Beetroot Juice and Dietary Nitrates

Ellen Coleman, MA, MPH, RD, CSSD was past author of this educational activity but has not had an opportunity to influence the content of this current version. ContinuingEducation.com guarantees that this educational activity is free from bias.

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Introduction

A diet rich in vegetables has cardiovascular benefits that have long been well documented. It has been proposed that these health effects may be due in part to vegetables’ high nitrate content. While nitrate is found in all vegetables, it is especially abundant in beetroot and leafy greens. Dietary nitrate lowers blood pressure, thereby helping to protect the heart. Recent research suggests that dietary nitrate supplementation not only decreases blood pressure, improves endothelial function, reduces arterial stiffness and improves blood flow in hypoxic tissues, but also reduces the amount of oxygen needed during exercise and enhances athletic performance.

The blood pressure and athletic performance benefits are most likely mediated through the metabolic conversion of dietary nitrate (NO\(^3\)) to biologically active nitrite (NO\(^2\)) and then to nitric oxide (NO). Nitric oxide has numerous functions in the body, including the regulation of blood flow, muscle contractility, glucose and calcium homeostasis, and mitochondrial respiration and biogenesis.

Dietary Nitrate, Nitrite and Nitric Oxide

About 85% of dietary nitrate comes from vegetables, with the remainder coming from drinking water. Dietary nitrate is absorbed rapidly from the stomach and small intestine. About 25% of ingested nitrate enters the entero-salivary circulation, where it is reduced to nitrite by bacterial nitrate reductases from symbiotic anaerobic bacteria on the surface of the tongue. This nitrite is swallowed and reduced to nitric oxide in the acidic environment of the stomach or is absorbed via the gastrointestinal tract and re-enters the circulation as nitrite. There is additional generation of nitric oxide in the acidic environment of the stomach or is absorbed via the gastrointestinal tract and re-enters the circulation as nitrate. There is additional generation of nitric oxide in the acidic environment of the stomach or is absorbed via the gastrointestinal tract and re-enters the circulation as nitrate. Nitric oxide is a potent vasodilator that governs systemic blood pressure and retards atherogenesis by inhibiting inflammatory cell recruitment and platelet aggregation. Nitric oxide is
Lowering Blood Pressure

Dietary nitrates were previously believed not to have any effect on blood pressure because it was thought that dietary nitrates could not increase circulating nitrites, which could lead to nitric oxide production. But in a study on the effects of 0.5 L of beetroot juice (22.5 mmol of nitrate) on blood pressure, plasma nitrite concentrations and endothelial function were evaluated. Systolic blood pressure dropped 10.4 mm Hg 3 hours after ingestion, and diastolic blood pressure fell 8 mm Hg 2.5 hours after ingestion. Plasma nitrite increased twofold after beetroot juice ingestion, reached a peak at 3 hours, and correlated with the decreases in blood pressure. Researchers measured endothelial function by brachial artery flow-mediated vasodilation after ischemic occlusion of the forearm. Beetroot juice significantly prevented endothelial dysfunction induced by an acute ischemic insult in the forearm and reduced ex vivo platelet aggregation.

The researchers also evaluated the effect of spitting out all saliva during and after beetroot juice ingestion on blood pressure and plasma nitrate concentrations. Spitting out saliva interrupted the enterosalivary circulation, thereby preventing nitrite-rich saliva from reaching the stomach. (The tongue converts nitrate to nitrite via bacterial nitrate reductase on the tongue.) Compared with swallowing, spitting blocked the rise in plasma nitrite concentration, prevented the decrease in systolic blood pressure and had no effect on platelet aggregation. Thus, the physiological effects of dietary nitrate are due to the production of nitrite from symbiotic anaerobic bacteria on the surface of the tongue rather than from nitrate itself. This study, and others, have provided evidence for a “nitrate-nitrite-nitric oxide pathway.”

