



E-ISSN: 2707-2835

P-ISSN: 2707-2827

IJPLS 2020; 1(2): 01-05

Received: 13-05-2020

Accepted: 16-06-2020

**Dr. Charu Bansal**

Professor, P.G. Department of Swasthavritta, Pt. KLS Govt. Ayurveda College & Institution, Bhopal Madhya Pradesh, India

**Dr. Rachna Jain**

Professor & HOD Department of Swasthavritta, R.D. Memorial P.G. Ayurveda College & Hospital, Bhopal, Madhya Pradesh, India

**Dr. Umesh Shukla**

Head P.G. Department of Panchakarma, Principal, Pt. KLS Govt. Ayurveda College & Institution, Bhopal, Madhya Pradesh, India

**Dr. Smita Paul**

Professor & HOD Department of Roga Nidan Evam Vikriti Vigyan, R.D. Memorial P.G. Ayurveda College & Hospital, Bhopal, Madhya Pradesh, India

**Corresponding Author:**

**Dr. Charu Bansal**

Professor, P.G. Department of Swasthavritta, Pt. KLS Govt. Ayurveda College & Institution, Bhopal Madhya Pradesh, India

## Preventive scope of *Nishamalaki Churna* (combination of turmeric and Indian gooseberry powder) in type 2 DM: Review

**Dr. Charu Bansal, Dr. Rachna Jain, Dr. Umesh Shukla and Dr. Smita Paul**

**DOI:** <https://doi.org/10.33545/27072827.2020.v1.i2a.10>

### Abstract

Diabetes mellitus is a fastest growing serious global health problem. In 2000, India with 31.7 million diabetic population topped the world followed by China (20.8 million) respectively. Poor glycaemic control has been observed in the Indian diabetic population which in long term lead to various micro and macro vascular complications. Diabetes is one of four priority non-communicable diseases (NCDs) targeted by all health agencies for the Prevention and Control of NCDs. Turmeric (*Curcuma longa*) and Indian Gooseberry (*Emblica officinalis*) powder in combination called as *Nisha Amalaki Churna* showed significant hypoglycemic, antioxidant and hyperlipidemia effect in many experimental and human research. Ayurveda strongly recommended its significant effect in the management of diabetes (Prameha). The present write up is an effort to discuss the opportunities of an effective herbal combination *Nishamalaki Churna* as preventive and health promotive dimensions in Type 2 Diabetes Mellitus.

**Keywords:** *nishamalaki churna*, haridra, *curcuma longa*, *emblica officinalis*, *amalaki*, type 2 DM prevention

### 1. Introduction

Diabetes mellitus is a fastest growing serious global health problem that affects all ages with high prevalence rate which have been steadily increasing over the past few decades. Diabetes is fast gaining the status of a potential epidemic in India. In 2014 WHO estimated, 422 million people in the world had diabetes with prevalence of 8.5% among the adult population. World health Organization also reported that Diabetes caused 1.5 million deaths in 2012 and by increasing the risks of cardiovascular and other diseases blood glucose Higher-than-optimal caused an additional 2.2 million deaths. In which 3.7 million deaths (43%) occur before the age of 70 years<sup>[1]</sup>.

Type 2 diabetes is also identified as or adult-onset diabetes develop due to ineffective use of insulin by body. Symptoms of Type 2 diabetes often less marked or absent in beginning. So, most of the time the disease remains undiagnosed for several years, until complications have already arisen. Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) are intermediate conditions in the transition between normal blood glucose levels and type 2 diabetes, though the transition is unexpected thus those are affected with IGT or IFG are simultaneously at increased risk of heart attacks and strokes.

#### 1.1 long term complications developed due to diabetes

Diabetes is an important cause of premature death and disability. In long term it can lead to complications like it can damage the heart, blood vessels, eyes, kidneys and nerves, and cause heart attack, stroke, kidney failure, leg amputation, vision loss and nerve damage. Diabetic retinopathy is an important cause of blindness and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. Number of research indicating that beyond these traditional complications, diabetes has been also associated with increased rates of specific cancers, and increased rates of physical and cognitive disability<sup>[2]</sup>.

