

Efficacy of some traditional Indian spices for treating diabetes

J Jeni James and V.N. Meena Devi *

Department Of Physics

Noorul Islam Centre for Higher Education

Kumaracoil, Thuckalay, 629 180, Tamilnadu

ABSTRACT

Even in this modern era India follows some traditional system of medicines for the curative property of diseases without any side effects. Spices are most commonly found in almost every Indian cuisine. They not only add flavors to dishes but have lots of medicinal properties. India is also considered as one of the largest producer of spices. Diabetes is a metabolic disorder, which cannot be cured completely. But can be controlled without adverse effect by following the traditional system of medicine. This review totally highlights the medicinal properties of fenugreek, black cumin seeds and coriander seeds.

KEY WORDS: *Diabetes mellitus, Nigella sativa, Indian spices, antioxidants.*

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I. INTRODUCTION

Diabetes mellitus is a multifactorial disease [1] conditions caused by many contributing factors such as lifestyles and environmental factors. It is caused by lack of insulin or insulin resistance or both at the cellular level [2]. The main role of the insulin is to allow the muscle cells organs like liver and stored fat to use up sugar content in the blood streams. In the muscles, liver and fat to take up sugar from the blood streams that have been absorbed from foods and to lower the blood sugar levels. The two major forms of diabetes are type 1 diabetes and type 2 diabetes. The first type of diabetes is developed when the body's immune systems are destroyed by beta cells present in pancreas and hence people suffering from this are not able to produce insulin. The most commonly seen diabetes is type 2 diabetes and is developed due to insulin resistance and insulin deficiency [3]. The lifelong diabetes for a longer duration of time could lead to many diseases like failures in the proper functioning of body organs such as kidney, heart, eyes etc. [4]. There are many ways treating diabetes, like injecting insulin or using antidiabetic drugs orally. But they are associated with number of serious adverse effects [5]. The traditional antidiabetic plants might provide new oral anti diabetic compounds without any side effects [6].

India has developed traditional medical systems in which herbal therapies were used. To treat different ailments by various traditional medicinal systems such as siddha, ayyurveda unani and allopathy several plant species are used [7]. Comparing to commercial antibiotics; natural products are more effective with least side effects. Therefore they are used as a substitute for curing various infections [8]. According to the survey conducted by World Health Organization (WHO) 80% of total world's population use traditional medicines for their basic health care needs [9]. Spice plant products that include different parts such as seeds, kernels, bulbs, stalk, roots, fruits, bark, leaves, pods or buds [10]. India is considered as one of the largest spice producer. Spices are most widely used as a part of daily food. It adds flavour to the foods and also shows many properties in curing diseases and health problems [11]. Spices acts as a rich source of phytochemicals [12]. Phytochemical screening method refers to the extraction, screening and identification of medicinally active components found in plants that are active in terms of biological behaviour and are those chemical compounds found in nature which have the capability to protect the plant tissues from further environmental disasters such as exposure to UV light, microbial attack, pollutants and stress related hazards [13]. These compounds are known as plant secondary metabolites [14].

The plant secondary metabolites can be divided into flavanoids, phenolic and poly phenolic compounds, alkaloids. Flavanoids could be used in adding colour and aroma to fruits and vegetables [15]. Phenolic compounds also play a major role in the growth, reproduction and protection against pathogens besides contributing them towards the colour and characteristics of fruits and vegetables [16].

The phytochemicals present in the medicinal plants gives a good opportunity for the development of new types of therapeutics [4]. Research displays the insulin potentiating activity of spices in normal cases as well as in experimentally inhibited diabetic animal models and humans [17]. The present review is aimed to highlight the antidiabetic properties of some selected spices.

II. SPICES INVESTIGATED

2.1 Description

2.1.1 Fenugreek

Trigonella foenum graecum usually accepted as fenugreek is an annual herb which belongs to the family Leguminosae [18] Division- Magnoliophyta, Order-Fabales and genus-Trigonella [19].

The fenugreek seeds are taken from the herb fenugreek which grows up to a height of 60 cm. The leaves are of pale green colour and whitish flowers are produced. They are followed by bean like pods 10 to 15 cm long containing up to twenty small yellowish brown seeds. The seeds are smooth and about 3 mm long [20]. They are cultivated in the areas where the climate is moderately cool [21]. The loamy or sandy loamy soil with ph value in the range 6-7 and with good drainage conditions are preferred [22].

Fenugreek seeds are routinely used in Indian kitchens. The fully developed *Trigonella* seed has many energetic organic compounds [23], alkaloids, flavanoids, amino acids, tannins and some steroidal glycosides, proteins [24]. The seed acts against diabetes, microbes, cancer, infertility, parasites, lactation stimulant and hypocholesterolemic effects [25]. The recent studies have proved that fenugreek seeds are beneficial for atherosclerosis, constipation, diabetes, high cholesterol and hyper triglyceridemia [26].

