REVIEW ARTICLE

A review on effect of *Nishakathakadi kashaya* in *Jataja prameha* with special reference to juvenile diabetes

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Abstract

Juvenile diabetes is one of the most common autoimmune diseases of childhood and, nowadays, is increasing an alarming rate. Type 1 diabetes mellitus (Juvenile diabetes) is an immune-mediated, insulin-dependent condition with unknown etiology. Considerable efforts have been made for the development of oral insulin for better patient compliance. However, such options are not yet available in the market and insulin remains the mainstay of treatment of type 1 diabetes. There is no exact reference found in Ayurveda text, but it can be correlated with *Sahaja* or *Jataja prameha* (~genetic or hereditary) of *Asadhya* (difficult to cure or non-curable) type.

Keywords: Ayurveda, juvenile diabetes, *Nishakathakadi kashaya*, type 1 diabetes mellitus

INTRODUCTION

Type 1 diabetes mellitus (T1DM) is insulin-dependent diabetes that is characterized by immune-mediated destruction of pancreatic β-cells, which leads to severe insulin deficiency.[1] It is the most common endocrine-metabolic disorder of childhood and adolescence, with important consequences for physical and emotional development. Type 1 (insulin-dependent) diabetes occurs worldwide and can appear at any age but is diagnosed mostly at the age of 7–15 years.[2] The genetic susceptibility is strongly associated with HLA-DQ and DR on chromosome 6, but genetic factors on other chromosomes such as the insulin gene on chromosome 11 and the cytotoxic T-lymphocyte antigen gene on chromosome 2 may modulate disease risk.[3] Numerous studies further support the view that environmental factors are important. Gestational infections may contribute to the initiation, whereas later infections may accelerate islet β-cell autoimmunity. The pathogenesis is strongly related to autoimmunity against the islet β-cells. Markers of autoimmunity include autoantibodies against glutamic acid decarboxylase, insulin, and islet cell antigen-2, a tyrosine phosphatase-like protein. Family history plays a role, but only in about 10–15% of people with type 1 DM.[2]

As per the study, the incidence of type 1diabetes in Asia is 15/1,00,000 population whereas the prevalence of type 1 diabetes is 6.9/10,000 people, which were statistically significant.[4] In an Indian study, over 13 years of data collection the Karnataka state T1DM registry listed an incidence of 3.7 in boys and 4.0 in girls/1 lakh of each sex.[5] At Karnal, in Haryana, the prevalence of T1DM is 26.6 in urban and 4.27 in rural areas of the district, leading to an average prevalence of 10.20 over 1 lakh population.[6] At present, the only therapy for type 1 diabetes is the administration of insulin or analogs. Patient discomfort due to multiple injections a day and weight gain is major demerits. Considerable efforts have been made for the development of oral insulin for better patient compliance. However, such options are not yet available in the market and insulin remains the mainstay of treatment of type 1 diabetes. A single, cost-effective, oral, and antidiabetic treatment with minimal side effects is the need of the day.[7]

Ayurveda described the genetic concept while classifying diseases into various seven groups. It has been nomenclature

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as *Adibala pravritta* or *Sahaja vyadhi* (~Genetic).[8] There are references available with respect to *Prameha* as *Kulaja vikara* (~hereditary disorder).[9] *Beeja* (~chromosome), *Beejabhaga* (~genes), and *Beejabhagavayava* (~fraction of part of a chromosome) were described while explaining the morbidity of sperm and ovum.[10] Ayurveda also says that hereditary diseases are incurable.[8] As per *Acharya sushruta*, *Prameha* is classified etiologically into *Sahaja* (~Hereditary) and *Apathya nimittaja* (~Due to Faulty diet and lifestyle).[11] Genetic (*Sahaja*) occurring in a young age from the very beginning of the life that has some similarities with the juvenile diabetes or insulin-dependent diabetes; *Sahaja* type of *Madhumeha* is due to specific defects in *Stri* and *Pumbeeja* (ovum and sperm) which is said to be *Matru pitru beeja dosha krita* (Chromosomal defect from parents) will result in *Sahaja prameha*.[11] *Acharya kashyapa* explained about the clinical features of *Prameha* in *Vedanadhyaya* of *Sutrasthana* such as heaviness in body, stiffness, lassitude and fatigue, sudden passage of urine in increased quantity, increase turbidity of urine, and ants or flies gets attracted to the baby's urine.[12]

