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Morph-metric studies of local variants of hypoglycemic *Syzygium cumini* and *Trigonella foenum graecum* from South-East Rajasthan

Asha Arora and Hetal Shah

Abstract
South east Rajasthan harbors differential climatic and topographical niches and nests various aboriginals' ethical tribes. These tribes deploy ancestral therapeutic methods to treat different maladies including modern life style mediated anomalies including wide spread diabetes mellitus II. Among various enlisted hypoglycemic plants, *Syzygium cumini* and *Trigonella foenum graecum* are utmost popular antihyperglycemic source. As Rajasthan differs drastically in its topography, the variants of these plants also form deviated clutches with different degree and clinical applicability. Therefore, the present study was carried out to analyze the morpho-metric differences among the variants so that the appropriate variant can be used for clinical purposes. Both the studied plants were analyzed using taxonomical attributes as provided by Bentham and Hooker flora. For matrices, the plant parts were measured using vernier-caliper and minimum to maximum or range calculations were made by random sampling of the parts and respective herbarium was prepared for further reference. The field studies reveals existence of four variants of *Syzygium cumini* and three variants of *Trigonella foenum graecum* which differed morph-metrically in fruits per clusterand number of seeds per pod respectively.

Keywords: Diabetes, hypoglycemic plants, *Syzygium cumini*, *Trigonella foenum graecum*, South East Rajasthan

Introduction
Diabetes mellitus is a complex metabolic disorder resulting from either insulin insufficiency or insulin dysfunction. Type I diabetes (insulin dependent) is caused due to insulin insufficiency because of lack of functional beta cells. Patients suffering from this are therefore totally dependent on exogenous source of insulin while patients suffering from Type II diabetes (insulin independent) are unable to respond to insulin and can be treated with dietary changes, exercise and medication. Type II diabetes is more common form of diabetes constituting 90% of the diabetic population. It (DM) is a chronic endocrine disorder which is characterized by high blood glucose levels that can interfere with carbohydrate, protein, and fat metabolism (Bastaki, 2005) [12]. It is caused due to the deficit production of insulin by the β-langerhans islet cells of the pancreas or due to defective insulin uptake in the peripheral tissues (Al-Goblan *et al*., 2014) [2]. An increase in the blood glucose level immediately after a meal triggers the release of insulin hormone from the pancreas. Insulin stimulates the liver to metabolize glucose and also stimulates the fat and muscle cells to remove glucose from the blood which results in a drop of blood sugar level to normal levels. If a person is diabetic, the blood sugar level remains high due to absentia or ineffective production of insulin by the pancreas (Dean and McEntyre, 2004). India has more than 61 million people living with diabetes and hence is considered to be the "capital of diabetes". Effective treatment of diabetes and its associated complications still remains a major challenge due to several issues such as inadequate health care system, lack of proper facilities, etc. (Viswanathan and Rao, 2013). Herbal formulations are favored over synthetic drugs to reduce the ill-effects of diabetes and its secondary complications due to lesser side effects and also being cost effective (Modak *et al*., 2007) [20]. Based on recent advances and involvement of oxidative stress in complicating diabetes mellitus, efforts are persuaded to find suitable antidiabetic and antioxidant therapy.
Medicinal plants are being looked up for the treatment of diabetes. Many conventional drugs have been derived from prototypic molecules in medicinal plants. To date, over 400 traditional plant treatments for diabetes have been reported, although only a small number of these have received scientific and medical evaluation to assess their efficacy. The hypoglycemic effect of some herbal extracts has been confirmed in human and animal models of type 2 diabetes. The World Health Organization Expert Committee on diabetes has recommended that traditional medicinal herbs should be further investigated.

These plants are rich source of anti-diabetic compounds such as flavonoids, alkaloids, phenols and tannins that improve the efficiency of pancreatic tissues by increasing the insulin secretion or decreasing the intestinal absorption of glucose (Kooti *et al*., 2016) [17]. Despite many anti-hyperglycemics, two plants i.e. *Syzygium cumini* and *Trigonella foenum-graecum* are prominently used in type 2 diabetes mellitus as they grow in immediate vicinity in both rural and urban localities.

