; Baral & Bosland 2002; Knapp 2002; Santiago-Valentin & Olmstead 2003; Baral & Bosland 2004; Mulla *et al*. 2005; Singh *et al*. 2006; Adedeji *et al*. 2007; Olmstead *et al*. 2008; Araceli *et al*. 2009; Wu & Tanksley 2010; N. Pab´on-Mora & Litt. 2011; Awan & Murtaza 2013; Dagnoko *et al* 2013; Zhigila *et al*. 2014; Samuels 2015).

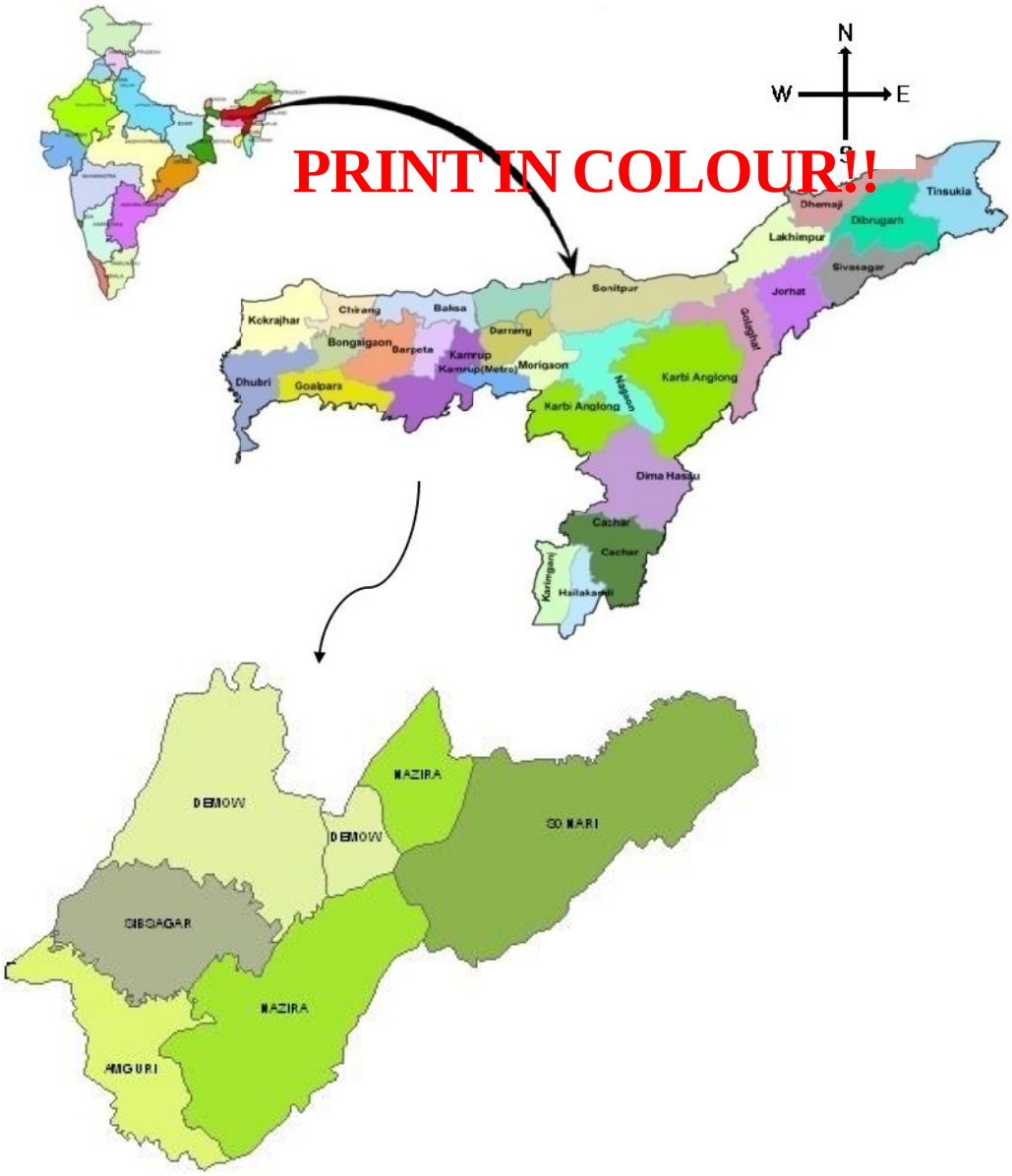

Figure 1. Location map of the Study Area

Various workers have estimated different number of species for Solanaceae both in World and India (Table1). The largest genus is *Solanum* with 1250 species distributed in tropical and subtropical regions of the world, especially in Americas (Mabberley 2008). According to Deb (1979) 10 genera and 34 species of *Solanum* are indigenous to India, while Kumari (2004) reported 49 species of *Solanum* from India.

