Review Article

Alternative therapies useful in the management of diabetes: A systematic review

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ABSTRACT

Diabetes mellitus is a metabolic disorder in the endocrine system. This dreadful disease is found in all parts of the world and becoming a serious threat of mankind health. There are lots of chemical agents available to control and to treat diabetic patients, but total recovery from diabetes has not been reported up to this date. In addition to adverse effects, drug treatments are not always satisfactory in maintaining euglycemia and avoiding late stage diabetic complications. Alternative to these synthetic agents, plants provided a potential source of hypoglycemic drugs and are widely used in several traditional systems of medicine to prevent diabetes. Several medicinal plants have been investigated for their beneficial effect in different type of diabetes. Other alternative therapies such as dietary supplements, acupuncture, hydrotherapy, and yoga therapies less likely to have the side effects of conventional approaches for diabetes.

KEY WORDS: Alternative therapy, diabetes, hydrotherapy, hypoglycemic, yoga

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia, abnormal lipid, and protein metabolism along with specific long-term complication affecting the retina, kidney, and nervous system.[1] Diabetes mellitus has a significant impact on the health, quality of life and life expectancy of patients as well as on the health care system.

Diabetes mellitus has been recognized as a growing worldwide epidemic by many health's advocacy group including WHO.[2] The WHO has estimated that diabetes will be one of the world leading cause of death and disability with next quarter century. The statistics are alarming; 30 million people were diagnosed with diabetes worldwide in 1985, by 1995 the number had risen to 135 million, and at the current rate there will be some 300 million by the year 2025 as predicted by the WHO.[3] Currently, there are more than 17 million type 2 diabetic patients in the United States (or ~5.9% of the population), 11 million in Europe, and 6 million in Japan; which represents a potential primary therapeutic market of over $6 billion. In the United States in 1997, the American Diabetes Association (ADA) reports that the total economic cost of diabetes was estimated to be $98 billion which includes $44 billion in direct medical and treatment costs, and $54 billion in indirect costs related to disability and mortality. The prevalence of all forms of diabetes is estimated to be 2%-3% of the world's population, with the number of diabetics increasing by 4%-5% per annum.

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Pathophysiology and Complication

Diabetes is known to have a strong genetic component with contributing environmental determinants. Although the disease is heterogynous, there appear to be a fairly consistent phenotype once the disease is fully manifested. Whatever the pathogenic cause the early stage of diabetes is characterized by resistance insulin, targeting tissue mainly in liver, skeletal muscle, and adipocytes. Insulin resistance in the tissue is associated with excessive glucose production by the liver and impaired glucose utilization by peripheral tissue, especially muscle.[4-6]

Most of the food we eat is broken down into simply sugar called glucose. The glucose is the main source of fuel to get energy for the body. After digestion, the glucose reaches our blood stream, where it is available for body cells to utilize for energy,

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but insulin is needed for glucose to get into cells. Insulin is a hormone secreted by the pancreas to transport glucose from blood into different cells of the body. If the pancreas does not produce enough insulin or the produced insulin does not work properly, the glucose cannot enter the body cells. So glucose stay in blood cells which makes the blood sugar level high.[7,8]

Thus the body losses the main source of fuel for the energy even though the blood contain high amount of glucose. Since glucose is not metabolized, high amount of glucose circulate in blood, kidney remove extra sugar from blood and excrete it in the urine.[9] Since body does not utilize glucose, the body is under constant impression of hunger that's why in diabetes appetite increases and patient eat more frequently.

With increased insulin secretion to compensate for insulin resistance, base line blood glucose level can be maintained with in the normal range, but the patient may demonstrate impaired response to prandial carbohydrate loading and to oral glucose tolerance test. The chronic over stimulation of insulin secretion gradually diminishes and eventually exhausts the islets beta cells reserve.[10]

The quality of life of diabetic patient with chronic and severe hyperglycemia is adversely affected. Characteristic symptoms of tiredness and lethargy can become severe and lead to a decrease in work performance in adults and an increase of falls in the elderly.[11]

The most common acute complications are metabolic problems (hyperosmolar hyperglycemic non ketonic syndrome or HHNS) and infections. The long-term complications are macrovascular complication, microvascular complications, and diabetic foot.[11]

Conventional Therapy

The general consensus on treatment of type 2 diabetes is that life style management at the forefront of therapy options. In addition to exercise, weight control and medical nutrition therapy, oral glucose lowering drugs, and injections of insulin are the conventional therapies.

Pharmacological treatment is indicated when fasting glucose level exceeds 140 mg/dl the postprandial glucose level exceeds 160 mg/dl or HbAlc exceeds 8 %.[12]

Pharmacological Treatment and Limitations

Oral glucose lowering drugs: Five classes of oral agents are approved for the treatment of diabetes. Oral therapy is indicated in any patients in whom diet and exercise fail to achieve acceptable glycemic control. Although initial response may be good, oral hypoglycemic drugs may lose their effectiveness in a significant percentage of patients. The drug category includes sulfonylurea, biguanide, alpha-glucosidase inhibitor, thiazolidinedione, and meglitinide. These drugs have various side effects such as sulfonylurea causes weight gain due to hyperinsulenemia[13,14] biguanide cause weakness, fatigue, lactic acidosis, alpha glucosidase inhibitor may cause diarrhea while thiazolidinediones may increase LDL-cholesterol level.

Insulin is usually added to an oral agent when glycemic control is suboptimal at maximal dose of oral medication. Weight gain and hypoglycemia are common side effect of insulin.[15-17] Vigorous insulin treatment may also carry an increase in atherogenesis.[16]

Need and Scope of Alternative Medicine

Regardless of the type of diabetes, patients are required to control their blood glucose with medication and/or by adhering to an exercise program and a dietary plan. Due to modernization of lifestyle type 2 diabetes mellitus is becoming a major health problem in developing countries. Patient with type 2 diabetes mellitus are usually placed on a restricted diet and are instructed to exercise the purpose of which primarily is weight control. If diet and exercise fail to control blood glucose at a desired level, pharmacological treatment is prescribed.[18] These treatments have their own drawbacks ranging from development of resistance and adverse effects to lack of responsiveness in a large segment of patient population. Moreover, none of the glucose lowering agents adequately control the hyperlipidemia that frequently met with the disease.[15]

The limitation of currently available oral antidiabetic agents either in terms of efficacy/safety coupled with the emergence of the disease into global epidemic have encouraged alternative therapy that can manage diabetes more efficiently and safely.

Alternative Approach

Complementary and alternative therapy is treatments that are neither widely taught in medical schools nor widely practiced in hospitals. The use of CAM in the worldwide is increasing. In 1997, 42% Americans had used an alternative medical therapy. Total visit to complementary *practitioners* (629 million) exceed total visit to US primary care physicians (386 million).[19] In Canada, a recent survey found that 75% people with diabetes used nonprescribed supplements (herbal, vitamin, mineral, or others) and alternative medications.[20] Overall research indicates that most people who use CAM therapies do so in addition to, rather than in place of conventional medical treatment[20,21] although some do not receive any concurrent conventional medical care.[22] CAM for diabetes have become increasingly popular the last several years. Alternative therapies with antidiabetic activity have been researched relatively, extensively, particularly in India. Ideal therapies should have a similar degree of efficacy without troublesome. Mechanism of Some complementary and alternative therapy used for lowering the blood glucose is summarized in Table 1.