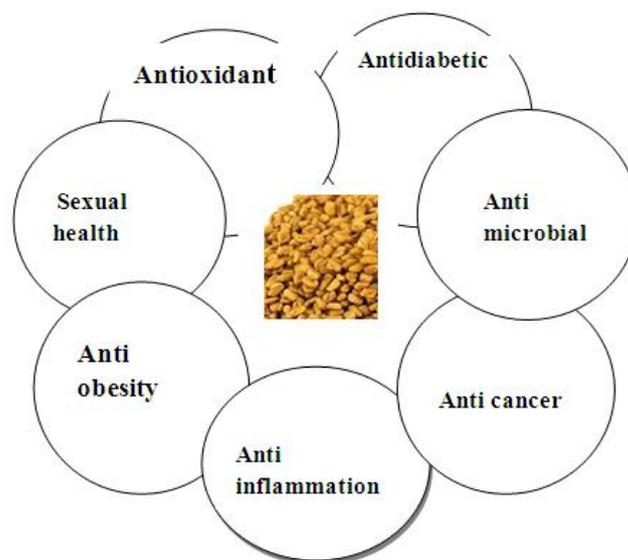


Fig 1: Figure on pharmacological activities of fenugreek seeds

2.1.2 Black cumin

Nigella sativa so called black cumin, Nigella, kalojeera and kalonji. It is a yearly blossoming plant in the family Ranunculaceae [27], division- Spermatophyta, Order - Ranunculales, Genus-*N sativa* [28]. The plant grows to a height of 20 to 90cm, and the leaves are closely filamentous. The size of the fruit is big and is a puffed capsule containing of 3 to 7 unified ducts with number of seeds [29]. Black seeds are small, black externally and white inside. The sloppy soils of moderate rainfall areas and ph 7.0 to 7.5 are suitable for cultivation. The native of black seed is Southern region of the Europe, regions of Africa and Southwestern Asia and also cultured globally [30]. Black cumin seeds also contain consequential level of iron, copper, zinc, phosphorus, calcium, thiamin, pyridoxine and folic acid [31]. It also contains many active components such as Thymoquinone, alkaloids, saponins, flavanoids, proteins and fatty acids [32].

Black seeds act against hypertensive, diabetes, cancer, microbes, renal disease and also reduce inflammation [33]. In traditional as well as in recent years it has been used for curing diseases caused by microbes without any described reaction, and also used as a natural remedy for illness like asthma, chest congestion, hypertension, diabetes, cough, headache, fever, influenza [34].

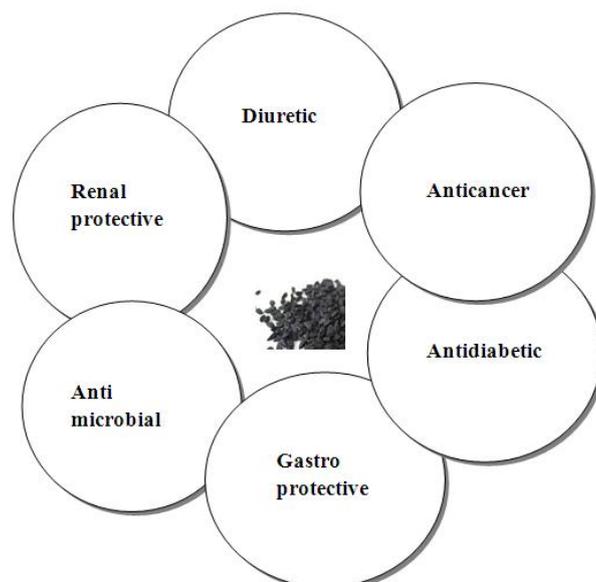


Fig 2: Figure on pharmacological activities of black cumin seeds

2.1.3 Coriander

Coriander scientifically named as *Coriandrum sativum* belongs to the Umbelliferae family, Division-Angiospermae, Order-Umbellales and Genus-Apiaceae [35]. It's so called “*Dhanya*” in India. The native of Coriander is Mediterranean and Mideast [36]. The plant grows to a range of about 20 and 140 cm based on the soil and atmosphere. It grows in any type of soil like sandy soil, well drained, wet, loam and light to heavy regur soil [37]. The leaves are oval and the upper parts of the leaves are collinear and more separated. The fruits are 6mm in diameter and are spherical with two husks, [38].After sowing the crops mature within 2 to 3 months, the fruits are sundried, winnowed and preserved [39].

Coriander seeds are used from the early period as a cholesterol reducing agent, a gastrointestinal stimulants and high blood pressure lowering agent [40]. It also acts against diabetes, cancer cell, ulcer, fungal and also showed anti feeding activity [41]. Coriander contains phytochemical constituents like flavanoids, alkaloids, tannins, saponins, terpenoids, sterol and carbohydrates [42].

