

# ON THE **CUTTING EDGE** Diabetes Care and Education

## EAST MEETS WEST: FUNCTIONAL, COMPLEMENTARY, AND INTEGRATIVE APPROACHES TO DIABETES MANAGEMENT

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### **Message from the Theme Editor:**

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Grab your zafu (meditation cushion), a cup of tea (ginger green tea or Chai perhaps?), and indulge your mind in the science of integrative diabetes care!

The National Center for Complementary and Integrative Health at the Institutes of Health defines integrative medicine as the combination of “mainstream medical therapies and complementary and alternative medicine (CAM) therapies for which there is some high quality scientific evidence of safety and effectiveness” (1). Andrew Weil, MD, a leading expert on integrative medicine and founder of University of Arizona Integrative Medicine Center, sees it as a healing approach that “takes account of the whole person (body, mind, spirit), including all aspects of lifestyle. It emphasizes the therapeutic relationship and makes use of all appropriate therapies, both conventional and alternative” (2).

The following principles of integrative medicine form the building blocks upon which this issue of *On The Cutting Edge (OTCE)* was constructed (2):

- A partnership between patient and practitioner in the healing process

- Appropriate use of conventional and alternative methods to facilitate the body’s innate healing process
- Consideration of all factors that influence health, wellness, and disease, including mind, spirit, community, and body
- A philosophy that neither rejects conventional medicine nor accepts alternative therapies uncritically
- Recognition that good medicine should be based in good science, inquiry-driven, and open to new paradigms
- Use of natural, effective, less-invasive interventions whenever possible
- Use of broader concepts encompassing promotion of health and prevention of illness as well as treatment of disease
- Training of practitioners to be models of health and healing, committed to the process of self-exploration and self-development

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## MISSION

Empowering DCE members to be leaders in nutrition and diabetes education, management and prevention.

## VISION

Optimizing the quality of life for people with diabetes.

In the issue, we showcase several functional and complimentary options. Functional ones, such as herbs and spices and pre/probiotics, have unique properties that help improve the health of individuals who use them. Complementary ones, such as meditation, yoga, or acupuncture, enhance outcomes when they are combined with prescribed allopathic modalities currently used. If you are skeptical about the utility of an integrative approach, read through this issue as a cutting-edge exploration of the AADE7™ self-care behaviors of coping, self-efficacy and problem-solving, being active, eating healthily, and taking medications (3) through the lens of mindfulness, yoga, and functional foods.

For an issue on integrative care, it is only fitting to welcome practitioners from other disciplines. Char Wilkins, MSW, LCSW, introduces us to mindfulness and meditation and skillfully guides us into a basic practice for ourselves and our clients. I've used many of these approaches with much success.

Annie B. Kay, MS, RDN, RYT, discusses yoga, a moving meditation of sorts, and how this ancient system is not only an integrative practice in its own right but an effective modality for increasing physical activity, improving self-efficacy, and perhaps even modulating glycemia.

Meghan Jardine, MS, MBA, RDN, CDE, and Gita Patel, MS, RDN, CDE, CLT, nourish the physical body. In the first of her two articles, Meghan discusses the role of gut microbiota in disease modulation with an eye toward diabetes. After tending to the gastrointestinal tract, where the outside world meets the interior one, she provides a feast of wisdom on plant-based nutrition and its functionality as a meal pattern for tertiary chronic disease care and primary disease prevention and health promotion. Adding flavor and spice to our "beans and rice" and "nuts and seeds," Gita shares her knowledge about the culinary and medicinal use of herbs and spices.

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## STRATEGIC PRIORITY AREAS

**GOAL 1:** Sustain and enhance participation and retention among members.

- Use electronic technology to engage new and existing members
- Promote and support member professional development
- Maintain a high value of membership

**GOAL 2:** Advance DCE's member relationships among industry, media, professional and public education.

- Collaborate with organizations to promote RDs in diabetes care, education and prevention

**Goal 3:** Support and promote public policy and research efforts in nutrition and diabetes

- Address and support public policy efforts involving nutrition and diabetes and pre-diabetes
- Increase research efforts

While preparing this issue, I had the pleasure of collaborating with nationally recognized acupuncturist, Elizabeth Trattner, A.P.L., Ac, Doctor of Oriental Medicine, who studied under and subsequently worked with Dr. Weil, to present a primer on traditional Chinese medicine and acupuncture.

For those inspired to learn more, Jessica Marshall, RDN, LDN, BCHHP, compiled a resource and reference list. We are also pleased to share a new feature — a teacher's guide for those of you who use this publication in the classroom! One article-related guide is provided here and additional ones, on the other articles, can be found at DCE.org.

This issue was truly a collaborative, integrative process. Many thanks to the theme team for clarifying the direction and scope of the issue and for suggesting authors and reviewers. Additional thank-yous to the reviewers, who provided constructive and insightful comments; to the editorial team for your patience, wisdom, and words of encouragement; and, of course, to our readers, who make a difference in the lives of countless individuals.

Namaste!

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# Mindfulness and Diabetes: Working in Tandem

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## Abstract

Mindfulness practices can augment a patient's ability to cope with his or her life with diabetes by helping to reduce anxiety, enhance mood, improve self-regulation and possibly glycemia, and encourage balance and self-determination in all aspects of life. Registered dietitian nutritionists (RDNs) can enhance their professional work by offering to help patients with diabetes mellitus (DM) incorporate simple mindful practices into daily routines.

## "Just tell me what to eat."

The love-hate relationship many people have with food, can make the RDN's job challenging. Food insecurity, fad diets, contradictory research ("go Paleo," "go vegan," "eat carbs," avoid carbs"), and the degree of the patient's readiness to change are just some of the obstacles the RDN must face. If only one of an RDN's tools was a magic fork that could be waved to make the disease disappear or at least make those 'oh-so-delicious' chocolate chip cookies taste great without the calories, carbohydrates, or fat!

Although there is no magic fork, mindfulness meditation is an age-old modality that is garnering new attention as an adjunctive therapy for chronic disease, including DM. The purpose of this article is to define mindfulness; examine research supporting its utility as a DM self-

management technique and, therefore, useful skill for RDNs and their clients; and introduce several simple mindfulness meditation practices.

## What is Mindfulness?

Mindfulness is intentionally paying attention, moment to moment, without judging what is happening internally in the body, mind, and heart and externally in the environment. Mindfulness and meditation are teachable techniques that can help develop the critical skills of pausing, listening, slowing down, and self-regulating. Although not part of formal RDN training, RDNs can introduce simple mindfulness exercises as part of their medical nutrition therapy session. They also can work collegially with therapists, licensed counselors, social workers, and behaviorists by securing training for themselves and/or referring patients for more in-depth instruction. Referring patients to a mindfulness-based program such as Mindfulness Based Stress Reduction (MBSR) can support the RDN's individual work. MBSR is a structured, evidence-based, 8-week program that provides instruction in mindfulness and meditation. Participants learn to relate differently to pain and illness, self-regulate fears about the future and regrets about the past, and become more skillful in staying present and nonjudgmental of themselves and others.

It is well recognized that stress negatively affects the entire human system. In addition, individuals who are stressed are less likely to engage in behaviors that support health. For the person with DM, a disease requiring daily self-management, this could have dire consequences. Lack of self-care is magnified by the fact that stress itself raises serum glucose levels. Introducing mindfulness practices is a small step down the path leading to improved self-care.

## Is There Proof That Mindfulness Helps?

Emotional distress is believed to affect 20% to 40% of patients with DM (1). Data from recent trials suggest that mindfulness practices empower patients with DM just as it does with other illnesses and disorders. In one study, researchers examined the effectiveness of mindfulness-based cognitive therapy (MBCT) in reducing emotional distress among outpatients with DM, depression, and anxiety (2). The authors concluded that, "Compared with usual care, MBCT resulted in a reduction of emotional distress and an increase in health-related quality of life in diabetic patients who initially had lower levels of emotional well-being" (2).

Beyond improving psychosocial parameters of health, mindfulness-based interventions, including MBSR

and MBCT, have been shown to improve glycemia in persons with DM. Researchers in a small pilot study examining the effects of MBSR on glycated hemoglobin (A1c), blood pressure, body weight, and psychological symptoms noted a reduction in depression, anxiety, and general psychological distress among patients who completed the 8-week program (3). They also documented 0.5% reduction in A1c and a 6-mm Hg reduction in mean arterial pressure. Analysis suggested that lifestyle changes did not account for the A1c reduction because participants' mean body weights did not change nor were there reported changes in medication, diet, or exercise that could account for the improved glycemic control (3).

A 2013 pilot study compared the effectiveness of a self-management intervention and a mindful eating intervention based on the Mindfulness-Based Eating Awareness Training program (4). The participants practicing meditation and mindful eating reported a significant decrease in energy intake immediately following the intervention and at a 3-month follow-up as well as a significant decrease in glycemic load at the end of the study (4). Although these studies suggest improvement in blood pressure and glucose control, more investigations are needed to fully understand the impact of mindfulness and meditation on the physiologic parameters and psychosocial stresses associated with DM. Such stressors not only interfere with adaptation to DM, which is clearly a key factor in long-term self-management, but they also affect metabolic outcomes through the neuroendocrine system (5).

Currently, a 5-year randomized, controlled trial is examining the

efficacy of MBSR as an intervention for reducing psychosocial distress, depression, and the progression of nephropathy and for improving the subjective health status of adults with T2DM (6). At 1-year follow-up, patients in the MBSR group achieved a prolonged reduction in levels of depression and improved health status compared with the control group. (6)

### **“I notice I actually chew my food and taste it when I’m being mindful.”**

Mindful Eating-Conscious Living is a training program for professionals that I teach with Jan Chozen Bays, author of the book *Mindful Eating: A Guide to Rediscovering a Healthy and Joyful Relationship with Food* (7). We teach clinicians and professionals on the front line of the obesity epidemic approaches for working in small ‘bites’ to establish skills that can be life-changing for their patients. Two of those skills are the Eight Hungers and pausing. The Eight Hungers are: mind, eye, nose, ear, mouth, heart, stomach, and cellular. We invite participants to experiment with all 8 and determine which ones are most demanding on a day-to-day basis.

One of the most useful skills to cultivate is pausing or ‘slowing down,’ which is not necessarily a popular idea in our fast-paced life. I encourage practicing this in small steps:

- Pausing to take three deep breaths in and out before approaching a buffet, perusing a menu, or while standing at the kitchen counter can momentarily interrupt our automatic pilot. Those three breaths can provide enough space to recognize that there are choices other than to proceed as usual.

- Always set a place and sit down at a table when you eat. Try eating without the usual distractions of newspaper, phone, or TV. When our attention is elsewhere, our eating goes on automatic pilot. When we eat without being fully present to the taste, textures, smells, sounds, and appearance of our food, we are more likely to eat more than our body needs without feeling satisfied.
- Our fork, spoon, and knife seem to be in perpetual motion. Most of us don’t realize that we never actually set down the fork and remove our hand from it. A simple mindful practice can break that cycle. If your fork is in your hand scooping food or heading toward your mouth: eat, don’t talk. If your fork is resting on the plate and separated from your hand: talk. Fork up, eat. Fork down, talk. Up, eat. Down, talk. You’re welcome to listen on either the up or down!

### **Mindfulness in Practice**

Many patients who are learning to be mindful worry that they aren’t ‘doing it right.’ They believe that they can either be mindful or they can follow their prescribed eating schedule without a middle ground. Their words reflect the extreme belief system that determines how they approach everything in life: right or wrong, too much or not enough, success or failure, never or always. The following case illustrates this approach:

I introduced Clara, a young woman with T2DM on oral medication, to the Eight Hungers. I asked her to check in with her body when she was about to eat by asking, “Who’s hungry in there?” and see if she could tell which of the Eight Hungers were hungry. She didn’t think it was possible to always be mindful and preemptive of

her hunger so as to keep her blood glucose from decreasing. Because her habituated thinking was either/or and right way/wrong way, she believed she had to ignore her nutrition prescription if she was going to do mindfulness 'right.'

We explored how preemptive eating and following her schedule actually was mindful of her body. Then we talked about expanding this mindful awareness to include a kindly attention to physical sensations in the body, such as stomach hunger and fullness, cellular hunger (i.e., the brain's need for glucose), and thirst and to consider how these signals might be included in tandem with rather than in opposition to her daily regimen. The idea that mindfulness is only one part of the larger picture, not the be-all-and-end-all, can be both a surprise and a relief.