Oxygen Cost of Exercise and Blood Pressure

Preliminary research suggested that consuming a large dose of pharmaceutical sodium nitrate (0.1 mmol/kg daily for three days) resulted in a lower oxygen cost during submaximal cycling. In practical terms, the nitrate supplementation improved exercise economy—the muscles used less oxygen for a given work rate. This finding was surprising and challenged a fundamental principle of human exercise physiology: During submaximal exercise, there is a predictable oxygen cost for a given work rate; furthermore, the increase in oxygen uptake is linearly related to the increase in work rate, and this relationship cannot be altered.

As a result, researchers in the U.K. became interested in whether they could obtain similar results when administering the nitrate dose in the form of nitrate-rich beetroot juice. This distinction is important because sodium nitrate is considered a drug, whereas beetroot juice is a natural food product individuals can readily include in their diet.

Nitrate levels in vegetables and vegetable juices can vary considerably, depending on many factors, including the environment (humidity, temperature, sunlight exposure, water available to growing plants), agricultural (use of herbicides and nitrogen-based fertilizers) and genetic factors of the plant.

So to provide a consistent nitrate dose (approximately 5 to 6 mmol), most of the studies evaluating...
the effect of beetroot juice on the oxygen cost of exercise have used “Beet It” organic beetroot juice. Researchers evaluated the effect of beetroot juice consumption for six days on the oxygen cost of moderate- and high-intensity exercise, blood pressure and plasma nitrite concentrations. The subjects consumed 0.5 L of Beet It (5.5 mmol of nitrate) or a placebo (a black currant cordial with negligible nitrate) for six days and completed a series of low- and high-intensity cycling tests on the last three days. On days four to six, plasma nitrite concentration was significantly higher and systolic blood pressure was dramatically lower (8 mm Hg) in subjects who drank beetroot juice compared with the placebo. The beetroot juice significantly reduced the oxygen cost of moderate-intensity cycling exercise (by 19%) and increased the time to exhaustion during high-intensity cycling (by 17%).

A follow-up study was conducted to determine the mechanisms by which beetroot juice lowered the oxygen cost of moderate-intensity exercise and improved tolerance of high-intensity exercise. Subjects consumed 0.5 L of Beet It (5.1 mmol of nitrate) or a placebo (black currant cordial) for six days and completed a series of low- and high-intensity knee extensor exercises in the prone position on the last three days. Beetroot juice more than doubled plasma nitrite concentrations and reduced the oxygen cost and rate of phosphocreatine breakdown during low- and high-intensity exercise. Compared with the placebo, beetroot juice significantly lowered systolic blood pressure (by 5 mm Hg) and diastolic blood pressure (by 2 mm Hg). Beetroot juice greatly reduced the oxygen cost of moderate-intensity knee extensor exercise (by 25%) and increased the time to exhaustion during high-intensity knee extensor exercise (by 25%).

Beetroot juice appears to lower the oxygen cost of exercise by reducing the total adenosine triphosphate cost of muscle force production—the muscles use less ATP to produce the same amount of work. Beetroot juice also decreases the breakdown of phosphocreatine (the limited reserve of high-energy phosphate that resynthesizes ATP), thus lessening muscle metabolic disruption. These changes may be due to an increased efficiency of mitochondrial oxidative phosphorylation or increased efficiency of calcium transport by the sarcoplasmic reticulum Ca$^2+$ ATPases. Dietary nitrate supplementation also may improve exercise performance by increasing blood flow to the exercising muscles and improving the match between blood flow and oxygen uptake.

The researchers noted that the protective effect of nitrite on infarct size reported in experimental models of myocardial ischemia may be due to a nitric oxide-mediated reduction in the energy (and oxygen cost) of contraction in the heart in addition to enhanced perfusion of ischemic areas.

Other researchers investigated the acute (2.5 hours) and chronic (up to 15 days) effects of dietary nitrate supplementation on blood pressure and the physiological responses to moderate-intensity and incremental cycling exercise. The subjects consumed 0.5 L of Beet It (5.2 mmol of nitrate) or a placebo (the black currant cordial) daily. The exercise protocol (two moderate-intensity step tests followed by a ramp test) was repeated 2.5 hours following the first ingestion and after five and 15 days.