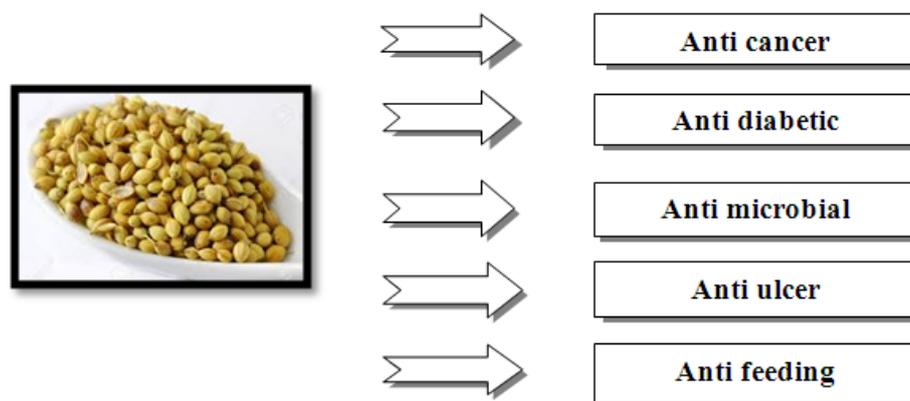


Fig 3: Figure on pharmacological activity of coriander seeds

III. RESEARCH FOCUS AND JUSTIFICATION

Diabetes is considered as one of the major metabolic disorders worrying a large proportion of the population all over the world [43]. It is predicted that by 2030, about 79.4 million individuals in India will be affected by diabetes [44]. Diabetes is related with oxidative stress due to hyperglycemia and hyperlipidemia [45]. The uncontrolled diabetes is the reason for hyperglycemia, and in excess of time it generates significant adverse effects to body, especially the nerve fiber and blood vessel [46]. Diabetes is considered as the third killer in the aspect of health of mankind [47]. The oral hypoglycemic agents used to decrease glucose level in patients include sulfonylureas, thiazolidinediones which increases the insulin sensitivity of the target tissues [48].

Dietary and life style modification acts as the main goal and management for the treatment of diabetes [49]. Casual plasma glucose concentration and fasting plasma glucose are the two diagnosis criteria for diabetes [50]. The currently available drugs have several disadvantages that they have to be given throughout the life and produce side effects [51]. As the traditional plant medicines are available cheaply and easily, it is used throughout the world for the management of diabetes [52]. The largest producer of medicinal herbs is our country India and is hence called as the botanical garden of the world [53].

The current study is focused to investigate the antidiabetic properties and antioxidant properties of some spice extracts which doesn't cause any side effects, and to find more efficient ways for controlling diabetes.

IV. ANTIDIABETIC ACTIVITIES

4.1 *Trigonella Foenum Graecum*

Asmena Mowla et al [54] studied the effect of Antihyperglycemic of *Trigonella Foenum-Graecum* (Fenugreek) seed extract and hence investigated it in Alloxan-Induced Diabetic rats. The blood glucose level in diabetic rats was introduced from the ethanol extract of fenugreek seeds of different doses (2g/kg, 1g/kg, 0.5g/kg and 0.1g/kg). The hypoglycemic effect of the extract was studied and compared with the single dose of Standard antidiabetic drug (glimepiride, 4mg/kg). The extract indicates a drastic change against the diabetic state induced in diabetic rats and the intensities of the hypoglycemic effect changes from dose to dose. When compared with standard antidiabetic drug 1g/kg was recognized as the most effective dose. The *T. foenum-graecum* seed ethanol extract doesn't show any acute toxicity and is compared to be more effective than antihyperglycemic dose. This could be administered orally at large dose level of 3 g/kg body weight. The phytochemicals screening was also done and it indicates the presence of secondary metabolites (carbohydrates, steroids and alkaloids). The traditional use of fenugreek seeds in the treatment of diabetes mellitus was depicted by this study.

Genet Alem Geberemeskel al [55] investigated on the newly diagnosed lipid profile of type II diabetic patients that depict the effect of seed powder solution of *Trigonella foenum-graecum*. The newly diagnosed diabetic patients were selected and split in two groups where one of the groups used *Trigonella foenum graecum* seed powder solution of 25 g orally taken twice a day for about one month and the other group received metformin. The first group is called as the treatment group and the second one as the control group. From each participant the respected blood samples were collected and were analyzed before and after the study. Mindray BS 200E fully automated clinical chemistry analyzer was used for the analysis of lipid profile. While comparing the treatment group and the control group there is a lower cholesterol level in the first group to that of baseline level of the second group. There is an increase in HDL-C level and significant decrease in TC, TG and LDL-C levels produced by the treatment group. The result of the study indicate strong reactions and effects which improves the lipid metabolism in type II diabetic patients with no side effects and further studies revealed that fenugreek seed offers new ideas and alternatives in clinical management of type II diabetes.

Neveen Helmy Abou et al [56] conducted a study that investigated the effect of fenugreek dried seeds alkaloid extract on blood glucose, lipid peroxidation, serum insulin. The histochemical and histological study of human body parts such as kidney and liver that are induced by streptozotocin in diabetic albino rats. Fenugreek dried seeds alkaloid extracts were tested in hyperglycemic rats induced by streptozotocin. The fenugreek seed was given to albino rats daily for about 21 days. Further studies in diabetic rats proved the effect of fenugreek seeds on blood glucose level, serum insulin quantity, lipids (total cholesterol, triglycerides, HDL and LDL) and peroxides of lipids. The result concluded that these alkaloids reduces the increased level of blood glucose and hereby prevents the diabetics caused hyperglycemia.

