



IJPPR

INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH

An official Publication of Human Journals

ISSN 2349-7203




Human Journals

**Review Article**

April 2016 Vol.:6, Issue:1


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# Indian Traditional Systems Used in Treatment of Diabetes Mellitus



ISSN 2349-7203

**IJPPR**  
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH  
An official Publication of Human Journals



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**Submission:** 7 April 2016  
**Accepted:** 12 April 2016  
**Published:** 25 April 2016



HUMAN JOURNALS

[www.ijppr.humanjournals.com](http://www.ijppr.humanjournals.com)

**Keywords:** Diabetes Mellitus, Traditional Systems, Yoga

## ABSTRACT

Diabetes Mellitus is most widely spreading disease and become a major problem that responsible for the death of people in developing and developed countries. Diabetes Mellitus cannot treat completely but can be controlled. For treatment of type 2 Diabetes Mellitus mostly synthetic oral hypoglycaemic agents are in use. In India at present status herbal medicines also used on a large scale because of its high potency to treat disease and nontoxicity also, herbal medicines are very cheap in India and preparation methods are very simple. Herbal medicines not only cure disease but also treat the cause of disease and does not have an expiry date because of an active constituent of herb does not lose its potency with an increase in time or duration. Conventional and Alternative Medicines technique is another way to approach therapy in diabetes mellitus treatment. Yogasanas, Hot tub therapy, massage, biofeedback are included in CAM technique. The aim of this review is to approach traditional systems used in India like ayurvedic herbal medicines, CAM.

## INTRODUCTION

Diabetes Mellitus is one of the most important non-communicable disease causes transience and morbidity in society<sup>(1)</sup>. A metabolic disorders Diabetes mellitus is associated with endocrine system.<sup>(2)</sup>In conjunction with cardiovascular and cerebrovascular cancer diabetes becomes third killer of human being.<sup>(3,4)</sup> It is also known as the seventh cause of death in the world.<sup>(5)</sup>Stress is responsible for impairment of antioxidant defense system by changing antioxidant enzymes, alter the ascorbic acid level and glutathione metabolism.<sup>(6, 7)</sup>Diabetes has a negative effect in quality of patient life and becomes costly to him.<sup>(8, 9, 10, 11.)</sup> Genetic factor and lack of exercise, obesity like environmental factors are responsible to cause Diabetes Mellitus..<sup>(12, 13)</sup>

### Types of Diabetes Mellitus

#### Type -I -Insulin-Dependent Diabetes Mellitus

Known as juvenile-onset, occurs due to T- Cell-mediated immune attack causes damage of beta cells of pancreas due to which decrease in lifetime of pancreatic cells occurs in conjunction with ketoacidosis in body fluid and tissues.<sup>(14)</sup>

#### Type-II - Non-insulin Dependent Diabetes Mellitus

Known as Adult-onset, occurs due to being deficient in insulin secretion, reduced insulin sensitivity, insulin tolerance, decreased no. of  $\beta$ -cells sand decreased glucose metabolism in peripheral tissues.

#### Gestational Diabetes Mellitus (GDM)

Characterized by decrease in the use of insulin. In pregnancy hormonal changes occurs which are responsible for inability of the body to use insulin which results in the development of carbohydrate intolerance. GDM disappears after childbirth.<sup>(16, 17)</sup>

#### Therapy for type 2 diabetes includes

- 1) Dietary modification,
- 2) Insulin and/or oral hypoglycemic agents,
- 3) Exercising regularly and self-monitoring to maintain good glycaemic control.

Thus changes in diet pattern, increased physical activity and weight control are become effective for patients with type 2 diabetes.

### **Blood glucose lowering mechanisms of medicines**

1) Increase insulin release by stimulating beta cells of pancreatic islet. 2) Reduce glycogen synthesis. 3) Increase insulin receptor sensitivity. 4) Increase glucose uptake of tissue and organ. 5) Body microcirculation increase. 6) Clear lipid and protein metabolism problem.<sup>(2, 12)</sup>

### **History of Diabetes Mellitus**

Hindu scholars documented description of diabetes so long as in 1500. Apollonius of Memphis is a founder of word diabetes around 250. Diabetes made the urine sweet so subsequently “mellitus” is used along with word diabetes. Diabetes to glycogen metabolism is correlated in beginning research. German medical student Paul Langerhans found islet cells of pancreas. In 1916, Sharpey-Shafer found “insulin”. The word insulin arised from the German word Insel, which is used for an islet or island. Insulin is extracted from the pancreas of experimental dogs by E.L. Scott and NikolaePaules.<sup>(18, 19, 20)</sup>