As mentioned by *Ayurveda*, *Beejabhaga dushti* or *Beeja dushti* of parents play an important role in the defect in the respective organ, a part of the whole body of their children's. Hence, proper *Shuddhi kriyas* followed by use of *Rasayana* (rejuvenating, antioxidants, and anti-ageing) can to some extent be beneficial for healthy progeny. Considering the conditions in children with *Prameha*, *Shodhana* is not possible. Hence, the drugs having *Pramehahara* (Antidiabetic) and *Rasayana* (Rejuvenating) properties could be the choice of drugs. Hence, here, we have chosen a herbal formulation *Nishakathakadi kashaya* explained in the classical text of *Sahastrayogam*, *Parishishta prakarana kashayam* as per Table 1.[13]

Information regarding the ingredients of *Nishakathakadi kashaya* (*Sahastrayogam*, *Parishishta Prakarana Kashayam*)[13] were referred, critically analyzed, and compiled from the classical Ayurveda texts, various internet sources, and research papers.

HARIDRA (CURCUMA LONGA LINN.)

Ayurvedic Pharmacological Action

Haridra (*C. longa*) is emphasized in most of *Nighantu* that *Haridra* possesses *Katu* (Pungent), *Tikta rasa* (Bitter), *Ruksha guna* (Non-unctuousness), *Ushna veerya* (Heat), and *Kapha-pitta shamaka* property. Some *Nighantu* mentioned *Haridra* having only *Tikta rasa*, and *Kapha-Vata-Rakta shamaka* property. A drug performs certain local and general actions either by its *Rasa*, *Guna,* and certain specific therapeutic actions by its *Vipaka* and *Veerya*. *Haridra* has been indicated in the management of *Meha* (Increased frequency and turbidity of urine).[14]

Pharmacological Actions

Anti-oxidant activity

The active principles in the rhizome of the Turmeric plant, namely, curcuminoids lower lipid peroxidation by maintaining the activities of antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase at higher levels.[15] It has high contents of polyphenols, flavonoids, tannins, and ascorbic acid. The 1,1-diphenyl2-picrylhydrazyl (DPPH) present in this plant shows free radical-scavenging activities.[16]

Immunomodulatory activity

The immunomodulatory activities of *C. longa* (turmeric extracts) were demonstrated in several *in vitro* and *in vivo* (both animal and human) studies.[17] The extract improved immune functions by increasing total IgE, decreasing inflammatory cytokines (interleukin-6 [IL-6], IL-1β, and tumor necrosis factor-α [TNF-α]), and total white blood count with increasing neutrophil count. These results suggest that turmeric might serve as a hypoglycemic natural antioxidant compound and help attenuate diabetic complications by reducing oxidative stress and improving immune functions.[18]

Anti-diabetic activity

Administration of methanolic extract of *C. longa* to alloxan-induced diabetic rabbits significantly improved the levels of serum glucose, serum transaminases, and antioxidant activity.[19] Aqueous extract induced stepwise stimulation of glucose uptake from abdominal muscle tissues in the presence and absence of insulin; meanwhile, the combination of the extract and insulin significantly potentiated the glucose uptake into abdominal muscle tissue.[14] Aqueous extract stimulated insulin secretion from mouse pancreatic tissues under both basal and hyperglycemic conditions, although the maximum effect was only 68% of that of the reference compound, tolbutamide. This extract induced stepwise stimulation of glucose uptake from abdominal muscle tissues in the presence and absence of insulin; meanwhile, the combination of the extract and insulin significantly potentiated the glucose uptake into abdominal muscle tissue.[19]

KATAKA (STRYCHNOS POTATORUM LINN)

Ayurvedic Pharmacological Action

Kataka (*S. potatorum*) has *Madhura* (Sweet), *Kashaya* (Astringent), *Tikta pradhana* (Bitter) *Pancha rasa*, *Laghu* (Light), *Vishada guna* (Clear), *Sheeta virya* (Cold potency), *Madhura vipaka* (Sweet), and *Kataka* is indicated as *Mehanashanam* (anti-diabetic).[20]

Pharmacological Actions

Anti-diabetic activity

Anti-diabetic activity in the ethanol extract of the plant on blood sugar level, which proved to be effective even at a lower dose (100 mg/kg) in decreasing blood sugar level in alloxan treated rats. The plant extract almost brought down blood glucose level by 50% in diabetic animals.[21]