4.2 *Nigella Sativa*

Amutha K and Godavari A [57] evaluated *Nigella sativa*' antidiabetic nature by the method of alpha glucosidase assay and alpha amylase through ethyl acetate extract that showed a higher increase in percentage of alpha glucosidase inhibition rate than alpha amylase. The hypoglycemic nature of *Nigella sativa* was hence revealed. The total inhibition oxygen capacity of this extract was evaluated by the phosphomolybdenum method. It showed high antioxidant capacity, as the total inhibition oxygen capacity of this extract was higher than that of the standard range of ascorbic acid. Phytochemical screening revealed that the presence of many chemical compounds produced by plants which possesses the properties to be antidiabetic in nature.

Meddah et al [58] aimed to study the properties and effects of *Nigella sativa* seed's crude aqueous extract on absorption of intestinal glucose thus by improving the glucose sustain property in rats. This aqueous preparation of *Nigella sativa* implemented a dose-dependent stoppage of glucose transport that is considered to be sodium-dependent apart in from rat jejunum. 80% was fixed as the maximum inhibition. The *Nigella sativa* after a treatment of 6-week, a sustainable tolerance oral test in rats were conducted and is estimated with that of metformin. The glucose tolerance level is improved and is found to be more effective as that of metformin by

this treatment. The body weight was also reduced by *Nigella sativa* and metformin without any toxic effects. The improved sustaining power of glucose is observed and the chronic oral measure which includes the body weight in rats also proved the effects of established use of *Nigella* for a long period of time.

M. Kaleem et al [59] examined diabetic rats and found out the different biological and chemical effects of *Nigella sativa* seeds in them. The ethanol extracts of *Nigella* seeds were orally administered to streptozotocin induced diabetes rats. The estimation of blood glucose level, total cholesterol content in plasma (TC), triglyceride contents and high density lipoprotein cholesterols (HDL-C) were done. In diabetic rats plasma lipid profile and glucose levels were found to be higher. The reduction of blood glucose level is seen in diabetic rats during the oral administration of *Nigella sativa* seeds extracts. And hence these rats showed various levels of improvement in their life span. Usually we could see muscle wasting in diabetes but in these experimental diabetic rats, their body organs like liver and kidney weights and glucose levels were found to be normal and hence preventing muscle wasting.

4.3 *Coriandrum sativum*

Aissaoui et al [60] investigated a special traditional treatment for diabetes in Moroccan culture using coriander seed aqueous extract. A single dose of this coriander seeds aqueous extract was given to hyperglycemic-hyperlipidemic and obese rats for time duration of 30 days prescribed at single dose. Coriander extracts suppresses hyperglycemia with a level of glucose taken to be normal showed the results. The study specified the traditional culture of using coriander seeds in diabetes.

Nayerh Parsaeyan [61] investigated the coriander seed powder effect on the atherosclerotic and cardio protective indices of type 2 diabetic patients. In this study 2 capsule of coriander seed powder was consumed to fifty patients affected by diabetes for a time period of 6 weeks. The glucose, cholesterol, triglyceride, LDL-C, HDL-C, urea, creatinine were measured. Atherosclerotic and cardio protective indices were calculated. The study demonstrated that oral intake of seeds of coriander in patient affected by type 2 diabetes that normalized the glucose level, decreased the cholesterol without any effect on plasma urea and creatinine. It validated the usage of coriander in treating diabetes and also showed that the daily usage of these coriander seeds could prevent the complications caused by hyperlipidemia in type 2 diabetes.

V. ANTIOXIDANT PROPERTIES

5.1 *Trigonella foenum graecum*

Subhashini et al [62] carried out a study on antioxidant activity of *Trigonella foenum* extract. The seed extracts was investigated for the invitro antioxidant assays including nitric oxide scavenging, superoxide scavenging, DPPH, flavanoid content, Thiocyanate and phosphomolybdenum method were done to measure the total antioxidant nature. In these methods the result of this extract showed a strong antioxidant activity.

Idries and AL. Mashkor [63] examined three types of solvent extracts of fenugreek seeds on total phenolic contents (TPC), Diphenyl-1-picrylhydrazyl(DPPH)and ferric reducing ability of Plasma(FRAP). The results showed that TPC, DPPH, FRAP and free radicals scavenging activity of extracts decreased with increased in organic solvent concentration. Good correlations with antioxidant activity FRAP and DPPH was obtained from the total phenolic content. The result concluded that the extraction solvent plays important role on the antioxidant activity of fenugreek seeds.

5.2 *Nigella sativum*

H Rusmarilin et al [64] investigated seeds of black cumin and sesame to test the natural antioxidants potential in them. The study was done to examine and to find out the biologically active components that could be used as another agent in decreasing diabetes mellitus. Fermentation process was carried out. The method of free radical in DPPH was done and antioxidant activity was determined. The extracts of sesame and black cumin showed a higher antioxidant behavior when mixed with coating materials such as maltodextrin as soy protein.

