Search for the Antidiabetic Plants: Pharmacological Aspects

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Summary

Throughout the world, more people are living less active lives in towns and cities. The world's population is increasing and more people are living longer. At the same time, people are eating less healthy types of food in larger quantities than they ever did before. The result of this unhealthy combination is that the total number of people in the world with diabetes in spiraling out of control. Diabetes mellitus is a common chronic endocrine disorder since ancient time's lots of herbal medicine, which are used to treat this disease. The pharmacological actions of active principles obtained from various plants are studied in media & abroad this article reviews some of the better planned studies.

Introduction

According to WHO figures:

1. In 1985, there were an estimated 30 million people with diabetes worldwide.
2. Today, there are at least 177 million people with diabetes, a nearly six fourth increase in just over 15 years.
3. If nothing is done to slow down the epidemic, the number will reach 300 million within 25 years.

What is diabetes?

Diabetes, or to give it its full name diabetes mellitus, is a chronic condition that occurs as a result of problems with the production and /or action of insulin in the body.

Insulin is a hormone made by the pancreas that enables cells to take in glucose from the blood and use it for energy. When a person has diabetes, either their pancreas does not produce the insulin they need (Type I diabetes), or their body cannot make effective use of the insulin they produce (Type 2 diabetes).

Consequently, people with diabetes cannot process glucose in the same way as people without the condition. This often leads to the amount of glucose in the blood increasing.

This high concentration of glucose of "high blood sugar" level is called hyperglycemia. This can result in short and long-term complications, many of which have the potential to reduce the quality of life of people with diabetes and their families.

The present article reviews the potential herbal drugs studied in India and abroad. Herbal medicines for diabetes can be classified into four categories according to their mode of action:

(1) **Drugs acting like Insulin** (2) **Drugs acting on Insulin Secreting Beta Cells** (3) **Drugs acting by Modifying Glucose Utilization** and (4) **Drugs acting by Miscellaneous Mechanisms.**

➢ (1) HERBAL DRUGS ACTING LIKE INSULIN

a. *Momordica charantia*

Fresh juice of fruit produced significant hypoglycemic effect in experimental animals.[1,2] "Plant Insulin", the hypoglycemic principle which exhibited a consistent hypoglycemic activity in diabetes mellitus patients was isolated from fruit .[3] Aqueous extract of fruits suppressed the hypoglycemia in albino rats.[4] Fruits produced hypoglycemic activity in alloxan –diabetic rabbits.[5] Tablets, prepared from the powder of fruits, or the fresh juice of fruits caused significant lowering of blood sugar levels in patients.[6,7] On oral administration of fruit juice showed hypoglycemic effect in normal as well as diabetic rabbits. But toxicity was observed, in the animals. [8] No glycosuria was observed in diabetic patient, taken fruits along with chloropropaamide. [9]
Fruit juice and dried extracts fruits caused mild hypoglycemic effect in diabetic rabbits. [10,11] Unripe fruits showed hypoglycemic action in rabbits.[12]
A non-nitrogenous substance charatin, produced hypoglycemic activity in fasting rabbits was isolated from unripe fruits.[13] No hypoglycemic effect was produced in rabbits only by the fruit extract alone, rather fruit extract potentialised hypoglycemic effects of tolbutamide and Jasadohasma.[14]
Seeds contain a glyco –alkaloid vicine, characterized as 2,6-diaminopyrimidinol –5 –D-glycopyranoside, showed hypoglycemic activity in fasting albino rats.[15] No hypoglycemic was produced in diabetic and normal human beings by alcoholic extract of the drug.[16] Marked hypoglycemic effects were exhibited both by a crude crystalline substance and an infusion of the crude drug. The drug showed toxicity in fish, rats and rabbits.[17,18]

b. *Azadirachta indica*

The loss in bidy weight of rats caused by prolong administration of anterior pituitary extract was orevented by "Tribang shila" a composite drug containing neem leaves.[19]
The hypoglycemic response of anterior pituitary extract in rats, reduced significantly by "Tribang shila" a composite drug containing neem leaves.[20] Aqeous extract of leaves produced significant reduction of the blood sugar level in diabetic dogs.[21]

➢ *(2) DRUGS ACTING ON INSULIN SECRETING BETA CELLS*

(a) *Allium cepa*

Significant hypoglycemic effect was produced in mice by onion oil and synthetic dipropyl disulphide oxide.[22] Oral administration of allicin (dially disulphide oxide) exhibited significant reduction of the blood sugar levels in alloxan diabetic rabbits.[23] Hypoglycemic activity was produced by the ether extract of juice expressed onion bulbs in diabetic rabbits.[24] Oral administration of ally propyl disulphide to the human volunteers caused significant fall in blood glucose level.[25] Petroleum ether extract of bulbs exhibited fall of blood sugar in rabbits.[26] Hypoglycemic activity was produced in rabbits by the light petroleum extract of dried onion.[27]