Physical Intervention

Yoga

Yoga is an old, traditional, Indian psychological, physical and spiritual exercise regimen that has been studied for several

Table 1: Complementary and alternative therapy with mechanism for lowering blood glucose

CAT	Mechanism
Yoga	Improve in insulin sensitivity and decline in insulin resistance[30]
Massage	At an injection site increase serum insulin, thereby decrease blood glucose[151]
Acupuncture	Act on pancreas to enhance insulin synthesis, accelerate the utilization glucose, resulting in blood sugar[51]
Aromatherapy	Ameliorate the stress of coping with a lifelong chronic condition such as diabetes[137]
Momordica charantia	Not known (In diabetic rabbit models it possesses a direct action similar to insulin)[152]
Trigonella foenum graceum	Hypoglycemic effect may be mediated through stimulating insulin synthesis and/or secretion from the beta pancreatic cells of Langerhans.[153]
Gymnema sylvestre	This is attributed to the ability of gymnemic acids to delay the glucose absorption in the blood[154]
Azadirachta indica	Not known
L-Carnitine	Effect insulin sensitivity and enhance glucose uptake and storage[155]
Vanadium	Insulin mimetic with up gradation of insulin receptors[156]
Chromium	Facilitates insulin binding and subsequent uptake of glucose into cell[86]
Vitamin E	Potent lipophilic antioxidant activity with possible influences on protein glycation lipid oxidation and insulin sensitivity and secretion[156,86]

decades for its role in the management of several chronic disease including hypertension, asthma, obesity, and psychiatric illness.[23-25]

Additionally yoga has been studied for controlling both the symptom and complication associated with type 2 diabetes mellitus.[26-39] The results from these studies suggest a statistically significant role of yoga in diabetes. Furthermore, yoga practice showed a significant improvement for those diabetic patients with pre-existing complication.[40] Yoga practices have a role even in prevention of diabetes. Yoga helps to regulate the body function and psychic processes, improve well-being and increase lovingly. There are several hypotheses for the biological mechanism that link the benefits of yoga to diabetes management.[30]

One hypothesis points to role of stress and relaxations[41-43] while others suggest that the noninvasive nature of yoga provides excellent support and few side effects to patient already taking medication for diabetes.

Massage therapy

Massage therapy could be incorporated into relaxation therapy, but it also serves another purpose that can be particularly useful for diabetes suffers. Massage has been recommended for diabetes for nearly 100 years.[44] Three published results[45-47] of two trials and one unpublished preliminary study have examined the positive effect of massage on normalizing blood glucose. One trial[48] also assess the improvement in 56% cases of diabetic neuropathy of the lower extremities by syncardial massage.

Several studies have documented the relaxing effect of massage. Massage has been demonstrated to reduce muscle tension in both subjective self-reports[49] an objective electromyographic testing.

Relaxation from massage has been demonstrated to be greater than that brought about from rest alone.[47] Massage can reduce heart rate and blood pressure, two features of the relaxation response.[50]

Additionally, patient massage has been shown to decrease anxiety in a variety of patient population including people with diabetes.[45-47] The extreme stress-reducing benefits of massage have raised the possibility that massage may be of benefits of to people with diabetes by including the relaxation response, thereby controlling the counter-regulatory stress hormones and permitting the body to use insulin more effectively. By skill fully the body's, massage can stimulate better blood movement around the body. Improve circulation can do wonders for diabetic neuropathy and other diabetic-related complications. Even then it is suggested that it is necessary to consult closely with health care team before using massage therapy as a diabetic even for relaxation purpose.

Acupuncture

Acupuncture therapy is a common approach to treating diabetes in China. Acupuncture is best known in the United States as an alternative therapy for chronic pain. However, it has been used for the treatment of diabetes and related complication during the past several decades. Acupuncture may be effective in treating not only diabetes, but also in preventing and managing complication of the disease.[51] A report in the 1994 Journal of traditional Chinese medicine serve as a model of effect of acupuncture on diabetic patients.[52]

The effect of acupuncture on diabetes have been observed experimentally and clinically.[53-56] Animal experiments have shown that acupuncture can activate glucose-6-phosphate and affect hypothalamus.[51] Acupuncture can act on the pancreas to enhance insulin synthesis, increase the number of receptors on target cells, and accelerate the utilization of glucose, resulting in lowering of blood sugar.[51] Data from other studies have shown the beneficial antiobesity effect of acupuncture.[51,57,58] It appears that the therapeutic effect of acupuncture on diabetes is not the result of its action on the single organ but on multiple system. Although acupuncture shown some effect in treating diabetes, its mechanism of action are still obscure.

Medicinal herbs

As per ancient literature, more than 800 plants are reported to have antidiabetic properties.[59] Ethanopharmacological surveys

indicate that more than 1200 plants are used in traditional medicine for their allied hypoglycemic activity.[60] Indian Materia Medica has mentioned numerous dravyas have been reported effective in Madhumeha.[61]

The indigenous diet may not be useful in lowering the blood sugar to the same extent as insulin and other hypoglycemic agent do, but it has some other influences, which may be useful for the management of the disease and its complications.[62] In diabetes, some herbal alternatives are proven to provide symptomatic relief and assist in the prevention of the secondary complication of the disease. Some herbs have also been proven to help in regeneration of ß-cells and in overcoming resistance. In addition to maintaining normal blood sugar level, some herbs are also reported to possess antioxidant activity and cholesterol lowering action. The management of type 2 diabetes mellitus is possible with drug that can lower the blood sugar level in one hand and restore the liver glycogen level on the other hand. In modern system of medicine, there is no drug, which is reported to possess both of the properties.[63] However, the hypoglycemic effect of some herbal extracts have been confirmed in human and animal models of type 2 diabetes and conventional drugs have been derived from the active molecule of these medicinal plants. Metformin, a less toxic biguanide and potent oral glucose lowering agents, was developed from Galega officinalis and used to treat diabetes.[64-68]

To the date, over 400 traditional plant treatments for diabetes have been reported,[65] although only a small number of these have received scientific and medicinal evaluation to assess their efficacy. The following is a summary of several of the most studied and commonly used medicinal herbs.

Momordica charantia

Momordica charantia, also known as bitter melon, has been used extensively in folk medicine as a remedy for diabetes. The blood sugar lowering action of fresh juice or unripe fruit has been established in animal experimental models as well as human clinical trials.[69-74]

It is composed of several compounds with confirmed antidiabetic activity. Alcohol-extracted charantin and *M. charantia* consist of mixed steroids was found to be more potent than the oral hypoglycemic agent tolbutamide in an animal study.[75]

Trigonella foenum graecum

Commonly known as Fenugreek, popular for its pungent aromatic properties and is often used to add flavors in homes.

