Useful ethnophytomedicinal recipes of angiosperms used against diabetes in South East Asian Countries (India, Pakistan & Sri Lanka)

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Abstract: This paper is based on data recorded from various literatures pertaining to ethnophytomedicinal recipes used against diabetes in South East Asia (India, Pakistan and Srilanka). Traditional plant treatments have been used throughout the world for the therapy of diabetes mellitus. In total 419 useful phytorecipes of 270 plant species belonging to 74 Angiospermic families were collected. From the review it was revealed that plants showing hypoglycemic potential mainly belong to the families, Cucurbitaceae (16 spp.), Euphorbiaceae (15 spp.), Caesalpiniaceae and Papilionaceae (13 spp. each), Moraceae (11 spp.), Acanthaceae (10 spp.), Mimosaceae (09 spp.), Asteraceae, Malvaceae and Poaceae (08 spp. each), Hippocrateaceae, Rutaceae and Zingiberaceae (07 spp. each), Apocynaceae, Asclepiadaceae and Verbenaceae (06 spp. each), Apiaceae, Convolvulaceae, Lamiaceae, Myrtaceae, Solanaceae (05 spp.each). The most active plants are *Syzigium cumini* (14 recipes), *Phyllanthus emblica* (09 recipes), *Centella asiatica* and *Momordica charantia* (08 recipes each), *Azadirachta indica* (07 recipes), *Aegle marmelos*, *Catharanthus roseus*, *Ficus benghalensis*, *Ficus racemosa*, *Gymnema sylvestre* (06 recipes each), *Allium cepa*, *A. sativum*, *Andrographis paniculata*, *Curcuma longa* (05 recipes each), *Citrullus colocynthis*, *Justicia adhatoda*, *Nelumbo nucifera*, *Tinospora cordifolia*, *Trigonella foenum-graecum*, *Ziziphus mauritiana* and *Wattakaka volubilis* (4 recipes each). These traditional recipes include extracts, leaves, powders, flour, seeds, vegetables, fruits and herbal mixtures. Data inventory consists of botanical name, recipe, vernacular name, English name. Some of the plants of the above data with experimentally confirmed antidiabetic properties have also been recorded. More investigations must be carried out to evaluate the mechanism of action of diabetic medicinal plants. Toxicity of these plants should also be explained. Scientific validation of these recipes may help in discovering new drugs from these medicinal plants for diabetes.

Keywords: Angiosperms, antidiabetic plants, recipes, South East Asia.

INTRODUCTION

Diabetes mellitus is the endocrine disorder that causes disturbance in carbohydrate, fat and protein metabolism (Rao, 2006**;** Ahmed, 2009).

Diabetes (Greek) means a "siphon". As the patients are passing too much water (polyuria) like a siphon. Mellitus (Latin) means "honey"; the urine and blood of people with diabetes has excess glucose that is sweet like honey. Diabetes mellitus could literally mean "siphoning off sweet water" (Annonymous, 2012)**.**

Diabetes is a chronic disease, which occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin it produces. This leads to an increased concentration of glucose in the blood (hyperglycaemia) (WHO, 2012; Li *et al*., 2011). It is a common and highly prevalent disease affecting the citizen of both developed and developing countries (Ediriweera and Ratnasooriya, 2009; Kavishankar *et al*., 2011).

There are two types of diabetes, namely type 1 and type 2. Type 1, insulin-dependent diabetes mellitus (IDDM), in which the body does not produce any insulin, most often occurs in children and young adults. People with type 1 diabetes must take daily insulin injections to stay alive. Type 1 diabetes accounts for 5-10% of diabetes. Type 2, noninsulin-dependent diabetes mellitus (NIDDM), in which the body does not produce enough, or properly use, insulin, is the most common form of the disease, accounting for 90-95% of diabetes (Li *et al*.,2011). Type 2 diabetes mellitus is usually called as adult onset diabetes (Ahmed, 2009).

Diabetes has significant health consequences for individual and communities, serious diabetes-related complications including heart disease, stroke and kidney failure kills people every day (Khan and Singh, 2012). It is estimated that 25% of the world population is affected by this disease (Erasto *et al*., 2005). Recent estimates indicate that there were 171 million people in the world with diabetes in the year 2000 and this is projected to increase to 366 million by 2030 (Wild *et al*., 2004).

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According to the International Diabetes Federation (IDF), the overall cost assessment for the global prevention and treatment of diabetes will run up to US$490 billion by 2030. The occurrence of diabetes is higher in men than in women, but more women are reported to be suffering from diabetes than men. A notable increase in the proportion of people suffering from diabetes with >65 years of age is also reported (Khan *et al*., 2012).

The cause of diabetes is a mystery, although both genetic and environmental factors such as obesity and lack of exercise appear to play a role (Jung *et al*., 2006). Up to now, many kinds of anti-diabetic medicines have been developed for patients, but almost all are chemical or biochemical agents. The fact is that it has never been reported that someone had recovered totally from diabetes (Li *et al*., 2011).

The use of herbal medicines for the treatment of Diabetes mellitus has gained importance throughout the world. The World Health Organization also recommended and encouraged this practice especially in countries where access to the conventional treatment of diabetes is not adequate. There is an increased demand to use natural products with antidiabetic activity due to the side effects associated with the use of insulin and oral hypoglycemic agents (Vohra *et al*., 2011).

Traditional medicines also have the potential to form the basis of pharmaceutical drugs for the treatment of a range of diseases. Thus, the loss of these potentially valuable genetic resources ultimately affects the whole society. There is an urgent need to document the knowledge or otherwise it is lost forever. More investigations must be carried out to evaluate the mechanism of action of medicinal plants with antidiabetic effect. The toxic effect of these plants should also be elucidated. Scientific validation of these recipes may help in discovering new drugs from these medicinal plants for diabetes.

The Present Review of Anti diabetic plants of South East Asian Countries

Anti diabetic plants are widely distributed in South East Asian countries particularly in India, Pakistan, Sri Lanka. This study presents the profile of 419 useful phytorecipes of 270 plant species belonging to 74 Angiospermic families collected through extensive available literature survey of the above countries. Out of these, 206 recipes of 57 plants have been described and also summarized in table 1, while the remaining 213 plants supported by only one reference each, were listed in the table 2. From this review it was revealed that plants showing hypoglycemic potential mainly belong to the families, Cucurbitaceae 16 spp. (5.926%), Euphorbiaceae 15 spp (5.556%), Caesalpiniaceae and Papilionaceae 13 spp. (4.814%) each, Moraceae 11 spp. (4.074%), Acanthaceae 10 spp. (3.704%) each, Mimosaceae 09 spp (3.333%) each, Asteraceae, Malvaceae and Poaceae 08 spp. (2.963) each, Hippocrateaceae, Rutaceae and Zingiberaceae 07 spp. (2.592%) each, Apocynaceae, Asclepiadaceae and Verbenaceae 06 spp. (2.222%) each, Apiaceae, Convolvulaceae, Lamiaceae, Myrtaceae, Solanaceae 05 spp. (1.851%) each (table. 3). The most active plants are *Syzigium cumini* (14 recipes), *Phyllanthus emblica* (09 recipes), *Centella asiatica* and *Momordica charantia* (08 recipes each), *Azadirachta indica* (07 recipes), *Aegle marmelos*, *Catharanthus roseus*, *Ficus benghalensis*, *F.racemosa, Gymnema sylvestre* (06 recipes each), *Allium cepa*, *A. sativum, Andrographis paniculata*, *Curcuma longa* (05 recipes each), *Citrullus colocynthi, Justicia adhatoda*, *Nelumbo nucifera, Tinospora cordifolia, Trigonella foenum-graecum, Ziziphus mauritiana* and *Wattakaka volubilis* (4 recipes each) table. 4.

Anti diabetic plants supported by at least two references each

***Abrus precatorius* L. (Papilionaceae)**

1. Recipe: Leaf of this plant is mixed with the leaves of *Andrographis paniculata, Gymnema sylvestre* and seeds of *Syzygium cumini*. The mixture is shade dried and ground into powder and taken orally along with cow's milk. Dosage: About 50 ml of mixture is taken twice a day before food for 120 days (Ayyanar *et al*., 2008).

2. Recipe: Juice is extracted by crushing the leaves of the plant and is kept for four to five hours in a vessel to settle down and the sediment is collected. 10gm of this sediment is mixed with Bee's honey and given for diabetic patients **(**Ediriweera andRatnasooriya, 2009).

3. Recipe: Leaf juice (2 teaspoon) given orally twice a day till cure (Yadav *et al*., 2012)

***Acacia nilotica* (L.) Willd. Ex Delile [Syn. *A. arabica* (Mimosaceae)].**

4. Recipe: Decoction is prepared with 60 gm of dried stem bark of *A. arabica* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

5. Recipe: Leaf powder and bark gum is used to treat diabetic ulcers. Bark decoction Mixed with milk is given before sleep (Jayakumar *et al*., 2010).

Acacia catechu (L. f.) Willdenow (Mimosaceae)

6. Recipe: Decoction of hard wood is used regularly and water extract of hard wood to be taken in the morning (Khan and Singh, 2012).

7. Recipe: Decoction of the hard wood is used regularly. Water extract of the hard wood and areca nut is to be taken in the morning and evening (Jayakumar *et al*., 2010).

***Aegle marmelos* (**L.) Correa (Rutaceae)

8. Recipe: The 50 gm of fresh leaves of *A. marmelos* are crushed.100ml of water is added and 120 ml of juice is extracted by squeezing and 15 ml to 30 ml of juice is given thrice a day (Ediriweera and Ratnasooriya, 2009).

9. Recipe: Tender leaf (10 mL) mixed with 2-3 drops of honey given twice daily (evening and morning) on empty

stomach to reduce blood sugar within 3-4 weeks (Dixit and Sudurshan, 2011).

10. Recipe: The Loi community eats tender raw leaf with milk. (Khan and Yadava, 2010).

11. Recipe: Leaves are soaked in water overnight and water is taken next morning (8).

12. Recipe: Leaves are kept in water for one night; next morning ground with water is taken along with the remaining water. Leaf powder mixed with equal amount of turmeric powder is taken orally for diabetic ulcers (Jayakumar *et al*., 2010).

13. Recipe: Leaf powder with cow's milk is takenorally/extracted juice mixed with a pinch of black pepper is taken orally with water daily for aboutone month (Yadav *et al*., 2012).

***Allium cepa* L. (Liliaceae)**

14. Recipe: Bulbs of *A. cepa* are cooked and eaten as a curry with other foods (Ediriweera and Ratnasooriya, 2009).

15. Recipe: Bulbs of *A. cepa* are crushed and juice is extracted by squeezing. The 120 ml of this juice is given twice a day (Ediriweera and Ratnasooriya, 2009).

16. Recipe: The juice obtained from the underground bulb is used, one tea spoon thrice a day. This is given for the control of blood sugar and high blood pressure amongst the Diabetics [Ahmad *et al*., 2009).

17. Recipe: Regular use of bulb decreases the sugar in blood (Khan and Singh, 2012).

18. Recipe: Leaf juice is taken orally with honey or milk tillcure (Yadav *et al*., 2012).

***Allium sativum* L. (Liliaceae)**

19. Recipe: Bulb was grounded with water and one teaspoon was taken along with meal twice a day for a month (Manzoor *et al.,* 2013).

20. Recipe: Leaf and bulb taken orally to treat diabetes (Yadav *et al*., 2012)

21. Recipe: Bulbs of A sativum and cooked and eaten as a curry with other foods.

22. Recipe: Bulbs of A sativum are boiled in water and drunk twice a day.

23. Recipe: Equal amount of A sativum, leaves of *Murraya koenigii* and rhizome of *Z. officinale* are ground together to make a paste and this is eaten with other food.

***Andrographis lineata* Wall.Ex Nees (Acanthaceae)**

24. Recipe: Leaf powder mixed with cow's milk is taken orally. (Yadav *et al*., 2012)

25. Recipe: Fresh leaf juice (50 ml) is taken with hot water internally twice a day for four to six days in diabetes (Alagesaboopathi, 2012).