Syzygium cumini (L.) Skeels, commonly known as Jamun in India, belongs to the family Myrtaceae and has a wide distribution in the Indian sub-continent, eastern Africa and South-east Asian countries (Srivastava and Chandra, 2013). Stem bark decoction is being consumed by the tribes of Sikkim and Darjeeling Himalaya, India, for the treatment of diabetes mellitus (Chhetri *et al.*, 2005). Oral administration of ethanolic and aqueous extracts of the bark of S. cumini (500 mg/kg for 21 days) showed significant blood glucose lowering effects in diabetic Wistar rats (Tripathi and Kohli, 2014). Oral administration of *S. cumini* kernel extract exhibited better hypoglycemic activity as compared to the whole seed extract in diabetic rats (Ravi *et al.,* 2004b). Biosynthesized silver nano-particles from the seeds of *S. cumini* exhibited higher antioxidant activities as compared to the seed extract (Banerjee and Narendhirakannan, 2011) [9].

Fenugreek seeds contain as much as 51.7% fiber comprising 19.2% mucilaginous fiber and 32.5% neutral fiber. A decoction of fenugreek seeds has been reported to improve diabetes and suppress glycosuria in mild diabetes as well as ameliorating the severity the diabetic condition (Srinivasan, 2005). Numerous animal studies on the potential antidiabetic effect of fenugreek seeds have employed diabetic rats, mice, rabbits, and dogs. Besides many animal studies, several human trials have unequivocally demonstrated the beneficial hypoglycemic potential of this spice in both type 1 and type 2 diabetes (Sharma *et al.*, 1990; Sharma and Raghuram, 1990). Defatted fenugreek (fiber-containing portion) or the soluble dietary fiber (SDF) fraction of fenugreek seeds has been shown to reduce postprandial increase of blood glucose in type 2 diabetic rats. A single oral dose of fenugreek has also been reported to be beneficial to glycemic control in experimental animals. There is much evidence to support that the hypoglycemic effect of fenugreek is attributable to fiber and gum, which constitutes as much as 52% of these seeds. The probable mechanism of hypoglycemic action is that dietary fenugreek delays gastric emptying by direct interference with glucose absorption. In addition, gel-forming dietary fiber reduces the release of insulinotropic hormones and gastric inhibitory polypeptides (Puri *et al.,* 2002) [27]. Therefore, it is inferred that fenugreek included in a daily diet (25–50 g) can be an effective supportive therapy in the management of diabetes.

Plants may very plastically in morphology, anatomy and chemical composition. The variation could take place with time due to environmental stress, mutation and sometimes because of the topography of the region. In many cases the intra and out breeding also play an important role in formation of local variants which might be different in their chemical composition which indirectly leads to change in the basic clinical properties of the medicinal plants. All this limitations lead to the morph-metric study of the local variants of the plants.

In a more broad way the topography of Rajasthan can be divided in the following regions- the Aravalli or the Hilly regions, the Thar and the other arid regions, the Plateaus including Vindhaya and the Malwa, the Fertile plains including the Mewar, the Forest Regions and the water bodies including Rivers and Salt Lakes. The soil and vegetation alters with its wide-ranging topography and the availability of water. The varied kind of soils available in Rajasthan are mostly sandy, saline, alkaline and chalky (calcareous). Due to such variations various temporary and permanent morphological variations can be observed in many species. In present study four variants of *Syzygium cumini* and three variants of *Trigonella foenum graecum* were observed. Both the plants are subjected to various geographical and climatic pressures as the oldest chain of fold mountains- the Aravali Range splits the state into two geographical zones- desert at one side and forest belt on the other. It has varying topographic features though a major part of the state is dominated by parched and dry region. The extensive topography includes rocky terrain, rolling sand dunes, wetlands, barren tracts or land filled with thorny scrubs, river-drained plains, plateaus, ravines and wooded regions.