(b) *Pterocarpus marsupium*

Rajasekharan and Tuli carried out clinical trial and found that *Pterocarpus marsupium* (beejak) bark is effective in type 1 diabetes mellitus.[28] Later, chakravathy et al. reported epicatechin to be the active hypoglycemic constituent.[29]

(c) *Chandraprabhavati*

It is a compound Ayurvedic preparation used in the treatment of diabetes mellitus. Tripathi et al. have reported that it is effective in lowering fasting blood sugar levels in rats.[30]

(d) *Ficus bengalensis*

Hypoglycemic activity was observed in normal and moderately diabetic rabbits produced by the bengaranoside isolated from the bark. [31]

Ethanolic extract of bark exhibited hypoglycemic activity in rabbits.[32] Flavonoids A,B, & C from bark produced hypoglycemic effect in normal rabbits.[33] No appreciable difference in blood sugar levels was caused in diabetic rabbits by the decoction of bark.[34] Hypoglycemic action was produced by the ethanolic extract of bark in normal male albino rats.[35]

(e) *Aloe barbadensis*

Semi transparent, amorphous solid of the fresh leaves produced hypoglycemic effect in normal albino rabbits when administered intravenously and significant hypoglycemic effect was also found in alloxandiabetic rabbits.[36]

- ***(3) PLAN DRUGS ACTING BY MODIFYING GLUCOSE UTILIZATION***

Zingiber officinal* (ginger) *Cyamopsis tetragonoloba* (gowar) and *Grewia assiatica (phalsa) are reported to produce hypoglycemic by modifying glucose utilization. Sharma and Shukla reported that ginger juice has glucose lowering effect in normal fasting animals and in alloxan diabetic animals.[37] Jenkins et al. reported the hypoglycemic effect of *Cyamopsis tetragonoloba* in diabetic and normal subjects. They reported that it decreases urinary glucose loss in diabetes.[38] Pillai et al studied its hypoglycemic activity using alloxan treated diabetic rabbits.[39] Gowar plant and the seeds at a dose of 40 g/kg showed hypoglycemic activity similar to that of tolbutamide. These workers have suggested that the mechanism of action of gowar is probably related its ability to increase the viscosity of gastrointestinal contents, slow gastric empying and also act as a barrier to diffusion. These workers concluded that gowar produces its hypoglycemic action by acting as an extra pancreatic site.[40] These workers reported that the fasting blood sugar levels come down to normal after the treatment and remain as such after discontinuation of treatment for another 15 days.

- ***(4) DRUGS ACTING BY MISCELLANEOUS MECHANISMS***

(a) Leguminous plants:

Hypoglycemic activity of some leguminous plants was studied by singh et al.and they reported that legumes in diet could reduce glucose levels in normal rats than could a normal diet.[41] Chopra (1955) reported that leguminous plants in diet could reduce blood sugar levels and cholestrol levels because of their dietary fiber content.

(b)Salvia lavanduligolia

The flowering spices of *Salvia lavandulifolia* are used in the treatment of diabetes mellitus in spain Jamenez et al. studied its effect and reported its hypoglycemic activity in normal as well as alloxan diabetic rabbits. The hypoglycemic effect is slight and independent of effects of insulin.[42]

➢ A FEW OTHER PLANTS WITH HYPOGLYCEMIC ACTIVITY

1. *Ocimum sanctum*

Leaves are used as stimulant, expectorant and used in bronchitis. The essential oil of leaves has antibacterial property.
Hypoglycemic activity was produced by the aqueous decoction of whole plant.[43]

(2) *Gymnema sylvestre*

Alcoholic extract of leaves produced hypoglycemic effect in mild diabetic animals.[44] An insignificant reduction of blood sugar occurred in normal rats but significant and marked hypoglycemic effect was observed in hyperglycemic animals caused by the alcoholic extract of leaves.[45,46,20,47]

(3) *Zea mays*

Hypoglycemic effect of well compatable with that of crystalline insulin was produced in fasting rabbits by the decoction of macerated styles.[48] Hypoglycemic activity was also caused in rabbits by a fermented preparation of style.[49]

(4) *Curcuma longa*

Tank et al. have reported hypoglycemic activity of 50% ethanol extract of Curcuma longa in allozan diabetic rats. The study was carried out in mild as well as severely diabetic rats at the dose levels of 5 and 10 mg/rat. They found a reduction of 33.53% (5 mg/rat) and of 49.33% (10 mg/rat) and of 49.33% (10 mg/rat) in blood glucose levels in severely and in mild diabetic rats respectively. A reduction of 34.53% (5 mg/rat) glucose was observed in case of rats.[50]