***Andrographis paniculata* (Burm.f.) Wall. ex Nees (Acanthaceae)**

26. Recipe: About 10 mL of leaf/root deoction given once a day for six months against both hyperglycaemia and gastric disorder (Dixit and Sudurshan, 2011).

27. Recipe: Leaf powder is taken with cow's or goat milk (Khan and Singh, 2012).

28. Recipr: Leaf is shade dried, powdered and mixed with boiled rice and cow's milk and taken rally. Dosage: 50 ml of mixture is taken thrice a day after food for 120 days (Ayyanar *et al*., 2008).

29. Recipe: Decoction of the leaves i.e. 50ml is given three times a day after food or fresh raw leaves eaten daily (Yadav *et al*., 2012).

30. Recipe: Whole plant extract is used for diabetic cure. The crude extract is taken at a dose of 1 tea spoonful in empty stomach in the morning hours before meal (Swargiary *et al*., 2013).

***Annona squamosa* L. (Annonaceae)**

31. Recipe: Raw bark or/and leaf were grinded and the extracts were obtained by squishing. The extract is then filtered and used 2 to 3 tea spoon full of extract every morning (Swargiary *et al*., 2013).

32. Recipe: 25g. leaves are taken orally with milk daily in the morning (Yadav *et al*., 2012).

33. Recipe: Decoction is prepared with 120gm of fresh matured leaves of *A. squamosa* and 120ml is used twice a day.

***Azadirachta indica* A. Juss. (Meliaceae)**

34. Recipe: It is also mixed with honey, cow's milk, butter and ghee and taken twice a day for a period of forty five days to treat diabetes (Maruthupandian*et al*., 2011).

35. Recipe: Its leaves along with leaves of *Justicia adhatoda* and *Zanthoxylum acanthopodium* are boiled and consumed by Meitei-pangal community (Khan and Yadava, 2010).

36. Recipe: Decoction is prepared with 60 gm of dried stem bark of *A. indica* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

37. Recipe: Bark decoction is used for drinking (Khan and Singh, 2012).

38. Recipe: Aqueous extract of leaves (15 ml) is taken once a day in empty stomach continuously one month for treatment of diabetes (Panda *et al*., 2011).

39. Recipe: Seven tender leaves of the plant are prescribed daily to the person suffering from diabetes. six seeds of the plant made into a paste with 50 ml rice wash and 5 mL of ghee should be given after meal in case of long standing diabetes (Dixit and Sudurshan,2011).

40. Recipe: Raw leaf extracts mixed with little water is taken at a dose of 2-3 tea spoons daily in empty stomach (Swargiary *et al*., 2013).

***Bauhinia variagata* L. (Caesalpinaceae)**

41. Recipe: A pinch of bark powder istaken daily with a cup of milk or water (Chavre *et al*., 2010).

42. Recipe: Dried flowers of *B. variagata* are boiled in water and is taken twice a day (Ediriweera and Ratnasooriya, 2009).

Table 1: Anti-diabetic plants of S.Asia (India, Pakistan and Sri Lanka) with at least 2 recipes each.

S. No.	Botanical Name	Family	Vern/local name	No. of recipes	Country
1	*Abrus precatorius*	Papilionaceae	Olinda wel (S), Kundumani (T)	3	Ind., SL
2	*Acacia nilotica*	Mimosaceae	Karuvelam, Seeni Idda (S)	2	SL, Ind
3	*A. catechu*	Mimosaceae	Khair, Karinjali (Mm)	2	Ind.
4	*Aegle marmelos*	Rutaceae	Beli (S), Bel (H), Kuvalam (Mm)	6	Ind., SL
5	*Allium cepa*	Liliaceae	Piaz (U), Rathu lunu (S)	5	SL, Pak.
6	*Allium sativum*	Liliaceae	Lahsan (U), Sudu lunu (S)	5	Pak, Ind, SL
7	*Andrographis lineata*	Acanthaceae	Siriya nangai (T)	2	Ind.
8	*Andrographis paniculata*	Acanthaceae	Heen-binkohomba (S), Siriyanangai (T)	5	Ind., SL
9	*Annona squamosa*	Annonaceae	Aithaphol. Sitaphala (S)	3	Ind, SL
10	*Azadirachta indica*	Meliaceae	Kohomba (S), Veppu (Mm)	7	Ind., SL
11	*Bauhinia variegata*	Caesalpiniaceae	Koboleela (S)	2	SL
12	*Benincasa hispida*	Cucurbitaceae	Alu Puhul (S)	3	SL, Ind
13	*Butea monosperma*	Papilionaceae	Kela, Gas Kela (S)	2	SL, Ind
14	*Cassia alata*	Caesalpiniaceae	Rata thora (S)	2	Ind, SL
15	*C. fistula*	Caesalpiniaceae	Ehala (S)	3	Ind, SL
16	*Cassia occidentalis*	Caesalpiniaceae	Chakwad, Kasoda (Marathi)	2	Ind
17	*Catharanthus roseus*	Apocynaceae	Mini-mal (S)	6	Ind,SL
18	*Centella asiatica*	Apiaceae	Gotukola (S), Muthil, Kudangal (Mm)	8	Ind, SL
19	*Cicer arietinum*	Papilionaceae	Channa (U)	2	Pak
20	*Citrullus colocynthis*	Cucurbitaceae	Yakkomadu (S), Andrayin (U)	4	Ind, SL, Pak
21	*Coccinia grandis*	Cucurbitaceae	Kowakka (S)	2	Ind, SL
22	*Costus specious*	Zingiberaceae	Thebu (S),Kostak-kilangu (T)	3	Ind, SL
23	*Curcuma longa*	Zingiberaceae	Ath-Kaha(S), Manjal (Mm)	5	SL, Ind
24	*Cynodon dactylon*	Poaceae	Karuka (Mm), Doobghas (H)	2	Ind
25	*Ficus benghalensis*	Moraceae	Bohr (U),Maha Nuga (S)	6	Pak, SL
26	*F. racemosa*	Moraceae	Attikka (S)	6	Ind, SL
27	*Glycine max*	Papillionaceae	Soya Bonchi (S),Nung hawai (M)	2	Ind, SL
28	*Gymnema sylvestre*	Asclepiadaceae	Bin nuga (S),Siru kurinjan (T)	6	Ind, SL
29	*Hordeum vulgare*	Poaceae	Jao (U)	3	Ind, Pak
30	*Ipomoea aquatica*	Convolvulaceae	Kankun (S),Taothrak (M)	2	Ind, SL
31	*Justicia adhatoda*	Acanthaceae	Nongmangkha angouba (M), Bhekar (U)	4	Ind, Pak
32	*Melia azedarch*	Meliaceae	Lunu Midella(S),Daraik (U)	3	Pak, SL
33	*Mimosa pudica*	Mimosaceae	Nidikumba (S), Thottavadi	2	Ind, SL
34	*Memecylon umbellatum*	Melastomaceae	Kora kaha (S), Sakkarai vaembu (T)	2	Ind, SL
35	*Momordica charantia*	Cucurbitaceae	Karavila(S),Kaattu pagar-kai(T),Karela(U)	8	Ind, Pak, SL
36	*Momordica dioica*	Cucurbitaceae	Jangli karaila (U), TumbaKaravila (S), ada	3	Ind, Pak, SL
37	*Murraya koenigii*	Rutaceae	Kadipatta, Nwrshing	2	Ind
38	*Nelumbo nucifera*	Nelumbonaceae	Nelum (S), Thambal (M)	4	Ind, SL
39	*Ocimum sanctum*	Lamiaceae	Tulsi, Kalitulsi (U)	2	Ind, Pak
40	*Phyllanthus emblica*	Euphorbiaceae	Heikru (M),Nelli (S)	9	Ind, SL
41	*P. urinaria*	Euphorbiaceae	Chakpa-heigru (M), Rath Pitawakka (S)	2	Ind, SL
42	*Pongamia pinnata*	Papillionaceae	Karanja (T), MagulKaranda (S)	2	Ind, SL
43	*Psidium guajava*	Myrtaceae	Pera (S), Amrood (U)	3	Ind, Pak
44	*Pterocarpus marsupium*	Papilionaceae	Vengai (T), Gammalu (S)Venga	3	Ind, SL
45	*Salacia reticulata*	Hippocrateaceae	Kothala-Himbutu (S), Ekanayakam	2	Ind, SL
46	*Scoparia dulcis*	Scrophulariaceae	Walkoth- thamalli(S),Bonsini	3	Ind, SL
47	*Sesbania sesban*	Papillionaceae	Senehe Kola (S), Chuchurangmei (M)	2	Ind, SL
48	*Solanum nigram*	Solanaceae	Mako (U)	2	Pak
49	*Strychnos potatorum*	Loganiaceae	Ingini (S) Thettambaral	2	Ind, SL
50	*Syzigium cumini*	Myrtaceae	Madan (S), Naaval maram(T), Jaman (U)	14	Ind, Pak, SL
51	*Tinospora cordifolia*	Menispermaceae	Rasakinda (S)	4	SL, Ind
52	*Tragia involucrate*	Euphorbiaceae	Wel- Kahambiliya (S)	2	SL
53	*Trigonella foenum-graecum*	Papillionaceae	Ulu-hal (S), Methi (U)	4	SL, Pak

continued…

Table 1: Continue

S. No.	Botanical Name	Family	Vern/local name	No. of recipes	Country
54	*Wattakaka volubilis*	Asclepiadaceae	Kiri-Anguna (S), Perun-kurinjan (T)	3	Ind, Pak, SL
55	*Withania coagulans*	Solanaceae	Paneer doda (U)	2	Pak
56	*Xanthium strumarium*	Asteraceae	Wal Rambutan, Uru Kossa (S)	2	SL
57	*Ziziphus mauritiana*	Rhamnaceae	Maha Debara (S), Ber (U)	4	Pak, SL

Key: M = Manipuri, Mm = Malayalam, S = Sinhala, T = Tamil, U = Urdu, Pak. = Pakistan, SL = Srilanka. Ind. = India

Table 2: Antidiabetic Plants (supported by one reference) in S.Asia (India, Pakistan, Srilanka).