Anti-inflammatory effect

The *S. potatorum* powder and *S. potatorum* extract both exhibited dose-dependent anti-inflammatory activity in acute and subacute inflammatory models, and its effect was also comparable with the standard drug diclofenac sodium.[22,23]

AMALAKI (EMBLICA OFFICINALIS GAERTN)

Ayurvedic Pharmacological Action

Amalaki has *Amla Pradhana*, *Pancha rasa*, *Guru* (Heavy), *Ruksa guna* (Dry), *Sheeta virya*, *Madhura vipaka,* and *Tridoshahara* as well as a *Rasayana* (Rejuvenating) and also *Keshya* and *Chakshushya* properties. *Amalaka Churna* is indicated in *Atisthoulya Chikitsa* and used in *Prameha. Amalaki svarasa* along with *Guduchi* and *Madhu* is indicated in *Prameha*.[24]

Pharmacological Actions

Anti-oxidant activity

Vitamin C in *E. officinalis* accounts for approximately 45–70% of the antioxidant activity.[25] Ethyl acetate extract of *Amlalaki* reduced the COX-2 and inducible nitric oxide synthase (iNOS) expression levels by inhibiting NF-kappaB activation in the aged rats. Thus, *Amalaki* would be a very useful antioxidant for the prevention of age-related renal disease.[26] The extracts showed strong free radical scavenging activity. *Amalaki* extracts orally administered to the diabetic rats slightly improved body weight gain and also significantly increased various oxidative stress indices of the serum of the diabetic rats. Moreover, the decreased levels of albumin in the diabetic rats were significantly improved with this drug. It also significantly improved the serum adiponectin levels. Thus, amla can be used for relieving the oxidative stress and improving glucose metabolism in diabetes.[27]

Immunomodulatory activity

Amalaki (*E. officinalis* Gaertn.) is an excellent source of Vitamin C, has immunostimulatory activity, and reported to improve the natural killer cell activity and cellular cytotoxicity.[28] *E. officinalis* has been reported to inhibit chromium-induced free radical production. It also inhibited the apoptosis and DNA fragmentation induced by chromium. It relieved the immunosuppressive effect of chromium on lymphocyte proliferation, and even restored the IL-2 and gamma-IFN production.[29]

Anti-diabetic activity

Oral administration of the aqueous extract of *Amalaki* to type I diabetic rats (alloxan-induced) for 84 days mediated its anti-hyperglycemic effects at least in part by increasing the levels of serum insulin.[30] Feeding an ellagic acid containing diet (5% for 12 consecutive weeks) to diabetic mice was also effective in increasing the plasma insulin levels.[31] Gallic acid increased the levels of plasma insulin and the histopathological studies of the pancreas confirmed the beneficial effects.[32,33] The oral administration of gallic acid for 28 consecutive days caused insulin-secretagogue effects and to mediate the protective effects by stimulating regeneration of b-cells of islets in STZ-induced diabetic rats.[34]

TECHIVER (PARANTI) (IXORA COCCINEA LINN.)

Ayurvedic Pharmacological Action

Techiver (*I. coccinea*) has *Kashaya tikta rasa*, *sheeta virya*, *Katu vipaka*, *Laghu guna,* and *Pittaghana karma*.[35]

Pharmacological Actions

Anti-oxidant activity

The methanolic extract of *I. coccinea* Linn. showed significant activities in all antioxidant assays compared to the standard antioxidant in a dose-dependent manner and remarkable activities to scavenge reactive oxygen species due to the high amount of hydrophilic phenolics. *I. coccinea* extract showed strong reducing power and total antioxidant capacity.[35]

Hypoglycemic and hypolipidemic activity

There is a report on the hypoglycemic and the hypolipidemic activity of the aqueous extract of the leaves of *I. coccinea* Linn in alloxan-induced diabetic albino rats. The aqueous extract of leaves of showed a significant reduction in the blood glucose levels and the serum lipid profile levels, with 400 mg/kg of bodyweight in the alloxan-induced diabetic rats as compared to the control.[35]

PACHOTTI (LODHRA) (SYMPLOCOS RACEMOSA ROXB)

Ayurvedic Pharmacological Action

S. racemosa has *Kashaya pradhana* rasa, *Laghu*, *Ruksha guna*, *Sheeta virya*, *Katu vipaka,* and *Lodhra* is indicated in *Prameha*.[36]