## 2. Need to develop preventive strategies to control the consequences of diabetes

Diabetes is one of four priority non-communicable diseases (NCDs) targeted by all health agencies for the Prevention and Control of NCDs [3]. The increased years of life spent with diabetes and their complications indicating a need to improve quality of life of diabetic population with simple interventions which could be safe and cost effective and easily supported and accepted by community. Though number of risk factors are recognized for the development of type 2 diabetes mellitus but Obesity and oxidative stress are important risk factor among all risk factors. Findings also indicated the strong link between Obesity and prediabetes, later on which could proceed into type 2 diabetes. Development of diabetes from normal glucose tolerance is a continuous process. The Prediabetes is widely recognized as early stage of diabetes mellitus and it impart variety of metabolic disorders. Various researches indicates that Prediabetes also responsible for micro and macrovascular complication like as Diabetes. Therefore, for the prevention of Diabetes specially type 2 diabetes and related complication it is a need to control this hyperglycaemia stage not only after diagnosis of type 2 diabetes mellitus but even before in prediabetes stage which is developed due to insulin resistance. The available therapeutic modalities in conventional system of medicine are not up to the mark to control this situation. World health organization reported nearly 60% of the world's population relies on herbal medicine and about 80% of the population in developing countries depends almost totally on it for their primary health care needs. Thus, selection of such herbal drugs that work as hypoglycaemic, hypolipidemic, and can reduce oxidative stress needed to prevent Type 2 DM and its complications.

## 3. Nishamalaki churna (herbal combination of *Curcuma longa* and *Embllica officinalis*)

Ayurveda the traditional Indian system of medicine offers a balanced and holistic multi-modality approach for diabetes. Many plant possessing both hypoglycemic and antioxidant properties. The use of combined herbal preparations is a common practice in Ayurvedic system of medicine. Herbal preparation 'Nishamalki Churna' is the powder combination of Haridra (Turmeric powder, *Curcuma longa*) and Amalaki (Indian gooseberry powder, *Embllica officinalis*) in 1:1 ratio. This combination is described as a best treatment for diabetes mellitus in Ayurvedic classics [4]. Number of research identified that Nisha Amalaki Churna had potential to control fasting blood sugar levels along with significant improvement in the lipids in diabetic patients [5].

### 3.1 Pharmacodynamic action of nishamalaki churna in ayurveda

According to Ayurveda, presence of excessive quantity of liquid *kapha Dosha* and excess *Meda Dhatu* (fat especially free fatty acid) in body initiates pathology of *Prameha* (Diabetes) [6]. Turmeric (*curcuma longa*) is pungent (*Katu Rasa*) and bitter in taste (*Tikta Rasa*), hot (*Ushan*), and dry (*Rukshna*) in property and so work as hypoglycemic drug [7]. Because, these property of turmeric reduces the excessive quantity and vitiation of *Kapha Dosha* and *Meda Dhatu* and also efficiently neutralizes the toxins (reactive oxygen species) due to its anti-toxic (*Vishaghna*) activities [8]. Thus it helps to reduce body weight and insulin resistance and

also decreases the quantity of FFA present in plasma. In short Turmeric is able to cease the pathology of diabetes (*Prameha*). The second ingredient of *Nishamalki Churna* is *Amalaki* (*Embllica officinalis*) which also work as antidiabetic, hypolipidemic, antioxidant, and hepato-protective [9] due to its astringent taste also cease the chain of diabetes pathology.

## 4. Scope of Nishamalaki Churna in prevention & control of type 2 DM

Various research indicates that oxidative stress is responsible to develop type 2 diabetes mellitus. Oxidative stress increases reactive oxygen species (ROS) production, which in turn, promotes cellular damage and contribute to the micro and macrovascular complications development and progression. ROS can directly damage lipids, proteins or DNA and modulate intracellular signaling pathways and cause diabetic patients more vulnerable for cardiovascular diseases, and cancer [10].

Hence, targeting hyperglycemia and oxidative stress at a time could be more effective than intensive treatment of hyperglycemia alone in the treatment and prevention of diabetes mellitus [11]. In combination, turmeric powder and Indian gooseberry these two plant products probably potentiate the actions of each other. Number of researches identified that *Nishamalaki Churna* had strong antioxidant properties along with hypoglycemic effect.