Materials and Methods

Plant specimens were collected from three different localities of south east Rajasthan i.e. Kotda (24.5854° N, 73.7125° E) Sitamata Sanctuary (24.2226° N, 74.4321° E) and Ranakpur (25.1160° N, 73.4725° E) and herbarium sheets were prepared with all related information. Plants were identified up to species level through flora of region and prior work. Herbarium sheets were deposited in Department for further reference

Morphometric studies of both ethno-hypoglycemic plants viz. *Syzygium cumini* and *Trigonella foenum graecum* were carried out following standard protocols and were characterized using flora of Bentham and Hooker. In current field studies 4 local variants of *Syzygium cumini* and 3 local variants of *Trigonella foenum graecum* were obtained. During field, survey following notations was restricted to avoid ambiguity related to variation due to environmental or climatic factors.

- The plants were selected from different topography.
- The plants were selected within confined time period.

All the local variants were studied for all the important character included under major classifying attributes as habit and habitat, bark, root, stem, leaves, inflorescence, flower, fruits and seeds. For matrices, the plant parts were measured using vernier-caliper and minimum to maximum or range calculations were made by random sampling of the parts. In case of *Syzygium cumini* old trees were preferred.

Trigonella foenum-graecum is a cultivated crop therefore it is effected by various cultivating practices and it is tedious to obtain its wild variant. Therefore, in present study the variants of *T. foenum-graecum* were obtained from remote areas where modern irrigation practices are not included for crop and peasants still use seeds of wild variants i.e. hybrid varieties are still not used for crop.

Observations

Field visits enumerate four local variants of *S. cumini* and three local variants *of T. foenum-graecum,* which differed significantly in their morphological characters. These morphological local variants were assigned as-

These morphological local variants were assigned as

Syzygium cumini	$SC_{LV}1$	SC_{LV} 2	SC_{LV} 3	SC_{LV} 4
Trigonella foenum-graecum	$TF_{LV}1$	TF_{LV} 2	TF_{LV} 3	-

The taxonomical differences among these variants are tabulated in Table 1 and 2.

Result and discussion

Morphological differences often created ambiguity regarding utilization of the variant for ethno-clinical purposes. Therefore, to ensure their specificity and to discriminate between variants, the plants for present study were collected from three different co-ordinates i.e. Kotda (24.5854° N, 73.7125° E) Sitamata Sanctuary (24.2226° N, 74.4321° E) and Ranakpur (25.1160° N, 73.4725° E). Although, these three localities reside on either side of Aravallis, then also they differ in their vegetation composition because of their altitude and preservation array. Sitamata sanctuary forms conserved area making non grazing non intervening zone whereas Ranakpur valley harbors water-shed and shade off slopes while Kotda goes with dense deciduous forest yet with scorching heat and scanty water.

In present study four morphological variant of *Syzygium cumini* and three variants of *Trigonella foenum graecum* were obtained. Variants of *S. cumini* were similar in their habit, habitat, root, bark, stem and inflorescence.In floral plan, all the variants were akin in calyx, corolla, androecium and gynoecium features. No alteration was observed neither in shape nor in size.

Table 1: Morph-metric comparison of local variants of *Syzygium cumini* (L.) Skeels (Myrtaceae)