Checking in with the Eight Hungers helps us to better understand our body's natural signals and whether we are reacting or responding to impulses to eat or drink. None of the hungers we experience are all bad or all good. For example, sometimes mind hunger is about "You shouldn't eat that because it's bad for you" (e.g., eating ooey-goey chocolate chip cookies for the *second* time in one day), but it can also be our skillful partner reminding us that 3 hours have passed and we need to stop and eat.

## Two Practices Better Are Than One

In this age of instant access to opinions, materials, and evidence of varying degrees of accuracy, it's easy for our clients to suffer from information overload, which often confuses and distracts them from what is happening right now in their lives. Diabetes self-care and mindfulness require commitment and practice and each 'feeds' the other. Mindfulness is a practical application of nonjudgmental awareness of how, what, where, and why we do or don't do what is best for us. "It is deliberately paying attention, being fully aware of what is happening both inside and outside yourself — in your body, heart and mind — and outside yourself, in your environment." (7). The good news is you don't need a guru, have to live in a cave, or even close your eyes to do that.

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# Yoga for Type 2 Diabetes and Related Comorbidities

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## Abstract

Many registered dietitian nutritionists (RDNs) encounter patients who want to follow healthy lifestyles but struggle to sustain such changes. Yoga, a system of practice originating in ancient India, may provide the modern practitioner with accessible tools to facilitate and sustain behavior change. Trials to date investigating yoga and related comorbidities in individuals with type 2 diabetes (T2DM) suggest significant benefit. New understanding of neurobiology and the emotional nervous system as well as advances in genomics provide insight into mechanisms underlying observed benefits in early trials.

## Introduction

The etiology of T2DM is complex and multifactorial. However, certain lifestyle issues, including lack of physical activity and poor nutrition, are modifiable risk factors for T2DM onset and progression. A variety of strategies, including yoga, may be of interest to individuals who want to improve their lifestyles to prevent T2DM, address modifiable risk factors, and sustain improvements in behaviors.

## Literature Review

Research investigating yoga for management of chronic conditions and their risk factors is proliferating. Randomized clinical trials (RCTs) have explored yoga as an adjunct therapy

for the management of arthritis (1), lower back pain (2,3), high blood pressure (4,5), CVD (6,7), respiratory disease (8,9), and stroke (10).

The majority of RCTs on yoga for T2DM in peer-reviewed journals suggest improvements in outcomes or risk indices with practice (11). Results have included significant improvements in blood glucose (12,13), lipid profiles (14,15), blood pressure (16), body weight or BMI (17,18), and markers of oxidative

stress (15). Trials to date are heterogeneous for key study factors, including design (yoga alone vs. with other education or diet), population (demographics and those with well vs. poorly controlled T2DM), dose (style of yoga, intensity, and duration), and outcome measures.

## Possible Mechanisms

Yoga supports positive behavior change through a variety of complex, multifactorial, interacting and dynamic pathways. The emotional

## Defining the Terms

### What is Yoga?

Yoga is an Indian philosophical system and a mind-body practice. Its beginnings may be traced as far back as 5000 BCE. The word *yoga* comes from the Sanskrit root *yuj*, which means “to bind, join, and yoke” or “to use and apply.” The defining elements of yoga practice include coordination of physical movement with attention to breathing and simultaneous mental focus within one’s body. While yoga in America today often focuses only on the physical postures (asana), the full practice may encompass every aspect of life, including diet, mental attitude, choices about lifestyle, and philosophical study.

Yoga practice commonly includes the following:

- A warm-up period of gentle stretches while focusing attention to breathing.
- Yoga postures (asana) performed sequentially with specific goals. They may be modified for the physical needs of the participant.
- Yoga breathing exercises (pranayama), deep relaxation, and meditation.

Yoga practice is generally considered safe in healthy individuals when practiced appropriately. Some postures are contraindicated in individuals with high blood pressure, glaucoma, or sciatica and for women who are pregnant. These individuals will benefit from the guidance of a skilled teacher.

nervous system's management of stress and cognitive processing likely interplay with in vivo biochemistry (19). Stress also induces a biochemistry that favors poor food choices and obesity by triggering secretion of glucocorticoids that increase motivation for food and insulin, which promotes food intake and obesity. Eating refined food may produce a feedback signal that reduces perceived stress and, thus, reinforces eating in response to stress (19). Yoga, meditation, and mindfulness practices appear to alleviate activation and reactivity of the hypothalamic-pituitary-adrenal axis and sympathoadrenal system, fostering recovery from stress and downstream effects, perhaps including modulation of stress-related eating (20).

Stress also biases cognition toward lessened executive function and increased emotional activity in the amygdala of the brain (20,21). Meditation, yoga, and mindfulness have been suggested to increase activity of the prefrontal cortex of the brain and with practice, may support the adoption of healthful lifestyle choices (22,23).

The vagus nerve runs from the cerebellum and brainstem to the viscera of the lower abdomen, coming into contact during its course with the heart, lungs, and sexual organs. Stimulating the vagus nerve with deep diaphragmatic breathing that includes a lengthened exhale is believed to improve vagal tone and (by slightly elevating heart rate on an inhale and decreasing heart rate on an exhale) increase heart rate variability (HRV), a marker of cardiovascular health. Yoga practice stimulates the vagus nerve and HRV, which shifts the autonomic nervous system from sympathetic (fight or

## Defining the Terms

### Diaphragmatic Breathing

1. Assume a comfortable seated position with a straight spine.
2. Place one hand on each side of the ribcage. Feel your ribcage expand outward as you inhale, thinking about the downward engagement of the diaphragm that fills your lungs.
3. Exhale slowly, feeling the ribcage coming back together as the diaphragm slowly relaxes and the lungs empty. Notice this for several breaths.
4. Begin practicing for 2 minutes and work your way up to 10 minutes or longer. Notice how you feel after this breathing practice.

flight) toward parasympathetic (rest and recovery) activation directly, providing a mind-body feedback loop for recovery from physiologic stress (20,21).

### Clinical Application

The yoga research community has not reached consensus on standard protocols and effective doses of yoga practice for various biomarkers. However, a threshold of benefit for yoga as adjunctive support to improve lifestyle behaviors appears to have been achieved. RDNs may choose to provide resources to those who are interested in yoga, provide referral to an appropriate qualified teacher, or become a credentialed provider by receiving professional yoga training.

### Yoga Styles and Teachers

A variety of CD and DVD practices in various styles for specific aims are available from leading yoga teachers to enable at-home practice. For beginning students of yoga, however, a skilled teacher provides greater safety and effectiveness. Awareness of the variety of yoga styles currently practiced can enable RDNs to make informed referrals. More vigorous and demanding styles of yoga include Ashtanga, Vinyasa, or Power Yoga. Bikrim Yoga and Hot

Yoga are also more vigorous, in part because they take place in a heated room and may be contraindicated for those with CVD and heat-sensitive health conditions.

Moderate Iyengar Yoga emphasizes proper alignment and has been used in a number of clinical trials. Kripalu Yoga has also been used in trials and is offered in gentle, moderate, and vigorous levels. Viniyoga, Yin Yoga, and Kundalini Yoga are gentle as well.

The experience and the training of the teacher determine the therapeutic value of the practice. Minimum qualifications generally recognized for a yoga teacher include the Registered Yoga Teacher (RYT) credential. A teacher with an RYT has completed a course of study approved by the national Yoga Alliance ([www.YA.org](http://www.YA.org)).

### Summary

Yoga is safe and inexpensive when practiced appropriately and can be adapted for individuals of all ages and physical abilities. New evidence investigating potential benefits of this ancient practice holds promise in the management of complex lifestyle-derived chronic diseases, including T2DM and CVD. Psychophysiology and genetics, two

areas of rapidly emerging science, may offer new insight into how yoga practice could provide benefits. RDNs may find yoga and other experiential mind-body practices useful tools for supporting and maintaining behavior change in those they serve.

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# The Role of the Microbiota in Obesity and Diabetes

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## Abstract

The connection between the gut microbiota, obesity, and diabetes is the subject of much interest. This article describes the microbiota, how it is formed, and the proposed mechanisms it plays in metabolic dysfunction. Prebiotics assist weight loss by decreasing energy intake and increasing energy expenditure. Potential use of probiotics as well as other healthy lifestyle habits may also help ensure a healthy gut microbiota.

## Introduction

In the last few decades, obesity and type 2 diabetes (T2DM) have dramatically increased. Scientific evidence suggests that the microbes living in the gut, combined with energy intake/expenditure and the environment, may contribute to obesity and T2DM. Those who are obese tend to have lower bacterial counts (gene diversity) than lean individuals (1). Some suggest that alterations in intestinal microbiota are implicated in conditions such as food allergies, irritable bowel syndrome (IBS), dyslipidemia, and cardiovascular diseases (2). The latter two are well-established comorbidities and/or complications of T2DM. Dysbiosis (altered microbiota) leads to increased intestinal permeability and mucosal immune response, which can contribute to the development of obesity and diabetes (1,3,4). An

altered microbiota has been implicated in increased energy extraction from the diet, production of low-grade inflammation, and altered fatty acid metabolism (1,3,4).

Approximately 80% to 90% of the bacteria phylotypes of the microbiota are primarily Bacteroidetes (gram-negative) and Firmicutes (gram-positive) (4). Actinobacteria (gram-positive) and Proteobacteria (gram-negative) comprise about 10% (4). Obesity is associated with a higher proportion of Firmicutes, a diminished count of Bacteroidetes, and an increase in Actinobacteria (5). Individuals with diabetes have lower counts of *Bifidobacterium* and *Faecalibacterium prausnitzii*, which possess anti-inflammatory properties (4). Bacterial counts can be reversed within a few days of increasing dietary fiber and decreasing fat intake (1).

## Importance of Microbiota

The typical human hosts trillions of tiny microbial cells in the gut, belonging to about 1,000 species and, outnumbering human cells by 10 to 1. The genome of the microbiota, known as the microbiome, outnumbers the human genome by two orders of magnitude and provides important metabolic, neurologic, and immunologic functions for the human host (3). The

microbiota releases enzymes that help digest and absorb nutrients as well as produce vitamin K, some B vitamins, and essential amino acids (6). A healthy microbiota protects the host against pathogens by competitive exclusion, making it harder for pathogens to proliferate, and assists in the development of the intestinal immune system (7).

## Factors That Shape the Microbiota

The skin of vaginally delivered babies soaks up healthy microbes from the mother's vagina and feces, while babies born by cesarean section acquire bacteria from the skin of the mother and delivery staff but end up with less microbial diversity (1). The microbiota of breastfed infants is dominated by *Bifidobacterium* and *Ruminococcus*, with significantly lower counts of *Escherichia coli*, *Clostridium difficile*, *Bacteriodes fragilis*, and *Lactobacillus* than seen in those fed exclusively by formula (4). The composition of the microbiota stabilizes by 3 years of age and is influenced throughout the lifecycle by diet, genetics, the environment, and antibiotics (1).

## Literature Review

In a study of gut microbiota in African and European children, (8), the African children's microbiota was significantly richer in Bacteroidetes and lower in Firmicutes, with a

unique abundance of bacteria from the genus *Prevotella* and *Xylanibacter*, which were absent in the European children's guts. Additionally, the African children had significantly more short-chain fatty acids (SCFA). The authors postulated that diet played a role in the diversity and richness of the African children's microbiota and is associated with health benefits such as decreased inflammation, protection from noninfectious colonic diseases, and a reduction in obesity.

Kalliomäki and colleagues (9) noted that babies with a greater number of *Bifidobacterium* and lower count of *Staphylococcus aureus* were leaner at the age of 7 years than those who became overweight. They concluded that dysbiosis precedes obesity. They also proposed that *S aureus* may trigger low-grade inflammation associated with obesity.

Antibiotic overuse may alter human intestinal microbial populations. A 5-day course of antibiotics can modify the human gut microbiota for up to 4 weeks, with some microbial communities failing to recover even after 6 months (3). Exposure to antibiotics during the first postnatal months has been associated with a higher body mass index later in life (10). Similarly, weight gain has been observed in individuals with long-term antibiotic use (4). Widespread exposure to low-dose antibiotics present in food and the environment (waste-related pollution) may lead to a chronic dysbiosis associated with obesity (7). In the early 1990s, increased antibiotic use in livestock helped promote growth, and some propose that antibiotic overuse and environmental exposure could contribute to obesity in humans (7).