Table 1. Number of genera and species of Solanaceae reported by different workers

Name of workers	Year	No. of Genera	No. of Species
In world			
Wettstein	1895	98	2300
Hunziker	1979		
D'Arcy	1986, 1991		
Zhi-yun *et al.*	1994	95	2300
Mabberly	1997	94	2950
Hunziker	2001	92	2300
Knapp *et al.*	2004	90	2000 – 3000
Olmstead & Bohs	2007	98	2700
Olmstead *et al.*	2008	100	2500
Shah *et al*.	2012	90	2000
In India			
Deb	1979	24	100
Gokhale & Purohit	2002	21	70
Kumari	2004	29	122
Shah *et al*.	2012	21	70

Assam (26° 14' 38.9616" N Latitudes and 92° 32' 16.2312" E Longitudes) is the second largest state of North East India. While most of the areas are part of IUCN recognized Himalaya Biodiversity Hotspot, some area is also falling in the Indo-Burma Hotspot. Due to the prevailing favourable climatic conditions, hilly terrains and diverse ecosystems wide diversity of habitat conditions are present in different parts of the state which is also reflected in its wide range of bio-cultural diversity (Das & Baruah 2014). Various communities like *Ahoms, Barahi, Bengalee, Chutia, Koch-Kalita, Manipuri, Mishing, Motok, Naga, Tai-Khamiyang, Tai-Shyam* and *Tea Garden Laborers* are inhibiting in the Sivasagar district, are using different wild species of plants including species of Solanaceae for food and medicinal purposes since time immemorial (Das & Baruah 2014).

Till date, almost no information is available on the Solanaceous plants of Sivsagar district. Therefore, present study was undertaken to assess the diversity and uses of Solanaceae in the Sivasagar district of Assam.

MATERIALS AND METHODS

Study Area: Sivasagar district (Figure 1), lies between 94°42 and 95°22 E Longitude and 26°52 and 27°12 N Latitudes, situated approximately 86.6 m above the mean sea level and covers an area of 2886 sq km. The district is bordered by the Brahmaputra River on the north, Nagaland and Arunachal Pradesh on the south, the Dibrugarh District on the east and

Table 2. Average rainfall data in mm of Sivasagar District [*Source*: http:// www.imd.gov.in]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	0	0	0	310	129	187	500	201	407	52.5	6.7	2
2012	22.7	4.1	37.8	348	176	208	324	285	205	45.3	0.1	4.4
2013	1.5	7.7	91.9	111	327	176	417	391	113	104	0	7.1
2014	4.5	21.5	32.3	57.3	135	331	451	241	155	57.6	6.1	0

the Jorhat District and Jhanji River on the west (http://sivasagar.nic.in/districtpage/sivasagar.htm). The climate is of tropical with four distinct seasons, namely spring, summer, autumn and winter. Due to Southwest Monsoon and North-Eastern Monsoon or Retreating Monsoon the area receive rainfall which varies from seasons to seasons (Table 2). The maximum temperature lies between 32^0 C and 37^0 C in summer while the minimum temperature remains between 10^0 C and 20^0 C in winter. The soil is suitable for the growth of plants with pH ranges from 4.3 – 6.5.

Methodology: The study was carried out throughout the district of Sivasagar in different seasons to make a complete record of different habit, habitat and characters of different parts at different stages of development of the species and their occurrence during 2011 – 2015 through random field survey. While collecting the information regarding their uses, standard approaches and methodology were followed; the collected specimens were with their reproductive parts and processed into mounted herbarium specimen following Jain and Rao (1977) for future references. The plants were identified using literature like *Flora of Assam* (Kanjilal *et al*. 1934 – 1940) and taxonomic keys available in the public domains (http://www.efloras.org) and by matching in Assam and GUBH herbaria. For the updated nomenclature http://www.theplantlist.org/ was consulted. The herbarium specimens were preserved in the herbarium of the Department of Botany, Gargaon College, Simaluguri, Assam for future references.

Different uses of the solanaceous plants were collected through interviews using structured questionnaires (Jain 1991; Parabia & Reddy 2002; Rout & Panda 2010) and by discussing with the village head men (*Gaon Burhas*), herbal medicine practitioners (*Ojha*), elderly women, and other peoples who have gathered knowledge hereditary from their fore-fathers and from their own experiences. Information was also collected from the patients under treatment with different practitioners. Ethical approval for this study was obtained from the studied village heads of Sivasagar district. All respondents were asked to sign a prior information-consent (PIC) form after the objectives and possible consequences of the study had been explained. The PIC was translated into the local Assamese language in accordance with guidelines of International Society of Ethnobiology (ISE) on the collection of information regarding traditional uses of plants (ISE 2006, 2008).