### **Traditional / Ayurvedic drugs**

#### **Ayurvedic Rasausadhies for treatment of Madhumeha**

Rasausadhies use organometallic formulations for treatment of Diabetes Mellitus which and comes under ayurvedic technique. Sodhan is purification and detoxification process; Marana is incineration process which is used to convert metals and minerals into easily delicate form, Murchana is a process of triturating drug to a fine powder state. Aushadha, linga and hetu is trisutra on which ayurveda system is based. Animals, plants, and minerals are sources of ayurvedic drugs. Madhu and meha is an expression about sweet substance which secretes through the urinary system.

Nidan (etiology)- Etiological factors of madhumeha are Increased sleep, extreme physical and mental work, sedentary habit and lack of exercise.<sup>(21,22)</sup>Purvarupa (sign and symptoms)- Increased thirst, burning sensation, sweetness in mouth, increased sweating, feeling of lazy and tiredness are the symptoms.<sup>(21, 22, 23)</sup>Lakshana and samprapti (signs-symptoms and pathogenesis)

- Disturbance of vata is a main cause of madhumeha. Vata converts into the unsympathetic taste and takes into urinary bladder which causes madhumeha. Upadravas (Complications)- Problems like cough, loss of sleep, Dryness of mouth and throat, pain in abdomen and heart region etc. Complications indicate diabetes mellitus. <sup>(23)</sup>Rasausadhies is one of the most effective ayurvedic medicine type used in madhumeha with no or few complications.

### Indian Medicinal Plants used as antidiabetics

Name of Drug	Family	Plant & Part Used	Mechanism	Type of Animal
<i>Andrographis paniculata</i> <sup>(24)</sup>	Acanthaceae		Prevent absorption of glucose from gut	Normal and streptozotocin induced diabetic rat
<i>Mangifera indica</i> <sup>(25)</sup>	Anacardiaceae	Leaves	Reduce intestinal glucose absorption	Rats
<i>Annona squamosa</i> <sup>(26)</sup>	Annonaceae	Leaf	Blood Glucose level lower to normal.	Streptozotocin diabetic rats and alloxanized rabbits
<i>Catharanthus roseus</i> <sup>(27)</sup>	Apocynaceae	Leaves	Reduce sugar level in blood	Normal rats
<i>Cocos nucifera</i> <sup>(28)</sup>	Arecaceae		lowers glycemic level -Fecal excretion of Cu, Cr, Mn, Mg, Zn and C increase	Rats fed 5%, 15% and 30% glucose
<i>Areca catechu</i> <sup>(29)</sup>	Arecaceae	Alkaloid fraction of Areca catechu	Hypoglycemic effect for 4_/6 h	Alloxanized rabbit
<i>Gymnema sylvestre</i> <sup>(30)</sup>	Asclepiadaceae	Leaves	Tissue glycogen content decreases by leaf extract	Normal and glucose fed Hyperglycaemic rats

<i>Bombax ceiba</i> <sup>(31)</sup>	Bombacaceae	C- flavonolglucos ide from Bombaxceiba	Reduce glycaemia	In Sprague- Dawley rats
<i>Brassica junce</i> <sup>(32)</sup>	Brassicaceae	Leaf Mustar	Activity of glycogen synthetase increase and lowers gluconeogenic and glycogenolysis , activity of glycogen phosphorylase and gluconeogenic enzymes lowers	In rats
<i>Salacia reticulate</i> <sup>(33)</sup>	Celastaceae	Root bark -natural a- glycosi- dase inhibitors such as kotalanol and salacinol	Inhibit sucrose synthesis	Overnight fasted rats
<i>Salacia oblonga</i> <sup>(34)</sup>	Celastaceae	Root bark Aqueous extract -petroleum ether extract  -aqueous methanolic extract	-serum glucose level decreases	-albino rats - streptozotocin induced diabetic rat  - sucrose and maltose loaded rats
<i>Beta vulgaris</i> <sup>(35)</sup>	Chenopodiacea e	Leaf beet	Skin proteins glycosylation increase	
<i>Artemisia pallens</i> <sup>(36)</sup>	Compositae	Aerial parts	Peripheral glucose utilization	Alloxan- induced diabetic rats

