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Mini review

Costus speciosus and *Coccinia grandis*: Traditional medicinal remedies for diabetes

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ABSTRACT

Diabetes mellitus is a major illness which has been implicated with numerous clinical manifestations. Herbal medicines have become a popular form of therapy for this disease and are now being engaged in complementary means together with the usual chemical or biochemical agents due to the fact that they are less toxic at recommended dosages than synthetic counterparts. Plants have the ability to synthesize phytochemicals of medicinal value and these products in turn can be used for therapeutic purposes especially in developing countries where resources are meagre. *Costus speciosus* and *Coccinia grandis* are plants which contain reservoirs of anti-diabetic effects as well as other medicinal properties. These plants have been known to demonstrate pharmacological activities such as anti-inflammatory, anti-microbial, antioxidant, anti-dyslipidemic and anti-cancer. This review discusses the morphology of these two herbs, uses of these plants in medicinal practices, their traditional methods of administration and the bioactive compounds which have been identified to possess the anti-diabetic properties.

Contents

1. Diabetes: the current global landscape

Diabetes mellitus is an endocrinal disorder. It has been clinically identified as a global pandemic where an estimated 47 million of the world's population are victims of this disease condition (American Diabetes Association, 2011; WHO Fact Sheet, 2013). The disease initializes with a group of metabolic alterations characterized by hyperglycemia resulting from defects in insulin secretion, or a lack of physiological responses to insulin or both. It has already been established that chronic hyperglycemia in the diabetic condition is associated with long-term damage, dysfunction and eventually the failure of organs, especially the eyes, kidneys, nerves, heart and blood vessels (Halliwell and Gutteridge,

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1999). Diabetic patients are known to be five times more likely to develop heart diseases or have a stroke, as the long term effect of the disease condition causes damage to blood vessels in the body (UKPDS, 1998). Given the aetiology of the disease it can be further divided into three categories out of which Type I and Type II are the most frequent forms of the malady. In Type I diabetes, the body does not or is unable to produce insulin because of the autoimmune destruction of insulin-producing β-cells of the pancreas (Maritime, Sanders and Watkins, 2003). As a result, the glucose levels in the blood stream are increased. This condition can be predominantly seen in children and young adults as well, and in these instances, it is also known as juvenile diabetes. It is manifested by impaired glucose metabolism due to the total loss of insulin after destruction of pancreatic β-cells and is also known as insulin-dependent diabetes mellitus (IDDM). Type II diabetes is the more predominant form of the disease, in which the body does not produce sufficient amounts of insulin, or in some cases, the body is resistant to insulin (Baynes, 1991). It may also appear that the target tissues are insensitive to insulin (Atkinson and Maclaren, 1994). This type of diabetes is also known as non-insulin-dependent diabetes mellitus (NIDDM). The exact cause of diabetes is a mystery, although both lifestyle, genetic and environmental factors such as obesity and lack of exercise appear to play an important role (Atkinson and Maclaren, 1994).

1.1. The failures of current anti-diabetic medications

Untreated diabetes, in particular, IDDM, can lead to serious complications often resulting in a high rate of mortality. Treatment of patients with Type I diabetes normally involves daily doses of insulin administered either orally or by injections (Atkinson and Maclaren, 1994). Up to now, many kinds of anti-diabetic medicines have been developed for patients contracted with NIDDM, but almost all of them are chemical or biochemical agents conceived under laboratory environments. Despite these infinite initiatives, a complete recovery from Type 1 diabetes has not been reported to date (UKPDS, 1998). High rates of mortality have been witnessed in diabetic patients who are incessantly administered with chemically synthesized drugs, most often due to the inability of the drugs to curb the progression of the disease as well as reduce the occurrence of complications (Atkinson and Maclaren, 1994; Guyton and Hall, 2011; Tahrani and et al., 2011). As a result of these observed consequences, the global trend now is to use herbal medicine or to engage it as a complementary therapeutic option together with the usual chemical or biochemical agents (Trease and Evans, 1978; Betteridge, 1997; Okopien et al., 2003). Given the safety and reduced toxicity of therapeutic agents and bioactive compounds of phytochemical origin, these plant-based remedies are touted as promising replacements for the chemical drugs and insulin therapy (Baynes, 1991).