5.3 *Coriandrum sativum*

Dua Anita et al [65] analyzed the methanolic extracts of seeds of *Coriandrum sativum* in the presence of antioxidants. For the identification and qualification of phenolics, the extract rich in polyphenolic compounds was subjected to HPLC analysis. Using the free radical scavenging method of DPPH, the oxidation barrier lipids and induced metal proteins and the antioxidant activity of this extract was determined. The result showed that polyphenols (gallic acid, quercetin, caffeic acid and kaempferol) were responsible for this high antioxidant activity.

Ehssan HJ et al [66] examined the different methods such as phytochemical screening, antioxidant behaviour and chemical composition nature of *Coriandrum sativum*. Usage of aqueous solvents alcohols such as ethanol, methanol, n-hexane petroleum ether etc where utilized for the extraction of these seeds by the method of soxhlet extraction method or maceration. Phytochemical screening of these extracts showed the presence of

saponins, tannins and cardenolides. Steam distillation method was done to extract the needful oil from these seeds and hence analyzed by GC-MS. Forty nine compounds were found out and linalool 66.7% were considered as the major constituent. DPPH radical –scavenging method was applied to obtain the antioxidant activity and the result revealed the presence of effective antioxidant activity of the coriander seeds.

VI. ANTIMICROBIAL ACTIVITIES

6.1 Fenugreek

Rehab et al [67] aimed to examine the seeds of fenugreek to study the in vitro antimicrobial nature microorganisms of against gram-negative and gram-positive. The test was done using two solvents such as aqueous extractions and methanol extractions. Agar diffusion methods such as disc diffusion and well diffusion were used to evaluate the antimicrobial activities. The result indicated that the fenugreek seeds contain active ingredients of antimicrobial behaviour and were found in boiling water extract, but absence of these figured in other extracts such as cold water and methanol extract.

6.2 Black cumin

Ozlem Turgay et al [68] examined black seeds to study the in vitro antimicrobial behaviour. The seeds were extracted using the solvents of acetone, diethyl ether, chloroform, ethanol, ethyl acetate, methanol, hexane by soxhlet equipment. Disc diffusion technique was applied to test the antimicrobial activity. The prepared extract was tested on 14 bacteria strains and 1 fungus. The result concluded that the seed extract prepared using ethyl acetate showed inhibitory activity on almost all microorganisms' strains.

6.3 Coriander

Uma B et al [69] investigated the phytochemicals and invitro antimicrobial activity of *coriandrum sativum* against some pathogens. The aqueous, methanol, chloroform, petroleum ether and hexane solvents were screened for the antimicrobial activity. The extracts were subjected for antimicrobial activity by disc diffusion method. The methanol extracts revealed a good antimicrobial activity compared to chloroform and aqueous extracts.

VII. ANTICANCER PROPERTIES

7.1 Fenugreek

Abdulaziz et al [70] focused to study the properties of anticancer effects and profiles of proteomic in fenugreek seeds. Different concentration level (100µg/ml, 200µg/ml and 300µg/ml) of fenugreek extracts were used in various normal cells and cancer cells at varying time points (0, 24, 48, 72 and 96 hrs). Proteomic expression profile was done to analyse the different fingerprints of proteins in fenugreek seeds that could be obtained from four different geographical landscape regions. The extract of fenugreek showed selective cytotoxic effects with in a cancer cell panel and hence was able observe T-cell lymphoma. This result concluded the in vitro effect in fenugreek seeds and hence showed the cytotoxicity nature to cancer cells and its usefulness in the treatment of cancer.

7.2 Black cumin

Agbaria R et al [71] aimed to investigate the role of therapeutic extracts and to determine the underlying mechanism of black seeds. The antiproliferative activity and Thymoquinone content in the mouse colon carcinoma were investigated by various seed thermal processing methods. The study showed the cytotoxic activity of the black seed extracts and its reduced cell growth in cancer cells.

7.3 Coriander

Fayyad et al [72] investigated the in vitro, antioxidant, anticancer, cytotoxic and antiviral activities of coriander seeds. MTT assay was done to assess the cytotoxic and anticancer effect of methanol, hexane and aqueous extract of the seeds. Hexane and aqueous exhibited inhibition of Vero cells by the MTT assay. The result demonstrated the anticancer and antiviral nature in hexane, methanol and coriander seeds aqueous extracts.

VIII. CONCLUSION

Traditional medicines are very important in the field of medicines as it acts as an affordable source of health care. Spices are considered to be using from ages. They offer fewer side effects and are brought at lower cost. Spices like fenugreek, coriander, black cumin have high antioxidant property which is very much needed for a human being. In the present review it is so clear that the above mentioned spices have several curative properties such as antidiabetic, anticancer, antioxidants. Following these Indian spices regularly can reduce the risk factors of several diseases.