It has been used as a remedy for diabetes, particularly in India.[76] The active principle is in the defatted portion of the seed, which contains the alkaloid gonelline, nicotinic acid and coumarin. Several animal experimental studies confirmed the antidiabetic potential of *T. foeneum graecum*.[15-18,77]

Human studies have confirmed the glucose and lipid-lowering test.[78] At least 50% of seeds is fiber and may constitute another potential mechanism of Fenugreek's beneficial effect in diabetic patients.[79]

In type 2 diabetes patients, the ingestion of 15 g of powder of Fenugreek seed soaked in water significantly reduced postprandial glucose levels during the glucose tolerance test.[79]

Gymnema sylvestre: Commonly known as Gurmar, has long been used as a treatment for diabetes. It appeared on the US market several years ago, known as a "Sugar blocker." In a study of type 2 diabetes, 22 patients were given 400 mg *Gymnema sylvestre* extract daily along with their oral hypoglycemic drugs. All patients demonstrated improved blood sugar control. Twenty one of 22 were able to discontinue oral medication and maintain blood sugar control with the Gymnema extract alone.[80] It was postulated that Gymnema sylvestre enhance the production of endogenous insulin.[81]

Azadirachta indica: Commonly known as neem. It has been long used as a treatment for diabetes. Aqueous extract of neem leaves significantly decreases blood sugar level and prevents adrenaline as well as glucose-induced hyperglycaemia.[82] Aqueous leaf extract also reduces hyperglycaemia in streptozotocin diabetes and the effect is possibly due to presence of a flavonoid, quercetin.[83] The plant blocks the action of epinephrine on glucose metabolism, thus increasing peripheral glucose utilization.[11] It also increased glucose uptake and glycogen deposition in isolated rat hemi diaphragm.[12]

Other plants which are most effective and the most commonly used in treatment of diabetes are summarized in Table 2. All plants have shown varying degree of hypoglycemic and anti-hyperglycemic activity.[84]

Dietary Supplement

Vitamins and minerals are micronutrients that our body requires

Table 2: Herbs used for antihyperglycemic activity

Herbs used for diabetes	Common name	Parts used
Momordica charantia	Bitter lemon	Fruit
Trigonella foenum graceum	Fenugreek	Seed
Gymnema sylvestre	Gurmar	Leaf
Azadirachta indica	Neem	Leaf
Allium sepa	Onion	Bulb
Allium sativum	Garlic	Bulb
Aloe vera	Ghikumari	Leaf
Cajanus cajan	Tuar	Seed
Coccinia indica	Kundru	Fruit
Caesalpinia bonducella	Kanderi	Bulb
Ficus benghalensis	Banyan Tree	Leaf
Ocimum sanctum	Tulsi	Leaf
Pterocarpus marsupium	Banda	Leaf
Swetria chirayita	Chirata	Leaf
Syzigium cumini	Jamun	Fruit
Tinospora cordifolia	Giloe	Leaf
Eugenia jambolana	Amrut	Fruit
Mucuna pruriens	Kiwanch	Leaf
Murraya koeingii	The curry tree	Leaf
Brassica juncea	Indian mustard	Leaf

in small quantities for specific function. They most commonly function as essential co enzyme and co factor for metabolic reaction and thus help supports basic cellular reactions. Micronutrients have been investigated as potential preventive and treatment agents for both type 1 and type 2 diabetes and for common complication of diabetes.[85,86]

Chromium

The trace element trivalent chromium (Cr^{3+}) for is an essential micronutrient for human. It is required for the maintenance of normal glucose metabolism.[87] Effects of chromium on glycemic control, dislipidemia, weight loss, body composition, and bone density have all been studied.[88] Considerable experimental and epidemiological evidence now indicates that chromium level are a major determinant of insulin sensitivity, as it functions as a cofactor in all insulin regulating activities.[89] Chromium facilitate insulin binding and subsequent uptake of glucose into the cell. Supplemental chromium has been shown to decrease fasting glucose level, improve glucose tolerance, lower insulin levels, and decrease total cholesterol and triglycerides while increases HDL cholesterol in normal, elderly, and type 2 diabetic subjects.[90] Without chromium insulin action is blocked and glucose level is elevated.[86] Although low recommended daily allowance has been established for chromium over 200 mg/day appears necessary for optimal blood sugar regulation. A good supply of chromium is assured by supplemental chromium[91] because chromium appears to increase the activity of insulin receptor, it is logical to expect that adequate level of insulin must also be present. Patient using chromium supplement should be cautioned about the potential for hypoglycemia, and monitoring renal function is prudent.

Vanadium

The trace element vanadium has not been established as an essential nutrients and human deficiency has not been documented.[88,92] Vanadium exist in natural valence state with vanadate(+4) and vanadyl (+5) forms most common in biological system.

Several small trials[93-96] have evaluated the use of oral vanadium supplements in diabetes most focus on type-2 diabetes[93] although animal study suggests that vanadium has also potential benefits in type 1 diabetes.[97] In subject with type 2 diabetes, vanadium increased insulin sensitivity as assessed by euglycemic hyperinsulinimic clamp studies in some[93-95] but not all[96] trials. Two small studies have confirmed the effectiveness of vanadyl sulphate at a dose of 100 mg/day in improving insulin sensitivity.[94,95]

Magnesium

The mineral magnesium functions as an essential cofactor for more than 300 enzymes. Magnesium is one of the more common micronutrient deficiency in diabetes.[85,86,98,99] Low dietary magnesium intake has been associated with increased incidence of type 2 diabetes in some[100] but not in all[101] studies. Magnesium deficiency has been associated with complication of diabetes, retinopathy in particular. One study found patients with the most severe retinopathy were also lowest in magnesium.[102]

Nicotinamide

Niacin (Vitamin B3) occurs in two forms, nicotinic acid and nicotinamide. The active coenzyme forms (nicotinamide adenine dinucleotide NAD and NAD phosphate) are essential for the functions of hundreds of enzymes and normal carbohydrate, lipid and protein metabolism.[103] The effects of nicotinamide supplementation have been studied in several trials focusing on the development [104-107] and progression[108-110] of type 1 diabetes a meta analysis[111] and one small trial in type 2 diabetes.[112]

Nicotinamide appears to be most effective in newly diagnosed diabetes and in subjects with positive islets cell antibodies but not diabetes. People who develops type 1 diabetes after puberty appear to be more responsive to nicotinamide treatment.[108-111] Study results have offered more support for the idea that nicotinamide help to preserve β-cell function[109] than for its possible role in diabetes prevention.[113]

Vitamin E

This essential fat soluble vitamin functions primarily as an antioxidant.[114] low levels of vitamin E are associated with increased incidence of diabetes[115] and some research suggest that people with diabetes have decreased levels of antioxidants.[116] People with diabetes may also have greater antioxidant requirement because of increased free radical production with hyperglycemia.[117,118]

Increased levels of oxidative stress markers have been documented in people with diabetes.[119,120] Improvement in glycemic control decrease markers of oxidative stress as does vitamin supplementation.[117-122]

Clinical trials involving people with diabetes have investigated the effect of vitamin E on diabetes prevention[123] insulin sensitivity[124,125] glycemic control,[126-128] protein glycation,[129] microvascular complication of diabetes,[130,131] and cardiovascular disease and its risk factor.[121,122,132,133]