S. #	Botanical Name	Family	Vern./local name	Country
1.	*Abutilon indicum* (L.) Sweet	Malvaceae	Thutthi	Pak
2.	*Acacia chundra* (Rottler) Willd.	Mimosaceae	Rathkihiriya (S)	SL
3.	*Achyranthes aspera* L.	Amaranthaceae	Gaskaralhaba (S)	SL
4.	*Aglaia roxburghiana* Bedd.	Meliaceae	Punyava	Ind
5.	*Aloe vera* Nill.	Liliaceae	Gikowar (U)	Pak
6.	*Alpinia calcarata* Rosc.	Zingiberaceae	Chittaratha (Mm)	Ind
7.	*Alpinia galanga* (L.) Willd.	Zingiberaceae	Heen Araththa (S)	SL
8.	*Alstonia scholaris* (L.) R. Br.	Apocynaceae	Gas Rukaththana(S)	SL
9.	*Alternanthera sessilis* (L.) DC	Amaranthaceae	Mukunuwenna(S)	SL
10.	*Anacardium occidentale* L.	Anacardiaceae	Kaju(S)	SL
11.	*Andrographis lineata* Nees.	Acanthaceae	Siriya nangai (T)	Ind
12.	*Anethum graveolens* L.	Apiaceae	Sathakuppa (S)	SL
13.	*Annona reticulata* L.	Annonaceae	Ramphal	Ind
14.	*Antidesma acidum* Retz.	Euphorbiaceae	Heikum (M)	Ind
15.	*Aporosa lanceolata* (Tul.) Thwaites	Euphorbiaceae	Heen Kebella (S)	SL
16.	*Aporosa lindleyana* (Wt.) Bail.	Euphorbiaceae	Kebella (S)	SL
17.	*Averrhoa bilimbi* L.	Oxalidaceae	Bilin (S)	SL
18.	*Aquilaria agallocha* Roxb.	Thymelaceae	Agil (S)	SL
19.	*Ardisia colorata* Roxb.	Myrsinaceae	Uthum (M)	Ind.
20.	*Areca catechu* L	Arecaceae	Kwa (M)	Ind.
21.	Aristolochia indica L.	Aristolochiaceae	Kalesar	Ind
22.	*Artemisia maritime* L.	Asteraceae	Ching laibakngnou	Ind
23.	*Artocarpus heterophyllus* Lam.	Moraceae	Panasa (Kos (Waraka)	SL
24.	*A. lakoocha* Wall. ex Roxb.	Moraceae	Hari-kokthong (M)	Ind.
25.	*Averrhoa carambola* L.	Oxalidaceae	Heinoujom (M)	Ind
26.	*Bacopa monnieri* (L.) Pennell	Scrophulariaceae	Neerpiramb	Ind
27.	*Bambusa vulgaris* Schrad.ex Wendl.	Bambusaceae	Una, Kaha Una (S)	SL
28.	*Barringtonia acutangula* (L.)Gaertn.	Lecythidaceae	Ela Midella (S)	SL
29.	*Boehaavia diffusa* L.	Nyctaginaceae	Sattaranai	Pak
30.	*Brassica juncea* (L.) Czern.	Brassicaceae	Sarson Seed	Ind
31.	*Brassica oleracea* L.	Brassicaceae	Gova (S)	SL
32.	*Capsicum annuum* L.	Solanaceae	Mulaku	Ind
33.	*Caesalpinia crista* L.	Caesalpiniaceae	Diya Vavulatiya (S)	SL
34.	*C. digyna* Rottl.	Caesalpiniaceae	Vakirimul (S)	SL
35.	*C. sappan* L.	Caesalpiniaceae	Pathagi (S)	SL
36.	*Cajanus cajan* (L.) Millsp	Papilionaceae	Arhar kid al (U)	Pak
37.	*Camellia sinesis* L.	Theaceae	The (S)	SL
38.	*Canarium zeylanicum* (Retz.) Blume.	Burseraceae Kekuna	Dik (S)	SL
39.	*Canthium parviflorum* Lam.	Rubiaceae	Sakkarai kovaimaram (T)	Ind
40.	*Caralluma edulis* (Edgew.) Hook.f	Asclepiadaceae	Chunga (U)	Pak
41.	*Caralluma tuberculata* N.E.Br.	Asclepia	Daceae Marmoot	Pak
42.	*Carica papaya* L.	Caricaceae	Pappali	Ind
43.	*Carmona retusa* (Vahl) Masam.	Boraginaceae	Heen-tambala (S)	SL

Continued…

Table 2: Continue

S. #	Botanical Name	Family	Vern./local name	Country
41	*Caseria tomentosa* Roxb.	Flacourtiaceae	Kadaka kinchil (T)	Ind
42	*C. zeylanica* (Gaertn.) Thwaites	Flacourtiaceae	Wal-Waraka (S)	SL
43	*Cassia auriculata* L.	Caesalpinaceae	Ranawara (S)	SL
44	*C. sophera* L.	Caesalpiniaceae	Uru thora (S)	SL
45	*Cassia tora* L.	Caesalpiniaceae	Chokar	Ind
46	*C. didymbotrya* L.	Caesalpinaceae	Dao pata achouba (M)	Ind
50	*Cichorium intybus* L.	Asteraceae	Kasni (U)	Pak
51	*Cissampelos pareira* L.	Menispermaceae	Ponmucutta	Ind
52	*Citrullus lanatus* (Thunb.) Mats. & Nakai	Cucurbitaceae	Komadu (S)	SL
53	*Citrus aurantium* L.	Rutaceae	Ambul Dodam (S)	SL
54	*Citrus limon* L. Burm. F	Rutaceae	Lemoo	Pak
55	*Clerodendrum indicum* (L.) Kuntze.	Verbenaceae	Charoidong (M)	Ind
56	*C. viscosum* Vent.	Verbenaceae	Kuthap-Manbi (M)	Ind
57	*Coccinia cordifolia* L.	Cucurbitaceae	Gulkakri	Ind
58	*Cocos nucifera* L.	Arecaceae	Naral	Ind
59	*Cordia dichotoma* Forssk.	Boraginaceae	Lolu (S)	SL
60	*C. myxa* L.	Boraginaceae	Lolu (S)	SL
61	*Coriandrum sativum* L.	Apiaceae	Koththamalli (S)	SL
62	*Costus picatus* L.	Zingiberaceae	Insulin chedi	Ind
63	Cressa cretica L.	Convolvulaceae	Uppumarikolunthu	Pak
64	*Cucumis callosus* (Rottler) Cogn.	Cucurbitaceae	Gon Kekiri (S)	SL
65	*Cucumis sativus* L.	Cucurbitaceae	Pipiknkna (S)	SL
66	*Cuminum cyminum* L.	Apiaceae	Suduru (S)	SL
67	*Cyperus esculentus* L.	Cyperaceae	Kaothum (M)	Ind
68	*Daucus carota* L.	Apiaceae	Gajar	Pak
69	*Debregeasia longifolia* (Burm.f.) Wedd	Urticaceae	U-khajing (M)	Ind
70	*Desmodium gangeticum* (L.) DC.	Papilionaceae	Undupiyaliya (S)	SL
71	*Dichrostachys cinerea* (L.) Wight & Arn	Mimosaceae	Vedathalan (T)	Ind
72	*Dodonaea viscosa* (L) Jacq.	Sapindaceae	Sanatha (U)	Pak
73	*Echinops echinatus*	Asteraceae	Uthkandam	Ind
74	*Elaeocarpus serratus* L.	Elaeocarpaceae	Weralu (S)	SL
75	*Elettaria cardamomum* L.	Zingiberaceae	Choti ilachi (U)	Pak
76	*Eleusine coracana* (L.) Gaertn.	Poaceae	Kurakkan (S)	SL
77	*Enhydra fluctuans* Lour.	Asteraceae	Komprek tujombi (M)	Ind
78	*Enicostema axillare* (Lam.) Raynal.	Gentianaceae	Nai	Ind
79	*Erythrina variegata* L.,	Papilionaceae	Mandar	Ind
80	*Euphorbia thymifolia* L.	Euphorbiaceae	Nilappala	Ind
81	*Evolvulus alsinoides* (L.) L.	Convolvulaceae	Visnu kranthi (S)	SL
82	*Ficus gibosa* Bl.	Moraceae	Ithi	Ind
83	*F. hispida* L.f.	Moraceae	Perelhei (M)	Ind
84	*F. palmata* Forssk.	Moraceae	Khabara (U)	Pak
85	*F. pomifera* Wall.Ex King	Moraceae	Heiba (M)	Ind
86	*F. religiosa* L.	Moraceae	Bo gaha (S)	SL
87	*Flacourtia jangomas* (Lour.) Raeusch	Flacourtiaceae	Heitroi (M)	Ind
88	*Gmelina arborea* Roxb.	Verbenaceae	Eth Demata (S)	SL
89	*Gmelina asiatica* L.	Verbenaceae	Ummi thekku	Ind
90	*Gossypium arboretum* L.	Malvaceae	Kapu (S)	SL
91	*Grewia abutilifolia*Vent Ex Juss.	Tiliaceae	Ching boroi (M)	Ind
92	*Helicteres isora* L.	Sterculiaceae	Edampiri valampiri	Ind
91	*Hemidesmus indicus* (L.) R. Br.	Asclepiadaceae	Nannari	Ind
92	*Hemidesmus indicus* (L.) R. Br.	Asclepiadaceae	Naruneendi (Mm)	Ind

Continued…

Table 2: Continue

S. #	Botanical Name	Family	Vern./local name	Country
94	*Hibiscus rosa-sinesis* L.	Malvaceae	Pokuru Vadamal (S)	SL
95	*H. syriacus* L.	Malvaceae	Juba kusum angouba (M)	Ind
96	*Hodgsonia heteroclita* (Roxb.)	Cucurbitaceae	Hagrani jwgwnar	Ind
97	*Holostemma annulare* K. Schum.	Asclepiadaceae	*Adapathiyan* (Mm)	Ind
98	*Hordeum vulgare* L.	Poaceae	Jau (U)	Pak
99	*Hybanthus enneaspermus* (L.) F. Muell.	Violaceae	Orilai thamarai	Ind
100	*Hygrophylla longifolia* (L.) Kurz	Acanthaceae	Katu-ikiriya,Neeramulliya (S)	SL
101	*Hygrophila phlomoides* Nees.	Acanthaceae	Ising langthrei (M)	Ind
102	*Ichnocarpus frutescens* (L.) R. Br.	Apocynaceae	Udarkodi	Ind
103	*Imperata cylindrica* (L.)P.Beauv	Poaceae	Imom (M)	Ind
104	*Ipomoea batatas* (L.) Lam.	Convolvuaceae	Batala (S)	SL
105	*Jatropha indica* L.	Euphorbiaceae	Kattamanakku	Ind
106	*J. gossipiifolia* L.	Euphorbiaceae	Aadalai	Ind
107	*Jussieua repens* L.	Ishing-kundo(M)	Ishing-kundo(M)	Ind
108	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	Patgaza	Ind
109	*Kickxia ramosissima* (Wall.) Janchen	Scrophulariaceae	Khunger booti	Pak
110	*Kokoona zeylanica* Thwaites	Celastraceae	Kokun;Wana-potu (S)	SL
111	*Kyllinga triceps* Rottb.	Cyperaceae	Chumthang namthibi (M)	Ind
112	*Lagerstroemia speciosa* L.	Lythraceae	Murutha (S)	SL
113	*Lantana camara* L.	Verbenaceae	Raimunia	Ind
114	*Lawsonia inermis* L.	Lythraceace	Muruthani	Ind
115	*Leucaena glauca* L.	Mimosaceae	Chigongnglei angouba (M)	Ind
116	*Leucas aspera* (Willd.) Link	Lamiaceae	Khangsisa	Ind
117	*Luffa acutangula* Roxb.	Cucurbitaceae	Maruluvikam	Ind
118	*Luffa cylindrica* (L.) Roem	Cucurbitaceae	Niyan,Watakolu (S)	SL
119	*Ludwigia octovalvis* (Jacq.)Raven.	Onagraceae	Kabo khaji (M)	Ind
120	*Lycopersicon esculentum* Miller	Solanaceae	Thakkali (S)	SL
121	*Madhuca indica* Gmel	Sapotaceae	Madhulai	Ind
122	*Mallotus philippensis* (Lam.) Muell.	Euphorbiaceae	Kabila	Ind
123	*Malva parviflora* L.	Malvaceae	Sonchal (U)	Pak
124	*Mangifera indica* L.	Anacardiaceae	Aam	Ind
125	*Mentha arvensis* L.	Lamiaceae	Nungshi hidak (M)	Ind
126	*Mentha piperita* L.	Lamiaceae	Podina	Pak
127	*Merremia emarginata* (Burman) Hallier	Convolvulaceae	Meekanpala (S)	SL
128	*Meyna spinosa* Roxb. ex Link	Rubiaceae	Lam heibi (M)	Ind
129	*Mimosa pudica* L.	Mimosaceae	Nidikumba (S)	SL
130	*Momordica balsamina* L.	Cucurbitaceae	Baad-karela (T)	Ind
131	*Moringa oleifera* Lam.	Moringaceae	Sahinjana (T)	Ind
132	*Morus alba* L.	Moraceae	Safaid atoot	Pak
143	*Morus indica* L.	Moraceae	Kabrangchak (M)	Ind
154	*Musa balbisiana* L.	Musaceae	Ati Kehel (S)	SL
165	*Musa sapientum* L.	Musaceae	Lafu (M)	Ind
176	*Nauclea orientalis* (L.) L.	Rubiaceae	Bakmi (S)	SL
137	*Ocimum americanum* L.	Lamiaceae	Mayangba (M)	Ind
138	*Olea ferruginea* Royle	Oleaceae	Kao (U)	Pak
139	*Oryza sativa* L.	Poaceae	Goyam; Vi (S)	SL
140	*Osbeckia nepalensis* Hook.	Melastomataceae	Yachubi (M)	Ind
141	*O. stellata* Buch.-Ham.exD.Don.	Melastomataceae	Yachubi (M)	Ind
142	*Osbeckia octandra* (L.) DC.	Melastomaceae	Heenbowitiya (S)	SL
143	*Parkia timoriana* (DC.) Merr.	Mimosaceae	Yongchak (M)	Ind
144	*Paspalum scrobiculatum* L.	Poaceae	Vapitam	Ind