			increase or glucose re - absorption in the proximal tubules inhibited	
<i>Ipomea batatas</i> (white skinned sweet potato) <sup>(37)</sup>	Convolvulaceae		Hyperinsulinemia reduces -Lipid metabolism normalize and regranulation of pancreatic islet B-cells produce	Zucker fatty rats
<i>Citrullus colocynthis</i> <sup>(38)</sup>	Cucurbitaceae	Fruit  - aqueous extract	Insulin release from isolated islets increases -plasma glucose reduce	-normal rabbits
<i>Coccinia indica</i> <sup>(39)</sup>	Cucurbitaceae	Leaves	Gluconeogenesis inhibit	Normal-fed and 48 h Fasted rats

***Syzygium cumini***

**Family:** Myrtaceae

**Synonym:** Jambul, Jamukoli

All parts of plant like leaf, seed, and bark have active constituent for antidiabetic activity. Ascorbic acid, vitamin A, thiamine, riboflavin, Niacin are active constituents present in the plant. Rather than antidiabetic activity this plant is also used as astringent, diuretic, antibacterial.<sup>(40)</sup>

***Momordica charantia* [Bitter Melon]**

**Family:** Cucurbitaceae

**Synonym:** Bitter Gourd, Karela

All parts of plant like roots, leaves, fruits and vines have active constituent for antidiabetic activity. Triterpenoids and related glycosides are major constituents of bitter melon fruit.<sup>(41)</sup>

### ***Ficus religiosa***

**Family:** Moraceae

**Synonym:** Peepal

All parts of plant contain active constituents like carbohydrate, tannins, alkaloid, phenolics, gum, amino acids. Leaf juice is used in treatment of diabetes, diarrhoea, asthma, migraine, gonorrhoea, toothache.<sup>(42)</sup>

### **Conventional and Alternative Medicinal treatment**

#### **Yoga**

Yoga based on a principle which believes there is a relationship between body and mind. In yoga breathing exercise and body posture improves blood flow, hormonal functions, oxygen uptake, muscle strength and flexibility. Yoga exercise affects haemodynamic and lipid profile, glycemic control when performed along with oral hypoglycemic agents. Reduction in fasting and postprandial blood glucose level and HbA1c% occur in a diabetic patient. Also, occurs a reduction in lipid parameters like total cholesterol, LDL, triglycerides, VLDL. Yoga causes relaxation and stress management also shows improvement in systolic and diastolic blood pressure.<sup>(43)</sup>

Type 2 diabetes is one of the major spates in both developing and developed countries and in India. Diabetes mellitus is responsible for the development of dyslipidemia and hypertension whose Poor control leads to the development vascular complications. Diabetic factors like levels of triglycerides, cholesterol, increased body mass index (BMI), hypertension, low- density lipoprotein (LDL) and very low-density lipoprotein (VLDL), cholesterol increase chances of development of coronary artery disease.

Name and duration of various yogasanas & pranayamas Used In DM<sup>(44)</sup>

S.No.	Name	Duration
1	Kapal- bhati	5-10 mins per day
2	Bhastrika- pranayama	3-5 mins per day
3	Bhastrika- pranayama	5 times a day
4	Bhramari	5 times a day
5	Anulom-viloma	5-10 mins per day
6	Surya namakar	3-7 turns of each, the pose being
7	Tadasana	¼ minute to one minute for adding ¼ minute per week.
8	Shavasana	2- 5 minutes, adding 1 minute per week
9	Bhujangasana	3-7 turns of each, the pose hold for 10 seconds adding one turn each, every fortnight
10	Pashimottanasana	one minute for each side, increasing ¼ minute per week
11	Trikona-asana	¼ minute to one minute for each side, adding ¼ minute per week

**Acupuncture**

Manually or electrically manipulated solid, thin, metallic needles are prick at different points of skin. Acupuncture technique used to improve insulin resistance and reduce hyperglycemia. Acupuncture lowers blood glucose level by increasing target cell receptors, increase glucose uptake, stimulate pancreatic beta cells to synthesis insulin.<sup>(45)</sup>