## Microbiota, Obesity, and Diabetes: Potential Mechanisms

Dysbiosis may contribute to obesity and diabetes by increasing energy harvest from the diet, altering gut permeability leading to endotoxemia, and prompting changes in energy expenditure and storage (1,3,4). Scientific data consistently implicate a high-fat diet with an "obesogenic" microbiota that include higher counts of Firmicutes and lower counts of Bacteroidetes (11). This dysbiosis is accompanied by increased extraction of energy from non-digestible oligosaccharides, resulting in increased de novo lipogenesis and accumulation of hepatic and adipose tissue triglycerides (11,12). Such increased uptake in SCFA is associated with an increased absorption of 140 to 180 kcal/day, potentially leading to weight gain (4). Of note, butyrate, a SCFA, has a bidirectional role by providing anti-inflammatory properties and improving gut barrier function (4).

It is well established that insulin resistance is related to chronic low-grade inflammation. Metabolic endotoxemia is two times higher in individuals with T2DM and may be related to dysbiosis (12). Evidence suggests that a high-fat diet increases systemic lipopolysaccharide (LPS), which activates toll-like receptor-4 (TLR-4), promoting the release of proinflammatory cytokines (1). Activated TLR-4 can compromise insulin action in the liver and muscle cells through the release of cytokines (3). Dysbiosis plays a further role in the absorption of LPS, a component of gram-negative bacteria, and possibly other antigens via disruptions in intestinal permeability. These findings are associated with a decrease in *Bifidobacterium* (4). Lastly, a high-fat diet contributes to

microbiota alterations that increase intestinal permeability and weaken the gut by decreasing mucus production (2).

Gut microbiota also appears to decrease fasting-induced adipose factor production, which inhibits the action of lipoprotein lipase, thus increasing storage of liver-derived triglycerides (1). Enzymes responsible for mitochondrial fatty acid metabolism are also down regulated by microbiota, further increasing adipose tissue hypertrophy (13).

## Dietary Factors

### Prebiotics

Prebiotics are "a selectively fermented ingredient that allows specific changes, both in composition and/or activity in the gastrointestinal microflora that confers benefits upon host well-being and health" (13,14). A prebiotic resists gastric activity in the upper gastrointestinal tract, is

**Table 1. Natural Prebiotic Sources (17,19)**

- Breast milk
- Jerusalem artichoke
- Chicory root
- Raw dandelion greens
- Leeks
- Onions
- Garlic
- Asparagus
- Whole grains
- Beans
- Banana
- Psyllium husk (Metamucil®)
- Wheat
- Oats
- Soybeans

#### Benefits of Prebiotics:

- Improved gut barrier function
- Improved host immunity
- Decreased pathogenic bacteria
- Increased SCFA production

fermented by the microbiota, and stimulates the growth and/or activity of intestinal bacteria improving health and well-being (15). Prebiotics feed and enhance the proliferation and growth of probiotics, specifically health-promoting *Bifidobacterium* and *Lactobacillus* (12,15,16). Table 1 lists sources of prebiotics.

Prebiotics also enhance the release of SCFA: acetate, propionate, and butyrate. They restore health by decreasing inflammation and increasing insulin sensitivity through improving gut barrier integrity and reducing LPS levels. SCFA also increase mitochondrial fatty acid oxidation by increasing Amp-activated protein kinase (13). Other benefits include: strengthening and feeding the colonocytes, decreasing hepatic cholesterol synthesis, and lowering the pH of the colon, thereby inhibiting the growth of pathogenic organisms. SCFA enhance the absorption of minerals, including calcium, magnesium, and possibly iron (15).

Prebiotics modulate peptide secretion, increase glucagon-like peptide (GLP-1) and polypeptide YY (PYY) and suppress ghrelin, which contribute to increased satiety, weight loss, and decreased postprandial plasma glucose (4,15).

### Probiotics

Probiotics are “live micro-organisms, which administered in adequate amount confer a health benefit on the host”(15,16). For a probiotic to be effective, it must be able to (17):

- Resist gastric, bile, and pancreatic digestion
- Adhere and colonize the enterocytes
- Remain metabolically active once it reaches the GI tract

- Nullify the effect of disease-causing (pathogenic) bacteria
- Balance pH levels in the colon
- Exhibit favorable immunomodulation properties
- Have the ability to influence metabolic activities

Probiotics have been reported to suppress diarrhea, treat IBS and IBD, enhance immunity, prevent and delay certain cancers, lower cholesterol, exclude the growth of pathogens, and restore microbiota community after antibiotic use (16,18,19).

**Table 2. Sources of Probiotics and Reported Strains**

<b>Plant-based Probiotics</b>	<b>Reported Strains</b>
Sauerkraut (fermented cabbage) (18)	<i>Lb. planatarum</i> <i>Lb. brevis</i> <i>P. acidilactici</i> <i>P. cerevisiae</i> <i>Leuc. Mesenteroides</i>
Kimchi (Korean spicy cabbage) (18)	<i>Lb. plantarum</i> , <i>Leuc. Mesenteroides</i> <i>L. brevis</i>
Tempeh (a fermented soybean product)	<i>Lb. planatarum</i>
Soy sauce	<i>Lb. brevis</i>
Miso (18)	<i>L. acidophilus</i>
Water kefir (23)	<i>Lb. casei</i> <i>Lb. hilgardi</i> <i>Lb. hordei</i> <i>Lb. nagelii</i> <i>Leuc. citreum</i> <i>Leuc. mesenteroides</i> <i>Ac. fabarum</i> <i>Ac. orientalis</i> Yeasts: <i>H. valbyensis</i> <i>Lachancea fermentati</i> <i>Saccharomyces cerevosoae</i> <i>Zygorulasporea florentina</i>
<b>Dairy-based Probiotics</b>	<b>Reported Strains</b>
Yogurt (19)	<i>Lb. bulgaricus</i> <i>Lb. acidophilus</i> <i>S. thermophiles</i> <i>Bifidobacterium</i>
Kefir (18)	<i>Lb. kefir</i> <i>Lb. kefiranofacies</i> <i>Lb. brevis</i>
<i>Ac.=Acetobacter; L.=Lactococcus; Lb.=Lactobacillus; Leuc.=Leuconostoc; P.=Pediococcus; S.=Streptococcus</i>	
Note: Strains may vary, depending on processing technique	
Benefits of Probiotics:	
<ul style="list-style-type: none"> <li>• Secretion of antimicrobial substances</li> <li>• Strengthening of gut epithelial barrier</li> <li>• Competitive adherence to gut mucosa</li> <li>• Modulation of immune system</li> </ul>	

For individuals with T2DM, probiotics appear to reduce inflammation-induced insulin resistance. This may be due to decreased intestinal permeability as well as immune system modulation. Moroti and associates (20) reported that individuals with T2DM who received *Lactobacillus acidophilus*, *Bifidobacterium bifidum*, and fructooligosaccharides had a significant reduction in fasting glucose in 45 days.

Table 2 lists common plant- and dairy-based probiotics along with their reported bacterial strains. Table 3 lists microorganisms available as probiotics. Supplemental probiotics are generally recognized as safe, but bloating, flatulence, and in rare circumstances, infections may occur (22).

## Clinical Application

Registered dietitian nutritionists should be aware of how alterations in microbiota can contribute to obesity, insulin resistance, and diabetes and suggest pre- and probiotics for persons with T2DM. More human trials are required to delineate specific strains and dosing in general and for specific age groups and health conditions.

## Summary

The human gut microbiota may contribute to obesity and diabetes by increasing energy extraction from the diet, increasing inflammation associated with insulin resistance, and altering metabolism contributing to hypertrophy of adipocytes. The bacterial population of the human microbiome may evolve with diet changes, the environment, and overuse of antibiotics. Further research should examine the following: Does an unhealthy microbiota lead to obesity

**Table 3. Microorganisms Used as Probiotics**

<p><b>Bacteria</b></p> <p><i>Lactobacillus species</i></p> <p><i>L. acidophilus</i></p> <p><i>L. bulgaricus</i></p> <p><i>L. casei</i></p> <p><i>L. crispatus</i></p> <p><i>L. fermentum</i></p> <p><i>L. gasseri</i></p> <p><i>L. johnsonii</i></p> <p><i>L. lactis</i></p> <p><i>L. plantarum</i></p> <p><i>L. reuteri</i></p> <p><i>L. rhamnosus GG</i></p>
<p><i>Bifidobacterium species</i></p> <p><i>B. adolescentis</i></p> <p><i>B. animalis</i></p> <p><i>B. bifidum</i></p> <p><i>B. breve</i></p> <p><i>B. infantis</i></p> <p><i>B. lactis</i></p> <p><i>B. longum</i></p> <p><i>Bacillus cereus</i></p> <p>*<i>Enterococcus faecalis</i></p> <p><i>Enterococcus faecium</i></p> <p><i>Escherichia coli</i> Nissle</p> <p><i>Streptococcus thermophilus</i></p>
<p><b>Yeast</b></p> <p><i>Saccharomyces boulardii</i></p>
<p>*Concerns exist about using enterococci as probiotics because of possible pathogenicity and vancomycin resistance. Reprinted with permission from Williams (24).</p>

and its related sequelae (diabetes/ metabolic syndrome) or does obesity precipitate dysbiosis? What is the ideal microbiota? What pre/probiotic combinations will improve metabolic function for people with T2DM?

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# Plant-Based Nutrition: A Therapeutic Option for Diabetes

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## Abstract

Vegan and vegetarian eating patterns have been associated with lower rates of chronic disease, including diabetes. Vegetarians are about half as likely to have diabetes as non-vegetarians (1). Plant-based diets have been found to be protective against other conditions related to poor diet, such as cardiovascular disease (CVD) and cancer, both of which disproportionately affect individuals with diabetes. This article reviews the research on plant-based nutrition as a therapeutic approach to prevent and treat diabetes and provides registered dietitian nutritionists (RDNs) with strategies to counsel their patients on adopting this eating pattern.

## Introduction

Plant-based nutrition is gaining popularity for health, environmental, and ethical reasons. Current dietary strategies for diabetes management include limiting or controlling carbohydrate intake, reducing saturated fat and cholesterol intake, and if needed, reducing caloric intake (2). Despite an increase in the carbohydrate load of many plant-based eating patterns, such diets can significantly improve insulin resistance, while lowering blood pressure, low-density lipoprotein (LDL) cholesterol, and body weight. The American Diabetes Association (ADA) reports that a variety of eating

patterns, including a plant-based one (vegan or vegetarian), have been shown to be effective in managing diabetes (3).

Adopting a plant-based eating pattern requires commitment, knowledge, and support. RDNs are in the perfect position to encourage adoption of this cost-effective dietary approach for patients with diabetes while ensuring nutrition adequacy.

## Literature Review

### *Observational Studies*

Seventh Day Adventists (SDAs) is a health-conscious Christian denomination that encourages its members to abstain from alcohol and tobacco and engage in regular physical activity. Vegetarian eating

is also recommended. About 50% of SDAs are reported to be vegetarian, making them an ideal control group to study the health effects of various eating patterns. Table 1 defines various plant-based eating patterns inclusive of those described in the Adventist Health Studies (AHS).

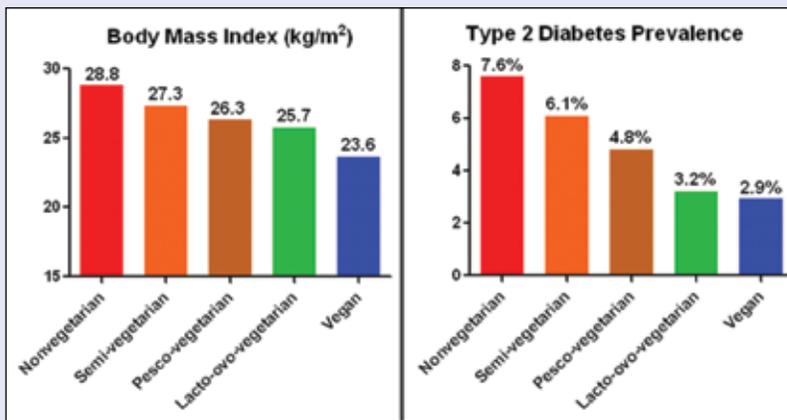
In longitudinal cohorts, dating as far back as 1960, AHS has demonstrated the prevalence of diagnosed diabetes as 1.6 to 2 times higher in non-vegetarians compared to vegetarians (2,4). Even a small amount of meat increases diabetes risk by an estimated 29% (2).