Continued…

Table 2: Continue

S. #	Botanical Name	Family	Vern./local name	Country
145	*Passiflora foetida* L.	Passifloraceae	Pada wel (S)	SL
146	*Peristrophe fera* C.B.Clarke	Acanthaceae	Ishing langthrei (M)	Ind
147	*Phaseolus vulgaris* L.	Papillionaceae	Bonchi (S)	SL
148	*Phlogocanthus tubiflorus* Nees.	Acanthaceae	Nongmangkha angangba (M)	Ind
149	*P. thyrsiflorus* Nees	Acanthaceae	Titaphool	Ind
150	*Phyllanthus fraternus* Web.	Euphorbiaceae	Heikruman (M)	Ind
151	*P. niruri* L.	Euphorbiaceae	Bhui-anwla (T)	Ind
152	*Piper betle* L.	Piperaceae	Bulat-wel (S)	SL
153	*Pithecellobium dulce* (Roxb.) Benth	Mimosaceae	Wilayati Chinch	Ind
154	*Plumbago indica* L.	Plumbaginaceae	Senkoduveri	Ind
155	*Plumbago rosea* L.	Plumbaginaceae	Chethikoduveli	Ind
156	*Plumbago zeylanica* L.	Plumbagenaceae	Chitrak (T)	Ind
157	*Portulaca oleracea* L.	Portulacaceae	Gneda kola (S)	SL
158	*Portulaca quadrifida* L.	Portulacaceae	Sirupasalai Tharaipasalai	Ind
159	*Premna latifolia* Roxb.	Verbenaceae	Pachu mallai (T)	Ind
160	*Pterocarpus santalinus* L. f.	Papilionaceae	Rath Hadun (S)	SL
161	*Prunus amygdalus* Batsch.	Rosaceae	Badam	Ind
162	*Punica granatum* L.	Punicaceae	Madhulam (Mm)	Ind
163	*Pyrus malus* L.	Rosaceae	Apple	Pak
164	*Rauwolfia serpentina* (L)Benth ex Kurz	Apocynaceae	Ekaveriya (S)	SL
165	*Raphanus sativus* L.	Brassicaceae	Mooli (U)	Pak
166	*Rhazya stricta* Decne.	Apocynaceae	Veriana	Pak
167	*Ricinus communis* L.	Euphorbiaceae	Avanakku (Mm)	Ind
168	*Rosa damascena* Mill.	Rosaceae	Chittagulab	Pak
169	*Rubia cordifolia* Linn.	Rubiaceae	Manjatti	Ind
170	*Rubus fruticosus* (L)	Rosaceae	Gwswm bwigri	Ind
171	*Saccharum officianarum* L.	Poaceae	Uk (S)	SL
172	*Salacia beddomei* Gamb	Hippocrateaceae	Anakorandi	Ind
173	*Salacia chinesis* L.	Hippocrateaceae	Heen Himbutu (S)	SL
174	*Salacia fruticosa* DC.	Hippocrateaceae	Cherukorandi	Ind
175	*Salacia macrosperma* Wt.	Hippocrateaceae	Saptarangi	Ind
176	*Salacia oblonga* Wall.	Hippocrateaceae	Ponkorandi	Ind
177	*Salacia prinoides* DC.	Hippocrateaceae	Korandi	Ind
178	*Saraca indica* Linn.	Caesalpiniaceae	Asokam (Mm)	Ind
179	*Scleria terristris* (L.) Fuss.	Cyperaceae	Lam thangjou (M)	Ind
180	*Senna auriculata* L.	Caesalpiniaceae	Avarai (T)	Ind
181	*Sida acuta* L.	Malvaceae	Karuncaranai	Ind
182	*Smilax lanceifolia* Roxb.	Smilacaceae	Kwa manbi (M)	Ind
183	*Solanum surattense* Burm. f.	Solanaceae	Mokri,Kandiari (U)	Pak
184	*Setaria italic*	Poaceae	Tana-hal (S)	SL
185	*Solanum xanthocarpum*	Solanaceae	Ambu fanthao	Ind
186	*Sphaeranthus indicus* L.	Asteraceae	Mudamahana(S)	SL
187	*Spinacia oleracea*	Amaranthaceae	Palang.	Ind
188	*Spondias dulcis*	Anacardiaceae	Amberella (S)	SL
189	*Stroblanthus hyneanus* Nees.	Acanthaceae	Karinkurunji	Ind
190	*Swertia chirayita*	Gentinaceae	Kiratha (S)	SL
191	*Symplococos cochinchinensis*	Symplocaceae	Lodra (S)	SL
192	*Syzygium caryophyllatum*	Myrtaceae	Dan;Heen dan (S)	SL
193	*Syzygium malaccense*	Myrtaceae	Jambu (S)	SL
194	*Syzygium samarangens*	Myrtaceae	Pini Jambu (S)	SL
195	*Tectona grandis*	Verbenaceae	Thekka (S)	SL

Continued…

Table 2: Continue

S. #	Botanical Name	Family	Vern./local name	Country
196	*Terminalia arjuna*	Combrtaceae	Kumbuk(S)	SL
197	*T. bellirica* (Gaertner) Rorb	Combrtaceae	Bulu (S)	SL
198	*T. catappa* L.	Combretaceae	Nattuvatham	Ind
199	*T. chebula* Retz.	Combrtaceae	Aralu (S)	SL
200	*Thespesia populnea* (L.) Sol. ex Corr.	Malvaceae	Suriya (S)	SL
201	*Taraxicum officinale* F.H.Wigg.	Asteraceae	Saag	Pak
202	*Thevetia peruviana* (Pers.) Merr.	Apocynaceae	Utong lei (M)	Ind
203	*T. crispa*	Menispermaceae	Titta-kinda (S)	SL
204	*Tragia plukenetii* A.R.Sm.	Euphorbiaceae	Churchuri	Ind
205	*Tribulus terresteris* L.	Zygophyllaceae	Chota-gokru Njerinjil	Ind
206	*Trichosanthes dioica* Roxb.	Cucurbitaceae	Dummella (S)	SL
207	*Vateria copallifera* (Retz.) Alston	Dipterocarpaceae	Hal (S)	SL
208	*Vigna mungo* L.	Papilionaceae	Raw matimah	Ind
209	*Xanthium strumarium* L.	Asteraceae	Wal Rambutan, Uru Kossa(S)	SL
210	*Zanthoxylum acanthopodium* Candol.	Rutaceae	Muthrubi tingkhang panbi (M)	Ind
211	*Z. armatum* DC.	Rutaceae	Muthrubi (M)	Ind
212	*Zingiber officinale* Roscoe	Zingiberaceae	Inguru (S)	SL
213	*Ziziphus rugosa* Lam.	Rhamnaceae	Maha Eraminiya (S)	SL

***Benincasa hispida* Thunb. (Cucurbitaceae)**

43. Recipe: Fruits are eaten as a vegetable (Ediriweera and Ratnasooriya, 2009).

44. Recipe: Plup of fruit of B. hispidais chopped in to small pieces and juice is extracted squeezing.60-120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

45. Recipe: Fruit juice is taken daily (Jayakumar *et al*., 2010).

***Butea monosperma* (Lam.) Taub (Papilionaceae)**

46. Recipe: Dry flowers of *B. monospemaare* pounded and 12 gm. of this powder is given twice a day (Ediriweera and Ratnasooriya, 2009).

47. Recipe: The leaf extract (10 mL) is administered once a day fro 5-10 days on empty stomach. This reduces blood sugar and is also useful in glycosuria (Dixit and Sudurshan, 2010).

***Cassia alata* L. (Caesalpinaceae)**

48. Recipe: Decoction is prepared with 120 gm. of fresh leaves or entire creeper of *C. alata* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

49. Recipe: Meitei community prescribes the boiled extract of tender leaf (Khan and Yadava, 2010).

***C. fistula* L. (Caesalpinaceae)**

50. Recipe: Decoction is prepared with 60 gm. of dried stem bark of C. fistula and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

51. Recipe: Pod extract of the plant is used for treating diabetes (Dixit and Sudurshan, 2011).

52. Recipe: One tea spoon powder of seeds is given once in the morning for about 15 days or more (Yadav *et al*., 2012)

***C. occidentalis* L. (Caesalpinaceae)**

53. Recipe: One teaspoon seeds with water is taken orally forabout 15 days (Yadav *et al*., 2012)

54. Recipe: Fresh root juice is taken at morning time (Chavre *et al*., 2010).

***Catharanthus roseus* (L.) G. Don. (Apocynaceae)**

55. Recipe: Fresh twig with two leaf buds is given daily for 7 days on empty stomach. During this administration, eating sugar containing food stuffs is strictly prohibited (Dixit and Sudurshan, 2011).

56. Recipe: 20 ml of the boiled water extract of flowers is taken thrice a day for a period of one month to treat diabetes (Maruthupandian *et al*., 2011).

57. Recipe: Decoction is prepared with 60 gm of dried roots of C. rosea and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

58. Recipe: Leaf juice is taken twice a day (Khan and Singh, 2012; Jayakumar *et al.,*2010).

59. Recipe: Powdered plant material is taken with water (Chavre *et al*., 2010).

60. Recipe: Fresh leaf extracts or fresh leaf may be chewed in empty stomach (Swargiary *et al*., 2013).

***Centella asiatica* (L.) Urban (Apiaceae)**

61. Recipe: Decoction is prepared from 60 gm of dried whole plant or 120 gm of fresh plant of *C. asiatica* and 120 ml. is given twice a day (Ediriweera and Ratnasooriya, 2009).

62. Recipe: Fresh whole plant of is crushed and juice is extracted by squeezing. The 20 ml of this juice is given twice a day (Ediriweera and Ratnasooriya, 2009).

Table 3: Percent share and number of recipes of families of anti diabetic plants

S. No	Family	No.of plants	%age	No. of recipes
1.	Cucurbitaceae	16	5.926	31
2.	Euphorbiaceae	15	5.556	25
3.	Papilionaceae	13	4.814	25
4.	Caesalpiniaceae	13	3.814	18
5.	Moraceae	11	4.074	21
6.	Acanthaceae	10	3.704	18
7.	Mimosaceae	09	3.333	12
8.	Asteraceae	08	2.963	09
9.	Malvaceae	08	2.963	08
10.	Poaceae	08	2.963	11
11.	Hippocrateaceae	07	2.592	08
12.	Rutaceae	07	2.592	13
13.	Zingiberaceae	07	2.592	13
14.	Apocynaceae	06	2.222	11
15.	Verbenaceae	06	2.222	06
16.	Asclepiadaceae	06	2.222	13
17.	Apiaceae	05	1.851	12
18.	Convolvulaceae	05	1.851	06
19.	Lamiaceae	05	1.851	06
20.	Myrtaceae	05	1.851	20
21.	Solanaceae	05	1.851	08
22.	Melastomataceae	04	1.481	05
23.	Rosaceae	04	1.481	04
24.	Rubiaceae	04	1.481	04
25.	Anacardiaceae	03	1.111	03
26.	Boraginaceae	03	1.111	03
27.	Brassicaceae	03	1.111	03
28.	Combrtaceae	03	1.111	03
29.	Cyperaceae	03	1.111	03
30.	Flacourtiaceae	03	1.111	03
31.	Liliaceae	03	1.111	11
32.	Meliaceae	03	1.111	11
33.	Menispermaceae	03	1.111	07
34.	Plumbagenaceae	03	1.111	03
35.	Scrophulariaceae	03	1.111	05

63. Recipe: Khyme or Kada is prepared with *C. Asiatica* is also given for diabetic patients especially before breakfast (Ediriweera and Ratnasooriya, 2009).