### 4.1 Research review on hypoglycemic effect of turmeric (*curcuma longa*)

Number of Scientific studies proved that turmeric (*curcuma longa*) work as antioxidant, anti-inflammatory, antidiabetic and lipid lowering activities [12]. The hypoglycemic effect of turmeric has been suggested to be due to increased peripheral glucose utilization, decreased hepatic glucose synthesis and/or increase in insulin secretion [13]. Wickenberg J, *et al.* (2010) in the study effects of *Curcuma longa* (turmeric) on postprandial plasma glucose and insulin in healthy subjects reported that the ingestion of 6 g turmeric increased postprandial serum insulin levels in healthy subjects [14]. Khan A, *et al.* (1990) reported Turmeric potentiated action of insulin on glucose metabolism in rat epididymal fat cell assay [15] suggesting a possible mechanism of action of turmeric on glycemic control.

Jain Sushil K. *et al.* in study, Effect of curcumin on protein glycosylation, lipid peroxidation, and oxygen radical generation in human red blood cells exposed to high glucose levels found that curcumin prevents protein glycosylation and lipid peroxidation caused by high glucose levels using an erythrocyte cell model. The study also suggested that curcumin may inhibit oxygen radical production caused by high glucose concentrations in a cell-free system, and increase glucose utilization in erythrocytes. This provides evidence for a novel mechanism by which curcumin supplementation may prevent the cellular dysfunction associated with diabetes [16].

Another study conducted by Guruprasad Rao, *et al.* Effect of Treatment with 'Nishamalaki' Powder on Glycemic Control and Markers of Erythrocyte Oxidative Stress in Diabetic Rats Compared to Troglitazone had been also reported that curcumin decreased lipid peroxidation in erythrocytes of diabetic rats and its negative correlation with glycated hemoglobin [17]. These findings support a role for

curcumin in the prevention of hyperglycemia associated oxidative damage seen in diabetes.

#### 4.2 Research review on hypoglycaemic effect of amalaki (*Embllica officinalis*)

It has been reported that *Embllica officinalis* decreases the fasting blood sugar or glycated hemoglobin levels in diabetic patients [18]. Ghosal S. *et al.*, in the study Active constituents of *Embllica officinalis*: Part 1. The chemistry and antioxidative effects of two new hydrolysable tannins, Emblicanin A and B reported that the antioxidant activity of *Embllica officinalis* is due to presence of ascorbic acid and tannins [19].

Suresh V. Nampoothiri *et al.* in *vitro* study antioxidant and inhibitory potential of *Terminalia bellerica* and *Embllica officinalis* fruits against LDL oxidation and key enzymes linked to type 2 diabetes, reported that methanolic extract of *Embllica officinalis* was found to exhibit scavenging activity against hydroxyl, superoxide and nitric oxide radicals [20].

Bhattacharya A, *et al.* In *vitro* study; Antioxidant activity of active tannoid principles of *Embllica officinalis* (Amla) administered active tannoids of *Embllica officinalis* (Amla) to rats for 7 days and reported decreased lipid peroxidation in the brain of rats [21].

Study conducted by Guruprasad Rao, *et al.* Effect of Treatment with 'Nishamalaki' Powder on Glycemic Control and Markers of Erythrocyte Oxidative Stress in Diabetic Rats Compared to Troglitazone had reported antioxidant activity of *Embllica officinalis* (amla) in addition to proving its efficacy as an antidiabetic agent in association with turmeric [22].

These findings support a role for *Embllica officinalis* in the control of hyperglycaemia and their associated oxidative damage seen in diabetes.

#### 5. Discussion

The epidemic increase in diabetes and its serious long-term consequences strongly support that only therapeutic control of type 2 diabetes mellitus is not enough. Serious efforts should be needed more to prevent the occurrence of type 2 DM and its related morbidity and mortality. Obesity is established as one of the major risk factors for diabetes. Even relatively lean Indian adults with a lower BMI are at equal risk of type 2 DM as those who are obese [23] compared with Europeans [24]. Furthermore, Indians are genetically predisposed to the development of coronary artery disease due to dyslipidaemia and low levels of high density lipoproteins; these determinants make Indians more prone to development of the complications of diabetes at an early age (20-40 years) compared with Caucasians (>50 years) [25]. An international study reported that diabetes control in individuals worsened with longer duration of the disease ( $9.9 \pm 5.5$  years) [26] with neuropathy the most common complication (24.6 per cent) followed by cardiovascular complications (23.6 per cent), renal issues (21.1 per cent), retinopathy (16.6 per cent) and foot ulcers (5.5 per cent) [27].