**Massage**

Massage of connective tissue and muscle promotes their relaxation and improve function. It also improve blood circulation, pancreatic function and metabolism. In type 1 Diabetes Mellitus massage at the site of infection increases short term absorption and blood level of insulin. With



inducing relaxation response control counter-regulatory stress hormones and insulin is more effectively used by body.<sup>(46,47)</sup>

### Hot tub therapy

HemoglobinA1c (HbA), fasting plasma glucose and in body weight decreased in hot tub therapy. Increase glucose uptake and blood flow by immersion in hot water after exercise.<sup>(45)</sup>

### Biofeedback

Biofeedback increase positive image which causes relax and ultimately reduce stress. Thus reduction of stress helps to manage diabetes Mellitus. Stress is responsible for poor glycemic control and glucose intolerance. Biofeedback informs about getting control on stress response and muscle tension, skin temperature like psychological activities.<sup>(48)</sup>

### REFERENCES

1. Muhammad Muzaffar Ali Khan Khattaka, Muhammad Taherb, Solachuddin Jauhari AriefIchwanc, NuranizaAzaharia a Department of Nutrition Sciences, Kulliyah of Allied Health Sciences, PSU-USM International Conference on Humanities and Social Sciences Selected herbal extracts improve diabetes associated factors in 3T3-L1 adipocytes, *Procedia - Social and Behavioral Sciences* 91 ( 2013 ) 357 – 375
2. W.L. Li , H.C. Zheng, J. Bukuru, N. De Kimpe\*, Review Natural medicines used in the traditional Chinese medicalsystem for therapy of diabetes mellitus, *Journal of Ethnopharmacology* 92 (2004) 1–21
3. DK Patel, R Kumar, D Laloo, S Hemalatha\*, Natural medicines from plant source used for therapy of diabetes mellitus: An overview of its pharmacological aspects Pharmacognosy Research Laboratory, Department of Pharmaceutics, Institute of Technology, Banaras Hindu University, Varanasi-221005, India
4. Chauhan A, Sharma PK, Srivastava P, Kumar N, Dudhe R. Plants having potential anti-diabetic activity: A review. *Der Pharmacia letter* 2010;2(3):369-87.
5. Mahmoud Bahmani<sup>1</sup>, Arman Zargarani<sup>2</sup>, Mahmoud Rafeian-Kopaei<sup>3\*</sup>, Kourosh Saki<sup>4</sup> Ethnobotanical study of medicinal plants used in the management ofdiabetes mellitus in the Urmia, Northwest Iran Document heading doi: 10.1016/S1995-7645(14)60257-1
6. Rosen P, Nawroth PP, King G, Moller W, Tritschler HJ, Packer L. The role of oxidative stress in the onset and progression of diabetes and its complications: a summary of a Congress Series sponsored by UNESCO-MCBN, the American Diabetes Association and the German Diabetes Society. *Diabetes Metab Res Rev.* 2001;17:189–212.
7. Baynes JW. Role of oxidative stress in development of complications in diabetes. *Diabetes.* 1991;40:405–12.
8. Fox C S, Coady S, Sorlie P D etal. Increasing cardiovascular disease burden due to diabetesmellitus: the Framingham Heart Study. *Circulation.* 2007;115 (12):1544–1550.
9. FrancoOH, SteyerbergEW, HuFB, MackenbachJ, Nusselder W. Associations of diabetes mellitus with toallife expectancy and life expectancy with and without cardiovascular disease. *ArchInternMed.* 2007;167(11):1145–1151.
10. Rodbard H W, Green A J, Fox K M, Grandy S. Impact of type2 diabetes mellitus on prescription medication burden and out-of-pocket healthcare expenses. *Dia-betes Res ClinPract.* 2010;87(3):360–365.
11. American Diabetes Association .Economic costs of diabetes in the U.S.in 2007. *Diabetes Care.* 2008;31(3):596–615.