The Adventist Health Study-2 (AHS-2) of 60,000 subjects demonstrated a dose-response relationship between

**Table 1. Classification of Plant-based Eating Patterns and Eating Patterns Described in the Adventist Health Studies as Reported by Subjects (3)**

Vegan	Consuming no animal products (red meat, poultry, fish, eggs, milk, and dairy products < 1 time/month)
Lacto-ovo-vegetarian	Consuming dairy products and/or eggs $\geq 1$ month but no fish or meat (red meat, poultry, and fish < 1 time/month)
Pesco-vegetarian	Consuming fish $\geq 1$ time/month and dairy products and/or eggs but no red meat or poultry (red meat and poultry < 1 time/month)
Semi-vegetarian	Consuming dairy products and/or eggs and meat (red meat and poultry $\geq 1$ time/month and < 1 time/week)
Non-vegetarian	Consuming animal products (red meat, poultry, fish, eggs, milk, and dairy products > 1 time/week)

**Figure 1.** Adventist Health Study-2 included 60,903 men and women. Body mass index increases with increased consumption of animal products. The incidence of type 2 diabetes also increases, with the highest incidence in the non-vegetarian group. Used with permission from Neal Barnard, MD.



animal product consumption and increased body mass index (BMI) and prevalence of type 2 diabetes mellitus (T2DM)(1) (Fig. 1). The vegan group (8%) had the lowest rate of T2DM and was the only group with an ideal body weight (1). Protection against diabetes for the vegetarian and vegan group was significant even after adjusting for BMI, age, gender, ethnicity, and physical activity.

The AHS have also provided clear evidence that vegetarians have lower

rates of coronary heart disease (CHD), which may be explained by lower LDL cholesterol, blood pressure, and obesity. A combined analysis of the Adventist Mortality Study (AMS), AHS-1, and cohorts of British and German vegetarians revealed a 32% higher CHD mortality rate in non-vegetarians (5). Regular nut and whole grain consumption was also associated with lower risk of CHD and lower rates of total cancer (5). Table 2 lists evidence-based benefits for plant-based eating.

**Table 2. Documented Benefits of Vegetarian and Vegan Eating Patterns Compared to Non-vegetarian Patterns**

Diabetes	50% lower risk of type 2 diabetes (5)
Body Weight	Lower BMI (1)
Lipids	Lower total and LDL cholesterol (5)
Blood Pressure	Lower blood pressure (1)
Coronary Heart Disease	Lower rates of coronary heart disease (5)
Mortality	16%-17% lower rates of all-cause mortality (6)
Cancer	Lower stomach, bladder, blood, and overall cancer rates (7)
Oxidative stress	Lower oxidative stress (8)
Green House Gas Emissions (GHGE)	One third fewer GHGE (6)

A meta-analysis of non-vegetarian populations in the United States and Europe reported that meat consumption significantly increased the risk of diabetes (6). In the European Prospective Investigation into Cancer and Nutrition (EPIC)-NL Study, animal protein from any source was associated with a significantly higher risk of diabetes (7). High animal protein intake was associated with a fivefold increase in diabetes mortality across all ages in a study population of more than 6,000 adults followed for 18 years (8). An increase in meat consumption of just one half of a serving per day was associated with a 48% increased risk of T2DM in a 4-year period (9).

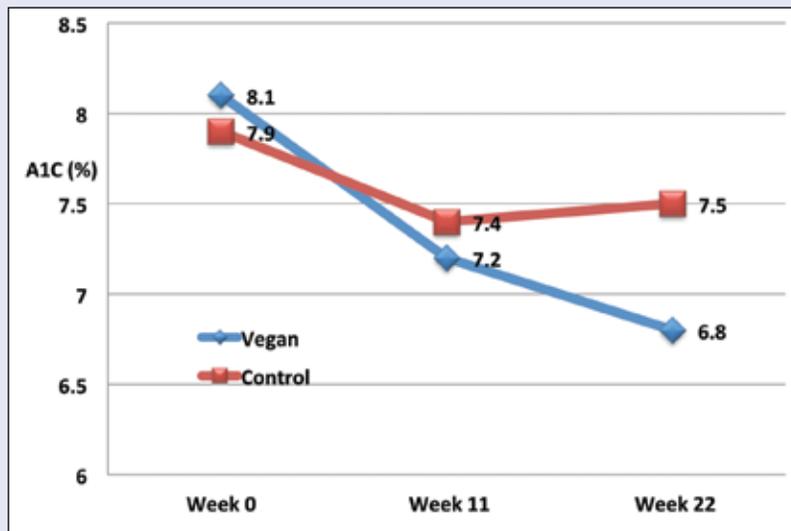
### *Interventional Studies*

A 22-week National Institutes of Health study compared a low-fat (10% to 15% of calories) vegan diet to a more conventional eating pattern in individuals with T2DM (10).

Both groups experienced improved glycemic and lipid control. However, among medication-stable patients, the vegan group had greater weight loss (14.3 lb vs. 6.8 lb  $P<0.001$ ), greater reductions in glycated hemoglobin (A1C) (1.23 vs. 0.38,  $P=0.01$ ), and greater reductions in LDL cholesterol (21.2% vs. 10%,  $P=0.02$ ) (Fig. 2) (10).

The authors postulated that these improvements were due to the higher fiber content of the vegan eating pattern, which improved satiety and reduced glucose absorption, providing a significant advantage in weight loss and glycemic control. Because the vegan eating pattern was also low in both total and saturated fat and contained no cholesterol, insulin sensitivity was further improved by decreasing intramyocellular lipids. This eating

**Figure 2.** A1C levels at baseline and at 11 and 22 weeks ( $P=0.01$ ) in individuals with T2DM following a low-fat, vegan diet or control group with no medication changes. Adapted from Barnard et al. (14)



**Figure 3.** The Power Plate



The Power Plate is a visual tool that can be used to educate patients on plant-based nutrition. It was created by the Physicians Committee for Responsible Medicine. Additional information is available at [www.ThePowerPlate.org](http://www.ThePowerPlate.org).

pattern is high in nutrient-dense, plant-based carbohydrates (70% of calories), has been implicated in increasing triglycerides (TG). However, this trend was not observed in the study; in fact, the vegan eating pattern decreased TG by 19%.

Crane and Sample (11) evaluated the effect of a low-fat vegan diet on painful diabetic neuropathy in 21 patients with T2DM participating in a residential program that also provided 30 minutes of daily walking. In two weeks, 17 of 21 patients had complete relief of pain; the other four reported partial relief (11).

## Potential Mechanisms for Meat and Diabetes Risk

Mechanisms for increased risk of T2DM with meat consumption include higher body weight, insulin resistance, fatty acid metabolism, heme-iron intake, oxidative stress, and an increased intake of advanced glycation end products (AGEs) (6,12,13). Consuming meat displaces potentially protective foods such as

legumes, vegetables, whole grains, and nuts.

Insulin resistance is associated with a higher intake of saturated fat, which may be mediated by the accumulation of intracellular lipids within the liver and muscle cells. A higher fat intake may also downregulate genes responsible for mitochondrial oxidative phosphorylation in muscle tissues. Research demonstrated that individuals who avoided animal products had significantly lower concentrations of intracellular lipid (14).

Heme-iron, which is found in red meats, is readily absorbed, and promotes higher iron stores, has been positively correlated with insulin resistance and diabetes (2). Similarly, high levels of iron can result in oxidative stress and cellular damage, leading to chronic inflammation, CVD, and T2DM (2).

Highly oxidant compounds with pathogenic significance, AGEs have been found to contribute to diabetes risk and exacerbate complications.

Analysis based on standard serving sizes showed that meats have the highest content of exogenous AGEs (6).

In addition to meat, animal protein from other sources, including eggs and dairy, can increase inflammation, leading to higher rates of CVD. Carnitine and choline, which are abundant in animal products, are metabolized by gut microbes to trimethylamine, which is absorbed into the bloodstream and metabolized to trimethylamine-N-oxide (TMAO) by the liver, increasing the risk of CVD (14). In one study, individuals consuming more meat, eggs, and dairy had higher levels of plasma TMAO as well as increased risk of CVD and adverse cardiac events (15).

## Nutrition Adequacy

According to the Academy of Nutrition and Dietetics, appropriately planned vegetarian diets, including total vegetarian or vegan diets, are healthful, nutritionally adequate, and may provide health benefits in the prevention and treatment of certain

**Table 3. Nutrients of Concern for Plant-based (Vegan) Eating Patterns**

Vitamin B-12	<p>Plant products contain no vitamin B-12, so it is important to consume a supplement each day and/or fortified cereals, non-dairy milks, or nutritional yeast.</p> <p>Note: All individuals &gt;50 years of age should consume a supplement (27)</p>
Calcium	<p>1 cup of cow's milk has 96 mg absorbable calcium. So do the following foods:</p> <ul style="list-style-type: none"> <li>• ½ cup Chinese cabbage</li> <li>• 1 cup bok choy</li> <li>• 1⅔ cups calcium-fortified soymilk/almond milk</li> <li>• 1½ cups kale</li> <li>• 5.4 oz. calcium-added set tofu</li> <li>• 2 cups white beans (28)</li> </ul> <p>Other sources of calcium: collards, broccoli, almonds, sesame seeds, fortified foods (18)</p> <p>In the EPIC Oxford trial, vegans (adjusted for age, sex, non-dietary factors) who consumed at least 525 mg/day of calcium had the same risk ratio for fractures as meat eaters (29).</p> <p>Vegetarians consume higher amounts of nutrients important in bone health: magnesium, potassium, vitamins C and K, and polyphenols.</p> <p>Daily consumption of legumes significantly decreases risk of fracture in vegetarian and non-vegetarian women (30).</p> <p>Oxalates in spinach and Swiss chard greatly reduce calcium absorption (23).</p>
Protein	<p>Plant protein can meet protein requirements as long as a variety of plant foods are consumed and energy needs are met (18). Sources of plant protein include legumes, whole grains, tofu, tempeh, seitan, and whole grains.</p>
Iron	<p>Green leafy vegetables and legumes provide iron. The incidence of iron deficiency anemia is similar among vegetarians and non-vegetarians (31).</p>
Essential Fatty Acids	<p>Plant sources of essential fatty acids include ground flaxseeds, walnuts, cauliflower, soybeans, tofu, and Brussels sprouts. These non-animal-based sources are free of saturated fat and cholesterol (32).</p>
Vitamin D	<p>Sources of vitamin D: sun exposure and fortified foods.</p> <p>Vitamin D deficiency is common in the general population and depends on sun exposure. Sun exposure need varies, depending on skin pigmentation, sunscreen use, and geographic latitude. Supplements may be needed if sun exposure and fortified foods are not sufficient to meet needs.</p> <p>Recommended Dietary Allowance for vitamin D: 600 IU/day for adults and 800 IU/day for adults &gt;70 years of age (33).</p>

diseases (16). Table 3 lists additional information on nutrients of concern.

Of special significance is vitamin B-12, which is produced by bacteria in the gastrointestinal tracts of mammals and is found only in animal products. Megaloblastic anemia, dementia, neuropathy, and irreversible nerve damage can be caused by vitamin B-12 deficiency. Thirty percent of patients on long-term chronic metformin therapy are deficient in vitamin B-12 (17). The condition is often misdiagnosed as neuropathy, further exacerbating the deficiency. As individuals age, their ability to produce intrinsic factor decreases, reducing the ability to absorb vitamin B-12. The Institute of Medicine (IOM) recommends that all individuals older than age 50 years take a vitamin B-12 supplement (18). The IOM recommends 2,000 µg of oral vitamin B-12 daily, followed by a decreased daily dose of 1,000 µg and then 1,000 µg weekly, and finally, monthly dosing to correct deficiencies (19). The Recommended Dietary Allowance (RDA) for vitamin B-12 is 2.4 µg/day. Supplemental doses must be individualized for people with diabetes and following a vegan diet because the RDA is not likely to be adequate for ongoing maintenance.

### Clinical Application

Patients who want to follow a plant-based eating pattern may include fruits, vegetables, beans, whole grains, and a small amount of nuts and seeds in their diets. Unlimited portions have been tested using the 'four food groups' with positive outcomes for glycemic control and reductions in LDL cholesterol, triglycerides, and weight (10,20). Table 4 provides more guiding principles of plant-based eating as well as reliable, evidence-based resources.

**Table 4. Principles of a Low-fat, Plant-based Eating Pattern and Resources for Registered Dietitian Nutritionists**

**Counseling Tips for Plant-based Nutrition for Diabetes:**

- Consume generous portions from four food groups: whole grains, legumes (beans, peas, and lentils; also known as pulses), vegetables, and fruits. Individuals who adjust insulin based on carbohydrate intake should continue to count carbohydrates; insulin requirements may need adjustments.
- Choose whole foods or minimally processed foods.
- Avoid added vegetable oils and other high-fat foods to aid in weight loss and increases in insulin sensitivity.
- Include 1 oz of nuts or seeds per day and limit because of the high fat and calorie content.
- Choose carbohydrates with a low glycemic index, such as steel-cut or old-fashioned oatmeal, sweet potatoes with skin, beans, whole grains, and most fruits and vegetables. This should improve glycemia and avoid an increase in triglycerides.
- Consume at least 25-40 g/day of fiber. Gradual increases may be necessary to avoid gastrointestinal distress.
- Avoid all sources of animal products to eliminate cholesterol and saturated fat.
- A vitamin B-12 supplement is recommended for those avoiding animal products and all individuals >50 years of age. Typical dosage is 25-100 µg/day or 1,000 µg twice a week.
- A macronutrient profile of 75% to 80% energy from carbohydrate, 10% to 15% from protein, and 10% from fat is recommended.