64. Recipe: Leaves of the plant are used as salads and eaten with other foods (Ediriweera and Ratnasooriya, 2009).

65. Recipe: Meitei-pangal community prescribes the extract of *Parkia timoriana* bark and *Ficus glomerata* fruits (Khan and Yadava, 2010).

66. Recipe: Paste of whole plant is taken with cow's milk (Khan and Singh, 2012).

67. Recipe: Whole plant paste is taken with a glass of milk. Leaf paste is used to treat diabetic ulcers (Jayakumar *et al*., 2010).

68. Recipe: Fresh leaf extracts 2 -3 teaspoons in empty stomach nearly 21 days in the early diabetic conditions. (Swargiary *et al*., 2013)

***Cicer arietinum* L. (Papilionaceae)**

69. Recipe: Decoction of fruit, roasted fruit or turgid fruit is used to treat flue, cough, jaundice, diabetes. Bread made up of its flour is also effective against diabetes [20]

70. Recipe: Equal quantity of *Cicer arietinum* (Seeds), *Daucus carrota* (Dried form), *Hordeum vulgare* (Seeds), *Oryza sativa* (Seeds), *Triticum aestivum* (Seeds) and *Zea mays* (yellow variety) are ground and made into powder. The bread is cooked from this mixed flour and taken as breakfast with fresh butter of cow for 2-month. This remedy is used as dietary supplement to co ntrol diabetes (Ahmad *et al.,* 2009).

Table 4: Anti-Diabetic plants with at least 3 recorded recipes of each species from S. Asia.

S. No	Botanical name	Family	No. of recipes	Countries
1.	*Syzigium cumini*	Myrtaceae	14	Ind, Pak, SL
2.	*Phyllanthus emblica*	Euphorbiaceae	09	Ind, SL
3.	*Centella asiatica*	Apiaceae	08	Ind, SL
4.	*Momordica charantia*	Cucurbitaceae	08	Ind, Pak, SL
5.	*Azadirachta indica*	Meliaceae	07	Ind., SL
6.	*Aegle marmelos*	Rutaceae	06	Ind, SL
7.	*Catharanthus roseus*	Apocynaceae	06	Ind, SL
8.	*Ficus benghalensis*	Moraceae	06	Pak, SL
9.	*Ficus racemosa*	Moraceae	06	Ind, SL
10.	*Gymnema sylvestre*	Asclepiadaceae	06	Ind, SL
11.	*Allium cepa*	Liliaceae	05	SL, Pak.
12.	*A. sativum*	Liliaceae	05	SL
13.	*Andrographis paniculata*	Acanthaceae	05	Ind., SL
14.	*Curcuma longa*	Zingiberaceae	05	SL, Innd
15.	*Citrullus colocynthis*	Cucurbitaceae	04	Ind, SL, Pak
16.	*Justicia adhatoda*	Acanthaceae	04	Ind, Pak
17.	*Nelumbo nucifera*	Nelumbonaceae	04	Ind, SL
18.	*Tinospora cordifolia*	Menispermaceae	04	SL
19.	*Trigonella foenum-graecu*	Papillionaceae	04	SL, Pak
20.	*Wattakaka volubilis*	Asclepiadaceae	04	Ind, Pak, SL
21.	*Ziziphus mauritiana*	Rhamnaceae	04	Pak, SL
22.	*Abrus precatorius*	Papilionaceae	03	Ind., SL
23.	Annona squamosa	Annonaceae	03	Ind, SL
24.	*Benincasa hispida*	Cucurbitaceae	03	SL, Ind
25.	*Cassia fistula*	Caesalpiniaceae	03	Ind, SL
26.	*Costus specious*	Zingiberaceae	03	Ind, SL
27.	*Hordeum vulgare*	Poaceae	03	Ind, Pak
28.	*Melia azedarch*	Meliaceae	03	Pak, SL
29.	*Momordica dioica*	Cucurbitaceae	03	Ind, Pak, SL
30.	*Murraya koenigii*	Rutaceae	03	SL
31.	*Scoparia dulcis*	Scrophulariaceae	03	Ind, SL
32.	*Psidium guajava*	Myrtaceae	03	Ind, Pak
33.	*Pterocarpus marsupium*	Papilionaceae	03	Ind, SL

***Citrullus colocynthis* (L.) Schrad. (Cucurbitaceae)**

71. Recipe: Dried roots or fruits of C. Colocynthis are made into powder. 500mg. of powder of fruits or 1-3 gm. of powder of roots are given to diabetic patients (Ediriweera and Ratnasooriya, 2009).

72. Recipe: Pickle of pulp is effective for diabetes. For cooling purposes local people put slices of 1-2 kg of fruit in a clay pot and pressed them with feet when tongue taste become bitter they removed feet from clay pot. For diabetes the same formula is used for seven days (Ahmad *et al*., 2012).

73. Recipe: Patients are advised to crush the fruits by legs in morning and roasted seeds are eaten in empty stomach (Khan and Singh, 2012).

74. Recipe: The bark of the red ripens fruit is dried and powdered. Powder being taken 5-10 gm with water in empty stomach (Swargiary *et al*., 2013)

***Coccinia grandis* (L.) Kovai (Cucurbitaceae)**

75. Recipe: Decoction is prepared from 120 gm of fresh leaves or whole creeper of *C. Grandis* plant and 120 ml. is given twice a day (Ediriweera and Ratnasooriya, 2009).

76. Recipe: Two fresh fruits are taken regularly to prevent diabetes (Maruthupandian *et al*., 2011).

***Costus specious* (Koenig.) J. E. Smith (Zingiberaceae)**

77. Recipe: Leaves of C. speciousare cut into thin slices scraped. Coconut, salt and very little amount tumeric powder is added and mixed well. The mixture is heated on a pan and lightly cooked. This is called "Mallum" and eaten with rice (Ediriweera and Ratnasooriya, 2009).

78. Recipe: Kada or Khyme is prepared with fresh leaves of *C. specious* and given for diabetic patients (Ediriweera and Ratnasooriya, 2009).

Table 5: Active phytoconstituents of antidiabetic plants

S. No	Botanical name	Active constituents	References
1.	*Syzigium cumini*	Glycoside jamboline (seed) Pandanus odorus (Toei-hom) a 4- hydroxybenzoic acid	Nair and Santhakumari, 1986 Patel *et al*., 2012
2.	*Phyllanthus emblica*	Flavonoids and tannins Polyphenol	Krishnaveni *et al*., 2010 Patel and Goyal, 2011
3.	*Centella asiatica*	Asiaticoside	Mustaffa *et al*., 2011
4.	*Momordica charantia*	Momordicine II and 3-hydroxycucurbita-5, 24-dien-19-al-7, 23- di-O-β-glucopyranoside Momordicin, charantin, and galactose-binding lectin Four cucurbitane lycosides, momordicosides Q, R, S and T and stereochemistry-established karaviloside XI Triterpenoids, Polypeptide p Charantin, Vicine	Joseph and Jini,2013 Patel *et al*., 2012 Min-Jia Tan *et al*.,2008 Cheng *et al*.,2008 Khanna *et al*., 1981 Patel and Li, 2012
5.	*Azadirachta indica*	Azadirachtin Nimbidin β-Sitosterol, a steroid	Semwal *et al.*,2007 Akter *et al*., 2013 Noor *et al*., 2013
6.	*Aegle marmelos*	Umbelliferone β-D-galactopyranoside Lupeol, Marmin Aegelin & Coumarins	Kumar *et al*., 2013 Perera and Ali, 2012 Semwal *et al.*,2007
7.	*Catharanthus roseus*	Catharanthine, lochnerine, vindoline, leurosine, vindoline, vindolinine Vincristine, Vinblastine, ajmalicine etc Ajmalicine (Indole alkaloids)	Saravanamuttu and Sudarsanam, 2012 Chavre *et al*., 2010 Semwal *et al.*,2007
8.	*Ficus benghalensis*	Leucocyandin 3-O-beta-d-galactosyl cellobioside, leucopelargonidin-3- O-alpha-L rhamnoside Leucopelargonidin-3-O-alpha-L rhamnoside Leucodelphinidin, FB(á-Amyrin acetate) Leucopelargonin	Patel *et al*., 2012 Romila *et al*.,2010 Romila *et al*.,2010 Saravanamuttu and Sudarsanam, 2012
9.	*Ficus racemosa*	Flavonoids, tannins Bsistosterol β-sitosterol Sitosteryl glucoside	Saravanamuttu and Sudarsanam, 2012 Joseph and Raj, 2010 Shiksharthi and Mittal, 2011 Chauhan *et al*., 2010
10.	*Gymnema sylvestre*	Gymnemic acids III, IV, V, VII and gymnemosides b Dihydroxy gymnemic triacetate Gymnemic acids, gymnemagenin, Gymnestrogenin Gymnemic acid, tartaric acid, buteric acid and formic acid	Noor *et al*., 2013 Daisy *et al*., 2009 Saravanamuttu and Sudarsanam, 2012 Chavre *et al*., 2010
11.	*Allium cepa*	S-methyl cysteine sulfoxide Allyl propyldisulfide	Kumari,*et al*.,1995;Perera and Ali,2012 Perera and Ali, 2012
12.	*A. sativum*	Allicin, (c) S-allyl cysteine, (d) ajoene a Garlic oil and diallyl trisulfide, allicin, S-allyl cysteine sulfoxide,	Khan *et al*., 2012 Perera and Ali, 2012
13.	*Andrographis paniculata*	Andrographolide Alkaloids, tannins, diterpenoids, saponins	Akteret *et al.*, 2013 Semwal *et al.*,2007

Continued…

Table 5: continue

S. No	Botanical name	Active constituents	References
14.	*Curcuma longa*	Curcumin, demethoxycurcumin, bisdemethoxycurcumin and ar-turmerone Curcumin Curcuminoids and sesquiterpenoids	Kuroda *et al*., 2005 El-Masry, 2012;Perera and Ali, 2012 Mustafa *et al*., 2011
15.	*Citrullus colocynthis*	Beta-pyrazol-1-ylalanine	Patel *et al*., 2012
16.	*Justicia adhatoda*	Polyphenols: flavonoids, kaempferol, ellagic acid, gallic acid Vasicine and vasicinol	Saravanamuttu and Sudarsanam, 2012 Rachana *et al.,* 2011
17.	*Nelumbo nucifera*	Liensinine, Daurisoline	Perera and Ali, 2012
18.	*Tinospora cordifolia*	Tinosporin, berberine, tinosporinone Isoquinoline alkaloid	Saravanamuttu and Sudarsanam, 2012 Semwal *et al.,*2007
19.	*Trigonella foenum-graecum*	4-hydroxyleucine and hydroxyisoleucine 4-hydroxyisoleucine (amino acid) Saponins, Proteins & Oils	Patel *et al*., 2012 Frank, 2008 Semwal *et al.,*2007
20.	*Wattakaka volubilis*	Several authors reported that flavonoids, sterols/terpenoids, phenolic acids	Maruthupandian *et al*., 2010
21.	*Ziziphus mauritiana*	Cyclopeptide alkaloids	
22.	*Abrus precatorius*	Trigonelline Flavoniod and alkaloid	Monago and Nwodo, 2010a Monago and Nwodo, 2010b
23.	*Annona squamosa*	Flavonoids, saponins, acetagenins, alkaloids and phenolics	Sangala *et al*., 2011
24.	*Benincasa hispida*	Carbohydrate, alkaloid and saponins Flavonoids like myricetin, a polyhydroxylated flavonol	Jayasree *et al*.,2011 Mohana and Mohan,2013
25.	*Cassia fistula*	Flavonoid	Malpani and Manjunath,2013
26.	*Costus specious*	Eremanthin Costunolide	Eliza *et al*., 2009a Eliza *et al*., 2009b
27.	*Hordeum vulgare*	A rich source of magnesium, fibers, selenium phosphorus and copper. Volatile oils, alkaloids, saponins, terpenoids	Khalaf and Mohamed,2008 Semwal *et al.,*2007
28.	*Melia azedarch*	Nimbin, nimbidin, nimbinin; azadirachtin	Saravanamuttu and Sudarsanam, 2012
29.	*Momordica dioica*	Steroids and/or triterpenoids and their glycosides	Reddy *et al*., 2006
30.	*Murraya koenigii*	Quercetin, murrayacine, carbazole Mahanine, Koenimbine	Saravanamuttu and Sudarsanam, 2012 Perera and Ali, 2012
31.	*Scoparia dulcis* (L.)	Scoparic acid D (a diterpenoid) Bitter irioid glycosides	Latha *et al*., 2009 Semwal *et al.,*2007
32.	*Psidium gajava* Linn	Strictinin, isostrictinin and pedunculagin	Patel *et al*.,
33.	*Pterocarpus marsupium* Epicatechin	Marsupsin, pterosupin and terostilbene Pterostilbene (phenolic compound) Pterocarpol, terostilbene Epicatechin and catechin flavonoids Tannin epigallo-catechin-3-gallate Amellin and scoparic Kinotannic acid kino-red & (-) epicatechin	Patel *et al*., 2012 Romila *et al*., 2010 Akteret *et al.,* 2013 Saravanamuttu and Sudarsanam, 2012 Mohana and Mohan,2013 Mohana and Mohan,2013 Saikia *et al*., 2011 Semwal *et al.,*2007