(5) *Trigonella foenum-graecum*

Alkaloid trigonelline hydrochloride with feed extract produced a mild, transient hypoglycemia in alloxdiabetic rats. Remarkable hypoglycemic activities were caused by nicotinic acid and nicotinamide.[51] Hypoglycemic activity was exhibited in rabbits by the seed extract.[49]
Nahar has worked on a large number of plants to find out an effective drug which might be used either as an oral hypoglycemic agent or as a dietary adjunct. The various plants studies by Nahar are shown in Table-1 [52]. in the recent years Chohachi Kanno et al. studied various plants for their antidiabetic properties. They have isolated active constituents and subjected them to pharmacological screening. (Table –2) [53,54,55]
Jain and Sharma tested antidiabetic indigenous plants for their hypoglycemic effect on normal rabbits. Only nine of these showed encouraging effect on oral administration of their total extracts. (Table –2)[56]

Besides these plant drugs, there are other plants also with proven hypoglycemic activity. a need for elaborate study of these plants still remains.

Among these plants are:

1. *Dipteracanthus prostatus* (entire plant).
2. *Pterocarpus santalinus* (seed).
3. *Rhus chinensis* (root).
4. *Ricinus communis* (root).
5. *Rosa brunani* (entire plant excluding root).
6. *Pulicaria foliolosa* (entire plant).

A number of other plants have been screened for their antidiabetic acivity some times encouraging results have come up, whereas some studies have led to nothing. Active antidiabetic principles have been isolated from many plants. Table -3 shows some of the active principles that have been reported to posse's hypoglycemic activity

Table 1: Some plants having hypoglycemic activity as studied by Nahar.[52]

PLANT	PLANT PART	*TYPE OF TEST SAMPLE*
Nephoelepsis tuberose	Bulbil	Juice
Costus specious	Rhizome	Juice
Plantago ovata	Husk	Powder
Stephania hernadifolia	Bulb	Juice
Allium sativum	Bulb	Juice
Hemidesmus indicus	Root	Alcohol extract

Table 2: Plant drugs possessing hypoglycemic activity [53,54,55]

(Activity demonstrated in normal and diabetic experimental animals)

PLANT	PART OF PLANT	ACTIVE CONSTITUENTS
Atractylodes japonica	Rhizome	Glycans A,BC,D Atractants
Lithospermum erythroizon	Root	Glycans A,B,C, Lithospermans
Morus alba	Root	Glycoprotein Mora A
Aconitum carmichaeii	Root	Glycans A,B,C,D,
Ephedra distachya	Entire	Glycans A,B,C,D,E
Saccharum officinarum	Stalk	Glycans A,B,C,D,E,
Gandoderma iucidium	Fruit	Glycans A,B
Oriza sativum	Root	Glycans A,B,C,D,
Dioscorea japonica	Rhizome	Glycans A,B,C,D,E,F
Coix lachryma	Seed	Glycans A,B,C
Panax ginseng	Root	Glycans A,B,C,D,E.

Table 3: Active antidiabetic principles isolated from some of the medicinal plants

PLANT	PART USED	ACTIVE PRINCIPLES	REFERENCES
Aconitum carmichaeii	Root	Aconitan A,B,C,& D	57
Anemarans	Rhizome	Anemarans A,B,C & D	58
Coptis chinensis	Aerial part	Bernerine	59
Capsicum annum	Fruit	Capsaicin	60,61
Eleutherococcus	Root	Eleutherans A, B, C, D, F &	62
senticosus	Seed	G	63
Galega officinalis	Bark	Galegin	64
Zizyphus rugosa		Kaempferol -3-0 Rhamnoside Quercetin -3-0 Rhamnoside & Miricetin -3-0 Rhamnoside	
Lathyrus japonica	Seed	Lathyrines	65
Lepdium ruderale	Aerial part	Lepidine	66,67
Bauhinia purpurea	Aerial part	Quercetin	68
Bauhinia variegate			
Clytia richardiana	Leaves	Saudin Rhamnoside	69
Tinospora cordifolia	Plant	1,2-substituted	70
Potetorum ancistroides	Aerial part	Pyrolidines Tormetic acid	71

Comments and conclusion

From the above data it can be concluded that there are a number of plants, indigenous as well as those from foreign countries that have active hypoglycemic principles. Further in depth studies are required to establish their mode of action and therapeutic efficacy so as to make best use of the available plant resources for the treatment of diabetes mellitus.

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