REFERENCE

- [1]. N.H Ugochukwu, N.E Babady. "The therapeutic properties of medicinal plants". Journal of life sciences 73 (15) (2003) Pp.1925-1938.
- [2]. K.A Wadkar, CS Magdum, SS Patil, NS Naikwade. "Anti-diabetic potential and Indian medicinal plants". Journal of herbal medicine and toxicology. 2 (2008) Pp. 45-50.
- [3]. Amy Hess-Fischl MS, RD, LDN, Daphne E.Smith-Marsh. "Endocrineweb". (2005).
- [4]. Akhilesh K.Tripathi and Seema Kohli. "Pharmacognostic and phytochemicals studies on the flowers of *Punica grantum* L". Asian Journal of medical and pharmaceutical researches. 3(2013) Pp. 1-7.
- [5]. Moller DE. "New drug targets for type 2 diabetes and metabolic syndrome". Nature. (2011) Pp. 414-821,
- [6]. Noor A, Gunasekaran. S, Soosai Manickam Amirtham, Vijayalkashmi M. A. "Antidiabetic activity of aloe Vera and histology of organs in streptozotocin-induced diabetic rats." Curr.sci. 94 (2008) Pp. 1070-1076.
- [7]. Tonia Rabe, Johannes Van Staden. "Antibacterial activity of South African plants used for medicinal purposes". Journal of ethno pharmacology. 56(1997) Pp. 81-87.
- [8]. Suman Upadhyaya, Divya Yadav, Ram Chandra and Naveen Arora. "Evaluation of antibacterial and phytochemicals properties of different spice extracts". African Journal of Microbiology Research. 12(2018) Pp.27-37.
- [9]. Himlal Paudel Chhetri, Nisha Shrestha Yogol, Jyoti Sherchan, KC Anupa, S Mansoor, Panna Thap. "Formulation and evaluation of antimicrobial herbal ointment". Kathmandu university journal of science, engineering and technology. 6(2009) Pp. 102-107.
- [10]. Radhakrishnan Praveen, Priya Rajan Prasad Verma, Sandeep Kumar Singh, Jerome Karippamattom. "Cross linked alginate gel beads as floating drug delivery system". Journal of pharmaceutical investigation 45 (2015) Pp.187-199.
- [11]. A Mandeel, Abdul Ameer A Al- Laith. "Ethnomycological aspects of the desert truffle among native Bahraini and non- Bahraini peoples". Journal of ethno pharmacology 110(2007) Pp. 118- 129.
- [12]. Rajendran Srinivasan, Chinnavenkataraman. Influence of native arbuscular mycorrhizal fungi on growth, nutrition and phytochemicals constituents of *Catharanthus roseus*.L. G. Don. J Coast Life Med. 2(2014) Pp. 31-37.
- [13]. Akram Ali, Fahad Alqurainy. "Activities of antioxidants in plants under environmental stress". Activities of antioxidants in plants. (2006)
- [14]. Linga Rao, N. Savithamma. "Screening of traditional medicinal plants for secondary metabolites". Middle East Journal of Scientific Research, 2(2011) Pp. 643-647.
- [15]. R J Griesbach. "Wiley Library". Plant breeds Rev 25(2005) Pp. 89-114.
- [16]. Cesarettin Alasalvar, John M.Grigor, Donglin Zhang. Comparison of volatiles, phenolics, sugars, antioxidant vitamins and sensory quality of different colored carrot varieties. Journal of Agricultural and food Chemistry. 49 (2001).
- [17]. K Srinivasan. "Plant foods in the management of diabetes mellitus: spices as beneficial antidiabetic food adjuncts". Int J Food Sci Nutr. 56(2005) Pp. 399-414.
- [18]. Sajad Ahamad Wani and Pradyuman. "Fenugreek: A review on its nutraceutical properties and utilization in various food products". Journal of Saudi society of Agricultural sciences. Vol 17 (2018) Pp. 97-106.
- [19]. Abdul Baset Mia. "Digital Herbarium of crop plants".(2016).
- [20]. Nybe E V. "New India Publishing". Vol 5(2007) Pp.206.