Table 6: Mechanism or mode of action of antidiabetic plants

S. No	Plant botanical name	Mode of Action	References
1	*Syzigium cumini*	Decrease in the sugar level Reduction in the blood glucose concentration Increase in serum insulin levels and inhibition of insulinase activity from liver and kidney	Nair and Santhakumari, 1986 Gupta and Sa Acherekar *et al*., 1991xena, 2011
2	*Phyllanthus emblica*	Reduction in the blood glucose level	Mali, 2012
3	*Centella asiatica*	Decrease in the blood glucose levels Protection and reduction in the blood glucose levels to normal in glucose tolerance test Exhibition of the significant effect in lowering blood glucose level	Rahman *et al*., 2011 Chauhan *et al.,* 2010 Mustaffa *et al*., 2011
4	*Momordica charantia*	Better show in insulin sensitivity, glucose tolerance and insulin signaling Reduction in the blood glucose levels	Sridhar *et al*., 2008 Rahman *et al.,* 2005
5	*Azadirachta indica*	Prompt effect of the combined extract of *Vernonia amygdalina* and *A. indica* in reduction of blood glucose level Reduction in blood glucose levels	Atangwho *et al*., 2012 Rahman *et al.,* 2005
6	*Aegle marmelos*	Decrease in the liver glycogen level Reduction in blood sugar	Ponnachan *et al*., 1993. Sabu and Kuttan, 2004
7	*Catharanthus roseus*	Reduction in the blood glucose levels due to beta cell rejuvenation, regeneration and stimulation Enhancement in secretion of insulin	Rahman *et al.,* 2005 Malviya *et al*., 2010
8	*Ficus benghalensis*	Reduction in blood sugar level Inhibition of insulinase activity from liver and kidney	Acherekar *et al*., 1991 Bnouham *et al*., 2006
9	*Ficus racemosa*	Reductions in blood glucose Decrease in the level of blood glucose	Vikas *et al*., 2010 Gul-e-Rana *et al.,* 2013
10	*Gymnema sylvestre*	Stimulation of insulin release from several β-cells and islets Increase in the insulin levels	Khan *et al*., 2012 Pate *et al*., 2012
11	*Allium cepa*	Controll of the post-prandial glucose levels.	Khan *et al*., 2012
12	*A. sativum*	Decrease in the blood glucose level	Chandra *et al*., 2008
13	*Andrographis paniculata*	Reduction in the levels of blood glucose Decrease in the blood glucose level Enhancement of glucose utilization by lowering plasma glucose level	Chowdhury and Biswas, 2012 Mustafa *et al*., 2011
14	*Curcuma longa*	Decrease in the plasma glucose level Decreases in blood glucose levels Increase in postprandial serum insulin levels	Mustafa *et al*., 2011 Santoshkumar *et al*., 2013 Krup *et al.,* 2013
15	*Citrullus colocynthis*	Increase in insulin and decrease in plasma glucose levels Dose-dependent increase in insulin release	Dallak *et al.,* 2009 Singh, 2011
16	*Justicia adhatoda*	Reduction in blood glucose levels. Observation of effects on the glucose tolerance, glycosylated haemoglobin, serum lipid profiles and body weight of experimental animals	Gulfraz *et al.,* 2011
17	*Nelumbo nucifera*	Reduction of blood glucose levels Produced of significant hypoglycaemia Reduction of blood glucose level	Mukherjee *et al*., 2006 Huralikuppi *et al*., 2006 Rakesh *et al*., 2011

Continued…

Table 6: continue

S. No	Plant botanical name	Mode of Action	References
18	*Tinospora cordifolia*	Decrease of the blood and urine glucose, Reduction of the blood glucose level and increase in glucose tolerance in rodents	Khan *et al*., 2012 Gupta *et al*., 1967
19	*Trigonella foenum-graecum*	Reduction of the blood glucose levels To cause glucose-induced insulin release *in vitro* and *in vivo*	Khosla *et al.,* 1995 Patel *et al*., 2012
20	*Wattakaka volubilis*	Reductions of blood glucose, and increase in plasma insulin Reduction in serum glucose, total cholesterol, triglyceride and an increase in HDL levels	Maruthupandian *et al*.,2010 Kumar *et al*., 2010
21	*Ziziphus mauritiana*	Reduction in the blood glucose level Exhibit of antihyperglycemic and hypoglycemic activities	Bhatia and Mishra, 2010 Plajekar *et al*., 2012
22	*Abrus precatorius*	Reduction of blood glucose level Reduction of glucose level and inhibition of the two major enzymes of glucose metabolism	Monago and Alumanah,2005 Monago and Nwodo,2010
23	*Annona squamosa*	Increase in plasma insulin level	Nugroho *et al*., 2012
24	*Benincasa hispida*	Reduction in the blood glucose levels, Decrease in glucose levels	Mohana and Mohan,2013 Patil *et al*
25	*Cassia fistula*	Reduction in blood glucose levels and also found effective in restoring the blood lipids to normal levels α-amylase inhibition in its activity	Malpani and Manjunath, 2012 Malpani and Manjunath, 2013
26	*Costus specious*	Decrease in glycosylated hemoglobin, serum total cholesterol, triglyceride, and increased plasma insulin and restored the altered plasma enzyme	Eliza *et al*., 2009a
27	*Hordeum vulgare*	Production of hypoglycemic and hyperinsulinemic effects in NIDDM subjects	Chauhan *et al.*,2010, Patel *et al.,* 2012 Khalaf and Mohamed, 2008
28	*Melia Azedarach*	Decrease in blood glucose level	Patel and Sharma, 2012
29	*Momordica dioica*	Reduction in blood glucoselevels Reduction in serum glucose, increase in serum insulin and urea levels	Reddy *et al*., 2006 Gupta *et al*., 2011
30	*Murraya koenigii*	Reduction of blood sugar Decrease in the levels of blood glucose, glycosylated hemoglobin Reduction in the blood glucose level	Yadav *et al*., 2002 Arulselvan *et al.,* 2006 Prabhu and Thamilanban,2012
31	*Scoparia dulcis*	Insulin-secretagogue activity	
32	*Psidium gajava*	Inhibition of the α-glucosidase activity in the small Intestine Enhancement insulin secretion from cells	Wang *et al*., 2007 Patel *et al*., 2012
33	*Pterocarpus marsupium*	To cause pancreatic β-cell regranulation Enhancement of insulin release and conversion of proinsulin to insulin *in vitro*	Chakravarty *et al*., 1980 Patel *et al*., 2012

79. Recipe: Fresh rhizome is ground into a paste and taken orally. Dosage: 20-25 gm is taken thrice a day after food for 2 months (Ayyanar *et al*., 2008).

***Curcuma longa* L. (Zingiberaceae)**

80. Recipe: 15-20 mL of fresh juice of the rhizome with equal amount of fresh juice of nelli (*Phyllanthus emblica*) given three times in a day for 15 days against glycosuria (Dixit and Sudurshan, 2011).

81. Recipe: Fresh rhizome of *C. longa* is pounded and juice is extracted by adding water.15 ml. to 30 ml of juice given thrice a day (Ediriweera and Ratnasooriya, 2009).

82. Recipe: Decoction of *C. longa, Strychnos potatorum* L., *Salacia oblonga* and *Aerva lanata* is given twice a day (Jayakumar *et al.,* 2010).

63. Recipe: Mixture of bark juice of *Tinospora cordifolia*, *Emblica officinalis* and *C. longa* powder is taken in empty stomach (Jayakumar *et al*., 2010).

84. Recipe: About 8g of raw turmeric were grinded, mixed with water and ½ spoon of honey and taken for 1 month after meal (Swargiary *et al*., 2013).

***Cynodon dactylon* Pers. (Poaceae)**
85. Recipe: Juice of whole plant is taken in morning (Khan and Singh, 2012).
86. Recipe: Plant juice is given in the morning. Whole plant and flower of *Lucas aspera* Ground with milk mixed with butter and is applied on diabetic ulcers (Jayakumar *et al.,* 2010).

***Ficus benghalensis* L. (Moraceae)**
87. Recipe: An infusion of the bark (10 g) mixed 5 g jaggery is an effective and specific medicine for diabetes. This should be given once daily for 10 15 days to reduce blood sugar. The laticiferous sap of this tree is also effective in controlling the diabetes: An increasing capacity of pancreatic cells (Dixit and Sudurshan, 2011).
88. Recipe: Decoction is prepared from 60 gm of dried stem bark or root bark of *F.benghalensis* and 120 ml. is given twice a day (Ediriweera and Ratnasooriya, 2009).
89. Recipe: 100 g of the dried stem bark and root bark are continuously boiled in 250 ml of water with 50 g of the dried stem bark of *Ficus hispida* Linn. f. (Peiathi). The decoction obtained is taken once a day for a period of six weeks to treat diabetes (Maruthupandian *et al*., 2011).
90. Recipe: Latex from aerial roots is vigorous and used to fill cracking of feet. Milky latex along with little quantity of honey is used before fasting as ant diabetic (Ahmad *et al*., 2012).
91. Recipe: The latex obtained from the aerial parts of the plant (leaves and young branches) and mixed with honey and used orally to control high blood glucose level (Ahmad *et al.,* 2009).
92. Recipe: Ground powder mixed along with honey is giventwice a day for about 21 days (Yadav *et al*., 2012).

***F. racemosa* L. (Moraceae)**
93. Recipe: Meitei-pangal community uses the extract obtained by boiling the fruits along with *C. asiatica* and *Parkia roxburghii* bark (Khan and Yadava, 2010).
94. Recipe: A wound is made in stem and the liquid that oozes out collected over a period of 12 hrs is diluted and given twice a day (Jayakumar *et al*., 2010).
95. Recipe: Seed powder mixed with honey is given at night before going to bed (Jayakumar *et al.,* 2010).
96. Recipe: Decoction is prepared with 60 gm. of dried stem bark or root bark of *F. racemosa* and 120 ml. is given twice a day (Ediriweera and Ratnasooriya, 2009).
97. Recipe: A paste (50g) made out of the boiled unripe fruit and equal quantity of fine rice, given with normal meal for 23 months to reduce the sugar level in urine.oot powder is taken with water twice a day (Dixit and Sudurshan, 2011).
98. Recipe: Dried frits taken with warm water are helpful in diabetes (Yadav *et al*., 2012)

***Glycine max* Willd. (Papillionaceae)**
99. Recipe: Seeds of *G. max* are boiled and eaten for breakfast or as a curry with rice (Ediriweera and Ratnasooriya, 2009).
100. Recipe: Dry seed powder, sugar candy or the water soaked sprouted seed is eaten raw by Meitei and Meitei-pangal communities (Khan and Yadava, 2010).