Furthermore, Poor glycaemic control has been observed in the Indian diabetic population [28] which causes micro and macro vascular changes and other complications. Therefore, early intervention would be a better option for delaying the onset of diabetes (diabetes prevention) and its complications. Studies indicating that for prevention of diabetes mellitus Prediabetes stage is most appropriate

stage. Type 2 diabetes could be delayed or restricted by proper management at prediabetes stage or IFG/IGT. Even by the preservation of  $\beta$ -cell function even after development of type 2 DM; the micro-vascular complications and cardiovascular complications will also be delayed or prevented. WHO emphasized that life style modulation can easily prevent us from diabetes and various lifestyle modification studies shown the result that intensive lifestyle intervention provides the greatest reduction in blood sugar levels in prediabetes and diabetes patients and also effectively reduce the body weight along with a modest reduction in CVD risk factors.

World health organization said Herbal drugs and their constituents have advantageous effects on long-term fitness and can be used to efficiently treat chronic and acute human diseases or disorders because of the presence of various active ingredients in herbs [29]. Thus selection of such herbal drugs that work as hypoglycaemic, hypolipidemic, and can reduce oxidative stress needed to prevent Type 2 DM and its complications. Ayurveda strongly recommended the use of 'Nishamalaki Churna' in Prameha (diabetes). Number of *vitro* and *vivo* researches indicating that Individually Turmeric (*Haridra*) and Indian gooseberry (*Amalaki*) powder and in combined combination as 'Nishamalaki Churna' showed significant hypoglycemic, antioxidant and hyperlipidemia effect. More effectiveness of 'Nishamalki churna' indicating that it works by combined/additional mechanisms, may have acted through multiple mechanism and showed protective effect. Suryanarayana P. *et al.* (2007), in study Effect of turmeric and curcumin on oxidative stress and antioxidant enzymes in streptozotocin-induced diabetic rat indicating that Curcuma and Amla both individually reduce lipid peroxidation and have anti-oxidant activity [30]. Guruprasad Rao in animal study found that Nisha Amalaki in dose of 0.9 g /kg wt of rats, showed significant lowering of plasma glucose and glycated hemoglobin in diabetic rats ( $p < 0.001$  when compare with Diabetic Control) as that of Glyburide (36 mg/kg) and Troglitazone (4 mg/kg) [31]. In Another study, Nisha Amalaki was given 1gm, 2 times/day with water for 6 weeks in 100 patients of Madhumeha (diabetic patients) in an open labelled clinical trial showed moderate hypoglycemic effect. There was reduction in fasting blood sugar level and symptoms of Madhumeha [32]. One more study, Nisha Amalaki in the dose of 1gm 2 times/day for 2 months in 10 patients of Prameha showed 8.6 and 15.7% reduction in FBS and 9.8 and 13.4% reduction in PPBS after 1 and 2 months respectively [33]. Jayshree Shriram dawane, *et al.* (2016), in study Evaluation of Effect of Nishamalaki on STZ and HFHF Diet Induced Diabetic Neuropathy in Wistar Rats, found Nishamalki had reduced MDA activity thus prevented lipid peroxidation and development of oxidative stress. Also, reported increase in the SOD and catalase levels, which have reduced superoxide radical production because of synergistic effect of combination. Study also reported that reduction in oxidative stress and anti-oxidant action of Nishamalki was significantly more than any other agent. Inside the neuronal tissue, the anti-oxidant effect indicating good penetration of Nishamalki inside the nerves. Furthermore, it had also reduced the cholesterol and triglyceride levels in rat. Study reveals that Nishamalki in Low Dose and High Dose (LD and HD) showed equivalent anti-oxidant action [34].



Results of these studies strongly support the use of *Nishamalaki Churna* as proposed effective herbal combination which is cost effective, easy to administer, have potential to not only to control blood sugar, lipid peroxidation in diabetic patients but effectively also can control risk factors of diabetes that is obesity and insulin resistance. Turmeric commonly used in India on daily bases as spice and *Amalaki* (Indian Gooseberry) also used as fruit in every home and easily available and affordable by common people. Hence, use of herbal combination of *Nishamalaki Churna* (combination of turmeric and Indian gooseberry powder) in the dose of 5gram daily with glass of water in morning could be advised as healthy lifestyle regimen in prediabetes and Diabetic patients and could be established as safest and very effective preventive and therapeutic remedy for Type 2 Diabetes Mellitus and incorporated it as a part of healthy regimen in healthy lifestyle.