Pharmacological Actions

Anti-oxidant activity

The ethanolic extract of *S. racemosa* (100 and 300 mg/kg) leaves and flowering tops showed significant antioxidant activity by reducing the extent of lipid peroxidation, superoxide dismutase, and catalase activity in Swiss Albino mice. The ethanolic extract of *S. racemosa* bark showed potent ABTS radical scavenging activity, moderate 2,2-diphenyl−1-picrylhydrazyl radical (DPPH), nitric oxide, and hydroxyl radical scavenging activity compared with the standard drugs ascorbic acid and rutin.[37]

Anti-diabetic activity

Treatment of methanol extract of *S. racemosa* bark (250 and 500 mg/kg) in streptozotocin-induced diabetic rats has resulted in reduced blood glucose and triglycerides levels after administration of extract. The possible mechanism behind this effect could be the insulin-like effect on peripheral tissues by either promoting glucose uptake metabolism or inhibiting hepatic gluconeogenesis. Methanol extract exhibited hypocholesterolemic and hypotriglyceridemic effects, while increased the levels of HDL in streptozotocin-induced diabetic rats was observed comparable to the standard hypoglycemic drug glibenclamide (0.6 mg/kg).[37]

Immunomodulatory activity

An indigenous herbal extract IM-133N (0–125 µg/mL) containing extracts of *S. racemosa* has been evaluated for potential immunomodulatory effects using RAW264.7 and THP-1 cells. The results indicated that non-cytotoxic doses of IM-133N effectively up-regulated iNOS, TNFα, IL-6, IL-10, IL-8, and interferon-gamma gene expression in both the RAW264.7 and THP-1 cells. IM-133N elicited dose-related increases in nitric oxide and TNF-α production by RAW264.7 and THP-1 cells. As clinical studies have shown IM-133N to be an effective immunomodulator without any adverse effects, the results of the study provide further support for the potential use of *S. racemosa* as an immunostimulant or as an immunotherapy adjuvant.[37]

BHADRIKA (GORAKSHGANJA) (AERVA LANATA JUSS)

Ayurvedic Pharmacological Action

Aerva lanata has *tikta*, *Kashaya pradhana rasa*, *Laghu*, *Tikshna guna*, *Ushna virya*, *Katu vipaka,* and *Bhadrika* is indicated in *Prameha*.[38]

Pharmacological Actions

Anti-oxidant activity

The aqueous, ethanolic, and aqueous ethanolic extracts of the plant were tested for antioxidant activity which included DPPH, superoxide anion, hydroxyl radical, nitric oxide radical, hydrogen peroxide radical, total antioxidant capacity assay, and anti-lipid peroxidation activity. A concentration of 2.5 mg/mL gave a strong radical scavenging activity. The hydroalcoholic extract gave potent antioxidant activity compared to aqueous and ethanolic extracts. The extracts were found to contain antioxidant compounds such as flavonoids, total phenols, tannin, carotenoids, and lycopene.[39]

Anti-diabetic activity

The ethanolic extract of the aerial parts was studied for its antidiabetic effect in normal and alloxan-induced diabetic rats (50, 100, and 200 mg/kg body weight). There was a significant dose-dependent decrease in blood glucose level, body weight, and various biochemical parameters such as cholesterol, urea, creatinine, bilirubin, and SGPT. The alcoholic extract of *Aerva lanata* was found to reduce the increased blood sugar level of alloxan-induced diabetic rats. In the subacute study, repeated administration (once a day for 28 days) of glyburide and *Aerva lanata* caused a significant reduction in the serum glucose level as compared to the vehicle-treated group.[40,41]

EKANAYAKAM (EKRANGI) (SALACIA CHINENSIS LINN)

Ayurvedic Pharmacological Action

S. chinensis has *Tikta*, *Kashaya pradhana rasa*, *Laghu*, *Ruksha*, *Tikshna guna*, *Ushna virya*, *Katu vipaka,* and *Ekanayakam* is indicated in *Madhumeha ghani* and *Yakrit roga hara*.[42]

Pharmacological Actions

Anti-oxidant activity

The *S. chinensis* root had the highest levels of phenolic compounds, flavonoids, proanthocyanidins, and saponins; it was followed by the stem and the leaf. The root also had the higher antioxidant capacity than the stem and the leaf. There were three major compounds in the root and the stem extracts.[43] Proanthocyanidins are an important subclass of phenolic compounds due to their potent antioxidant properties.[44]