***Gymnema sylvestre* (Retz.) R. Br ex Schultes (Asclepiadaceae)**
101. Recipe: One teaspoon of the powder made from the dried leaves and the flowers of *Cocos nucifera* L. (Coconut) is taken with hot water once a day for a period of one month to treat diabetes (Ahmad *et al*., 2012).
102. Recipe: Decoction is prepared with 120 gm. of (Asclepiadacece) (Bin nuga) leaves of fresh leaves of G. sylvetreand 120 ml. the climber is given twice a day (Ediriweera and Ratnasooriya, 2009).
103. Recipe: Dried leaf powder (2-3g) is given with water. Seven fresh leaves are prescribed daily in the morning for 15 days (Dixit and Sudurshan, 2011).
104. Recipe: Dried leaves are pounded and the fine powder thus obtained is taken orally along with milk. Dosage: About 50 ml is taken twice a day after food for 120 days to treat diabetes (Ayyanar *et al.,* 2008).
105. Recipe: Asclepiadaceae Chakkarakolli Leaf mercerized with water and the juice is taken daily. Leaf powder mixed with water is taken before meals (Jayakumar *et al.,* 2010).
106. Recipe: Leaves 2-4 g Powder of dry Leaves are recommended with water (Chavre *et al*., 2010).

***Hordeum vulgare* L. (Poaceae)**
107. Recipe: Seeds of *H. vulgare* 125 gram are roasted and mi xed with each of 50 gm of *Cicer arietinum* and *Elettaria cardamomum* and used @ half teaspoon with water thrice a day to control blood glucose level (Ahmad *et al*., 2009).
108. Recipe: Recommended food for diabetic patients (Jayakumar *et al.,* 2010).
109. Recipe: Seeds are roasted and mixed with *Elettaria cardamomum* L., ½ spoon powder is taken with water twice a day for a month along with meal (Manzoor *et al*., 2013).

***Ipomoea aquatic* Forssk. (Convolvulaceae)**
110. Recipe: Fresh leaves are cooked and eaten as a curry. (Ediriweera and Ratnasooriya, 2009).
111. Recipe: Meitei-pangal community uses the boiled extract of tender shoot against thirst in diabetic patients (Khan and Yadava, 2010)

***Justicia adhatoda* L. (Acanthaceae)**
112. Recipe: Meitei community gives the extract obtained by boiling the leaves along with the leaves of *Clerodendrum siphonanthus*; Meitei-pangal community uses the extract obtained by boiling the leaves along with

the leaves of *Azadirachta indica* and *Zanthoxylum acanthopodium* (Khan and Yadava, 2010).
113. Recipe: Decoction of leaves is used to cure diabetes (Panda, 2011).
114. Recipe: Extract obtained from the fresh leaves of plant mixed with water. About 10 ml of extract is used thrice a day to treat suga (Ahmad *et al*., 2009).
115. Recipe: Decoction is prepared with 60 gm of dried leaves of *A. vasica* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

***Melia azedarch* L. (Meliaceae)**
116. Recipe: Decoction is prepared with 120 gm. of fresh stem bark of *M. azedarch* or 60 gm. of dried stem bark 120 ml. is given twice a day (Ediriweera and Ratnasooriya, 2009).
117. Recipe: The dried fruits of the plant are ground to make powder. About ½ teaspoon is given with glass of water before breakfast daily for a month. The local people claim that it is an effective therapy for the treatment of diabetes (Ahmad *et al*., 2009).
118. Recipe: One cup extract of leaves along with one cup extract of *Rhazya stricta* (verian) leaves is effective for diabetes before fasting (Ahmad *et al*., 2012).

Memecylon umbellatum Burm.f. **(Melastomaceae)**
119. Recipe: Decoction is prepared with 60 gm. of dried leaves of *M. umbellatum* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
120. Recipe: Shade dried leaf powder is mixed with cup of water and boiled rice and kept overnight and taken orally. Dosage: One teaspoon is taken early in the morning for forty days or until cure (Ayyanar *et al.*, 2008).

***Mimosa pudica* L. (Mimosaceae)**
121. Recipe: Decoction is prepared with 120 gm. of fresh entire plant of *M. pudica* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
122. Recipe: Plant juice is taken orally twice daily (Jayakumar *et al*., 2010).

***Momordica charantia* L. (Cucurbitaceae)**
123. Recipe: Decoction of the fruits is given to the patients in the morning in empty stomach at least for one month. The patient is also advised at least for one month. The patient is also advised to take the fruit as vegetable in his/her daily diet. A mixture of *S. cumini*, Gymnema sylvestre, Azadirachta indica and leaves of *Acacia nilotica* in the ratio 1: 1: 1:2 is an effective remedy for diabetes (Dixit and Sudurshan, 2011).
124. Recipe: Fresh 50 gm of fresh leaves are crushed, 100 ml of water is added and c120 ml of juice is extracted by squeezing and given once or twice a day (Ediriweera and Ratnasooriya, 2009).
125. Recipe: 30 ml of the juice prepared from few fresh fruits and few fresh leaves with pieces of the stem bark of *Syzygium cuminii* is taken once a day to treat diabetes (Maruthupandian *et al*., 2011).
126. Recipe: The juice of fresh fruits, used, one small cup daily. This juice exhibits an anti diabetic property (Ahmad *et al*., 2009).
127. Recipe: The fruits are dried under shade, then ground to obtain powder. One spoon is administered twice a day to lower blood glucose level (Ahmad *et al*., 20090).
128. Recipe: Juice of the fruit was extracted and given to the patient early in the morning or fruit was cooked and taken twice a day for two weeks before meal (Manzoor *et al*., 2013).
129. Recipe: Fruits are strongly recommended either in the form of vegetable or green form (Chavre *et al*., 2010).
130. Recipe: Fresh extracts of fruit juice one ounce to be taken in empty stomach **(**Swargiary *et al*., 2013)

***M. dioica* Roxb. ex Willd. (Cucurbitaceae)**
131. Recipe: The fruits of *M. dioica* are deseeded and cut in to thin slices. Then these are crushed and juice is extracted by squeezing. 30 ml. of juice is given once or twice a day (Ediriweera and Ratnasooriya, 2009).
132. Recipr: Fresh juice is recommended for diabetes (Ahmad *et al*., 2012).
133. Recipe: Fruit juice is efective in controlling diabetes. It is also used as drink mixed with sugar candy, one glass daily, to control acidity (Panda *et al*., 20110).

***Murraya koenigii* (L.) Spreng. (Rutaceae)**
134. Recipe: Leaf extract, 2-3 tea spoon early in the morning (Swargiary *et al*., 2013).
135. Recipe: Fresh leaflets are chewed at morning (Chavre *et al*., 2010).

***Nelumbo nucifera* Gaertn. (Nelumbonaceae)**
136. Recipe: Seeds of N. nucifera are powdered and Roots 3-6 gm given twice a day.
137. Recipe: Roots are pounded and juice is extracted by squeezing. 10-20 ml of juice is given once a day (Ediriweera and Ratnasooriya, 2009).
138. Recipe: Meitei-pangal community uses the extract obtained by boiling the tender shoot along with Phyllanthus fraturnus (Khan and Yadava, 2010).
139. Recipe: Flowers made to juice and taken orally for about15 days (Yadav *et al*., 2012)

***Ocimum sanctum* L. (Lamiaceae)**
140. Recipe: Leaves were dried under shade and grounded to make powder and were taken with water twice a day after meal (Manzoor *et al*., 2013).
141. Recipe: Leaf powder is taken orally with honey (Yadav *et al*., 2012)

***Phyllanthus emblica* L. (Euphorbiaceae)**
142. Recipe: Meitei community eats the cooked tender leaves along with a local fish Ngakha meingangbi (*Puntius phutunio*) (Khan and Yadava, 2010).

143. Recipe: Fresh fruits of *P. emblica* are pounded and juice is extracted. 60 ml of juice is given twice a day (Ediriweera and Ratnasooriya, 2009).
144. Recipe: Paste prepared from equal quantity of boiled fruits of this plant and the fruits of Thani (*Terminalia bellirica*) given with 50ml cow's milk twice daily 1hour before food to rectify the problems of sugar related disease (Dixit and Sudurshan, 2011).
145. Recipe: Decoction is prepared with 60 gm of dried fruits P. embilica and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
146. Recipe: Dried or fresh fruits are directly eaten (Chavre *et al*., 2010).
147. Recipe: About 10 numbers of fruits were grounded and juice were mixed with honey and taken every day (Swargiary *et al*., 2013).
148. Recipe: Bark juice is taken with turmeric powder in morning in empty stomach (Khan and Singh, 2012).
149. Recipe: Mixture of bark juice of *Tinospora cordifolia*, *Emblica officinalis* and *Curcuma longa* powder is taken in empty stomach (Jayakumar *et al*., 2010).
150. Recipe: Meitei-pangal community prescribes the extract obtained by boiling the plant cut into pieces at the nodes (Khan and Yadava, 2010).

***P. urinaria* L. (Euphorbiaceae)**
151. Recipe: More or less similar to P. fraturnus (Khan and Yadava, 2010).
152. Recipe: Decoction is prepared with 120 gm of fresh entire plant of P. urinaria and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

***Pongamia pinnata* (L.) (Papilionaceae)**
153. Recipe: Recipe: The flowers are fried in ghee and taken with honey thrice a day to treat Diabetes (Maruthupandian *et al*., 2011).
154. Recipe: Decoction is prepared with 60 gm. of dried stem bark of *P. pinnataand* 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

***Psidium guajava* L. (Myrtaceae)**
155. Recipe: Decoction is prepared with 120 gm of fresh leaves of *P. guajava* and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
156. Recipe: Hot water extract made from the dried leaves of plant is used to reduce blood glucose level of diabetics. This hot tea was very common among the local people of the area (Ahmad *et al*., 2009).
157. Recipe: Fresh fruits were eaten or hot water extracts made from dried leaves of plant and taken twice a day after meal. (Manzoor *et al*., 2013).

***Pterocarpus marsupium* Roxb. (Papilionaceae)**
158. Recipe: 20 ml of the hot water extract of the stem bark/wood is taken twice a day to treat diabetes (Maruthupandian *et al*., 2011).
159. Recipe: One teaspoonful of latex of *P. marsupium* given daily (Ediriweera and Ratnasooriya, 2009).
160. Recipe: Heart wood soaked overnight with water and filtrate (10ml) is given daily for one month. Seeds of this plant are also used for the same but found less efficient than the wood. Both bark and heart wood is effectively used for diabetes (Dixit and Sudurshan, 2011).

***Scoparia dulcis* (L.) (Scrophulariaceae)**
161. Recipe: Fresh leaves 5- 6 in number are eaten or chewed for three times a day before meals. (Swargiary *et al*., 2013)
162. Recipe: Decoction is prepared with 120 gm of fresh entire plant or 60 gm of dried entire plant and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
163. Recipe: 10 gm dried powder of plant is used twice a day (Ediriweera and Ratnasooriya, 2009).

***Salacia reticulata* Wt. (Hippocrateaceae)**
164. Recipe: Root decoction is consumed regularly (14 Jayakumar *et al*., 2010).
165. Recipe: Decoction is prepared with 60 gm of dried root bark of S. reticulataand 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).

***Sesbania sesban* Jayanthi (Papilionaceae)**
166. Recipe: 2.5 gm. of dried leaves of *S. sesban* are powdered and given once a day [6].
167. Recipe: Meitei communities uses boiled extract of the leaf or tender shoot (Khan and Yadava, 2010).

***Solanum nigram* L. (Solanaceae)**
168. Recipe: Fresh aerial parts of the plant are cooked as vegetable and is recommended to control diabetes (Ahmad *et al.,* 2009).