## 6. Conclusion

Diabetes mellitus is reaching potentially epidemic proportions in India with related morbidity and mortality to. Its potential complications are enormous, and pose significant healthcare burdens on both families and society. As '*Nishamalaki Churna*' found effective in the clinical management as well as prevention of complications of Diabetes through *in vitro*, *in vivo* studies thus to adopt '*Nishamalaki Churna*' as healthy lifestyle regimen would be effective regimen to prevent and control of type 2 Diabetes Mellitus and its modifiable risk factors like obesity and Dyslipidaemia.

## 7. Reference

- Global Report on Diabetes- World Health Organization. [http://www.apps.who.int/iris/bitstream/9789241565257\\_eng](http://www.apps.who.int/iris/bitstream/9789241565257_eng). 7April, 2016.
- Wong E, Backholer K, Gearon E, Harding J, Freak-Poli R, Stevenson C *et al*. Diabetes and risk of physical disability in adults: a systematic review and meta-analysis. *Lancet Diabetes Endocrinology*. 2013; 1(2):106-114.
- Unites Nations high -level meeting of Noncommunicable. [Http://www.who.int/nmh/events/un\\_ncd\\_summit](http://www.who.int/nmh/events/un_ncd_summit). 20Sep, 2011.
- Gupta Atrideva K. Ashtangahradaaya of Acharya Vagbhata. Edn. 11, Vol. I, Chaukhambha Sanskrit Sansthan publishers Varanasi, 1993, 611.
- Guruprasad Rao, Surekha Bhat, Gurumadhva Rao S, Gopalakrishna Bhat P. Effect of Treatment with Nishamalaki Powder on Glycemic Control and Markers of Erythrocyte Oxidative Stress in Diabetic Rats Compared to Troglitazone. *Int. J Pharm. Sci. Rev. Res*. 2013; 19(2):127-134.
- Shastri K, Chaturvedi G. Charak Samhita of Agnivesha. Edn18, Vol. I, Chaukhambha Bharati Academy publisher, Varanasi, 1992, 632.
- Mishra B, Vaisya R. Bhavprakash of Shri Bhava Mishra. Edn 8, Vol. I, Chaukhambha Sanskrit Sansthan publisher, Varanasi, 1997, 114.
- Tripathi RD. Ashtanga Samgraha of Srimad Vriddhavgbhata. Edn 2 revised. Chaukhambha Sanskrit Pratishthan publishers, Delhi, 1992, 346.
- Krishnaveni M, Mirunalini S. Therapeutic potential of *Phyllanthus emblica* (amla): the ayurvedic wonder. *J Basic Clin Physiol Pharmacol*. 2010; 21(1):93-105.
- Fiorentino TV, Prioletta A, Zuo P, Folli F. Hyperglycemia-induced oxidative stress and its role in diabetes mellitus related cardiovascular diseases. *Curr Pharm Des*. 2013; 19(32):5695-703.
- Erejuwa OO. Management of diabetes mellitus: could simultaneous targeting of hyperglycemia and oxidative stress be a better panacea? *Int J Mol Sci*. 2012; 13(3):2965-2972.
- Luthra PM, Singh R, Chandra R. Therapeutic uses of *Curcuma longa* (turmeric). *Indian J Clin Biochem*. 2001; 16(2):153-60.
- Tank R, Sharma N, Sharma I, Dixit VP. Antidiabetic activity of *Curcuma longa* (50% ethanolic extract) in alloxaninduced diabetic rats. *Indian Drugs*. 1989; 27(11):587-9.
- Wickenberg J, Ingemansson SL, Hlebowicz J. Effects of *Curcuma longa* (turmeric) on postprandial plasma glucose and insulin in healthy subjects. *Nutr J*. 2010; 9:43.
- Khan A, Bryden NA, Polansky MM, Anderson RA. Insulin potentiating factor and chromium content of selected foods and spices. *Biol Trace Element Res*. Mar. 1990; 24(3):183-8.
- Jain Sushil K. Justin Rains, Kimberly Jones. Effect of curcumin on protein glycosylation, lipid peroxidation, and oxygen radical generation in human red blood cells exposed to high glucose levels. *Free Radical Biology and Medicine*. 2006; 41(1):92-96.
- Guruprasad Rao, Surekha Bhat, Gurumadhva Rao S, Gopalakrishna Bhat P. Effect of Treatment with Nishamalaki Powder on Glycemic Control and Markers of Erythrocyte Oxidative Stress in Diabetic Rats Compared to Troglitazone. *Int. J Pharm. Sci. Rev. Res*. 2013; 19(2):127-134.
- Deng R. A review of the hypoglycemic effects of five commonly used herbal food supplements. *Recent Pat Food Nutr Agric*. 2012; 4(1):50-60.
- Ghosal S, Tripathi VK, Chauhan S. Active constituents of *Embllica officinalis*: Part 1. The chemistry and antioxidant effects of two new hydrolysable tannins, Emblicanin A (1a) and B (1b). *ChemInform*, 2010, 27(47).
- Nampoothiri SV, Prathapan A, Cherian OL, Raghu KG, Venugopalan VV, Sundaresan A. *In vitro* antioxidant and inhibitory potential of *Terminalia bellerica* and *Embllica officinalis* fruits against LDL oxidation and key enzymes linked to type 2 diabetes. *Food Chem Toxicol*. 2011; 49(1):125-31.
- Bhattacharya A, Chatterjee A, Ghosal S, Bhattacharya SK. Antioxidant activity of active tannoid principles of *Embllica officinalis* (amla). *Indian J Exp Biol*. 1999; 37(7):676-80.
- Guruprasad Rao, Surekha Bhat, Gurumadhva Rao S, Gopalakrishna Bhat P. Effect of Treatment with Nishamalaki Powder on Glycemic Control and Markers of Erythrocyte Oxidative Stress in Diabetic Rats Compared to Troglitazone. *Int. J Pharm. Sci. Rev. Res*. 2013; 19(2):127-134.
- Zargar AH, Khan AK, Masoodi SR, Laway BA, Wani AI, Bashir MI *et al*. Prevalence of type 2 diabetes mellitus and impaired glucose tolerance in the Kashmir

