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Dual mechanisms of a Sri Lankan traditional polyherbal mixture in the improvement of pancreatic beta cell functions and restoration of lipoprotein alterations in streptozotocin induced diabetic rats

Donisha Shani Niharika Keembiya Liyanagamage [1], Susanthi Jayasinghe [2], Anoja Priyadarshani Attanayake [3], Veranja Karunaratne [1]

[1]*Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka.*

[2]*Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka. Electronic address: susanthij@pdn.ac.lk.*

[3]*Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Sri Lanka.*

Abstract

Ethnopharmacological relevance

Traditional polyherbal preparations have been utilized in Sri Lanka since ancient times and have gained a wide acceptance throughout the country. Although an extensive body of evidence supports the use of traditional herbal mixtures in the treatment of diabetes mellitus, only a few polyherbal mixtures have been subjected to systematic scientific investigations and their mechanisms for long-term glucose control remain unclear. In general, scientific evaluations of the effectiveness of antidiabetic formulations which are prescribed by traditional practitioners have received great attention, and therefore uncovering their mechanism of action would be beneficial.

Aim

The aim of the present study was to investigate the therapeutic efficacy, in terms of antidiabetic and antihyperlipidaemic activities, of a well-known traditional polyherbal mixture composed of leaves of Murraya koenigii L., -cloves of *Allium sativum* L., - fruits of Garcinia *quaesita* Pierre and seeds of *Piper nigrum* L. in streptozotocin induced diabetic rats.

Materials and methods

Equal amounts from each of the above plant parts (100 g) were mixed together and extracted into cold water, hot water (3 h, refluxed) and water-acetone (1:1) separately. Dose response study of cold water, hot water, and water-acetone extracts of the polyherbal mixture at three selected doses of 0.5 g/kg, 1.0 g/kg and 1.5 g/kg was conducted in streptozotocin (STZ) induced diabetic rats. Based on the dose response data, hot water and water-acetone extracts at the therapeutic dose of 1.0 g/kg were administered to STZ induced diabetic rats (n = 6/group) daily for 30 days in the long-term study. Glibenclamide (0.5 mg/kg) was used as the positive control. Glycaemic parameters, pancreatic β cell restoration, and lipid profile were evaluated in diabetic rats treated with the plant extract mixture. HPLC fingerprints of hot water and water-acetone

extracts of the polyherbal mixture were compared with those of extracts of individual plants with the respective solvents, in the standardisation protocol.

Results

The hot water and water-acetone extracts were shown to be active in the dose response study and 1.0 g/kg was selected for the long term study. Treatment with the hot water and water-acetone extracts of the polyherbal mixture and glibenclamide significantly lowered the glycated haemoglobin by 19%, 26%, and 43%, respectively, at the end of the intervention ($p < 0.05$). The serum insulin concentration was significantly increased ($p < 0.05$) upon the plant treatment, corroborating the evidence of β-cell restoration in the pancreas of H and E stained sections. Moreover, the above extracts reported an impressive restoration of lipoproteins in diabetic rats compared to the diabetic control rats. The homeostatic assessment of β-cell functions (HOMA-β) was also improved in rats treated with the hot water and water-acetone extracts of the polyherbal mixture. The HPLC fingerprints of the polyherbal mixture and the individual plants showed shifts in some peaks and formation of new peaks.

Conclusion

The results revealed that the aforementioned polyherbal mixture possesses potent antihyperglycaemic and antihyperlipidaemic effects with considerable restoration of pancreatic β-cells, justifying the traditional use of the mixture in diabetes associated dyslipidaemia.

Keywords: Acetone (pubchem CID: 180); Acetonitrile (pubchem CID: 6342); Antihyperglycaemic activity; Antihyperlipidaemic activity; Ayurveda; Citric acid (pubchem CID: 311); Formaldehyde (pubchem CID: 712); Hot water extract; Sodium citrate (pubchem CID: 6224); Sri lankan polyherbal mixture; Streptozotocin (pubchem CID: 29327); Traditional medicine asia and oceania; Water-acetone extract.