Beetroot juice significantly elevated plasma nitrite concentration throughout the 15-day test period, and this was accompanied by a marked reduction in systolic (4 mm Hg) and diastolic (4 mm Hg) blood pressure. These effects tended to be more pronounced after 12 days of dietary nitrate supplementation. Compared with the placebo, the oxygen cost during moderate exercise was acutely reduced (by 4%) after 2.5 hours and remained similarly lowered after five and 15 days of continual beetroot juice ingestion. While beetroot juice had no acute effects on maximal oxygen uptake and the gas exchange threshold, these parameters of aerobic fitness rose after 15 days of supplementation. The oxygen cost of moderate exercise didn’t decrease as much as in previous studies, but the subjects’ normal dietary nitrate intake wasn’t restricted at any time during the study period.

It is assumed that beetroot juice reduces blood pressure and the oxygen cost of exercise through the metabolic conversion of inorganic nitrate to bioactive nitrite and then to nitric oxide. However, because beetroot juice also is rich in several metabolically active compounds (betaine, antioxidants and polyphenols), it is uncertain whether the cardiovascular and physiological changes observed following beetroot juice ingestion can be attributed exclusively to its high nitrate content.

For example, the amino acid betaine has been used in the treatment of cardiovascular disease. The high antioxidant content of beetroot juice may provide protection against exercise-induced oxidative stress. Beetroot juice also contains the polyphenols quercetin and resveratrol, which have been linked with mitochondrial biogenesis and an associated increase in aerobic capacity. Thus, beetroot juice has the potential to influence blood pressure and exercise performance via numerous pathways.

In another study conducted to determine whether the physiological effects of beetroot supplementation (reduced blood pressure, lowered oxygen cost of submaximal exercise...
and enhanced tolerance to a high-intensity workout) were due to the juice’s high nitrate content, researchers provided a nitrate-depleted beetroot juice to serve as a placebo, which was similar in appearance, odor, taste, and texture to the nitrate-rich beetroot juice. This allowed the researchers to isolate the effects of dietary nitrate from the other potential active ingredients found in beetroot juice and ensured a genuinely double-blind experimental design.\(^\text{11}\)

The subjects consumed 0.5 L of Beet It (6.2 mmol of nitrate) or the nitrate-depleted beetroot juice placebo (0.003 mmol of nitrate) for six days. They engaged in treadmill exercise and knee extension tests on days four and five. The nitrate-rich beetroot juice significantly raised plasma nitrite concentration and decreased systolic blood pressure by 4% (5 mm Hg) compared with the placebo. The nitrate-rich beverage also lowered the oxygen cost of walking by 12% and of moderate- and high-intensity running by 7%. The nitrate-rich juice also increased the time to exhaustion during high-intensity running by 15% and during incremental knee extension exercise by 5%.\(^\text{11}\)

The consumption of nitrate-depleted beetroot juice did not alter any of the experimental variables at rest or during exercise compared with the nonsupplemented controls. These results indicate that the positive physiological effects of beetroot juice ingestion on blood pressure and exercise performance are due to the high nitrate content rather than other compounds.\(^\text{11}\)

**Beetroot Juice and Athletic Performance**

Most studies evaluating the performance effects of beetroot juice have used time-to-exhaustion protocols, which test exercise capacity, not athletic performance, and have been criticized as having limited validity in the athletic setting. A superior test of the effectiveness of beetroot juice as an ergogenic aid would involve subjects covering a certain distance in the fastest time possible—a time trial.\(^\text{12}\)

The effect of beetroot juice consumption on power output, oxygen uptake and performance during 4-km and 16.1-km cycling time trials was evaluated.\(^\text{12}\) The subjects’ normal dietary nitrate intake was not restricted at any time during the study. The competitive male cyclists consumed 0.5 L of Beet It (6.2 mmol of nitrate) or a nitrate-depleted beetroot juice placebo (0.0047 mmol of nitrate) and rested for 2.75 hours before completing either a 4- or 16.1-km bicycle time trial.