Miscellaneous approach

Aromatherapy

Aromatherapy has a long history of use;[134] clinical aromatherapy is the therapeutic use of essential oils, the efficacy of which is supported by research data. In aroma therapy, essential oils are inhaled or diluted and applied topically to the skin depending on the symptom. Essential oils are usually available in specialist and health shops and it is claimed that different oil impact on the mind and body in different ways. Oil may stimulate relax, sedate, sanitize and much more. All oils have a fragrance and a chemistry that can lead to a range of responses that affect the

therapeutic effect.[135] Essential oils can be used to reduce the side effects of some complication (ulcer: loss of skin integrity) and to reduce that often take longer to resolve than in non diabetic patients.[136] Essential oil can also ameliorate the stress of the coping with a lifelong chronic condition such as diabetes.[137] To use aromatherapy for stress put 3-5 drops of an undiluted essential oil on a handkerchief or cotton ball and ask the patients to hold the handkerchief to his/her nose and breathe slowly for 5 min. This treatment can be repeated every four hour or more frequently when necessary. Some essential oil when mixed in correct measures may help some diabetics particularly when used in conjunction with massage therapy. These include Eucalyptus, Juniper and Geranium oil.

However, before any aromatherapy is used to help diabetic person, it is vital to consult with diabetic health care team.

Biofeedback

Management of type 2 diabetes requires continuous monitoring and multiple interventions to prevent long term complication.[138] One of the contributing factors in the etiology of glucose intolerance and poor glycemic control in individuals with diabetes is stress response.[139,140]

Stress management is a generic term that may encompass biofeed back, relaxation, cognitive behavioral therapy, and imagery. Biofeed back is a therapeutic technique involving an instrument that provides information about psychological activity such as skin temperature or muscle tension, with the objective of learning control over maladaptive response to stress.

Evaluation of stress management in diabetic patients showed the small but significant decrease in glycohemoglobin after 1 year.[141] In a controlled study of bio-feedback-assisted relaxation therapy in type 1 diabetes.[141-143] decrease in blood glucose were found in the treated group compared with a wait list control groups. The moderating effects of mood on glycemic control highlight the complex relationship between depression and diabetes.[141-144]

Use of biofeed back and relaxation for three months in diabetic patients were associated with significant decrease in average blood glucose in comparison to control.[145] The prevalence of mood and anxiety disorders is higher in individuals with type 2 diabetes in caparison to general population.[146] So further research is necessary to determine the long term effect of bio feedback on patient's response to treatment.

Hydrotherapy

Hydrotherapy is the treatment of illness and injury through the use of water both hot and cold. Hydrotherapy helps the body to get rid of toxins and relax muscle. It also relaxes body both mentally and physically.

Since hot-tub therapy can increase both flow to skeletal muscle, it has been recommended for the patients with type 2 diabetes who are unable to exercise.[147] A study reported that eight patients were asked to sit in a hot tub at an athletic facility with water up to their shoulders for 30 min for three weeks. During the study the patients weight, mean plasma glucose level and their mean Glycosylated hemoglobin decreased.[15] Caution should be taken that the water not to be too hot as neuropathy may prevent the patient from noticifying they are burning themselves. Hot-tub therapy should be further evaluated as a therapy for patients with type 2 diabetes mellitus. The benefit could result from increased blood flow to skeletal muscle.[148]

Proper water sanitation and appropriate guidance should be considered when prescribing hot-tub therapy for diabetic patients.[149]

Chromotherapy

Chromotherapy involves therapeutic use of colors. According to this system, the cause of any disease can be treated by the lack of color harmony in the human system and this imbalance can be removed by the use of colored light to the body.

Color therapy uses sensitive to color to identify and correct any imbalance in body's internal energy pattern that might lead to physical ill health. Therapist believe that each organ and body system has its own characteristic vibrational energy and disorder can be healed by applying color of corresponding vibrational energy, either to whole body or to organs.

According to chromotherapy, diabetes is generally caused by a deficiency of orange and yellow colors in the body. There are two methods of treating disease by color, by application of light filtered through different colored glasses and by the external or internal use of color charged water.

Lemon yellow is the color the pancreas. It is a laxative and diuretic. It is a stimulant of brain, the liver and spleen. Green and orange are also helpful in controlling diabetes.[150]

Conclusion

Alternative therapies with antihyperglycemic effects are increasingly sought by patient with diabetes. This comes as no surprise sinic alternative treatments have been most widely used in chronic disease, which may be only partially alleviated by conventional treatment. Herbal medications are the most commonly used alternative therapy for blood sugar control. Scientific validation of several Indian plant species has provided the efficacy of the botanicals in reducing the sugar level. However, their safely and efficacy need to be further evaluated by well designed, controlled clinically because various non-standardized forms of the herbs have of been the testing material, the result have been difficult to replicates; therefore, preparations of standardized medicinal herbs is urgently needed in future studies and therapies several dietary supplements have been found to benefit people with diabetes, either because of potential or because of the beneficial effect on glucose metabolism. among the most important dietary supplements are chromium magnesium, vanadium, nicotinamide, and

vitamin E. Other potential alternative treatments for diabetes include acupuncture, hydrotherapy, massage therapy, yoga and Chromotherapy, etc.