**Resources for Plant-Based Nutrition:**

- Vegetarian Nutrition Dietetic Practice Group (VNDPG) of the Academy of Nutrition and Dietetics: <http://vndpg.org>
- VNDPG consumer site: <http://vegetariannutrition.net/>
- Meal Planning for Vegetarian/Vegan Diets (ADA): <http://www.diabetes.org/food-and-fitness/food/planning-meals/meal-planning-for-vegetarians/>
- Physicians Committee for Responsible Medicine (PCRM) 21 Day Vegan Kick Start: a free monthly online program providing 3 weeks of menus (planned by RDNs), shopping lists, recipes, education and motivational messages: <http://www.pcrm.org/health/diets/kickstart/kickstart-programs/>
- More PCRM resources on diabetes: <http://www.pcrm.org/health/diabetes-resources/>
- Free continuing education on plant-based nutrition: <http://www.nutritioncme.org/>
- eCornell Certificate in Plant Based Nutrition: <http://www.ecornell.com>

Patients with diabetes adopting a whole-foods, plant-based eating pattern need to be aware of potential significant decreases in blood glucose that require alterations in insulin or oral medications. Changes in glycemia can be dramatic or gradual over several weeks or months (20). Less frequently, patients may see an increase in postprandial blood glucose and may need to count carbohydrates either temporarily or on an ongoing basis. Advising these patients to select unrefined, low GI carbohydrates such as vegetables and legumes and to control portions of whole grains and fruits may improve postprandial glucose. Initially, all patients should check their blood glucose levels more frequently and receive instruction on treating highs and lows. Patients with T1DM and T2DM who adjust meal time insulin must continue to count carbohydrates, but over time they may need to recalculate their insulin-to-carbohydrate ratios. Reductions in blood pressure and lipids also may require medication adjustments. Patients should be told that symptoms of low blood glucose or low blood pressure may be a good sign, and in some cases, they may be able to eliminate medications completely.

## Summary

A whole-foods, plant-based eating pattern is highly effective for the prevention, treatment, and management of diabetes. Observational and interventional studies have demonstrated a reduction in insulin resistance, improvement in glycemic control, promotion of weight loss, and attenuation of macrovascular (CVD) and possibly microvascular comorbidities/complications. RDNs are in a unique position to provide education and support, thereby improving the health of their patients with diabetes.

Adapted from Trapp and Levin (32).

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### CPE CREDIT ANSWER KEY

See the CPE credit self-assessment questionnaire on page 38.

1. D
2. D
3. D
4. B
5. C
6. C
7. B
8. D
9. D
10. A

# Spice it Up: Functional Foods, Herbs & Spices in Diabetes Management

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## Abstract

Diabetes mellitus (DM) requires patient self-management to prevent acute complications and reduce the risk of long-term comorbidities. In view of their specific health benefits and potential to influence glycemic control, reduce cardiovascular disease risk, and modulate inflammation, functional foods (FFs) could be an important part of such management.

## Introduction

The role of FFs in chronic disease risk reduction and management has received increasing attention over the past several years. Although numerous foods have demonstrated hypoglycemic, hypocholesterolemic, antiatherogenic, and anti-inflammatory effects, this article focuses on medical culinary use of select herbs and spices.

## Functional Foods

The International Food information Council defines an FF or medicinal food as “Foods or dietary components that may provide a health benefit beyond basic nutrition and may play a role in reducing or minimizing the risk of certain diseases and other health conditions” (1,2). The Academy of Nutrition and Dietetics defines the term FFs as “whole foods along with fortified, enriched, or enhanced foods that have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis at effective levels

based on significant standards of evidence” (1). There is evidence that some food components in plant foods that are not considered nutrients in the traditional sense, such as phytochemicals, phytoestrogens, flavonoids, lignins, isoflavones, and phenolic compounds, may provide positive health benefits, and these foods are known as FFs (1).

FFs include the healthful components in plant foods, fermented foods, and fortified/enhanced foods. Functional attributes of many traditional foods are being discovered, while new food products are being developed with beneficial components (1,2). Foods marketed as FFs fall into three general categories (1):

- Conventional foods containing natural bioactive food compounds that provide benefits beyond basic nutrition. Examples are the antioxidant vitamins in orange juice, prebiotics in bananas, and probiotics in yogurt.
- Modified foods containing bioactive food compounds through enrichment or fortification, such as n-3 fatty acids in margarine spreads and eggs.
- Food ingredients that are synthesized, which provide prebiotic benefits, such as oligosaccharides or resistant starch.

Resistant starches are starches that escape digestion in the small

intestine. They provide some of the health benefits of both soluble and insoluble fiber. Natural resistant starch is found in whole grains, seeds, beans, legumes, and under-ripe fruit (e.g., green bananas) and is especially prevalent in cooked starches that have been cooled (e.g., beans, lentils, legumes, pasta salad, potato salad, and sushi rice). Soluble fiber feeds the intestinal bacteria, while insoluble fiber aids in digestion by trapping water in the colon and inactivates many intestinal toxins (3). The benefit of resistant starches for diabetes is a smaller contribution of carbohydrate energy and the benefit of delayed digestion that, in turn, helps reduce postprandial blood glucose spikes.

## Herbs and Spices

Herbs and spices, in use since approximately 5000 BCE, are among the richest sources of antioxidants and can play a central role in cooking. Herbs are from the leaf, while spices are created from any other part of the plant, such as buds (e.g., cloves), bark (e.g., cinnamon), roots (e.g., ginger, turmeric), berries (e.g., peppercorns), and aromatic seeds (e.g., cumin) (3,4).

### Bitter Melon

(*Momordica charantia*;  
Family: *Cucurbitaceae*)

This plant resembles a light green, pointed cucumber. It is cooked with potato, onion, and/or tomato;

pickled; or occasionally dried. Soaking the cut bitter melon in water, squeezing out the water, and cooking it with onions and tomatoes or tomato sauce can reduce the bitter taste.

Bitter melon fruit and seeds may help to improve glucose tolerance and reduce blood glucose concentrations in individuals with T2DM (5). The hypoglycemic effect is dependent on viable beta-cell function. Bitter melon contains a mixed sterol, charantin, that lowers blood glucose as well as polypeptide-p, an insulin-like polypeptide (6). Possible mechanisms of action include increased insulin secretion, tissue glucose uptake, liver muscle glycogen synthesis, glucose oxidation, and decreased hepatic gluconeogenesis (7). Additive hypoglycemic effects have been reported when large quantities of bitter melon curry were consumed while taking chlorpropamide (8).

### Fenugreek (*Trigonella foenum-graecum*; Family: *Fabaceae/Leguminosae*)

These seeds contain 45.4% dietary fiber (32% insoluble and 13.4% soluble) and are associated with reduced glycemia and cholesterolemia. Fenugreek's hypoglycemic effect has been documented in humans and animals with both T1DM and T2DM (9).

When taken with food, fenugreek delays gastric emptying, slows carbohydrate absorption, and inhibits glucose transport. Its constituent, 4-isoleucine, appears to stimulate insulin secretion. Fenugreek may reduce blood glucose levels and might have additive effects when used with medications to lower blood glucose (9). Accordingly, glucose levels should be closely monitored (9).

Fenugreek seeds or powder (ground seeds) may be used in pickles, vegetables, rice dishes, and curries. The powder may be added to flour in baked foods or pancake batter. The seeds can be sprouted for adding to salads or cooked with rice, beans, or vegetables. Fenugreek leaves are eaten in India as a fresh green vegetable or added to rice, dried bean dishes, potatoes, or flour to make a variety of breads.

### Cinnamon (*Cinnamomum aromaticum*, synonyms *Cinnamomum cassia*, *Cinnamomum ramulus*; Family: *Lauraceae*)

Polyphenolic polymers such as hydroxychalcone found in *Cinnamomum verum* and *Cinnamomum cassia* are believed to be responsible for potentiating insulin action, thereby lowering glucose levels. These polyphenolic compounds increase phosphorylation of the insulin receptor, which increases insulin sensitivity. Increased insulin sensitivity improves blood glucose control and serum lipid levels. Cinnamon extracts also may activate glycogen synthetase and increase glucose uptake (8). Although cinnamon consumption is associated with statistically significant decreases in fasting plasma glucose, total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels as well as an increase in high-density lipoprotein cholesterol levels, no significant effect on glycated hemoglobin (HbA1c) was found (10).

### Ginger (*Zingiber officinale*, synonym *Amomum zingiber*; Family: *Zingiberaceae*)

In laboratory models of diabetes, ginger seems to increase the release of insulin and lower cholesterol levels. Preliminary in vivo research suggests that ginger might increase

insulin and/or decrease blood glucose levels (8)

Fresh ginger can be pickled with garlic and enjoyed with food. Similarly, fresh, crystalized, or powdered ginger can be added to a variety of foods during cooking. Grated ginger can be added to hot water or green or black tea for a ginger tea. An especially enjoyable and tasty combination is fresh or powdered ginger with cardamom.

### Turmeric (*Curcuma longa*, synonym *Curcuma domestica*; *Curcuma aromatica*; Family: *Zingiberaceae*)

Curcumin, the active ingredient in turmeric, has anti-inflammatory and antioxidant effects. A 9-month curcumin intervention (1,500 mg daily) in a prediabetic population significantly decreased the number of individuals who eventually developed T2DM compared to placebo (11). In addition, the curcumin treatment appeared to improve overall beta-cell function with very minor adverse effects (11). In Asian Indian cooking, turmeric is added to all vegetables, beans, legumes, grains, flours, and yogurt along with a source of fat such as oil or ghee and spices. Fresh grated turmeric mixed with lime juice, salt, and herbs is eaten as a condiment during the winter months in India.

### Cumin (*Cuminum cyminum*, synonym *Cuminum odorum*; Family: *Apiaceae/Umbelliferae*)

This spice, used regularly in Asian, Indian, and Mexican cooking, may have hypoglycemic effects. Along with ginger, cinnamon, black pepper, and green tea, cumin has been shown to prevent and/or inhibit protein glycation. Protein glycation has been implicated in several pathophysiologies associated with

aging and diabetes. Inhibition of the formation of protein glycation is believed to play a role in the prevention of diabetes-related complications (12).

Cumin is added to stir-fry vegetables, grains, yogurt beverages, and legume and beans dishes such as chili.

### **Garlic (*Allium sativum*; Family: *Alliaceae* or *Liliaceae*)**

The active ingredients of garlic, allicin and allyl propyl disulphide, have hypoglycemic effects and have been shown to improve blood glucose control. Researchers have noted the association of garlic use with increased serum insulin levels and improved insulin sensitivity (13).

Garlic can be used to flavor a variety of foods during cooking or in salad dressings and pesto.

### **Cocoa (*Theobroma cacao*, synonyms *Theobroma sativum*; Family: *Malvaceae* or *Sterculiaceae*)**

Cocoa seeds are a significant source of naturally occurring flavanoids, which are anti-inflammatory, antihypertensive, and antithrombotic. In addition, flavanoids increase insulin sensitivity and increase postprandial insulin secretion, thus potentially improving glycemic control (14,15).

## **Conclusion**

Bitter melon, fenugreek seeds, cinnamon, ginger, turmeric, cumin, garlic, onion, coriander, cloves, and cocoa can be used frequently in cooking. These FFs have a beneficial effect on health. Research is showing potential impact on blood glucose, coagulation status, lipid levels, and blood pressure. Individuals with

diabetes who use herbs and spices to improve their diabetes management must monitor blood glucose closely and discuss the use of any herbs with a qualified health care professional.

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# Diabetes and Traditional Chinese Medicine: Managing a Modern Epidemic With Ancient Medicine

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## Abstract

Traditional Chinese Medicine (TCM), which includes acupuncture, herbal phytotherapy, nutrition, and the mind-body modality Qi Gong and related ancient practice Tai Chi, is gaining global popularity. The National Institutes of Health currently funds more than 40 clinical trials on the use of acupuncture in myriad chronic conditions (1). This article is a primer on TCM, with a special emphasis on acupuncture and its potential benefit for the person with diabetes mellitus (DM).