The nitrate-rich beetroot juice significantly increased plasma nitrite concentrations and decreased systolic blood pressure by 6 mm Hg. The oxygen uptake values were not significantly different between the beetroot juice and placebo time trials. However, the nitrate-rich beetroot juice significantly increased mean power output compared with the placebo during the 4-km time trial (292 vs. 279 watts) and the 16.1-km time trial (247 watts vs. 243 watts). As a result, beetroot juice improved performance by 2.8% (11 seconds) in the 4-km time trial and by 2.7% (45 seconds) in the 16.1-km time trial. The improved time trial performance following beetroot juice ingestion was due to a significantly higher power output for the same oxygen uptake—7% to 11% greater power output per liter of oxygen consumed.\(^\text{12}\)

Based on the length of time it took the subjects to complete the time trials, the results suggest that dietary nitrate supplementation has the potential to improve performance in events lasting 5 to 30 minutes. Statistical analysis to derive the true effect of the intervention indicated that dietary nitrate supplementation may have a practical and meaningful benefit for athletic performance.\(^\text{12}\)

In the real world, an 11-second advantage in a 4-km cycling time trial and a 45-second advantage in a 16.1-km cycling time trial separate the podium finishers from the rest of the pack.

Trained male cyclists (n = 12) on time trial protocols were also studied. Cyclists were given 140 mL of beetroot juice for six days leading up to the time trial in a placebo-controlled crossover trial.\(^\text{13}\) The subjects receiving beetroot juice reduced maximal oxygen uptake during submaximal exercise and improved their time trial results. The researchers found that beetroot juice reduced pulmonary oxygen uptake during submaximal exercise and increased the ability to exercise at high intensity for a longer period of time.

Since the realization that beetroot juice may be an effective ergogenic aid for exercise performance, the first meta-analysis of nitrate supplementation in healthy individuals’ exercise performance was completed.\(^\text{14}\) The researchers identified 17 studies that used inorganic nitrate supplementation, commonly beetroot juice or sodium nitrite, with doses ranging from 300 to 600 mg of nitrate and prescribed in ranges as a single dose to 15 days of ingestion. The meta-analysis showed a small benefit to exercise performance when nitrate-based supplements were used. In studies that used time trial performance as the endpoint, there was about a 0.9% improvement in performance. As the authors point out, this may not seem like a large improvement, but at the elite level of sports the distance between first and fourth place (and therefore no medal awarded on the podium) can be as little as a 0.3% difference in finishing time.\(^\text{14}\)

To date, beetroot juice supplementation has been found to:

- Have a small, positive effect on exercise by improving oxygen uptake—7% to 11% greater power output per liter of oxygen consumed.\(^\text{12}\)

http://www.integrativeRD.org
consumption
- Improve time to exhaustion
- Improve overall time to complete the exercise task

More research is needed on more athletes (larger sample sizes) and in women.\(^{15}\)

**Beetroot Juice and Peripheral Artery Disease**

In addition to the research examining the effects of beetroot juice on blood pressure and athletic performance, studies have evaluated its impact on exercise tolerance in patients with peripheral artery disease, a type of cardiovascular disease in which atherosclerotic occlusions impair blood flow to the lower extremities and cause intermittent claudication (ischemic leg pain that occurs with walking and improves with rest).