References

1. Qureshi SA, Asad W, Sultan V. The effect of *Phyllantus emblica* Linn. On type II diabetes, triglycerides and liver specific enzyme. Pak J Nutr 2009;8:125-8.
2. "Diabetes Mellitus", World Health Organization Fact Sheet 1999, No. 138.
3. "Diabetes Mellitus", American Diabetes Association - General Fact Sheet, 1999.
4. Chattopadhyay RR, Chattopadhyay RN, Nandy AK, Poddar G, Maitra SK. Preliminary report on antihyperglycemic effect of a fraction of fresh leaves of *Azadirachta indica* (Beng.Neem). Bull Calcutta Sch Trop Med 1987;35:29-33.
5. Khosla P, Bhanwra S, Singh J, Seth S, Srivastava RK. A study of hypoglycemic effects of *Azadirachta indica* (Neem) in normal and alloxan diabetic rabbits. Indian J Physiol Pharmacol 2000;44:69-74.
6. Pillai NR, Santhakumari G. Hypoglycemic Activty of melia Azadirechta Linn (neem). Indian J Med Res 1981;74:931-3.
7. Edwin E, Sheeja E, Gupta VB, Jain DC. Fight Diabetes the herbal way. Express Pharma Pulse 2006;1:41-2.
8. Andrew JK. Diabetes. New York: Churchill living stone; 2000.
9. Alam K, Mahpara S. Role of diet, nutrients, spices and natural products in diabetes mellitus. Pak J Nutr 2003;2:1-12.
10. Clark CM Jr. The burden of chronic hyperglycemia. Diabetes Care 1998;21 Suppl 3:C32-4.
11. Chattopadhyay RR. Possible mechanism of antihyperglycemic effect of *Azadirachta indica* leaf extract. Part IV. Gen Pharmacol 1996;27:431-4.
12. Chattopadhyay RR, Chattopadhyay RN, Nandy AK, Poddar G, Maitra SK. The effect of fresh leaves of *Azadirachta indica* on glucose uptake and glycogen content in the isolated rat hemi diaphragm. Bull Calcutta Sch Trop Med 1987;35:8-12.
13. Dorababu M, Prabha T, Priyambada S, Agrawal VK, Aryya NC, Goel RK. Effect of Bacopa monniera and *Azadirachta indica* on gastric ulceration and healing in experimental NIDDM rats. Indian J Exp Biol 2004;2:389-97.
14. Halim EM. Lowering of blood sugar by water extract of *Azadirachta indica* and *Abroma augusta* in diabetes rats. Indian J Exp Biol 2003;41:636-40.
15. Zia T, Hasnain SN, Hasan SK. Evaluation of the oral hypoglycemic effect of *Trigonella foenum-graecum* in normal mice. J Ethanopharmacol 2001;75:191-5.
16. Ribes G, Sauvaire Y, Da Costa C, Baccou JC, Loubatieres- Mariani MM. Antidiabetic effects of subfractions from fenugreek seeds in diabetic dogs. Proc Soc Exp Biol Med 1986;182:159-66.
17. Abdel-Barry JA, Abdel-Hassan IA, Al-Hakiem MH. Hypoglycemic and antihyperglycemic effects of *Trigonella foenum- graecum* leaf in normal and alloxan induced diabetic rats. J Ethnopharmacol 1997;58:149-55.
18. Khosla P, Gupta DD, Nagpal RK. Effect of *Trigonella foenum graecum* (Fenugreek) on blood glucose in normal and diabetic rats. Indian J Physiol Pharmacol 1995;39:173-4.
19. Eisenberg DM, Davis RB, Ettner SL, Appel S, Wilkey S, Van Rompay M, *et al*. Trends in alternative medicine use in the United States, 1990-1997: Results of a follow-up national survey. JAMA 1998;280:1569-75.
20. Ryan EA, Pick ME, Marceau C. Use of alternative medicines in diabetes mellitus. Diabet Med 2001;18:242-5.
21. Astin JA. Why patients use alternative medicine: Results of a national survey. JAMA 1998;279:1548-53.
22. Eisenberg DM, Kessler RC, Foster C, Norlock FE, Calkins DR, Delbanco TL. Unconventional medicine in United States: Prevelance, cost and pattern use. N Engl J Med 1993;328:246-52.
23. Ramaratnam S, Sridharan K. Yoga for epilepsy. Cochrane Database of Systematic Reviews 2002, Issue 1. Art.No.: CD001524 DOI: 10.1002/14651858.CD001524
24. Sabina AB, Williams A, Wall HK, Bansal S, Chupp G, Kartz DL. Yoga intervention for adults with mild to moderate asthma: A pilot study. Ann Allergy Asthma Immunol 2005;94:543-8.
25. Gupta N, Khera S, Vempati RP, Sharma R, Bijlani RL. Effect of yoga based lifestyle intervention on state and trial anxiety. Indian J Physiol Pharmacol 2006;50:41-7.
26. Malhotra V, Singh S, Tandon OP, Madhu SV, Prasad A, Sharma SB. Effect of yoga asanas on nerve conduction in type 2 diabetes. Indian J Physiol Pharmacol 2002;46:298-306.
27. Malhotra V, Singh S, Tandon OP, Sharma SB. The beneficial effect of yoga in diabetes. Nepal Med Coll J 2005;7:145-7.
28. Sahay BK, Sahay RK. Lifestyle modification in management of diabetes mellitus. J Indian Med Assoc 2002;100:178-80.
29. Manyam BY. Diabetes mellitus, Ayurveda, and yoga. Comment. J Altern Complement Med 2004;10:223-5.
30. Sahay BK. Role of yoga in diabetes. J Assoc Physicians India 2007;55:121-6.
31. Dham S, Shah V, Hirsch S, Banerji MA. The role of complementary and alternative medicine in diabetes. Curr Diab Rep 2006;6:251-8.
32. Gupta SM. Modern medicine and yoga. J Intern Med India 2001;4:155-6.
33. Kaplan-Mayer G. Get moving with yoga. Diabetes Self Manag 2003;20:28,31-3.
34. Khalsa SB. Yoga as a therapeutic intervention: A bibliometric analysis of published research studies. Indian J Physiol Pharmacol 2004;48:269-85.
35. Nagarathna R, Nagendra HR. Integrated approach of yoga therapy in the management of diabetes mellitus. Proceedings of the Ninth Annual Conference of the IEEE Engineering in Medicine and Biology Conference. New York, NY, USA: IEEE 1987. p. 1593-4.
36. Nayak NN, Shankar K. Yoga: A therapeutic approach. Phys Med Rehabil Clin N Am 2004;15:783-98.
37. Shembekar AG, Kate SK. Yoga exercises in the management of diabetes mellitus. J Diabetic Assoc India 1980;20:167-71.
38. Singh S, Malhotra V, Singh KP, Madhu SV, Tandon OP. Role of yoga in modifying certain cardiovascular functions in type 2 diabetic patients. J Assoc Physicians India 2004;52:203-6.
39. Stevens DL. The use of complementary and alternative therapies in diabetes. Clin Fam Prac 2002;4:911-28.
40. Innes KE, Bourguignon C, Taylor AG. Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: A systematic review. J Am Board Fam Pract 2005;18:491-519.
41. Surwit RS, Schneider MS. Role of stress in the etiology and treatment of diabetes mellitus. Psychosom Med 1993;55:380-93.
42. Jablon SL, Naliboff BD, Gilmore SL, Rosenthal MJ. Effects of relaxation training on glucose tolerance and diabetic control in type II diabetes. Appl Psychophysiol Biofeedback 1997;22:155-69.
43. Da Silva GD, Lorenzi-Filho G, Lage LV. Effects of yoga and the addition of Tui Na in patients with fibromyalgia. J Altern Complement Med 2007;13:1107-13.
44. Elson DF, Meredith M. Therapy for type II diabetes mellitus. Wis Med J 1998;97:49-54.
45. Field T. Massage therapy for infants and children. J Dev Behav Pediatr 1995;16:105-11.
46. Field T, Hernandez RM, LaGreca A, Shaw K, Schlanberg S, Kuhn C. Massage therapy lowers blood glucose levels in children with diabetes mellitus. Diabetes Spectrum 1997;10:237-9.
47. Vest G. Acupressure, breath awareness help diabetes patients. Massage Magzine 2000;86:64.
48. Valtonen EJ, Lilius HG. Syncardial massage in diabetic and other neuropathies lower extremities. Dis Nerv Syst 1973;34:192-4.
49. Matheson DW, Edelson R, Hiatrides D, Newkirk J, Twinem K, Thruston S. Relaxation measured by EMG as a function of vibroactile stimulation. Biofeedback Self Regul 1976;1:285-92.
50. Yates J. A physician's guide to therapeutic massage: Its physiological effects and their application to treatment. Vancover, British Columbia, Massage Therapists' Association of British Columbia, 1990.
51. Hu H. A review of treatment of diabetes by acupuncture during the past forty years. J Tradit Chin Med 1995;15:145-54.
52. Chen D, Gong D, Zhai Y. Clinical and experimental studies in treating diabetes mellitus with acupuncture. J Tradit Chin Med 1994;14:163-6.
53. Chen JF, Wei J. Changes of plasma insulin level in diabetics treated with acupuncture. J Tradit Chin Med 1985;5:79-84.
54. Huang KC. Diabetes mellitus. In: Huang KC, editor. Acupuncture: The Past and the Present, 1st ed. New York: Vantage Press; 1996. p. 202.
55. Chen JF. A hemorrheological study on the effect of acupuncture in treating diabetes mellitus. J Tradit Chin Med 1987;7:95-100.