## Introduction

Originating more than 2500 years ago, TCM is a Chinese system of medicine that is rooted in ancient Taoist philosophy.

When examining TCM, theoretical concepts of disease and health must be understood before evaluating the efficacy of its components or modalities (1). In this article we provide an elementary overview of TCM theory, then discuss DM through the lens of TCM and evaluate the available research on acupuncture pertaining to the treatment and management of DM, its related comorbidities and complications.

## TCM: Theory and Terms (2,3)

### Yin and Yang

Yin and yang represent two

oppositional but complementary forces between and within the physical body, environment, and metaphysical worlds. This concept is best understood pictorially: night and day, cold and hot, winter and summer, moist and dry, pallor and erythema. Yin is associated with cooling or darkness (i.e., cold, winter) whereas heat and warmth are descriptive qualities of yang. Qi is made from the interaction of yin and yang.

### Qi

Qi or Chi (pronounced “chee”) is ‘vital energy or (life) force.’ It is best described by the phrase “No Qi, no life!” According to TCM, Qi performs multiple functions in creating, maintaining, and supporting health.

### Spirit

Spirit or ‘shen’ in TCM represents one’s ‘state of mind.’ Shen resides in the heart, receiving nourishment by blood.

### Blood

In TCM, blood represents the nutritive aspect of the body. Blood supports and nourishes shen. Qi, blood, and shen circulate throughout the body — they are the yin and yang aspects of one another.

### The Five Elements

The Five Elements, a TCM subsystem, is used by many practitioners to differentiate symptomatology and categorize illness. The Table illustrates the interrelationship between the

Five Elements of the material world — wood, fire, earth, metal, and water, the human body, and the metaphysical.

### Meridian Pathways and Acupoints

According to TCM, meridians or energetic pathways form an intricate system by which blood and Qi travel throughout the body and, thus, explain how the body communicates internally with itself. Acupoints (acupuncture points) are points of energy confluence along meridians and related channels. Visualize an interstate highway and ancillary road system: major interstates are meridians, exits are acupuncture points, and county roads and city streets are extraordinary vessels and divergent channels (2,3,4).

Like police officers who direct traffic flow, acupuncture reinforces, reduces, or harmonizes Qi in the body (2,3,4). Simplistically, there are 12 primary meridians corresponding to bodily organ systems. They are located between the epidermis and muscles and run a mapped course along anatomic structures, body organs, and bony landmarks. Only 360 of the 2,000 acupuncture points are commonly used clinically.(4). Acupuncture is performed by manually inserting very fine, sterile, disposable needles in the skin at specific energetic (acupuncture) points (1). The needles can be

manipulated manually, or electrically via electrical stimulation, called electroacupuncture (1,2,3).

Because of the possible placebo effect, numerous studies have attempted to distinguish sham (needles inserted at non-acupoints) from verum (needles inserted at acupoints) acupuncture. One study (5) inserted acupuncture needles into sham and verum points corresponding to ocular points on both feet. Using magnetic resonance imaging, the researchers noted ocular activity when the corresponding eye acupuncture points on the feet were stimulated, but no ocular activity on the sham-stimulated points.

## Diabetes from a TCM Perspective

The word diabetes is not used in TCM. Rather, its constellation of symptoms (polydipsia, polyphagia, polyuria with emaciation) is called Xiaoke, which means “thirsting and wasting disorder” or “diabetic exhaustion” (2,3,6).

Xiaoke is a constitutional yin deficiency characterized by fatigue, weakness, lethargy, and pale complexion (2,3,6). When persons with DM experience too much heat, they become thirsty, with corresponding bodily depletion (i.e., muscle atrophy/weight loss) or wasting (2,3,6).

DM in TCM is divided into three categorical regions: upper, middle, and lower Xiaoke (2,3,6). These correspond respectively to the lungs (and in TCM, mouth/throat), which have “excess thirst” (polydipsia); the stomach, which has excess hunger (polyphagia); and the kidneys, which have excess urination (polyuria). Finally, liver Qi stagnation is related to and reflected in emotional factors that often trigger and coexist with

Xiaoke. The lungs, stomach, liver, and kidneys are the organs commonly associated with a yin deficiency (2,3,6).

This ancient definition resembles the classic allopathic presentation of type 1 diabetes mellitus (T1DM) or type 2 diabetes mellitus (T2DM). T2DM is generally associated with greater body mass index as a consequence of excess caloric intake. Similarly, insulin resistance and hyperglycemia are associated with inflammation (heat), and if hyperglycemia is persistent, polydipsia, polyphagia, and polyuria often occur, with consequent weakness and weight loss (7,8).

## Diagnosis and Treatment in the TCM Model

Similar to the nutrition-focused physical assessment, diagnosis in TCM is made by taking the pulse and looking at the tongue, skin, eyes, hair, and body habitus in tandem with a detailed patient history and intake assessment. The tongue reflects the interior bodily landscape, in particular digestion, and different areas of the tongue correspond to geographic areas in the body. The tongue of the person presenting clinically like T1DM is dry. A pale and swollen tongue with or without accompanying teeth marks is a hallmark of Xiaoke resembling T2DM. Tongue characteristics change with disease progression or comorbidities.

The goal of TCM nutritional therapy for Xiaoke is to nourish, moisten, and cool the yin deficiency. Recommended foods include vegetables, berries, and soy (2). Notably, these foods are generally lower in glycemic index and/or glycemic load, lower in total fat, and higher in fiber and antioxidants (9).

## TCM from an Evidenced-based Platform

Experimental and clinical case study data suggest benefits of acupuncture. It may positively affect glycemia and glucose metabolism in impaired glucose tolerance (IGT) and T2DM (10–13), favorably alter neuroendocrine metabolic dysfunction associated with obesity (14,15), improve systolic blood pressure (16,17), modulate pain and symptomatology associated with diabetic peripheral neuropathy (DPN) (18,19), improve gastric motility in diabetic gastroparesis (20), and improve mood (12).

Meng and colleagues (10) demonstrated that electroacupuncture reduced HbA1c and 2-hour postprandial blood glucose levels in individuals with IGT. Likewise, in a study published in abstract form, Mingming and Qianqian (11) demonstrated that meridian-acupuncture treatment reduced postprandial hyperglycemia in individuals with IGT. In a randomized, controlled trial (RCT), Shen and Kong (12) compared metformin hydrochloride (control group) and metformin hydrochloride plus acupuncture (experimental group) on glycemia. The results suggested that acupuncture and metformin hydrochloride were superior ( $P < 0.05$ ) in improving fasting blood glucose, 2-hour postprandial glycemia, and HbA1c.

Several meta-analyses evaluated acupuncture’s use in hypertension (HTN) (16,17), a common comorbidity in persons with T2DM; obesity (14,15), a common precursor to T2DM; and DPN (18,19) and gastroparesis (20), common microvascular complications of DM. The reviews on essential HTN suggested that acupuncture is an effective therapeutic intervention,

especially when combined with a pharmacologic agent;(16,17). The authors contended that acupuncture and pharmacotherapy are superior to either pharmacotherapy or acupuncture alone. Furthermore, some proposed that acupuncture is advantageous as an adjunctive management modality because it is associated with a relatively low incidence of adverse effects. Admittedly, these positive preliminary findings must be interpreted cautiously because of methodologic flaws, including heterogeneity, unclear/questionable sequence generation and/or blinding, small sample size, and lack of intent-to-treat analyses in many of the studies.

As with HTN, the methodological quality of trials on acupuncture and DPN is poor for similar reasons as earlier noted. Despite this, however, Chen and associates (18) in their systematic review of RCTs on acupuncture and DPN indicated that acupuncture alone and/or in combination with B-vitamin

supplementation modulated pain perception and symptomatology, with improved nerve conduction velocity. As with the HTN reviews, no serious adverse events were reported; however, the authors admitted that RCTs are not the ideal template for identifying rare but serious harm. Limited research suggests acupuncture may also improve mood (12) and gastric motility in those with diabetic gastroparesis (20). More carefully conducted research on acupuncture and the aforementioned DM comorbidities and complications is requisite.

Belivani and colleagues (15) published a comprehensive narrative review of acupuncture as a management modality for obesity. The article expanded upon a previous review by Cho et al. and coworkers (15), which demonstrated that acupuncture concurrent with diet and exercise was superior to lifestyle advice, sham acupuncture, and conventional medicine alone for weight management.

Current scientific thinking suggests that the neurophysiologic effect of acupuncture is likely exerted by central nervous system activation, which is essential for autonomic nervous system modulation and consequently neuroimmunologic and hormonal regulation (21). The Belivani group (14) further elucidated the postulated mechanisms by which acupuncture modulates anorexigenic and orexigenic peptides, glucose, insulin, and lipid metabolism as well as inflammatory markers. Succinctly, stimulation of specific acupoints along the vagal and cholinergic nerves alters circulating neuropeptides (e.g., ghrelin, leptin, B-endorphin).

## Conclusion

Acupuncture, a component of TCM, shows promise as an integrative and complementary modality for DM and its comorbidities and complications. Working together with TCM practitioners, integrative registered dietitian nutritionists can bridge the 'east-west' gap and optimize health

**Table. Five Elements (2)**

Phenomenon	Wood	Fire	Earth	Metal	Water
<b>Direction</b>	east	south	center	west	north
<b>Color</b>	green/blue	red	yellow	white	black
<b>Climate</b>	wind	heat	damp	dryness	cold
<b>Taste</b>	sour	bitter	sweet	acid	salty
<b>Organ pair</b>	liver/ gallbladder	heart/ small intestine	spleen/ stomach	lung/ large intestine	kidney/ bladder
<b>Tissue</b>	tendon	vessel	muscle	skin	bone
<b>Sense organ</b>	eye	mouth	tongue	nose	ears
<b>Power</b>	expansion	fusion	moderation	contraction	consolidation
<b>Action</b>	metamorphosis	realization	unification	transmutation	revelation
<b>Values</b>	utility	intuition	harmony	purity	durability
<b>Emotion</b>	anger	joy	pensiveness	grief	fear
<b>Expression</b>	initiative	communication	negotiation	discrimination	imagination
<b>Changes</b>	germinate	transform	transform	reap	store

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for clients who subscribe to functional and integrative medicine and health care.

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# Lesson Plans

## Dear Colleagues of the Diabetes Care and Education (DCE) Practice Group,

We are pleased to introduce a new OTCE feature — lesson plans! We developed these with the input of colleagues at universities and colleges throughout the country. We hope they enhance your use of OTCE articles in your class presentations and discussions.

Please let us know if you find them helpful – how they were used and the impact they made. Send your comments to: Marla Solomon, RD, LD/N, CDE at Children’s Hospital of University of Illinois at marlacs@uic.edu.

Thank you for helping us assist you as you teach future DCE professionals!

The 2014-2015 DCE Publication Team

### Yoga for Type 2 Diabetes and Related Comorbidities

Instructor’s Plans	Objectives	Student’s Assignment
<p>Provide diabetes and stress presentation.</p> <p><a href="http://www.diabetes.org/living-with-diabetes/complications/mental-health/stress.html">http://www.diabetes.org/living-with-diabetes/complications/mental-health/stress.html</a></p> <p><a href="http://www.webmd.com/diabetes/features/stress-diabetes">http://www.webmd.com/diabetes/features/stress-diabetes</a></p> <p>Describe the events that occur with overeating through the hypothalamic-pituitary-adrenal and sympathoadrenal pathways.</p>	<p>The student explains how blood sugars increase during times of stress for those with diabetes.</p>	<p>Student will interview 2-3 individuals with diabetes to learn how they cope (positive and negative) with the disease and if possible, ask about their blood sugar results.</p>
<p>From a yoga professional, present yoga and its health benefits.</p> <p>a) Encourage students to participate in the yoga demonstration.</p> <p>b) Demonstrate breathing technique that can be incorporated into any exercise regimen.</p>	<p>When discussing exercise, the student will provide yoga and its benefit as an option.</p>	<p>After participating in a yoga demonstration conducted by the guest speaker, the student will develop a handout that contains different yoga postures and breathing technique.</p>
<p>Provide a presentation on mindfulness.</p>	<p>The student will reflect on their own ability in helping another person to improve their health status.</p>	<p>After a mindfulness presentation, students will reflect on their own experiences in helping a patient deal with a difficult situation such as developing a new nutrition plan or accepting a new diagnosis. These ideas will be written in an essay format.</p>

## The Role of Microbiota in Obesity and Diabetes

Instructor's Plans	Objectives	Student's Assignment
Provide a lecture on probiotics/prebiotics in relation to the digestive system.	The student will correctly define the terminology: probiotics and prebiotics.	The student develops a patient nutrition handout on the nutritional benefits of probiotics and prebiotics with good food sources.
	The student correctly recites the names of two bacteria identified in the gastrointestinal system (found in the article).	The student researches one of the two bacterium and develops a presentation card with name, its development, and a health attribute. This information is presented on a large card for the group to view.
After obtaining the large cards from the class members, display 2-3 cards on an easel for the students to view.	After viewing the cards, each student will actively ask questions or make comments that will generate discussion.	For each bacteria, the student will complete a card with at least one comment or question that will assist in the class discussion.
To continue this subject matter, the following project will be conducted in connection with the younger grade teacher(s).	Each bacteria presented will be learned and discussed by each student through a group project.	Two to three bacterium will be presented by each student. Outside presenters are encouraged so that our students can learn from professionals.