In one study, subjects were given 0.5 L of Biotta beetroot juice (9 mmol of nitrate) or a placebo (orange juice with a negligible nitrate content) 3 hours before undergoing a maximal cardiorespiratory exercise test.\(^{16}\)

Beetroot juice significantly increased plasma nitrite concentration. Beetroot juice ingestion dramatically reduced diastolic blood pressure at rest and during the maximal cardiorespiratory exercise test. In addition, the subjects walked 18% longer before the onset of claudication pain and were able to walk 17% longer following the consumption of beetroot juice compared with those who received the placebo. Thus, beetroot juice ingestion significantly increased exercise tolerance by almost 20%—a statistically and clinically significant increase in functionality for a disease state characterized by reduced physical function and quality of life.\(^{16}\)

In addition to the lower blood pressure, measurements of gastrocnemius (calf muscle) tissue oxygenation suggest that increased tissue perfusion was responsible for the improvement in exercise tolerance. Because there was no change in endothelial function, researchers surmise that the beetroot juice probably improved peripheral blood flow in areas of tissue hypoxia by increasing nitric oxide production.\(^{16}\)

**Real-World Concerns**

These findings have encouraged some endurance athletes to consider supplementing with inorganic nitrate salts (sodium or potassium nitrate) to reduce the oxygen cost of exercise and improve performance. This has raised concern among researchers, who caution against the uneducated and uncontrolled use of nitrate salts, and especially nitrate salts, to enhance performance. Nitrate salt is used to preserve food and is available on the Internet. While inorganic nitrate is nontoxic at higher doses, inorganic nitrate can cause serious harm at considerably lower levels. The LD50 (median lethal dose) for nitrite is 100 to 200 mg/kg, comparable to that of cyanide. Nitrite toxicity is due to elevated methemoglobin levels (an oxidized form of hemoglobin that has an increased affinity for oxygen) and may cause life-threatening tissue hypoxia. In high doses, nitrite also may cause hypotension, especially if combined with other vasodilatory drugs.\(^{17}\)

The researchers also note that nitrate-containing vegetable juice presents a potential risk if it is stored incorrectly. If bacteria that convert nitrate to nitrite contaminate the juice, high levels of nitrite could accumulate over time, which could be potentially harmful.\(^{17}\)

Many healthcare professionals may also be concerned about the potential for increased cancer risk when nitrate conversion to nitrites leads to the formation of N-nitrosamines, which are carcinogenic in animals.\(^{2}\) However, the link between N-nitrosamine formation and increased cancer risk in humans has not been definitively proven.\(^{10}\) While nitrate intake, especially from vegetable sources, is most likely safe, caution is advised when athletes take other supplements, such as creatine, which could increase the formation of N-nitrosamines; this is an issue that has not yet been studied.\(^{19}\)

Athletes and other individuals also may be confused about the differences between inorganic nitrates (found in dietary sources, such as beetroot juice, vegetables and nitrate salts), organic nitrates (e.g., the drug nitroglycerin) and organic nitrites (e.g., the drug amyl nitrite). Organic nitrates and nitrites are extremely potent vasodilators, and an unintentional overdose can lead to fatal vascular collapse. While the acute toxicity of inorganic nitrate is very low, any confusion that could lead to a large unintentional intake of organic nitrates or nitrites is potentially life threatening.\(^{17}\)

On the other hand, consuming dietary nitrate from vegetables or vegetable juice is presumed safe.\(^{17,20,21}\) In fact, diets high in dietary nitrate are associated with reduced blood pressure and a decreased incidence of cardiovascular disease.\(^{17,20}\) Dietary nitrate may represent an effective treatment for hypertension in addition to current medication regimens.\(^{1,4,15,22}\) The Dietary Approaches to Stop Hypertension (DASH) diet provides approximately 20 mmol of nitrate per day (about the amount provided in the Webb study\(^{\ast}\) and twice that provided in the Kenjale study\(^{16}\)) and has reduced blood pressure in both normal and hypertensive subjects.\(^{1,16}\)

Individuals with cardiovascular disease or related risk factors should consult their physician before consuming a high-nitrate diet. Also, certain medications may adversely...
interact with a high-nitrate diet, including organic nitrate or nitrite drugs used for angina and phosphodiesterase type 5 inhibitors, such as sildenafil, tadalafil, and vardenafil. As with most substances ingested to affect the body's structure or function, the dosage and formulation often determine whether the effects are beneficial or detrimental. As with other nutritional supplements, it is essential to consider the risk/benefit ratio when evaluating the effects of dietary nitrate ingestion on human physiology. More research is needed to determine the optimal amounts of dietary nitrate to reduce blood pressure and enhance athletic performance. It is prudent to suggest that clients follow the Dietary Guidelines for Americans and the USDA's MyPlate recommendations to determine the amount of vegetables they should consume each day for optimal health. 