- Valley of the Indian subcontinent. *Diabetes Res Clin Pract.* 2000; 47(2):135-46.
24. Rao CR, Kamath VG, Shetty A, Kamath A. A cross-sectional analysis of obesity among a rural population in coastal southern Karnataka, India. *Australas Med J.* 2011; 4(1):53-57.
  25. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. *Int J Obes (Lond).* 2011; 35(2):167-87.
  26. Mohan V, Shah S, Saboo B. Current glycemic status and diabetes related complications among type 2 diabetes patients in India: data from the Alchieve study. *JAPI (Suppl).* 2013; 61:12-15.
  27. Ramachandran A, Snehalatha C *et al.* Diabetes Epidemiology Study Group in India (DESI). High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia.* 2001; 44(9):1094-101.
  28. Unnikrishnan RI, Rema M *et al.* Prevalence and risk factor of diabetic nephropathy in an urban south Indian population; The Chennai urban rural Epidemiology study (CurES-45). *Diabetes Care.* 2007; 30:2019-2024.
  29. Suaib Luqman, Syed Ibrahim Rizvi *et al.* Efficacy of Herbal Drugs in Human Diseases and Disorders. Evidence-Based Complementary and Alternative Medicine. 2014; Article ID 273676: 2 pages.
  30. Suryanarayana P, Satyanarayana A, Balakrishna N, Kumar PU, Reddy GB. Effect of turmeric and curcumin on oxidative stress and antioxidant enzymes in streptozotocin-induced diabetic rat. *Medical Science Monitor.* 2007; 13(12):BR286-92.
  31. Guruprasad Rao. Effect of treatment with Nishamalaki Powder on Glycemic Control and Markers of Erythrocyte Oxidative Stress in Diabetic Rats Compared to Troglitazone. *International Journal of Pharmaceutical Sciences Review and Research*, 19(2), 127-134.
  32. Nanda GC, Chopra KK, Sahu D *et al.* Nisha Amalaki in Madhumeha (NIDDM): A Clinical Study. *Journal of Research in Ayurveda and Siddha.* 1998; 19(1-2):34-40.
  33. Kashinath Samagandi *et al.* A clinical study on the efficacy of wheat grass juice in Prameha. *IRJP*, 2012, (3)4.
  34. Jayshree Shriram dawane, vijaya Anil Pandit *et al.* Evaluation of Effect of Nishamalaki on STZ and HFHF Diet Induced Diabetic Neuropathy in Wistar Rats. *J clin Diagn Res.* 2016; 10(10):FF01-FF05.