56. Han DW, Xu RL. Progress in the research of blood activation and hemostasis removal. Abstr Chin Med 1988;2:466-83.
57. Hou AL. Blood sugar response of diabetes to acupuncture of sanyinjiao. Int J Clin Acupunct 1993;4:361-4.
58. Liu ZC, Sun FM. Acupuncture treatment of non-insulin-dependent diabetes mellitus: A clinical study. Int J Clin Acupunct 1994;5:249-59.
59. Eddouks M, Maghrani M. Phlorizin-like effect of *Fraxinus excelsior* in normal and diabetic rats. J Ethnopharmacol 2004;9:149-54.
60. Kesari AN, Kesari S, Santosh KS, Rajesh KG, Geeta W. Studies on the glycemic and lipidemic effect of *Murraya koenigii* in experimental animals. J Ethnopharmacol 2007;112:305-11.
61. Sabu MC, Subburaju T. Effect of *Cassia auriculata* Linn. on serum glucose level, glucose utilization by isolated rat hemidiaphragm. J Ethnopharmacol 2002;80:203-6.
62. Subbulakshmi G, Naik M. Indigenous foods in the treatment of diabetes mellitus. Bombay Hosp J 2001;43:548-61.
63. Shrabana C, Tuhin KB, Begum R, Liaquat A, Mosihuzzaman M, Nilufer N, *et al*. Advanced studies on the hypoglycemic effect of *Caesalpinia bonducella* F. in type 1 and 2 diabetes in Long Evans rats. J Ethnopharmacol 2003;84:41-6.
64. Fabricant DS, Farnsworth NR. The value of plants used in traditional medicine for drug discovery. Environ Health Perspect 2001;109 Suppl 1:69-75.
65. Bailey CJ, Day C. Traditional plant medicines as treatments for diabetes. Diabetes Care 1989;12:553-64.
66. British Herbal Medicine Association. British Herbal Pharmacopoeia. Keighley, UK;1979.
67. Petricic J, Kalogjera Z. Bestimmung des galegins und die antidiabetische wirkung droge herba galegae. Planta Med 1982;45:410.
68. Sterne J. Pharmacology and mode of action of the hypoglycemic guanidine derivatives. In: Campbell GD, editor. Oral Hypoglycemic Agents. New York, NY: Academic Press; 1969. p. 193-245.
69. Karunanayake EH, Jeevathayaparan S, Tennekoon KH. Effect of *Momordica charantia* fruit juice on Streptozotocin induced diabetes in rats. J Ethnopharmacol 1990;30:199-204.
70. Khanna P, Jain SC, Panagariya A, Dixit VP. Hypoglycemic activity of polypeptide-p from a plant source. J Nat Prod 1981;44:648-55.
71. Bailey CJ, Day C, Turner SL, Leatherdale BA. Cerasee, a traditional treatment for diabetes. Studies in normal and streptozotocin diabetic mice. Diabetes Res 1985;2:81-4.
72. Singh N, Tyagi SD, Agarwal SC. Effects of long term feeding of acetone extract of *Momordica charantia* (whole fruit powder) on alloxan diabetic albino rats. Indian J Physiol Pharmacol 1989;33:97-100.
73. Jayasooriya AP, Sakono M, Yukizaki C, Kawano M, Yamamoto K, Fukuda N. Effects of *Momordica charantia* powder on serum glucose levels and various lipid parameters in rats fed with cholesterol-free and cholesterol-enriched diets. J Ethnopharmacol 2000;72:331-6.
74. Ahmad N, Hassan MR, Halder H, Bennoor KS. Effect of *Momordica charantia* (Karella) extracts on fasting and postprandial serum glucose levels in NIDDM patients. Bangladesh Med Res Counc Bull 1999;25:11-3.
75. Sarkar S, Pranava M, Marita R. Demonstration of the hypoglycemic action of *Momordica charantia* in a validated animal model of diabetes. Pharmacol Res 1996;33:1-4.
76. Miller LG. Herbal medications, nutraceuticals, and diabetes. In: Miller LG, Murray WJ, editors. Herbal Medicinals, A Clinician's Guide. Binghamton, NY: Pharmaceutical Products Press, Imprint of the Haworth Press, Inc.; 1998. p. 115-33.
77. Ribes G, Sauvaire Y, Baccou JC, Valette G, Chenon D, Trimble ER, *et al*. Effects of fenugreek seeds on endocrine pancreatic secretions in dogs. Ann Nutr Metab 1984;28:37-43.
78. Sharma RD, Raghuram TC, Rao NS. Effect of fenugreek seeds on blood glucose and serum lipids in type I diabetes. Eur J Clin Nutr 1990;44:301-6.
79. Madar Z, Abel R, Samish S, Arad J. Glucose-lowering effect of fenugreek in noninsulin dependent diabetics. Eur J Clin Nutr 1988;42:51-4.
80. Baskaran K, Kizar Ahamath B, Radha Shanmugasundaram K, Shanmugasundaram ER. Antidiabetic effect of a leaf extract from *Gymnema sylvestre* in non-insulindependent diabetes mellitus patients. J Ethnopharmacol 1990;30:295-300.
81. Shanmugasundaram ER, Rajeswari G, Baskaran K, Rajesh Kumar BR, Radha Shanmugasundaram K, Kizar Ahmath B, *et al*. Use of *Gymnema sylvestre* leaf extract in the control of blood glucose in insulin-dependent diabetes mellitus. J Ethnopharmacol 1990;30:281-94.
82. Murty KS, Rao DN, Rao DK, Murty LBG. A prelimnary study of hypoglycemic and antihyperglycemic activity of *Azadirachata indica*. Indian J Pharmacol 1978;10:247–250
83. Chakraborty T, Uerotta L, Poddar G, Evaluation of *Azadirachta indica* leaf extract for hypoglycemic activity in rats Phytother. Res 1989;3:30-32
84. Grover JK, Yadav S, Vats V. Medicinal plants of India with anti-diabetic potential. J Ethnopharmacol 2002;81:81-100.
85. Franz MJ, Bantle JP. American Diabetes Association Guide to Medical Nutrition Therapy for Diabetes. Alexandria Va., American Diabetes Association;1999.
86. Mooradian AD, Failla M, Hoogwerf B, Marynuik M, Wylie-Rosett J. Selected vitamins and minerals in diabetes. Diabetes Care 1994;17:464-79.
87. Anderson RA. Chromium, glucose intolerance and diabetes. J Am Col Nutr 1998;17:548-55.
88. Sarubin A. The Health Professional's Guide to Popular Dietary Supplements. Chicago, The American Dietetic Association; 2000.
89. Offenbacher EG, Pi-Sunyer FX. Beneficial effect of chromium-rich yeast on glucose tolerance and blood lipids in elderly subjects. Diabetes 1980;29:919-25.
90. Baker B. Chromium supplements tied to glucose control. Fam Pract News 1996;15:5.
91. Anderson RA, Bryden NA, Polansky MM. Dietary chromium intake. Freely chosen diets, institutional diet, and individual foods. Biol Trace Elem Res 1992;32:117-21.
92. Harland BF, Harden-Williams BA. Is vanadium of nutritional importance yet? J Am Diet Assoc 1994;94:891-4.
93. Goldfine A, Simonson D, Folli F, Patti ME, Kahn R. Metabolic effects of sodium metavanadate in humans with insulin-dependent and noninsulin dependent diabetes mellitus *in vivo* and *in vitro* studies. J Clin Endocrinol Metab 1995;80:3311-20.
94. Halberstam M, Cohen N, Shlimovich P, Rossetti L, Shamoon H. Oral vanadyl sulfate improves insulin sensitivity in NIDDM but not obese nondiabetic subjects. Diabetes 1996;45:659-66.
95. Cohen N, Halberstam M, Schilmovich P, Chang CJ, Shamoon H, Rosetti L. Oral vanadyl sulfate improves hepatic and peripheral insulin sensitivity in patients with non-insulin dependent diabetes mellitus. J Clin Invest 1995;95:2501-9.
96. Boden G, Chen X, Ruiz J, van Rossum GD, Turco S. Effects of vanadyl sulfate on carbohydrate and lipid metabolism in patients with noninsulin dependent diabetes mellitus. Metabolism 1996;45:1130-5.
97. Poucheret P, Verma S, Grynpas MD, McNeil JH. Vanadium and diabetes. Mol Cell Biol 1998;188:73-80.
98. de Valk H. Magnesium in diabetes mellitus. J Med 1999;54:139-46.
99. American Diabetes Association. Magnesium supplementation in the treatment of diabetes (Consensus statement). Diabetes Care 1992;15:1065-7.
100. Meyer KA, Kushi LH, Jacobs DR, Slavin J, Sellers TA, Folsom AR. Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. Am J Clin Nutr 2000;71:921-30.
101. Kao WH, Folsom AR, Nieto FJ, Mo JP, Watson RL, Brancati FL. Serum and dietary magnesium and the risk of type 2 diabetes mellitus: The atherosclerosis risk in communities (ARIC) study. Arch Intern Med 1999;159:2151-9.
102. McNair P, Christiansen C, Madsbad S, Lauritzen E, Faber O, Binder C, *et al*. Hypomagnesemia, a risk factor in diabetic retinopathy. Diabetes 1978;27:1075-7.
103. Cam MC, Brownsey RW, McNeil JH. Mechanisms of vanadium action: Insulin mimetic or insulin-enhancing agent? Can J Physiol Pharmacol 2000;78:829-47.
104. Greenbaum CJ, Kahn SE, Palmer JP. Diabetes 1996;45:1631-4.
105. Lampeter EF, Klinghammer A, Scherbaum WA, Heinze E, Haastert B, Giani G, *et al*. The deutsch nicotinamide intervention study: An attempt to prevent type 1 diabetes. DENIS Group.Diabetes 1998;47:980-4.
106. Elliott RB, Pilcher CC, Fergusson DM, Stewart AW. A population-based strategy to prevent insulin-dependent diabetes using nicotinamide. J Pediatr Endocrinol Metab 1996;9:501-9.
107. Gale EA. Nicotinamide: Potential for the prevention of type 1