12. Donga J.J.\*, Surani V.S., Sailor G.U., Chauhan S.P., Seth A.K. A systematic review on natural medicine used for therapy of diabetes mellitus of some Indian medicinal plants, Vol-2, Issue-1, 2011 ISSN: 0976-7908,
13. Om Prakash<sup>1</sup>, Rajesh Kumar<sup>1</sup>, Ritika Srivastava<sup>1</sup>, Pragya Tripathi<sup>1</sup>, Shradha Mishra<sup>2</sup>, Ajeet<sup>3</sup>,\*Plants Explored with Anti-diabetic Properties: A Review , American Journal of Pharmacological Sciences, 2015, Vol. 3, No. 3, 55-66, DOI:10.12691/ajps-3-3-2.
14. National Diabetes Fact Sheet (NDFS), United States (2005). ([http://www.cdc.gov/diabetes/pubs/pdf/ndfs\\_2005.pdf](http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf)) (Accessed on November 10, 2009).
15. Ostenson CG. "The pathophysiology of type 2 diabetes mellitus: an overview". Acta Physiologica Scandinavica, 171, 241-247, 2001.
16. Conn EE. & Stumph PK. Outline of Biochemistry, 5th Edition, John Wiley & sons, New York.
17. Holt RIG. "Diagnosis, epidemiology and pathogenesis of diabetes mellitus: an update for psychiatrists". British Journal of Psychiatry. 184, s55-s63, 2004.
18. AK Das, Siddharth Shah History of Diabetes: From Ants to Analogs, Supplement to JAPI • april 2011 • VOL. 59.
19. MacCracken J. Puzzles and promises in diabetes management. Postgrad Med 1997; 101:138-40, 143-1-5, 149-50.
20. Bliss M. The discovery of insulin. Chicago: University of Chicago Press, 1982.
21. Charaka, charakasamhita, English translated by Sharma DR PK and Dash Vaidya Bhagwan, verse 1/17/83, 2/4/37, 44, 47, 6/6/4, 15, 57 4<sup>th</sup> edn. (Chaukhambha Sanskrit Series Office Varanasi) 2000.
22. Susruta samhita English translated by Murty DR KRS 4<sup>th</sup> edn. (Krishnadas Academy, Varanasi) 2000.
23. Vagbhata, Ashtanga Hridaya English translated by Murty DR KRS 2/10/19, 24, 27-33, 2/11/4-6 4<sup>th</sup> edn. (Krishnadas Academy, Varanasi) 2000.
24. Borhanuddin M, Shamsuzzoha M and Hussain AH: Hypoglycaemic effects of Andrographis paniculata Nees on non-diabetic rabbits. Bangladesh Medical Research Council Bulletin 1994; 20: 24-26.
25. Aderibigbe AO, Emudianughe TS and Lawal BA: Antihyperglycaemic effect of Mangifera indica in rat. Phytotherapy Research 1999; 13: 504-507.
26. Shirwaikar A, Rajendran K, Dinesh Kumar C and Bodla R: Hypoglycemic activity of aqueous leaf extract of Annonasquamosa in streptozotocin - nicotinamide type 2 diabetic rats. J Ethnopharmacology 2004; 91: 171-175.
27. Chattopadhyay RR, Sarkar SK, Ganguly S, Banerjee RN and Basu TK: Hypoglycemic and antihyperglycemic effect of leaves of Vincarosea Linn. Indian J Physiol Pharmacol 1991; 35: 145-151.
28. Sindurani JA and Rajamohan T: Effects of different levels of coconut fiber on blood glucose, serum insulin and minerals in rats. Indian J Physiol Pharmacol 2000; 44: 97-100.
29. Chempakam B: Hypoglycemic activity of arecoline in betel nut Areca catechu Indian J Exp Biol 1993; 31 (5): 474-475.
30. Shanmuga sundaram ER, Rajeswari G, Baskaran K, Rajesh Kumar BR, Radha Shanmuga, sundaran K and Kizar Ahmath B: Use of Gymnemasylvestre leaf extract in the control of blood glucose in insulin-dependent diabetes mellitus. J Ethnopharmacol 1990; 30: 281-294.
31. Saleem R, Ahmad M, Hussain SA, et al: Hypotensive, hypoglycaemic and toxicological studies on the flavonol C-glycoside shamimin from Bombaxceiba. Planta Med 1999; 65: 331-334.
32. Khan BA, Abraham A and Leelamna S: Hypoglycaemic action of Murraya Koenigii (curry leaf) and Brassica juncea (mustard): Mechanism of action. Indian J Biochem Biophys 1995; 32: 106-108.
33. Arunanayake EH, Welihinda J, Sirimanne SR and Sinnadorai G: Oral hypoglycemic activity of some medicinal plants of Sri Lanka. J Ethno pharmacology 1984; 11: 223-231.
34. Augusti KT, Joseph P and Babu TD: Biologically active principles isolated from Salacia oblonga wall. Indian J Physiol Pharmacol 1995; 39: 415-417.
35. Tunali T, Yarat A, Yanardag R, et al: The effect of Chard (Beta vulgaris L. ver. Cicla) on the skin of streptozotocin induced diabetic rats. Pharmazie 1998; 53: 638-640.
36. Subramoniam A, Pushpangadan P, Rajasekharan S, Evans DA, Latha PG and Valsaraj R: Effects of Artemisia pallens Wall. on blood glucose levels in normal and alloxan-induced diabetic rats. J Ethnopharmacology 1996; 50 (1); 13-17.