- [21]. Jagdish Reddy. "Agri Farming". (2015)
- [22]. Agrihortico. "Redefining food and agriculture". (2016)
- [23]. Farrukh Aqil and Iqbal Ahmad. "Broad spectrum antibacterial and antifungal properties of certain traditionally used Indian medicinal plants". World Journal of Microbiology and Biotechnology. 19(2003) Pp.653-657.
- [24]. Ansari SH. "Essentials of Pharmacognosy", Birla Publication Pvt.Ltd, 1th edn: (2005) Pp. 357-384.
- [25]. Leena, Priyanka Siwach, Sheema Bai, Anupama Malik, Pooja Bharti, Sunita Dalal. "Free radical scavenging activity, phenolic contents and phytochemicals analysis of seeds of *Trigonella foenum graecum*". Asian Pacific Journal of Health Sciences. 1(2014) Pp. 219-226.
- [26]. Sowmya P, Rajyalakshmi P. "Hypocholesterolemic effects of germinated fenugreek seeds in human subjects". Plant Food Hum Nutr. 53(1999) Pp. 359-365.
- [27]. Heiss and Andreas. "Vegetation History and Archaeobotany", 14(2005) Pp. 562-570.
- [28]. Sabira Sultana, Hafiz Muhammad Asif, Naheed Akhtar, Asif Iqbal, Haleema Nazar, Riaz Ur Rehman. "Nigella sativa: Monograph". Journal of Pharmacognosy and Phytochemistry. 4(2015) Pp. 103-106.
- [29]. Warriar PK, Nambiar VPK, Ramankutty. "Indian Medicinal plants-a compendium of 500 species". Wiley online library. 46(2004) Pp .139-142.
- [30]. Khare CP. "Encyclopedia of Indian medical plants". (2004).
- [31]. Mohamed Fawzy Ramadan. "Nutritional value, functional properties and nutraceutical applications of black cumin: an overview". International journal of food science & amp. 42 (2007) Pp. 1208-1218.
- [32]. Butt MS, Sultan MT. "Nigella sativa: reduces the risk of various maladies". Crit Rev Food sci nutr. 50(2010) Pp. 654-665.
- [33]. Abel-Salam BK. "Immunomodulatory effects of black seeds and garlic on alloxan induced rats". Allergol Immunopathol (Madr). 40(2011) Pp. 336-340.
- [34]. Salib, Sayed AEI-Toumy. "Plant and marine based phytochemicals for human health"; 1st edn: (2018) Pp. 295 .
- [35]. John William Purseglove, EG Brown, CL Green, SRJ Robbins. "Spices" vol 2 (1981) Pp. 447-813.
- [36]. Muhammad Nadeem, Faqir Muhammed Anjum, Muhannad Issa Khan, Saima Tehseen, Ahmed. "Nutritional and medicinal aspects of coriander". British food journal. (2013)
- [37]. A Verma, S N Pandeya, S K Yadev, S Singh. "A review on coriandrum sativum, an Ayurvedic medicinal herb of happiness". (2011) Pp. 1-37.
- [38]. O Ceska, S K Chaudhary, P Warrington, MJ Ashwood-Smith, GW Bushnell, GA Poulton. "Coriandrin, a novel highly photoactive compound isolated from coriandrum sativum". Phytochemistry 27(1988) Pp. 2083-2087.
- [39]. Ekezie Flora-Glad Chizoba. "A comprehensive review on coriander and its medicinal properties". International journal of scientific research and reviews. 4(2015) Pp. 28-50.
- [40]. Snighdha Chawla, Monika Thakur. "Coriandrum sativum: A promising functional and medicinal food". International Journal of Phytomedicines and related industries. 5(2013) Pp. 59.
- [41]. Josphat Matasyoh, Zacharia Kibet Maiyo, Ngure Raphael, R Chepkorir. "Chemical composition and antimicrobial activity of essential oil of coriandrum sativum". Food chemistry. 113(2009) Pp. 526-529.
- [42]. Pongsak Rattanachakunsopon, Parichat Phumkhachorn. "Potential of coriander oil as a natural antimicrobial in inhibiting campylobacter jejuni in raw meat". Journal of Bioscience and Bioengineering; 110(2010) Pp.61.