RESULT

A total of 22 species under 8 genera were collected from wild, home gardens, roadsides and cultivated area of the Sivasagar District of Assam (Table 3). Out of which 10 (45 %) species belongs to *Solanum*, 4 (18 %) species to *Capsicum*, 2 (9 %) species each to *Cestrum* and *Datura* and 1 (5 %) species to each *Brugmansia, Nicotiana, Petunia* and *Physalis* (Figure 2; Table 5). Thirteen species are shrubs and nine are herbs. Flowers of four species, fruits of twelve species and stem-tuber of one species are used for different purposes. On the other hand, of the recorded plants, 12 species have medicinal value, 14 species are edible

as vegetable, 4 species ornamentals, 2 species used in religious rituals and 1 species are used for playing. Of the medicinally important plants, four are used against tonsillitis and pharyngitis, one to repel intestinal worms; and one species each in burn, cardiovascular disorder, muscular pain, liver problem, acidity, pain reliever, diabetes and hepatitis (Table 4).

Table 3. Species of Solanaceae collected from the Sivasagar district of Assam

Name of the Species	Local/ Assamese Name	English/ Common Name	Habitat	Habitat
Brugmansia suaveolens Persoon; DD- 22	*Nishigandha*	Angel Trumpet	Shrub	Home gardens
Capsicum annuum Linnaeus; DD- 16	*Jati Jalokia*	Chili	Shrub	Cultivated fields, Home gardens
Capsicum baccatum Linnaeus; DD- 22 ; Photograph-7	*Buttam Jalokia*	Chili	Shrub	Home Gardens
Capsicum chinense Jacquin; DD- 10 ; Photo - 1	*Bhut Jalokia*	Chili	Shrub	Cultivated fields, Home gardens
Capsicum pubescens Ruiz & Pavon; DD- 17	*Jalokia*	Chili	Shrub	Home Gardens
Cestrum diurnum Linnaeus; DD- 24 ; Photograph-6	*Bonoria dhapat*	Day-blooming Jasmine	Shrub	Riparian zones, disturbed, scrublands, shrubland
Cestrum nocturnum Linnaeus; DD- 14	*Hasnana*	Night blooming Jasmine, Night scented Jessamine	Shrub	Home gardens
Datura innoxia P. Miller; DD- 18	*Dhatura*	Thorn-apple, downy thorn-apple, Indian-apple, sacred datura	Herb	Roadsides, near religious sites
Datura metel Linnaeus; DD- 23	*Dhatura*	Devil's Trumpet Flower	Herb	Roadsides, Near Religious sites
Nicotiana plumbaginifolia Willdenow ; DD- 08; Photo -8	*Saru dhapat*	Tex-Mex Tobacco	Herb	Moist waste places
Petunia x hybrida (Hooker f.) E. Vilmorin; DD- 03	*Petunia*	Petunia	Herb	Home gardens
Physalis minima Linnaeus; DD- 04 ; Photograph-15	*Kapal Phuta*	Tomatillo	Herb	Roadsides
Solanum aethiopicum Linnaeus; DD- 21; Photograph-12	*Titiki Bengana*	African Eggplants	Herb	Home gardens
Solanum americanum P.Miller; DD- 11; Photograph-3	*Laskasi*	Black Nightshade, Garden Nightshade, Glossy Nightshade	Herb	Roadside and waste lands

PLATE – I. Solanaceae in Sibsagar district of Assam: 1. *Capsicum chinense;* 2. *Solanum spirale;* 3. *Solanum americanum;* 4. *Solanum torvum;* 5. Cultivar of *Solanum melongena* var. *inerme;* 6. *Cestrum diurnum*; 7. *Capsicum baccatum*; 8. *Nicotiana plumbaginifolia;* 9. *Capsicum annum*; 10. Cultivar of *Solanum melongena* var. *inerme;* 11. Cultivar of *Solanum melongena* var. *inerme*; 12. *Solanum aethiopicum*; 13. *Solanum myriacanthum*; 14. *Solanum indicum*; 15. *Physalis minima*