S. No	Morphological Character	$SC_{LV}1$	SC_{LV} 2	SC_{LV} 3	SC_{LV} 4
1.	**Habit and Habitat** 1.1- Evergreen perennial tree up to 30 meters height and girth of 3.6 meters with a bole up to 15 m	1.1	1.1	1.1	1.1
2.	**Root** 2.1. Tap root system	2.1	2.1	2.1	2.1
3.	**Bark** 3.1. Light-grey, rough, cracked with flakes	3.1	3.1	3.1	3.1
4	**Stem /Trunk** 4.1. Cylindrical, erect with crown	4.1	4.1	4.1	4.1
5	**Leaves** With turpentine smell, opposite, oblong-oval or elliptic, blunt or tapering at the apex; pinkish when young, becoming leathery, glossy, dark-green above, lighter beneath, with a conspicuous, yellowish midrib when mature. 5.1. Leaf length: 5-25 cm, Width: 2.5-10 cm; 5.2. Leaf length: 5-20 cm, Width: 2.5-10 cm.	5.1	5.1	5.1	5.2
6	**Inflorescence** 6.1. Panicled cymes	6.1	6.1	6.1	6.1
7	**Flowers** 7.1 Fragrant, in clusters, 2.5-10 cm long, each being 1.25 cm wide and 2.5 cm long, with a funnel-shaped calyx and 4-5 united petals, shedding rapidly to leave only the numerous stamens.	7.1	7.1	7.1	7.1
8	**Fruits** Round or oblong, often curved, from green to magenta 8.1. 10-40 units/ clusters with 1.25-5 cm length; **8.2.** 10-28units/ clusters with 1.25-4 cm length	8.1	8.2	8.2	8.2
9	**Seeds** Green or brown single seed 9.1. Seed length up to 4 cm**; 9.2.** Seed length up to 3.2 cm	9.2	9.2	9.1	9.1
10	% population of local variant	61.11	16.66	12.96	9.25
Total specimens collected = 54					

Table 2: Morph-metric comparison of local variants of *Trigonella foenum-graecum* L (Fabaceae)

S. No.	Morphological Character	$TF_{LV}1$	TF_{LV} 2	TF_{LV} 3
1.	**Habit and Habitat** 1.1- Erect annual herb up to 50 cm height	1.1	1.1	1.1
2.	**Root** 2.1. Tap root system with nitrogen fixing nodules	2.1	2.1	2.1
3	**Leaves** Trifoliate with obovate to inverted lance shaped leaflets, toothed or incised 3.1. Leaflets 1- 3 cm long, 5-15 mm broad; 3.2**.** Leaflets 1- 2 cm long, 5-10 mm broad	3.1	3.2	3.2
4	**Inflorescence** 4.1. Racemose	4.1	4.1	4.1
5	**Flowers** 5.1. Flowers 1-2 in leaf axis. 1.2- 1.8cm long. Sepal cup 7-8 mm long	5.1	5.1	5.1
6	**Fruits** 6.1. Fruits 5-11 mm long, 3-5 mm broad, smooth or velvety, tapering into a beak	6.1	6.1	6.1
7	**Seeds** 7.1. No of seeds per pod-10-20; 7.2. No of seeds per pod-8-14	7.2	7.2	7.1
8	% population oflocal variant	74.60	11.11	14.28
Total specimens collected = 63				

One of the variant (SC_{LV} 4) differed in length of leaf. It was slightly small as compared to the leaf length in other variants (SC_{LV} 1-3). The number of fruit units also varied in $SC_{LV}1$ as it has comparatively more fruits in clusters. While seed length varied up to 50%. Among collected 54 botanical accessions maximum population resembled $SC_{LV}1$ while SC_{LV} 4 differing in all three morphological characters i.e. leaf length, fruit number and seed length were least in count (9.25%).

Similar observations were also obtained by Khan *et al.*, (2010) [21]; these researchers also marked prominent change in number of fruits per cluster and in seed length among genetically diversified populations of *Syzygium* (Table 1).
Variability in *Trigonella foenum-graecum* L has been studied by many workers but the study was more confined to number of pods per plant and no of seeds per pods (Narolia *et al*., 2017; Yadav *et al*., 2018) [23]. In present study, the three variants obtained differed in leaflet size i.e. length and breadth as well as seeds per pod. The variant $TF_{LV}1$ with 10-20 seeds per pod and with leaflet length 1-3 cm and breath 5-15 mm dominated (74.60 %) the population (Table 2).

Conclusion

The field studies of Rajasthan with special reference to hypoglycemic reveals existence of four variants of *Syzygium cumini* which differed morph-metrically and in the number of fruits per cluster. Whereas the field studies of three variants of *Trigonella foenum graecum* differed morph-metrically in leaf size and number of seeds per pod. While in the vegetative characters both the plants were at par similar among variants revealing mutational pressure on reproductive units.

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