diabetes? Horm Metab Res 1996;28:361-4.
108. Pozzilli P, Vissali N, Girhlanda G, Manna R, Andreani D. Nicotinamide increases C-peptide secretion in patients with recent onset type 1 diabetes. Diabet Med 1989;6:568-72.
109. Pozzilli P, Vissali N, Signore A, Baroni MG, Buzzetti R, Cavallo MG, *et al*. Double-blind trial of nicotinamide in recent onset IDDM (the IMDIAB III study). Diabetologia 1995;38:848-52.
110. Vissali N, Cavallo MG, Signore A, Baroni MG, Buzzetti R, Fioriti E, *et al*. A multi-center, randomized trial of two different doses of nicotinamide in patients with recent-onset type 1 diabetes (the IMDIAB VI). Diabetes Metab Res Rev 1999;15:181-5.
111. Pozzolli P, Browne PD, Kolb H. The Nicotinamide Trialists: Meta-analysis of nicotinamide treatment in patients with recent-onset IDDM. Diabetes Care 1996;19:1357-63.
112. Polo V, Saibene A, Pontiroli AE. Nicotinamide improves insulin secretion and metabolic control in lean type 2 patients with secondary failure to sulphonylureas. Acta Diabetol 1998;35:61-4.
113. Kolb H, Volker B. Nicotinamide in type 1 diabetes mechanism of action revisited. Diabetes Care 1999;22 (Suppl. 2):B16-20.
114. Shils ME, Olson JA, Shike M, Ross AC. Modern Nutrition in Health and Disease. 9th ed. Philadelphia Pa: Lea and Febiger; 1999.
115. Salonen JT, Nyyssonen K, Tuomainen TP, Maenpaa PH, Korpela H, Kaplan GA, *et al*. Increased risk of noninsulin-dependent diabetes mellitus at low plasma vitamin E concentrations: A four-year study in men. BMJ 1995;311:1124-7.
116. Polidori MC, Mecocci P, Stahl W, Parente B, Cecchetti R, Cherubini A, *et al*. Plasma levels of lipophilic antioxidants in very old patients with type 2 diabetes. Diabetes Metab Res Rev 2000;16:15-9.
117. Sharma A, Kharb S, Chugh SN, Kakkar R, Singh GP. Evaluation of oxidative stress before and after control of glycemia and after vitamin E supplementation in diabetic patients. Metabolism 2000;49:160-2.
118. Ceriello A, Bortolotti N, Motz E, Crescentini A, Lizzio S, Russo A, *et al*. Meal-generated oxidative stress in type 2 patients. Diabetes Care 1998;21:1529-33.
119. Santini SA, Marra G, Giardina B, Cottroneo P, Mordente A, Martorana GE, *et al*. Defective plasma antioxidant defenses and enhanced susceptibility to lipid peroxidation in uncomplicated IDDM. Diabetes 1997;46:1853-8.
120. Ceriello A, Bortolotti N, Falleti E, Taboga C, Tonutti L, Crescentini A, *et al*. Total radical-trapping antioxidant parameter in non-insulin dependent diabetic patients. Diabetes Care 1997;20:194-7.
121. Reaven PD, Herold DA, Barnett J, Edelman S. Effects of vitamin E on susceptibility of low-density lipoprotein and low-density lipoprotein subfractions to oxidation and on protein glycation in NIDDM. Diabetes Care 1995;18:807-16.
122. Devaraj S, Jialal I. Low-density lipoprotein postsecretory modification, monocyte function, and circulating adhesion molecules in type 2 diabetic patients with and without macrovascular complications. Circulation 2000;102:191-6.
123. Pozzolli P, Vissali N, Cavallo MG, Signore A, Baroni MG, Buzzetti R, *et al*. Vitamin E and nicotinamide have similar effects in maintaining residual _ cell function in recent onset insulin-dependent diabetes (The IMDIAB IV study). Eur J Endocrinol 1997;137:234-9.
124. Paolisso G, D'Amore A, Giugliano D, Cereillo A, Varricchio M, D'Onofrio F. Pharmacological doses of vitamin E improve insulin action in healthy subjects and non-insulin dependent diabetic patients. Am J Clin Nutr 1993;57:650-6.
125. Skrha J, Sindelka G, Kvasnicka J, Hilgertova J. Insulin action and fibrinolysis influenced by vitamin E in obese type 2 diabetes mellitus. Diabetes Res Clin Pract 1999;44:27-33.
126. Gómez-Pérez FJ, Valles-Sanchez VE, López-Alvarenga JC, Choza-Romero R, Ibarra Pascuali JJ, González Orellana R, *et al*. Vitamin E modifies neither fructosamine nor HbA1c levels in poorly controlled diabetes. Rev Invest Clin 1996;48:421-4.
127. Jain SK, McVie R, Jaramillo JJ, Palmer M, Smith T. Effect of modest vitamin E supplementation on blood glycated hemoglobin and triglyceride levels and red cell indices in type 1 diabetic patients. J Am Coll Nutr 1996;15:458-61.
128. Paolisso G, D'Amore A, Galzerano D, Balbi V, Giugliano D, Varriccho M, *et al*. Daily vitamin E supplements improve metabolic control but not insulin secretion in elderly type 2 diabetic patients. Diabetes Care 1993;16:1433-7.