37. Kusano S and Abe H: Antidiabetic activity of white Skinned potato (*Ipomoea batatas*) in obese Zucker fatty rats. *Biological and Pharmaceutical Bulletin* 2000; 23 (1): 23-26.
38. Abdel-Hassan IA, Abdel-Barry JA and Tariq Mohammeda S: The Hypoglycemic and antihyperglycemic effect of *Citrulluscolocynthis* fruit aqueous extract in normal and alloxan diabetic rabbits. *J Ethnopharmacology* 2000;71: 325–330.
39. Hossain MZ, Shibib BA and Rahman R: Hypoglycaemic effects of *Coccinaindica*: inhibition of key gluconeogenic enzyme, glucose-6-phosphatase. *Indian J Exp Biol* 1992; 30: 418-420.
40. Syed Ibrahim Rizvi and Neetu Mishra, Traditional Indian Medicines Used for the Management of Diabetes Mellitus, *Journal of diabetes research*, PMID: PMC3687502, *J Diabetes Res.* 2013; 2013: 712092, doi: 10.1155/2013/712092.
41. Shi-Biao Wu<sup>1\*</sup>, Grace G. L. Yue<sup>2,3\*</sup>, Ming-Ho To<sup>2,3</sup>, Amy C. Keller<sup>1</sup>, Clara B. S. Lau<sup>2,3</sup>, Edward J. Kennelly<sup>1</sup>, Transport in Caco-2 Cell Monolayers of Antidiabetic Cucurbitane Triterpenoids from *Momordica charantia* Fruits, Wu S-B et al. *Transport in Caco-2...* *Planta Med* 2014; 80: 907–91142.
42. Megha Kapoor, Nidhi Jasani, Niyati Acharya, Sanjeev Acharya, Vimal Kumar\* *Phytopharmacological evaluation and anti-asthmatic activity of *Ficus religiosa* leaves* *Asian Pacific Journal of Tropical Medicine* (2011)642-644.
43. Satyavani Kumpatla & Clementina Michael & Vijay Viswanathan, Effect of yogasanas on glycaemic, haemodynamic and lipid profile in newly diagnosed subjects with type 2 diabetes, *Int J Diabetes Dev Ctries* DOI10.1007/s13410-014-0255-2.
44. Savita Singh, Tenzin Kyizom, K P Singh\*, O P Tandon and S V Madhu\*, Influence of pranayamas and yoga-asanas on serum insulin, blood Glucose and lipid profile in type 2 diabetes, *Indian Journal of Clinical Biochemistry*, 2008/23(4)365-36845.
45. Awanish Pandey, Poonam Tripathi, Rishabh Pandey, Rashmi Srivastava, and Shambaditya Goswami, Alternative therapies useful in the management of diabetes: A systematic review, PMID: PMC324969745, *J Pharm Bioallied Sci.* 2011 OctDec; 3(4): 504–512. doi: 10.4103/09757406.9010346.
46. Jeanette Ezzo, MsT, MPH, PhD; Thomas Donner, MD; Diane Nickols, BA, PA-C; and Mary Cox, MsT, BS, Is Massage Useful in the Management of Diabetes? A Systematic Review, *Diabetes Spectrum* Volume 14, Number 4, 2001
47. Matheson DW, Edelson R, Hiattides D, Newkirk J, Twinem K, Thruston S. Relaxation measured by EMG as a function of vibroactile stimulation. *Biofeedback Self Regul.* 1976;1:285–92.
48. Surwit RS, van Tilburg MA, Zucker N, McCaskill CC, Parekh P, Fienglos MN, et al. Stress management improves longtermglycemic control in type 2 diabetes. *Diabetes Care.* 2002;25:30–4.