169. Recipe: Fresh leaves or leaves and stem after cooking (saag) are used for diabetes (Ahmad *et al*., 2012).

***Strychnos potatorum* L. (Loganiaceae)**
170. Recipe: Seeds of *S. potatorumare* ground with rice washed water and made in to a fine paste.10 gm. is given twice a day (Ediriweera and Ratnasooriya, 2009).
171. Recipe: Seeds ground with honey is used regularly. Seed paste with honey is applied on diabetic ulcers (Jayakumar *et al*., 2010).

***Syzigium cumini* (L.) Skeels. (Myrtaceae)**
172. Recipe: Seeds of the plant are dried under shade, then ground to make powder About 25 gm powder is used thrice a day with water. This decreases blood glucose level very significantly (Ahmad *et al*., 2009).
173. Recipe: The fruit pulp (5g) or dried powder (1-2g) is given twice a day for 15 days. However, the seed powder (1-2g) given twice daily is more effective than the fruit. Periodic sugar level in blood to be checked (Dixit and Sudurshan, 2011).

174. Recipe: The seeds in 25 gm of *Syzygium cumini*, *Momordica charantia*, 12 gm of *Cyperus rotundus* and *Rosa alba* are made into powder. This is used successfully for lowering blood glucose by the inhabitants of an area (Ahmad *et al*., 2009).
175. Recipe: Meitei and Meitei-pangal communities uses boiled extract of the seed (Khan and Yadava, 2010).
176. Recipe: 30 ml of the hot water extract of the seeds is taken twice a day for a period of one month to treat diabetes (Ahmad *et al*., 2012).
177. Recipe: An ounce (c.28 g) of the hot water extract of the stem bark is taken twice a day for a period of forty five days to treat diabetes (Ahmad *et al*., 2012).
178. Recipe: Seeds of S. cuminiare put into a wide mouth earthen pot and heated while stirring until roasted. Roasted seeds are pounded well and 2.5 gm. of powder is given twice a day pouring with hot water (Ediriweera and Ratnasooriya, 2009).
179. Recipe: Decoction is prepared with 60 gm of dried stem bark of S. cumini and 120 ml. is given twice a day (Ediriweera and Ratnasooriya, 2009).
180. Recipe: Juice extracted from the leaf is mixed with honey or cow's milk and fresh fruits are taken orally. Dosage: 2 teaspoon of juice is taken twice a day after food for 3 months (Ayyanar *et al*., 2008).
181. Recipe: Seed powder is taken twice or thrice daily [Jayakumar *et al*., 2010].
182. Recipe: Ripened fruits are eaten directly and half spoon of seed powder is taken internally with milk daily. (Chavre *et al*., 2010).
183. Recipe: Fresh fruits were cut into slices and taken early in the morning for three weeks. (Manzoor *et al*., 2013).
184. Recipe: Seeds are ground to make powder. The powder is taken 3 times daily. This is recommended for diabetes. The eating of its fruit in season is also very useful for diabetes (Marwat *et al*., 2011).
185. Recipe: Seed powder about 1teaspoonful is taken with water in the morning in empty stomach and also in the evening before meals (Swargiary *et al.,* 2013)

Tinospora cordifolia (Thunb.) Miers **(Menispermaceae)**
186. Recipe: Decoction is prepared with 60 gm of (Rasakinda) dried stem of the plant and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
187. Recipe: 60 gm. of Fresh stem of T. cordifolia are chopped into small pieces and pounded. 100 ml of water is added and 120 ml of juice is extracted by squeezing and 15-30 ml of juice given thrice a day (Ediriweera and Ratnasooriya, 2009).
188. Recipe: Decoction of bark is taken with turmeric powder 2 times a day (Khan and Singh, 2012).
189. Recipe: Bark juice and juice of Emblica officianalis mixed with *Curcuma longa* powder is taken twice a day (Jayakumar *et al*., 2010).

Tragia involucrate **L. (Euphorbiaceae)**
190. Recipe: Decoction is prepared with 120 gm. of fresh entire creeper of T.involucrate and 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
191. Recipe: Root decoction is given twice a day (Jayakumar *et al.,* 2010).

Trigonella foenum-graecum **L. (Papilionaceae)**
192. Recipe: Twenty five gm seeds are given daily for 21 days with water. The inhabtants claimed that it is one of the effective treatments to reduce blood glucose in diabetic patients (Ahmad *et al*., 2009).
193. Recipe: The equal quantity of Tylophora hirsuta leaves, Trigonella foenum-graecum seeds and aerial parts of *Fumaria indica* is ground and made into powder. This mixture is claimed a significant therapy to reduce blood sugar of diabetic patients (Ahmad *et al*., 2009).
194. Recipe: Seeds of *T. foenum-graecum* are put into a wide mouth earthen pot and heated while stirring until roasted. Roasted seeds are pounded well and one teaspoonful of powder is given twice a day with water (Ediriweera and Ratnasooriya, 2009).
195. Recipe: Fresh leaves were boiled in water and cooked as vegetable and were taken twice a day along with meal (Manzoor *et al*., 2013).

Wattakaka volubilis (L.f.) Stapf **(Asclepiadaceae)**
196. Recipe: A salad prepared of leaves of W. volubilis are given to diabetic patients (Ediriweera and Ratnasooriya, 2009).
197. Recipe: Fresh leaves are cut into very thin slices and mix with little scraped coconuts, salt, lemon juice, chopped onions and green chillies (Ediriweera and Ratnasooriya, 2009).
198. Recipe: One teaspoon of the leaf powder is taken regularly with water to treat diabetes **(**Maruthupandian *et al*., 2011).

Withania coagulans **(Stocks.) Dunal. (Solanaceae)**
199. Recipe: Fifteen gm seeds of the plant are soaked in water for the whole night. This is given early morning before br eakfast to diabetic patients (Ahmad *et al*., 2009).
200. Recipe: Dry seeds along with equal quantity of nigella seeds are effective for diabetes. Local people dipped seeds in water on night and used solution next day before fasting against diabetes (Ahmad *et al*., 2012).

Xanthium strumarium **L. (Asteraceae)**
201. Recipe: decoction is prepared with 60 gm of dried root of *X. strumarium* and 120 ml is Given twice a day (Ediriweera and Ratnasooriya, 2009).
202. Recipe: Seeds are dried and powdered. 2.5-5 gm of powder is given twice a day (Ediriweera and Ratnasooriya, 2009).

Ziziphus mauritiana (Rhamnaceae)
203. Recipe: Ripen fruits are eaten as a fruit (Ediriweera and Ratnasooriya, 2009).

204. Recipe: Decoction is prepared with 120 gms of fresh leaves of *Z. mauritianaand* 120 ml is given twice a day (Ediriweera and Ratnasooriya, 2009).
205. Recipe: 4-5 fresh leaves are chewed daily to lower blood glucose level (Ahmad *et al*., 2009).
206. Recipe: Fresh fruits were taken twice a day for a month after meal (Manzoor *et al*., 2013).

Medicinal Plants with experimently confirmed antidiabetic properties

Plants have always been a very good source of drugs and many of the currently available drugs have been derived directly or indirectly from them. Several such plants have shown anti-diabetic activity when evaluated using different type of experimental techniques. This study presents the profile of 242 antidiabetic plants, collected from available literature. Out of these the following 43 plants have been reported with experimently confirmed antidiabetic properties. Most of the medicinal researches have aimed to evaluate the therapeutic value of plants. The antidiabetic properties of some of the plants have been experimentally proved. *Acacia Arabica* (Wadood *et al*., 1989;Singh, L. W., 2011), *Achyranthes aspera* (Akhtar and Iqbal, 1991; Bnouham *et al*., 2006), *Aegle marmelose* (Sabu and Kuttan, 2004; Seema *et al*., 1996; Ponnachan *et al*., 1993), *Allium cepa* (Kumari *et al*., 1995;Roman *et al*;1995; Mathew and. Augusti,1975), *Allium sativum* (Chauhan *et al*., 2010;Eidi *et al*., 2005), *Aloe barbadensis* (Ajabnoor,1990., Jain *et al*., 2010; Okyar *et al*., 2001;105 Yagi *et al*., 2009; Misawaa *et al*., 2008; Kim *et al.,* 2009; Noor *et al*., 2008), *Andrographis paniculata* (Dandu and Inamdar, 2009,Zhang and Tan, 2000), *Aporosa lindleyana* (Jung *et al*., 2006), *Averrhoa bilimbi* (Pushparaj *et al*., 2001; Pushparaj *et al*., 2000), *Azadirachta indica* (Waheed *et al*., 2006), *Boehaavia diffusa* (Ayodhya *et al*., 2010;Malviya *et al*., 2010), *Cajanus cajan* (Bnouham *et al*., 2006;Amalraj and Ignacimuthu, 1998a), *Catharanthus roseus* (Bnouham *et al*., 2006; Nammi *et al*., 2003), *Centella asiatica* (Chauhan,*et al.,* 2010a; Mutayabarwa *et al*., 2003;George *et al*., 2008; Sashida and Mimaki, 2007), *Cichorium intybus* (Pushparaj *et al*., 2007), *Coriandrum sativum* (Bnouham *et al*., 2006;Pushparaj *et al.,* 2007;Eidi *et al*., 2009), *Citrullus colocynthis* (Nmila *et al*., 2000; Abdel-Hassan and Abdel-Barry, 2000;Singh, 2011;Dallak *et al*., 2009a; Dallak *et al*., 2009b), *Curcuma longa* (Hussain and Eshrat, 2002; Mohankumar *et al*., 2011; Nwozo *et al*., 2009; Hussain and Eshrat, 2002), *Ficus bengalensis* (Achrekar *et al*., 1991; Kumar and Augusti, 1989), *Gymnemasylvestre* (Baskaran *et al*., 1990;Saxena and Vikram, 2004;Rao *et al*., 2010; Kaczmar, T., 1998), *Hordeum vulgare* (Chauhan *et al*., 2010b), *Ipomea aquatica* (Malalavidhane *et al*., 2000), *I . batatas* (Kusano and Abe, 2000), *Mangifera indica* (Aderibigbe *et al*., 1999; Aderibigbe *et al.,* 2001), *Memecylon umbellatum* (Amalraj and Ignacimuthu,1998b), *Momordica charantia* (Singh *et al*., 2008; Tiangda *et al*., 1987; Mohammady *et al*., 2012; Gunjan *et al*.,2010; Aswar and Kuchekar, 2012), *Murraya koenigii* (Khan *et al*., 1995), *Musa sapientum* (Bnouham *et al*., 2006; Pari and Umamaheswari, 2000), *Myrtus communis* (Jung *et al*., 2006), *Nelumbo nucifera* (Mukherjee *et al*., 1995; 75 Mukherjee *et al*., 1997), *Ocimum sanctum* (Jung *et al*., 2006; Chattopadhyay, 1993; Rai *et al*., 1997; Vats *et al*., 2002; Vats *et al*., 2004), *Osbeckia octandra* (Bnouham *et al*., 2006; Fernando *et al*., 1990), *Phyllanthus amarus* (Raphael *et al*., 2002; Srividya, N. and S.Periwal, 1995), *Phyllanthus urinaria* L.(Higashino *et al*., 1992), *Psidiumguajava* (Mukhtar *et al*., 2006;Rai *et al*., 2010), *Pterocarpus marsupium* (Jung *et al*., 2006; Mukhtar *et al*., 2005; Jahromi and Ray, 1993; Modak *et al*., 2007;Saxena and Vikram, 2004), *Rhazya stricta* (Ali, 1997.), *Salacia reticulate* (Serasinghe *et al*., 1990), *Syzigium cumini* (Kumar *et al*., 2008; Gupta and Saxena, 2011; Singh,2011), *Swertia chirayita* (Jung *et al*., 2006; Bajpai *et al*., 1991; Grover *et al*., 2002), *Trigonella foenum graecum* (Jung *et al*., 2006; Abdel-barry *et al*., 1997), *Tinospora cordifolia* (Jung *et al*., 2006;Stanely *et al*., 2000).

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