## Mindfulness and Diabetes: Working in Tandem

Instructor's Plans	Objectives	Student's Assignment
Present the basic concept of mindfulness.	The student will recite the definition of mindfulness and provide one example of how mindfulness and medical nutrition therapy can be used together.	The student will provide one page diary that defines "mindfulness" in their own words along with an example of mindfulness in a nutrition counseling session. This will be collected for a class journal.
Instruct the students to read the following book(s) for a class discussion: <b>Eat What You Love, Love What You Eat with Diabetes: A Mindful Eating Program for Thriving with Pre-diabetes or Diabetes</b> by Michelle May, MD and Megrette Fletcher, Med, RD, CDE <b>Approaches to Behavior: Changing the dynamic between patients and professionals in diabetes care and education</b> (selective chapters) by Janis Roszler, MS, RD, LD/N, CDE, FAND and Wendy Satin Rapaport, PsyD, LCSW	The student will actively read the suggested book/chapter for interactive class discussion, and apply concepts learned from the original class assignment. <i>(Consider using this subject matter at different times throughout the semester/year for productive informal discussions.</i>	During the individual assigned reading sessions, written chapter notes will be completed and those thoughts will be shared during the classroom discussions.

## Plant-Based Nutrition: A Therapeutic Option for Diabetes

Instructor's Plans	Objectives	Student's Assignment
Presents the Academy's position paper: <b>The Role of Nutrition in Health Promotion and Chronic Disease Prevention</b> with focus on diabetes. (link on Academy's website)	Besides grains, the student provides the approximated cost of these foods: vegetables and fruits (fresh/frozen), and the seasonal fruits, and their seasonal availability.	Based on low income (\$8.55/day), the student will develop a vegetarian meal plan that follows the basic nutrition guidelines (2,000 kcal, <65grams fat, 20grams saturated fat, 25g fiber).
Present the diabetes oral medication metformin which affects vitamin B-12.	The student will prepare a list of vitamin B-12 food sources with their content.	In the meal plan designed above, vitamin B-12 sources will be identified with a daily goal of 2.4 mcg.
Present the concept of glycemic index and the impact of fiber on postprandial blood sugars.	The student will state the foods with high and low glycemic index values and know their fiber content.	Design a high and low glycemic index breakfast meal plan; compare the fiber content.
Provide research criteria to the students to use in evaluating the chosen articles found in the reference listings.	The student will identify the pros and cons of a research article to determine if the statements provided about meat consumption are accurate.	From the references #12-15, a student will identify the key points: sample size, independent/dependent variables or hypothesis.
Present the concept of advanced glycation endproducts (AGE) and the influence of TZD diabetes medications.	The student will be able to explain the impact of AGE on one body organ.	The student will conduct research on diabetes complications (neuropathy and retinopathy) and AGE.

## Spice It Up: Functional Foods, Herbs & Spices in Diabetes Management

Instructor's Plans	Objectives	Student's Assignment
Present overview with Academy's position paper: <b>Functional Foods</b> found on the website link.	The student will provide recipe substitutions using resistant starch.	The class will prepare the following comparison recipes: a) white sauce with white flour vs cornstarch; b) potato starch cake vs. standard white cake.
As a guest speaker, a culinary professional will present the history of Indian cuisine that contains many of the noted functional food spices, as cumin, turmeric, and fenugreek.	From the assignment, the student has a list of functional foods along with their carbohydrate content.	The student prepares a patient handout on the benefits of Functional Foods with a list of food items.
Present information on nutrition and the consumer found on the website link in the Academy's practice paper: <b>Communicating Accurate Food and Nutrition Information.</b>	From the assignment, the student will present their findings.	The student identifies an article that discusses the "magical findings" of a functional food, that improves health status. Evaluate the findings to determine if it is accurate information and how the consumer can use it.

## Diabetes and Traditional Chinese Medicine

Instructor's Plans	Objectives	Student's Assignment
Provide introductory discussion of Traditional Chinese Medicine (TCM) theories found in the journal article; present glucose metabolism with the impact of hyperglycemia.	<p>The student will accurately recite the meaning of Yin and Yang, Qi, Spirit and Blood within the TCM theories.</p> <p>The student will correctly identify and compare the terms TCM-"Xiaoke" with medical term-"Diabetes."</p>	<p>In a group, develop a road map of glucose metabolism with possible barriers that cause diabetes. Pinpoint areas that represent the TCM theories.</p> <p>Each student will develop a chart with three Xiaoke areas that correspond with diabetes complications.</p>
<p>Request an acupuncture professional to demonstrate a patient session from assessment to implementation. Ideally this could be a patient who has diabetes and/or is overweight. Also, at this time students will learn how to take an accurate pulse rate.</p> <p>Instructor provides a listing of malnutrition clinical signs of tongue, eyes, skin, etc.</p>	<p>By understanding the process and knowledge from a TCM professional, the dietetic professional will obtain accurate patient information when obtaining a patient history.</p> <p>Student will accurately obtain a person's pulse rate.</p>	<p>In groups of two, the dietetic students will obtain colleague's pulse rate and observe their tongue appearance. To be performed by each individual. Record findings and discussion among each other.</p>
Provide research criteria to the students to use in evaluating the chosen article found in the reference listings.	In an organized manner, each student will provide a research abstract that correlates with a diabetes issue-including hypothesis and conclusion.	From references #10 to 20, a student identifies one article to read and develop an abstract class presentation that focuses on the degree of their own acceptability.
Invite an endocrinologist to the class to discuss various hormones of the endocrine system with the potential hormone imbalances.	After the discussion, student will identify at least five hormones and their physiological actions.	Each student will identify one hormone and research its acupuncture impact. From one article, present findings to class in a 5-10 minutes talk.
Question? Five element table?		

# Integrative, Complementary, and Functional Medicine Resources

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## Member/Group/Professional Organizations

RESOURCE	WEBSITE	DESCRIPTION
The Dietitians in Integrative and Functional Medicine Group	<a href="http://www.integrativerd.org">www.integrativerd.org</a>	Dietetic practice group (DPG) of The Academy of Nutrition and Dietetics dedicated to promotion and education about integrative/functional nutrition via webinars, newsletters, seminars, and resource network
The Vegetarian Nutrition DPG	<a href="http://www.vegetariannutrition.net">www.vegetariannutrition.net</a>	DPG of the Academy that provides evidenced-based research/tools to promote/plan plant-based meals
American Botanical Council	<a href="http://www.herbalgram.org">www.herbalgram.org</a>	An independent scientific resource/clearinghouse on herbs/herbal medicine that offers print and online publications as well as educational/training opportunities
The Institute for Functional Medicine	<a href="http://www.functionalmedicine.org">www.functionalmedicine.org</a>	Network of multidisciplinary clinicians/researchers who practice and promote functional medicine via multilevel continuing medical education (CME) courses and training modules
American Holistic Medical Association	<a href="http://www.holisticmedicine.org">http://www.holisticmedicine.org</a>	A nonprofit network that links patients with holistic practitioners and offers practitioner educational resources via conferences, retreats, and newsletters
International Society of Nutrigenetics/Nutrigenomics	<a href="http://www.nutritionandgenetics.org">www.nutritionandgenetics.org</a>	Organization devoted to increasing public and professional understanding of nutrigenetics, nutrigenomics, epigenetics, and proteomics via promotion/publication/application of research
United Natural Products Alliance (UNPA)	<a href="http://www.unpa.com">www.unpa.com</a>	A consortium of dietary supplement and functional food companies committed to providing natural health products of superior quality and reliability
Physicians Committee for Responsible Medicine	<a href="http://www.pcrm.org">www.pcrm.org</a>	A nonprofit organization that advocates for preventive medicine, designs/conducts/reviews nutrition and health-related research, and provides patient and professional education
The Center for Mindful Eating	<a href="http://www.thecenterformindfuleating.org">www.thecenterformindfuleating.org</a>	A nonprofit organization that promotes and trains both professionals and the public in principles of mindful eating and meditation

## Government Agencies

RESOURCE	WEBSITE	DESCRIPTION
The Office of Dietary Supplements (ODS), National Institute of Health (NIH)	<a href="http://www.ods.od.nih.gov">http://www.ods.od.nih.gov</a>	The government agency that supports and disseminates dietary supplement (DS) research and produces The International Bibliographic Information on Dietary Supplements (IBIDS) database, which provides access to bibliographic citations and abstracts from published, international, and scientific literature on DS. Users can choose to search the Full IBIDS Database or subsets of Consumer Citations Only or Peer-reviewed Citations Only. Go to <a href="http://dietary-supplements.info.nih.gov">dietary-supplements.info.nih.gov</a> and select "Health Information."
The National Center for Complementary and Integrative Health (NCCIH)	<a href="https://www.nccih.nih.gov">https://www.nccih.nih.gov</a>	A subdivision of NIH that maintains a free website providing health information, research, clinical trials, training opportunities, and information about complementary and alternative therapies (CAM) and offers quarterly online free newsletter NCCIH at the NIH
The Agency for Healthcare Research and Quality (AHRQ)	<a href="http://www.ahrq.gov/clinic/epcindex.htm#complementary">http://www.ahrq.gov/clinic/epcindex.htm#complementary</a>	One of 12 agencies within the Department of Health and Human Services, this one supports/promotes evidenced-based health care and houses a section entitled Complementary and Alternative Care that lists meta-analyses and/or systematic reviews on DS
Center for Food Safety and Applied Nutrition (CFSAN)	<a href="http://www.fda.gov">www.fda.gov</a>	The agency that oversees the safety and labeling of supplements, foods, and cosmetics and offers consumer-based publications on DS

## Publications

RESOURCE	WEBSITE	DESCRIPTION
CAM on PubMed	<a href="https://nccih.nih.gov/research/camonpubmed">https://nccih.nih.gov/research/camonpubmed</a>	Jointly developed by NCCIH and the National Library of Medicine, CAM on PubMed offers more than 220,000 citations/links to and abstracts of peer-reviewed scientific publications on CAM; look for the Alerts and Advisories, treatment information, resources, and links to other organizations (e.g., FDA, AHRQ, ODS)
The Cochrane Library	<a href="http://www.cochrane.org">www.cochrane.org</a>	A collection of science-based reviews from the Cochrane Collaboration, abstracts of which can be read on the Web free of charge
Clinical Trial Database	<a href="http://clinicaltrials.gov/search/intervention=dietary+supplements&amp;recruiting=true">http://clinicaltrials.gov/search/intervention=dietary+supplements&amp;recruiting=true</a>	A web-based catalogue of all federally funded DS trials
Longwood Herbal Task Force	<a href="http://www.longwoodherbal.org">www.longwoodherbal.org</a>	Limited free resource providing peer-reviewed monographs, clinician summaries, patient information, and links to reputable sites

## Websites/Databases

RESOURCE	WEBSITE	DESCRIPTION
Dr. Andrew Weil	<a href="http://www.drweil.com">www.drweil.com</a>	A consumer-friendly online resource for integrative medicine that offers newsletters, social media platforms, provider referral network, recipes, tip of the day, and more
Natural Medicines Comprehensive Database	<a href="http://www.naturaldatabase.com">www.naturaldatabase.com</a>	An evidence-based subscription scientific online database for herbs/DS
Natural Standard	<a href="http://www.naturalstandard.com">www.naturalstandard.com</a>	An evidence-based subscription online database searchable by condition and CAM subject
HerbMed	<a href="http://www.hermed.org">www.hermed.org</a>	An evidence-based subscription resource providing hyperlinked access to scientific data on medicinal use of herbs
Oldways	<a href="http://www.oldwayspt.org">www.oldwayspt.org</a>	A nonprofit food and nutrition education organization promoting health through traditional eating/culinary heritage that translates nutrition science into food selections, develops consumer-friendly tools (e.g., Mediterranean Diet Pyramid), and offers CME courses/training
NSF	<a href="http://www.nsf.org">http://www.nsf.org</a>	Manufacturers, regulators, and consumers look to NSF International for the development of public health standards and certification programs that help protect the world's food, water, consumer products, and environment; the NSF mark assures consumers, retailers, and regulators that products have been rigorously tested to comply with all standard requirements
Consumer Labs	<a href="http://www.consumerlab.com/">http://www.consumerlab.com/</a>	The leading provider of independent test results and information to help consumers and health care professionals identify the best-quality health and nutrition products; it publishes results of its tests in comprehensive reports on dietary supplements, prescription medications, sports supplements, and personal care products
United States Pharmacopeia (USP)	<a href="http://www.usp.org">http://www.usp.org</a>	The scientific nonprofit organization that sets standards for the identity, strength, quality, and purity of medicines, food ingredients, and dietary supplements manufactured, distributed, and consumed worldwide; USP drug standards are enforceable in the United States by the Food and Drug Administration and the standards are used in more than 140 countries