Name of the Species	Local/ Assamese Name	English/ Common Name	Habitat	Habitat
Solanum indicum Linnaeus; DD-15; Photograph- 14	*Bhekuri Tita*	Poison Berry, Indian Nightshade, African Eggplant	Shrub	Home Gardens, roadside and waste lands
Solanum lycopersicum Linnaeus; DD- 02	*Bor Bilahi*	Tomato	Shrub	Cultivated fields, Home gardens
Solanum melongena Linnaeus; DD- 05; Photos-5 ,10, 11	*Bengena*	Eggplants	Shrub	Cultivated fields, Home gardens
Solanum myriacanthum Dunal; DD-19; Photograph-13	*Kata Bengena*	Tomate	Herb	Roadside and waste lands
Solanum pimpinellifolium Linnaeus; DD- 06	*Kan Bilahi*	Cherry Tomato	Shrub	Cultivated fields, Home gardens
Solanum spirale Roxburgh; DD-09 ; Photograph-2	*Lora tita*	Brush Nightshade	Shrub	Roadside and waste lands
Solanum torvum Swartz; DD- 07 ; Photograph-4	*Hati Bhekuri*	Prickly solanum, Turkey berry, Wild egg plant, Devil's fig	Shrub	Roadside and waste lands
Solanum tuberosum Linnaeus; DD- 13	*Aalu*	Potato	Herb	Cultivated fields, Home gardens

Table 4. Uses of the Solanaceae species of in the study area

Name of the Species	Part used	Medicinal uses	Other Uses
Brugmansia suaveolens	Flower	Paste of matured leaves are applied on the affected area against muscles pain	Ornamental
Capsicum annuum	Fruit	-	Salad, vegetables and preparation of pickles
Capsicum baccatum	Fruit	-	Salad, vegetables and preparation of pickles
Capsicum chinense	Fruit	Fresh fruit used in case of liver problem, acidity, tonsillitis and pharyngitis	Salad, vegetables and preparation of pickles
Capsicum pubescens	Fruit	-	Salad, vegetables and preparation of pickles
Cestrum diurnum	Flower	-	
Cestrum nocturnum	Flower	-	
Datura innoxia	Flower, Fruit, Seed	Paste of matured leaf is applied against pain. Young leaves paste are applied on breast against pain due to deposition of excess milk among lactating mother	Seeds are taken orally with milk, elaichi, clove, dalchini and sugar as narcotics during puja to prepare 'Ghuta' in Hindu rituals

Name of the Species	Part used	Medicinal uses	Other Uses
Datura metel	Flower, Fruit and Seeds	Paste of matured leaf is applied against pain,	Seeds are taken orally with milk, elaichi, clove, dalchini and sugar as narcotics during puja to prepare 'Ghuta' in Hindu rituals
Nicotiana plumbaginifolia	-	-	-
Petunia x hybrida	Flower	-	Ornamental
Physalis minima.	Leaves and Fruit	Young leaves are used in the form of recipe for removing worms from stomach	Playing purpose by children in rural areas,
Solanum aethiopicum	Fruit	-	Vegetable and preparation of pickles
Solanum indicum	Fruit	Fresh fruit taken orally against diabetes	Vegetable
Solanum lycopersicum	Fruit	Orally in the form of recipe with ginger, garlic, onion, clove, elaichi, roots of *Lygodium* species to treat tonsillitis, pharyngitis and hepatitis	-
Solanum melongena	Fruit		Salad, vegetables and preparation of sauces
Solanum myriacanthum	Fruit	Orally in the form of recipe with jaggery and seeds of piper against tonsillitis and Pharyngitis, Hepatitis B	Vegetable
Solanum americanum	Twig and Fruit	Fresh fruit is used against Hepatitis B	Vegetable
Solanum pimpinellifolium	Fruit	-	Vegetable
Solanum spirale	-	-	-
Solanum torvum	Fruit , Seeds	Two to five fresh seeds are used daily for cardiovascular problem	Vegetable
Solanum tuberosum	Tuberous stem	Small thin slices are applied locally on minor burns	Vegetable

Following KEY TO THE GENERA can be used to recognise the solanaceous plants of Sibsagar district of Assam upto the genus level.

1a. Plants perennial shrubs, fruits not prickly ……. 2
1b. Plants herbs, annual to biannual ……... 4
2a. Corolla rotate; plants prickly or not; fruits small globular ……. *Solanum*
2b. Corolla tubular or infundibuliform …… 3