- [43]. Zimmet P, Alberti KGMM, Shaw J. "Global and societal implications of the diabetes epidemic". *Nature* 414(2001) Pp.782-787.
- [44]. Wild S, Roglic G, Green A, Sicree R, King H. "Global prevalence of diabetes: estimates for the year 2000 and projections for 2030". *The diabetes care*. 27(2004) Pp. 1047-1053.
- [45]. Baynes J W and Thorpe SR. "Role of oxidative stress in diabetic complications: a new perspective on an old paradigm". *Diabetes* 48(1999) Pp. 1-9.
- [46]. Danaei G, Finucane MM, Lu Y, Sing G M, Cowan M J, Paciorek C J et al. "National, regional and global trends in fasting plasma glucose and diabetes prevalence". *The lancet*. 378(2011) Pp. 31-40.
- [47]. Chauhan A, Sharma P K, Srivastava P, Kumar N, Dudhe R. "Plants having potential anti diabetic activity: a review". *Der Pharmacia letter*. 2(2010) Pp. 369-387.
- [48]. Trafton JA, Ramani A. "Methadone: A new old drug with promises and pitfalls". *Curr pain headache*. 13(2009) Pp. 24-30.
- [49]. Bethesda. "National institute of health". *Diabetes in America*, 2nd edition, Bethesda. (1995)
- [50]. Bastaki S. "Review diabetes mellitus and its treatment". *Int Journal Diabetes and metabolism*. 13(2005) Pp.111-134.
- [51]. Halin E M. "Effects of *Coccinia indica* and *Abroma Augusta* on glycemia, lipid profile and on indicators of end organ damage in streptozotocin induced diabetes rat". *Indian journal of clinical Biochemistry*. 18 (2003) Pp. 54-63.
- [52]. Switi B, Gaikwad, G, Krishna Mohan and M. Sandhya Rani. "Phytochemicals for diabetes management". *Pharmaceutical crops*. 5(2014) Pp. 11-28.
- [53]. Chinmay D, Dshmkh and Anurekha Jain. "Diabetes Mellitus a review". *International journal of pure and applied bioscience*. 3(2015) Pp. 483-488.
- [54]. Asmena Mowla, M Alauddin, Md Atiar Rahman and Kabir Ahmed. "Antihyperglycemic effect of *Trigonella graecum* seed in alloxan induced diabetic rats and its use in diabetes mellitus". *Afr J Tradit complements Altern Med*. 6(2007) Pp.255-261.
- [55]. Genet Alem Geberemeskel, Yared Godefa Debebe and Nigisty Abraha Nguse. "Antidiabetic effect of fenugreek seed powder solution on hyperlipidemia in diabetic patients". *J Diabetes Res*. (2019).
- [56]. Naveen Helmy Abou El- Soud, Jihan Hussein, Mona Youssef Khalil, Abdel Razik H. Farrag. "Antidiabetic effects of fenugreek alkaloid extract in Streptozotocin induced hyperglycemic rats". *Journal of Applied Science*. 3(2007) Pp.1073-1083.
- [57]. Amutha. K and Godavari. A. "Antidiabetic and phytochemicals screening of *Nigella sativa*". *Journal of Chemical and Pharmaceutical Research*. 7(2015) Pp. 432-436.
- [58]. Bouchra Meddah, Robert, Moulay El Abbes Faouzi, Bruno Eto, Lahcen Mahraoui, Ali Benhaddou-Andaloussi, Louis Charles Martineau, Pierre selim Haddad. "Nigella sativa inhibits intestinal glucose absorption and improves glucose tolerance in rats". *Journal of Ethnopharmacology*. 121 (2009) Pp. 419-424.
- [59]. Kaleem M, Kirmani D, Asif M, Ahmed Q. "Biochemical effects of *Nigella sativa* L seeds in diabetic rats". *Indian journal of experimental biology*. 44(2006) Pp. 745-748.
- [60]. Abderrahmane Aissaoui, Soumia Zizi, Zafar H Israili, Badiia Lyoussi. "Hyperglycemic and Hyperlipidemic effects of *Coriandrum Sativum* L. in Meriones Shawi rats". *J Ethnopharmacol*. 137(2011) Pp. 652-61.
- [61]. Nayereh Parsaeyan. "The effects off coriander seed powder consumption on Atherosclerotic and cardioprotective indices of type 2 diabetes patients". *Iranian journal of diabetes and obesity*. 4 (2012).
- [62]. Subhashini N, Thangathirupathi A, Lavanya N. "Antioxidant activity of *Trigonella foenum graecum* using various in vitro and ex vivo models". *International journal of pharmacy and pharmaceuticals*. 3(2011) Pp. 96-102.
- [63]. Idries Muhson Abeed AL. Mashkor. "Phenolic content and antioxidant activity of fenugreek seed extract". *Journal of Pharmacognosy and phytochemicals reaearch*. 6(2014) Pp. 841-844.
- [64]. Rusmarilin H, Lubis Z, Lubis L M, Y A P Barutu. "Potential of natural antioxidants of black seed and sesame seed extract by microencapsulation methods". *Conf.series: Earth and Environmental science*. (2019).
- [65]. Dua Anita, Agrawal Sharad, Kaur Amanjot, Mahajan Ritu. "Antioxidant profile of *Coriandrum sativum* methanolic extract". *International research journal of pharmacy*. 5(2014).
- [66]. Ehssan H.J Ahmed, Ragaa S.M Abadi and Abdelhafeez M.A Mohammed. "Phytochemicals screening, chemical composition and antioxidant activity of seeds essential oil of *coriandrum sativum* L. from the Sudan". *International journal of herbal medicine*. 6(2018) Pp. 01-04.
- [67]. Rehab R Walli, Rabia A Al-Musrati, Hana M Eshtewi, Fathi M Sherif. "Screening of antimicrobial activity of fenugreek seeds". *Pharmacy and Pharmacology International Journal*. 2(2015).
- [68]. Ozlem Erdogru, Edip Ciftci, Hakan Bozdogan and Sevil Toroglu. "Antimicrobial activity of black cumin seeds". *Asian Journal of Chemistry*. 21(2009) Pp. 467-470.
- [69]. B Uma, K. Prabhakar, S.Rajendran and Y.Lakshmi Sarayu. "Antimicrobial activity and phytochemicals analysis of coriander sativum against infectious diarrhea". *Ethno botanical Leaflets*. 13 (2009) Pp. 590-94,
- [70]. Abdulaziz Alsemari, Fahad Alkhodairy, Ahmad Aldakan, Mai Al-Mohanna, Eman Bahoush, Zakia Shinwari and Ayodele Alaiya. "The selective cytotoxic anti cancer properties and proteomic analysis of *Trigonella Foenum Graecum*". *BMC Complementary Medicine and Therapies*. 14(2014).
- [71]. Agbaria R, Gabarin A, Dahan A, Ben-Shabat S; Drug Design. "Anticancer activity of *Nigella sativa* and its relationship with the thermal processing and quinine composition of the seeds". *Drug des development and Therapy*. 9 (2015) Pp. 3119-3124.
- [72]. A G Fayyad, N Ibrahim and W A Yaakob. "Evaluation of biological activities of seeds of *coriandrum sativum*". *International Journal of Scientific and Engineering research*. 8(2017) Pp.1058-1063.