## Credentialing/Licensure/Certification Programs

RESOURCE	WEBSITE	DESCRIPTION
Arizona Center for Integrative Medicine (AzCIM)	<a href="http://integrativemedicine.arizona.edu/">http://integrativemedicine.arizona.edu/</a>	Organization that conducts research on the integration of complementary therapies with conventional medicine, corporate health improvement research, and methods to study clinical outcomes in integrative medicine; hosts the annual Nutrition & Health CME Conference that assembles internationally recognized researchers, clinicians, educators, and chefs whose work focuses on the interface between nutrition and healthful living
The Center for Mind-Body Medicine	<a href="http://www.cmbm.org">www.cmbm.org</a>	A nonprofit organization that trains multidisciplinary health care providers on mind-body (e.g., meditation, imagery, mindful eating, biofeedback) therapies and offers CME professional training/certification in mind-body medicine, cancer guides, and food as medicine
Institute for Integrative Nutrition	<a href="http://www.integrativenutrition.com">http://www.integrativenutrition.com</a>	A health coach certificate program presenting numerous dietary theories, holistic health care philosophies, and business/marketing principles
National College of Natural Medicine	<a href="http://www.ncnm.edu">www.ncnm.edu</a>	An organization that offers graduate degrees and certificates through the schools of Chinese medicine, naturopathic medicine, and research and graduate studies
American College of Healthcare Sciences (online)	<a href="http://www.achs.edu">www.achs.edu</a>	An online educational institution that offers holistic health education with certificate, diploma, and undergraduate and graduate degree programs
Bastyr University	<a href="http://www.bastyr.edu">www.bastyr.edu</a>	An educational institution that embraces a “whole food” approach to studying food in its entirety, its individual components, and how it affects the human body; it offers the following degrees: BS in Nutrition, Nutrition & Culinary Arts, Nutrition & Exercise Science, Nutrition/Didactic Program in Dietetics, Herbal Sciences; MS in Nutrition (Research Track), Nutrition/Didactic Program in Dietetics, Nutrition & Clinical Health Psychology; and dietetic internship
Massachusetts College of Pharmacy and Health Sciences (MCPHS)	<a href="http://www.mcphs.edu">www.mcphs.edu</a>	A part-time program for individuals interested in developing expertise in the area of natural products that offers an MS in Applied Natural Products as well as a Graduate Certificate in Applied Natural Products whose credits can be transferred toward the MS in Applied Natural Products
Saybrook	<a href="http://www.saybrook.edu">www.saybrook.edu</a>	This organization offers Graduate Education for a Humane and Sustainable Future, with the following degrees: MA, PhD, PsyD in Psychology; MA, PhD in Human Science; MA, PhD in Organization Systems; and MS, PhD in Mind Body Medicine
Maryland University of Integrative Health, formerly Tai Sophia Institute	<a href="http://www.muih.edu">www.muih.edu</a>	An accredited graduate school for the healing arts and sciences offering an MS in Health Promotion, Nutrition and Integrative Health; Therapeutic Herbalism; or Yoga Therapy as well as an MA in Health and Wellness Coaching and Master of Acupuncture or Oriental Medicine in addition to Graduate Certificates in all areas of study.

## Credentialing/Licensure/Certification Programs *continued*

RESOURCE	WEBSITE	DESCRIPTION
University of Bridgeport, CT	<a href="http://www.bridgeport.edu/academics/graduate/nutrition-ms/">www.bridgeport.edu/academics/graduate/nutrition-ms/</a>	A web-based fully accredited academic program offering an MS in Human Nutrition
University of Kansas School of Medicine, Departments of Integrative Medicine and Dietetics and Nutrition	<a href="http://Integrativemed.kumc.edu">http://Integrativemed.kumc.edu</a>	A university-based Dietetic Internship Fellowship and MS in Dietetics & Nutrition with Integrative Nutrition emphasis for candidates who have completed a BS, including prerequisites for an Academy-approved dietetic internship whose goal is to provide intensive experience in the integrative medicine clinic and create a nutrition professional knowledgeable in integrative and functional nutrition care to function as a skilled practitioner and member of multidisciplinary and integrative patient care teams. In addition, they offer an Online Graduate Dietetics and Integrative Medicine (DIM) 12-hour Certificate that encompasses four online graduate classes of 3 CE/semester over 1 year: Introduction to DIM, Inflammation and Immune Regulation, Dietary and Herbal Supplements, Nutrigenomics and Nutrigenetics in Health and Disease, requiring a prerequisite BS or concurrent study in genetics or by approval of instructor
University of Medicine and Dentistry (UMDNJ) – School of Health Related Professions (SHRP) & UMDJN Institute for Complementary and Alternative Medicine	<a href="http://shrp.umdj.edu/programs/graduate.html">http://shrp.umdj.edu/programs/graduate.html</a> <a href="http://shrp.umdj.edu/dept/primary_care/ICAM/About/index.html">http://shrp.umdj.edu/dept/primary_care/ICAM/About/index.html</a>	An online program offering a 30-credit MS degree in Integrative Health and Wellness that focuses on expanding certified health professionals' competencies in CAM as well as Certificate programs
A4M - American Academy of Anti-Aging Medicine	<a href="http://www.faafm.com/index.html">http://www.faafm.com/index.html</a>	Offers functional medicine training and an MS or certificate through the USF School of Medicine
Huntington College of Health Sciences	<a href="http://www.hshs.edu">www.hshs.edu</a>	A distance learning program for an MS in Nutrition that meets eligibility requirements for American College of Nutrition's national board examination for Certified Nutrition Specialist (CNS)
Certification Board for Nutrition Specialist	<a href="http://cbns.org">http://cbns.org</a>	Certification for health professionals with a master's degree or higher in nutrition from a regionally accredited university (physicians and other health professionals); nutritionists, dietitians, or nurses prerequisite is a master's degree or higher
Clinical Nutrition Certification Board	<a href="http://www.cncb.org">www.cncb.org</a>	Web-based Certified Clinical Nutritionist certification for individuals holding a BS from a regional-, national-, state-, or distance learning-accredited University or online school or to qualified health professionals in licensed categories, including but not limited to holders of MD, DO, DC, DDS, DPM, OD, RPh, PharmD, DPT, PA, LAc, or RD
Kripalu Center for Yoga & Health	<a href="http://www.kripalu.org">www.kripalu.org</a>	Retreat center for general public and mind-body practitioners offering yoga teacher training, school of Ayurveda, and CMEs in a plethora of mind-body modalities (e.g., tai chi, meditation/mindfulness, nutrition, somatic movement, yoga)

# 2014-2015 DCE OFFICER DIRECTORY

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# CPE Credit Self-Assessment Questionnaire

After reading this issue of *On The Cutting Edge*, "East Meets West: Functional, Complementary, and Integrative Approaches to Diabetes Management," DCE members can earn 4.0 hours of free continuing professional education units (CPEUs level 1) approved by the Commission on Dietetic Registration (CDR). CPE eligibility is based on active DCE membership status from June 1, 2014 to May 31, 2015.

DCE members must complete the post-test of the CPEs page on the DCE website: <http://www.dce.org/resources/cpeus> by 2/13/18. For each question, select the one best response. After passing the quiz, to view/print your certificate, access your CPEU credit history or view the learning objectives, go to: <http://www.dce.org/account/history>.

Please record 4.0 hours on your Learning Activities log and retain the certificate of completion in the event you are audited by CDR. The certificate of completion is valid when the CPE questionnaire is successfully completed, submitted, and recorded by DCE/Academy of Nutrition and Dietetics.

Select the one best answer for each question below.

- 1) Select the correct statement:
  - a. Improvement of self-regulation and glycemia are rarely the result of mindfulness practices.
  - b. In a 2013 pilot study of the effectiveness of mindful eating, the majority of participants had a significant increase in energy intake.
  - c. Mindfulness can result in increased emotional distress in 20% to 40% of patients.
  - d. Mindfulness is a teachable technique that can result in improved self-care.
- 2) One of the most useful skills in mindfulness is:
  - a. Changing hands when eating.
  - b. Eating only when standing.
  - c. Eating without talking.
  - d. Pausing.
- 3) Select the correct statement:
  - a. Clinical studies on electroacupuncture have not demonstrated effectiveness in reducing HbA1c in individuals with impaired glucose tolerance.
  - b. One disadvantage of acupuncture as a treatment modality is the relatively high incidence of adverse effects in individuals.
  - c. The most impressive result when using acupuncture in individuals with diabetes is the improvement of diabetic gastroparesis.
  - d. The neurophysiologic effect of acupuncture is likely exerted by central nervous system activation which is essential for autonomic nervous system modulation.
- 4) In Traditional Chinese Medicine, recommended foods as nutrition therapy for Xiaoke include:
  - a. Beans, greens and peanut oil.
  - b. Berries, vegetables and soy.
  - c. Fish, rice and apples.
  - d. Meat, grains and milk.
- 5) Select the correct statement:
  - a. Clinical trials studying yoga have not shown improvements in blood glucose levels.
  - b. Lipids and blood pressure do not appear to respond to yoga in clinical studies.
  - c. Positive behavior change is supported by yoga through a variety of complex multifactorial, interacting and dynamic pathways.
  - d. Yoga exercises typically focus on breathing but rarely include physical stretching.
- 6) Current microbiota literature has found that:
  - a. Obesity is related to higher proportion of Actinobacteria.
  - b. About 80% to 90% of the bacteria phylotypes of microbiota are mainly Actinobacteria and Proteobacteria.
  - c. A healthy microbiota can protect an individual against pathogens.
  - d. Breast- and formula-fed babies have similar microbiota composition.
- 7) Which of the following can cause dysbiosis?
  - a. Prebiotics.
  - b. Antibiotics.
  - c. Probiotics.
  - d. All of the above.
- 8) Select the correct statement:
  - a. Vitamin B-2 is of concern for individuals who are on a plant-based diet.
  - b. The rates of coronary heart disease in individuals on vegetarian or vegan diets are similar to people who are not on these diets.
  - c. Lacto-ovo-vegetarian had the lowest prevalence of type 2 diabetes in the Adventist Health Study-2.
  - d. Animal protein was related to higher risk of diabetes in the European Prospective Investigation into Cancer and Nutrition Study.
- 9) Which of the following may be helpful in diabetes management?
  - a. Cumin.
  - b. Bitter melon fruit.
  - c. Fenugreek.
  - d. All of the above.
- 10) Literature on herbs and spices has shown that:
  - a. Curcumin treatment can improve beta-cell function.
  - b. Cocoa, but not cocoa seed, is associated with higher levels of inflammation.
  - c. Garlic consumption is associated with hyperglycemia.
  - d. There is significant effect of cinnamon on glycosylated hemoglobin.



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Participant Name: \_\_\_\_\_

RD/RDN/DTR Number: \_\_\_\_\_

Session Title: East Meets West: Functional, Complementary, and  
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CDR Activity Number: 118922 (Expires 2/13/2018)

Date Completed: \_\_\_\_\_ CPEUs Awarded: 4.0

Learning Need Code: \_\_\_\_\_ CPE Level: 1

Diane M. Enos, MPH, RDW, FAND  
Provider Signature

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*\*Refer to your Professional Development Portfolio Learning Needs Assessment Form (Step 2)*



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## LETTERS TO The Editor

Have you ever wanted to ask an *OTCE* author a question after reading an article? Did you ever disagree with an author? Or maybe you just wanted to comment on something you read. The Letters to the Editor column is a forum to ask questions or comment about any of the *OTCE* articles that interest you. Please send your questions or comments to the *OTCE* editor at the following address:

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*Let us hear from you!*