3a. Corolla slender-tubular; flowers many, erect in terminal cype; fruits white (if any), berry-like ……. *Cestrum*
3b. Corolla infundibuliform; flower solitary, axillary, pendulous; fruits green, capsule ….. *Brugmansia*
4a. Corolla rotate ……. 5
4b. Corolla tubular …… 7
5a. Inflorescence extra-axillary; cymes few to many flowered …….. *Solanum*
5b. Inflorescence cymose solitary …… 6
6a. Berries with small persistent calyx, generally pungent; flowers white …… *Capsicum*
6b. Berries remain completely covered with persistent calyx; sweet; flowers yellow … ... *Physalis*
7a. Flowers in raceme, limbs rotate on a long tube, white; plants rosette ....*Nicotiana*
7b. Flowers axillary, limbs spreading – not rotate …….... 8
8a. Plants diffuse much branched herb; fruits not prickly, small, less than 5 cm in diameter; lamina entire, symmetric; corolla produced in many colours in different plants …… *Petunia*
8b. Plants erect; fruits prickly, over 5 cm in diameter; lamina not entire, asymmetric; corolla white to purple ……...*Datura*

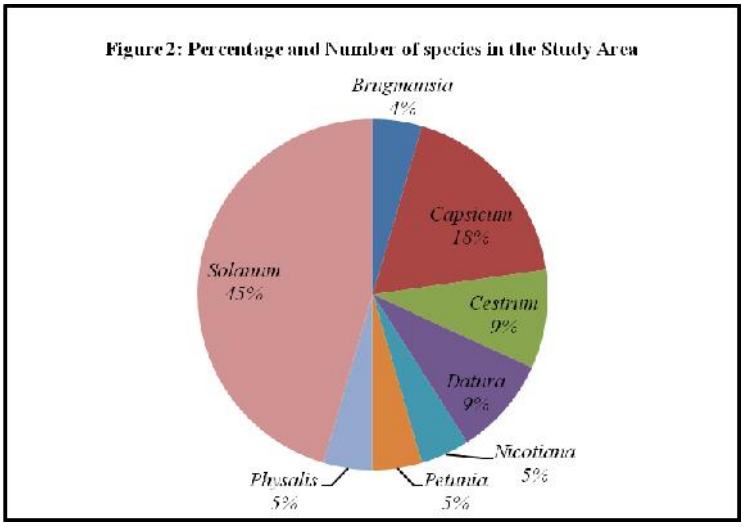

Table 5. Representative of Solanaceae species in the study area with respect to World, India and Assam

Name of the Genus	Number of Species Present				Percentage in Study Area w. r. t.		
	World[#]	India	Assam[c]	Study Area	World	India	Assam
Brugmansia	12	-	1	1	08.33%		100%
Capsicum	43	6	6	4	9.30%	66.67%	66.67%
Cestrum	247	2	2	2	00.81%	100%	100%
Datura	13	3	3	2	15.38%	66.67%	66.67%
Nicotiana	68	-	1	1	01.47%	-	100%
Petunia	21	1	1	1	04.76%	100%	100%
Physalis	133	6[a]	2	1	00.75%	16.67%	50%
Solanum	1225	48[b]	11	10	00.90%	22.92%	90.91%

NB: **#:** http://www.theplantlist.org/ (Accepted names); **a:** Floristic Diversity of Assam: Study of Pabitora Wildlife Sanctuary: By Bora, Yogendra Kumar; **b:** Kumari, (2004) *A Taxonomic Revision of Indian Solanaceae*. Ph. D. Thesis; **c:** *Assam's Flora (Present Status of Vascular Plants)*: By S. Chowdhury

DISCUSSION

Solanum melongena is an important cash crop of the study area and is characterized by great morphological diversity on the basis of the shape of the fruit and colour (Martin & Rhodes 1979; Choudhury 1976). Their colour varies from white, green, purple to pinkish purple and are traditional cultivars which has to be conserved for our future generation to come.

Species of *Capsicum* are also important cash crops of the area. They exhibit morphological variation, especially in fruit shape, color and size (Walsh & Hoot 2001). Both green and red (ripe) chilies are used to impart pungency to the food. Fruits of *Solanum lycopersicum* (tomato) are used as vegetable, taken as salad and for the preparation of numerous other food items. Fruits of *Solanum pimpinellifolium* are cooked with pulses by the local people **(**Das & Baruah 2014).

There are a large number of ornamentals in Solanaceae. However, from the Sibsagar district only four of these plants are cultivated as ornamentals, namely Petunia (*Petunia x hybrida*), *Brugmansia suaveolens*, *Cestrum diurnum* and *Cestrum nocturnum*.

Although, fruits of *Solanum indicum*, *Solanum aethiopicum*, *Solanum americanum*, *Solanum myriacanthum*, *Solanum pimpinellifolium* and *Solanum torvum* have local market value; species like *Solanum pimpinellifolium* and *Solanum aethiopicum* have potential to promote these two species for commercialization. It was observed during the study that due to adoption of exotic culture, young generation is not interested to adopt age old traditional herbal practice. Therefore, there is urgent need to document their traditional knowledge properly on these plants.

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