Anti-diabetic activity

The levels of blood glucose and insulin were reverted back to near normal levels in the diabetic rats treated with mangiferin and glibenclamide.[45] Administration of mangiferin exerted a significant anti-diabetic effect, probably due to the stimulation of insulin secretion/action from remnant pancreatic b-cells, which enhanced glucose utilization/metabolism in peripheral tissues of experimentally induced diabetic rats.[45]

RAMACHAM (USHEERA) (VETIVERIA ZIZANIOIDES)

Ayurvedic Pharmacological Action

Ramacham (*V. zizanioides*) has *Tikta*, *Madhura pradhana rasa*, *Laghu*, *Ruksha*, *Tikshna guna*, *Sheeta virya*, *Katu vipaka,* and *Ramacham* is indicated in *Prameha*.[46]

Pharmacological Actions

Anti-oxidant activity

The root extract of *V. zizanioides* contained high levels of phenolic content that strength has accounted for the resolute activity observed against free radical scavenging antioxidant activity.[47] The presence of b-vatirenene also reveals an important role for vetiver oil in scavenging DPPH free radicals and chelating ferrous ions.[48]

Anti-diabetic activity

Preliminary phytochemical analysis of ethanol extracts revealed the presence of flavonoids, sterols, saponins, and polyphenolic compounds. Flavonoids and saponins containing plants were known to exhibit antidiabetic activity.[49]

Juvenile diabetes, often known as T1DM, is an immune-mediated condition with an unidentified aetiology. There is no exact reference found in Ayurveda text, but it can be correlated with *Sahajaprameha* or *Jataja prameha* (T1DM) of *Asadhya* (difficult to cure or non-curable) type. *Nishakathakadi kashayama* contains eight drugs, namely, *Haridra* (*C. longa* Linn), *Kataka* (*S. potatorum* Linn), *Amalaki* (*Nellikka*) *E. officinalis gaertn*, *Techiver* (*Paranthi*) *I. coccinea*, *Pachotti* (*Lodhra*) *S. racemosa roxb*, *Bhadrika* (*Gorakshganja*) *Aerva lanata*, *Ekanayakam* (*Ekrangi*) *S. chinensis* Linn, *Ramacham V. zizanioides*, etc. Overall, the ingredients of *Nishakatakadi Kashayam* have *Tikatakashayarasa* (Bitter), *Laghu* (Light), *Ruksha guna* (Non-unctuousness), *Sheetoshna veerya*, and *Katu-Madhura Vipaka* (Pungent-Sweet) as per Table 2. The above formulation also has *Tridoshahara*, *Pramehahara,* and *Rasayana* (Rejuvenating) properties as per Table 3. It has *Tridoshahara* property but specially *Kaphahara* property. Its acts on vitiated *Kapha*, *Meda,* and *Kleda*. It has capacity to improve tone of *Saptadhatus* and reduces *Dhatu shaithilya*. Due to its *Deepana* and *Pachana* properties, it also works on *Jatharagni* and *Dhatwagni*, which reduces the *Ama* and *Kleda* present in the body. It improves *Dhatwagni* which helps to improve disturbed metabolism. The formulation also having *Deepana*, *Pachana,* and *Anulomaa* properties so, by virtue of these it works on *Srotodushti* and glucose metabolism. Due to its *Ruksha guna,* this formulation is doing *Kleda Shoshana* which is useful in blocking the pathogenesis of diabetes.[50] The ingredients have proven pharmacological action as an antioxidant, immunomodulator, and anti-diabetic activity [Table 3]. Evidence based in-vivo studies of extracts of ingredients of *Nishakathakadi kashaya* (like *C. longa,*

Table 1: Ingredients of *Nishakathakadi kashaya*,[13] (Ref-*Sahastrayogam*, *Parishishta Prakarana Kashayam*)

S. No.	Ingredients	Botanical name	Family	Part used	Quantity
1.	*Nisha* (Haridra)	*Curcuma longa* Linn.	*Zingiberaceae*	Heart wood	1 part
2.	*Kataka* (Nirmali)	*Strychnos potatorum* Linn.	*Loganiaceae*	Seed	1 part
3.	*Nellikka* (Amalaki)	*Emblica officinalis Gaertn.*	*Phyllanthaceae*	Fruit rind/pericarp	1 part
4.	*Techiver* (Paranti)	*Ixora coccinea* Linn.	*Rubiaceae*	Root	1 part
5.	*Pachotti* (Lodhra)	*Symplocos racemosa* Roxb.	*Symplocaceae*	Bark	1 part
6.	*Bhadrika* (Gorakshganja)	*Aerva lanata* Juss.	*Amaranthaceae*	Root	1 part
7.	*Ekanayakam* (Ekrangi)	*Salacia chinensis* Linn.	*Hippocrateaceae*	Root	1 part
8.	*Ramacham* (Usheera)	*Vetiveria zizanioides* Linn.	*Gramineae*	Root	1 part