129. Cerillo A, Giugliano D, Quataro A, Donzella C, Dipalo G, Lefebrve PJ. Vitamin E reduction of protein glycosylation in diabetes. New prospect for prevention of diabetic complications? Diabetes Care 1991;14:68-72.
130. Tutuncu NB, Bayraktar N, Varli K. Reversal of defective nerve conduction with vitamin E supplementation in type 2 diabetes: A preliminary study. Diabetes Care 1998;21:1915-8.
131. Bursell SE, Clermont AC, Aiello LP, Aiello LM, Schlossman DK, Feener EP, *et al*. High-dose vitamin E supplementation normalizes retinal blood flow and creatinine clearance in patients with type 1 diabetes. Diabetes Care 1999;22:1245-51.
132. Yusuf S, Dagenais G, Pogue J, Bosch J, Sleight P. Vitamin E supplementation and cardiovascular events in high-risk patients. The Heart Outcomes Prevention Evaluation Study Investigators. N Engl J Med 2000;342:154-60.
133. Andrew R, Skyrme-Jones P, O'Brien RC, Berry KL, Meredith IT. Vitamin E supplementation improves endothelial function in type 1 diabetes mellitus: A randomized, placebo-controlled study. J Am Coll Cardiol 2000;36:94-102.
134. Lawless J. Aromatherapy and the Mind. Thorons; San Francisco, 1994.
135. Betts T. The fragment breeze: The role of aromatherapy in treating epilepsy. Aromatherapy Quarterly 1996;51:25-7.
136. Mowat A, Macsween R, Percy-Hobbs L, Fouils A. Liver, billiary tract and pancrease. In Muir's Textbook of Pathology. 13th ed. MacSween R, Whaley K, editors. London, Arnold; 1993: p 674-41.
137. Grey M. Coping and Diabetes. Diabetes Spectrum 13:167-169,2000
138. National Institutes of Diabetes and Digestive and Kidney Diseases. Diabetes Statistics. Bethesda, MD: NIDDK; 1995; NIH publication no. 96-3926.
139. American Diabetes Association: Diabetes 1996: Vital Statistics. Cowie CC, Eberhardt MS, Eds. Alexandria, VA, American Diabetes Association,1996
140. Diabetes Research Working Group. Conquering Diabetes A Strategic Plan for the 21st Century. NIH publication No. 99-4398; 1999. p. 1-2.
141. Surwit RS, van Tilburg MA, Zucker N, McCaskill CC, Parekh P, Fienglos MN, *et al*. Stress management improves long-term glycemic control in type 2 diabetes. Diabetes Care 2002;25:30-4.
142. Jablon SL, Naliboff BD, Gilmore SL, Rosenthal MJ. Effects of relaxation training in glucose tolerance and diabetic control in type II diabetes. Appl Psychophysiol Biofeedback 1997;22:155-69.
143. McGrady A, Horner J. Role of mood in outcome of biofeedback assisted relaxation therapy in insulin dependent diabetes mellitus. Appl Psychophysiol Biofeedback 1999;24:79-88.
144. Talbot F, Nouwen A. A review of the relationship between depression and diabetes in adults: Is there a link?. Diabetes Care 2000;23:1556-62.
145. McGinnis RA, Cox SA, McGrady A, Dowling KA. Biofeedback-Assisted Relaxation in type II Diabetes. Diabetes Care 2005;28:2145-9.
146. Anderson RJ, Freedland KJ, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: A meta-analysis. Diabetes Care 2001;24:1069-78.
147. Hooper PL. Hot-tub therapy for type 2 diabetes mellitus. N Engl J Med 1999;341:924-5.
148. Baron AD, Steinberg H, Brechtel G, Johnson A. Skeletal muscle blood flow independently modulates insulin mediated glucose uptake. Am J Physiol 1994;266:E248-53.
149. Hooper PL. Hot-tub therapy for type 2 diabetes mellitus. Reply to discussion. N Engl J Med 2000;342:218-9.
150. Bakhru HK. Conquering Diabetes Naturally. New Delhi, India: Orient Paperbacks; 2008. p. 166-8.
151. Ezzo J, Donner T, Cox M. Is massage useful in the management of diabetes? A systematic review. Diabetes Spectr 2001;14:223.
152. Akhtar MS, Athar MA, Yaqub M. Effect of Momordica charantia on blood glucose level of normal and alloxan diabetic rabbits. Planta Med 1981;42:205-12.
153. Puri D, Prabhu KM, Murthy PS. Mechanism of action of a hypoglycemic principle isolated from fenugreek seeds. Indian J Physiol Pharmacol 2002;46:457-62.
154. Kanetkar P, Singhal R, Kamat M. Gymnema sylvestre: A Memoir. J Clin Biochem Nutr 2007;41:77-81.
155. Giancaterini A, De Gaetano A, Mingrone G, Gniuli D, Liverani E, Capristo E, *et al*. Acetyl-L- Carnitine infusion increases glucose disposal in type-2 diabetes patients. Metabolism 2000;49:704-7.
156. O'Connell B. Select vitamins and minerals in the management of diabetes. Diabetes Spectr 2001;14:133-48.

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