1.2. Edible plants as anti-diabetic remedies

Medicinal plants are known to be of great importance in human culture to meet the primary health care needs, as indicated by their usage throughout history and in traditional medicinal systems. Nearly 25% of the world's population relies on traditional medicinal systems for different aspects of primary health care (Prabhakar, 2008). These traditional systems like Ayurveda, Traditional Chinese Medicine and tribal medicines use plants as the primary means of disease prevention. Plants are capable of producing phytochemicals which are able to extend therapeutic properties (Patel et al., 2012). These phytochemicals are relatively non-toxic and safe for consumption, provided the correct dosages being administered. Better yet, in recent years, despite the origin of the remedies in the East, there has been an increasing interest in herbal medicines as they have increased in popularity in the West as well (Mullarkey et al., 1990). This popularity is mostly due to the fact that the herbal products are more abundant and cheaper than synthetic products. Many higher order plants have been observed to be the major sources of natural products (secondary metabolites) such as terpenes, alkaloids and cardiac glycosides which possess pharmaceutical importance (Golbidi et al., 2011). Many new bioactive drugs, isolated from plants, have demonstrated anti-diabetic effects which are even more potent than known oral hypoglycaemic agents such as daonil, tolbutamide and chlorpropamide (Devasagayam et al., 2004). The present therapeutic pathways of medicinal plants are focused on controlling and lowering blood glucose through the following means:

- Stimulation of β-cells in the pancreatic islets to release insulin
- Increasing the quantity of insulin receptors
- Decreasing gluconeogenic enzymes, thereby controlling blood glucose levels
- Fighting against free radicals by behaving as antioxidants and thereby, decreasing cell damage
- Inhibition of enzymes responsible for increased blood glucose levels

Out of these mechanisms, the inhibition of enzymes could be deemed as a more novel aspect when it comes to plant-based anti-diabetic remedies.

1.3. Costus speciosus and Coccinia grandis as anti-diabetic remedies

C. grandis and *C. speciosus* are two medicinal plants which have been used throughout history in traditional medicinal practices, especially in South Asia, to treat diabetic patients. At present, many scientific studies have been carried out or are ongoing on these two plants to exploit their beneficial effects for commercial purposes, although many of these studies are still in in vitro or in vitro phases, and not progressed onto human trials. In this aspect, toxicological studies of the two herbs are also underway. Despite their relative lack of scientific evidence, both herbs are consumed in South Asia for general health and wellness purposes and not only during the contraction of a disease condition, mostly due to their historical applications. In contrast with most medicinal plants, both species do not carry a repulsive flavour which deters them from being consumed in raw form or as a salad. They are abundantly found in the tropics and do not require special means of nurturing or harvesting. They have a very high growth rate where they might even be considered as weeds. Administration of these two plants is simple for medicinal purposes and does not require extensive preparation methods. Given the ease of cultivating these two plants, their therapeutic value, non-toxic nature and availability, this review is an attempt to emphasize the importance of *C. speciosus* and *C. grandis* as effective herbal remedies, especially to reduce the incidence of diabetes as well as to reduce the progression of the disease.

2. *C. grandis*

2.1. Morphology and applications

Fig. 1 shows the fresh, mature plant leaves and the fruit of *C. grandis*. *C. grandis* belongs to the family Cucurbitaceae. It is native to East Africa and has been widely spread in tropical Asian countries. This plant has become naturalized in these parts of the world because it is capable of thriving well in warm, humid, tropical regions (Arunvanan et al., 2013). *C. grandis* has many names such as baby watermelon, little gourd or Tindora and Kowakka as it is commonly known in Sri Lanka. This plant is a fast-growing perennial and herbaceous climber which grows into several metres covering lands that readily cover shrubs and small trees. The shape of the leaves varies from heart to pentagon, and the leaves are arranged alternately along the stem. The upper surface of the leaf is hairless whereas the lower surface is hairy (Pekamwar et al., 2013). Flowers are large, white and star-shaped, and the fruits are smooth and green. When the fruits ripen, they turn bright red, and have an ovoid to ellipsoid shape (Ediriweera and Ratnasooriya, 2009).There are 3–8 glands on the blade near the leaf stalk. Tendrils of the plant are simple. It has an extensive tuberous root system and succeeds in any soil but prefers a sunny sheltered position in a humus-rich open soil, while it is necessary