Table 2: Ayurveda pharmacological properties of *Nishakathakadi kashaya*

S. No.	Ingredients	*Ras*	*Guna*	*Veerya*	*Vipaka*
1.	*Haridra*	*Tikta*, *katu*	*Ruksha*, *Laghu*	*Ushna*	*Katu*
2.	*Amalaki* (*Nellikka*)	*Pancharas* (*Lavanrahita*) *Amlapradhana*	*Guru*, *Ruksha*	*Seeta*	*Madhura*
3.	*Kataka*	*Mdhura*, *Kashaya*, *Tikta*	*Laghu*, *Vishada*	*Seeta*	*Madhura*
4.	*Techiver* (*Paranti*)	*Kashaya*, *Tikta*	*Laghu*	*Seeta*	*Katu*
5.	*Pachotti* (*Lodhra*)	*Kashaya*	*Laghu*, *Ruksha*	*Seeta*	*Katu*
6.	*Bhadrika* (*Gorakshganja*)	*Kashaya*, *Tikta*	*Laghu*, *Tikshna*	*Ushna*	*Katu*
7.	*Ekanayakam* (*Ekrangi*)	*Kashaya*, *Tikta*	*Laghu*, *Ruksha*	*Ushna*	*Katu*
8.	*Ramacham* (*Ushira*)	*Tikta*, *Madhura*	*Ruksha*, *Laghu*	*Seeta*	*Katu*

Table 3: Pharmacological actions of *Nishakathakadi kashaya*

S. No.	Ingredients	Ayurveda pharmacological action	Modern pharmacological action
1.	*Haridra*	*Kapha-pitta* pacifying, *Mehahara* (anti-diabetic)[14]	Anti-oxidant activity[15,16] Immunomodulatory activity[17,18] Anti-diabetic activity[14,19]
2.	*Amalaki* (*Nellikka*)	*Tridoshahara*, *Rasayana* (Rejuvenation and Immunomodulating)[24]	Anti-oxidant activity[25-27] Immunomodulatory activity[28,29] Anti-diabetic activity[30-33]
3.	*Kataka*	*Mehanashanam* (anti-diabetic)[20]	Anti-diabetic activity[21] Anti-inflammatory effect[22,23]
4.	*Techiver* (*Paranti*)	*Tridoshahara* (pacifying all *Dosha*)[36]	Anti-oxidant activity[35] Hypoglycaemic and Hypolipidaemic Activity[35]
5.	*Pachotti* (*Lodhra*)	*Pramehahara* (anti-diabetic)[36]	Anti-oxidant activity[37] Anti-diabetic activity[37] Immunomodulatory activity[37]
6.	*Bhadrika* (*Gorakshganja*)	*Pramehahara* (anti-diabetic)[38]	Anti-oxidant activity[39] Anti-diabetic activity[40,41]
7.	*Ekanayakam* (*Ekrangi*)	*Madhumehaghni* (anti-diabetic)[42]	Anti-oxidant activity[43,44] Anti-diabetic activity[45]
8.	*Ramacham* (*Ushira*)	*Pramehahara* (anti-diabetic)[46]	Antioxidant activity[47,48] Antidiabetic activity[49]

E. officinalis, S. racemosa, S. chinensis) have properties to enhance the insulin secretion/action by B-cell stimulation, B-cell regeneration and also insulin like effect on peripheral tissues.[19,32,33,37,45]

CONCLUSION

The present review reveals that the *Nishakathakadi kashaya* is indicated, as a *Pramehahara* (anti-diabetic) in classics. Modern *in vivo* and *in vitro* studies also proved that the ingredients of this formulation possess anti-diabetic, antioxidant, immunomodulatory, and anti-inflammatory action. The present findings prove that the *Nishakathakadi kashaya* possesses potential for the management of T1DM and future clinical studies may provide the evidences.

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