Sources of Dietary Nitrate

Beetroot juice is an easy way to quickly ingest a substantial amount of dietary nitrate. However, some individuals may find the taste of beetroot juice unpleasant. Furthermore, it can cause red urine (beeturia) and stools. Fortunately, beetroots are just one of many vegetables that are high in nitrate. Leafy green vegetables tend to be the top sources.

The dose of dietary nitrate used in the research to reduce the oxygen cost of exercise, improve athletic performance and lower blood pressure ranges from 300 to 500 mg. Clients can readily obtain these amounts through their diet. For instance, celery, cress, chervil, lettuce, red beetroot, spinach and arugula (also called rocket or ruco) contain very high nitrate levels (more than 250 mg/100 g), and celeriac, Chinese cabbage, endive, fennel, kohlrabi, leek and parsley are among those with high nitrate levels (approximately 100 to 250 mg/100 g). More specifically, 1 cup of raw spinach contains approximately 900 mg of nitrate; 1/2 cup of cooked collard greens, approximately 200 mg; 1 cup of raw leaf lettuce, approximately 100 mg; and 1/2 cup of vegetable juice, approximately 40 mg.

Researchers have developed the Nitrate Veg-Table to provide additional information on the nitrate content of vegetables popular in the U.K. The range of dietary nitrate in various vegetables can be found in the chart below and will be useful in determining a daily range of intake for individuals.


<table>
<thead>
<tr>
<th>Nitrate content (mg/100 g fresh weight)</th>
<th>Vegetables</th>
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<tbody>
<tr>
<td>Very low (&lt; 20)</td>
<td>Artichoke, asparagus, broad bean, eggplant, garlic, onion, green bean, mushroom, pea, pepper, potato, summer squash, sweet potato, tomato, watermelon</td>
</tr>
<tr>
<td>Low (20 to &lt; 50)</td>
<td>Broccoli, carrot, cauliflower, cucumber, pumpkin, chicory</td>
</tr>
<tr>
<td>Medium (50 to &lt; 100)</td>
<td>Cabbage, dill, turnip, savoy cabbage</td>
</tr>
<tr>
<td>High (100 to &lt; 250)</td>
<td>Celeriac, Chinese cabbage, endive, fennel, kohlrabi, leek, parsley</td>
</tr>
<tr>
<td>Very high (&gt; 250)</td>
<td>Celery, cress, chervil, lettuce, red beetroot, spinach, arugula</td>
</tr>
</tbody>
</table>


Questions:
1. The blood pressure-lowering benefits of consuming beetroot juice are due to the body’s production of:
   A. Nitrate  
   B. Nitrite  
   C. Nitric Oxide  
   D. Nitroglycerin

2. Beetroot juice appears to reduce the oxygen cost of exercise by:
   A. Reducing the total ATP cost of muscle force production  
   B. Increasing muscle metabolic perturbation  
   C. Increasing the breakdown of phosphocreatine  
   D. Decreasing blood flow to the exercising muscles

3. What ingredient in beetroot juice is likely responsible for its positive effects on blood pressure and exercise performance?
   A. Nitrate  
   B. Antioxidants  
   C. Betaine  
   D. Polyphenols

4. In a study on the effect of beetroot juice consumption on power output, oxygen uptake and performance during 4-km and 16.1-km cycling time trials, researchers found that beetroot juice:

5. Researchers found that beetroot juice supplementation in trained cyclists led to:
   A. Reduced gastrocnemius fractional tissue oxygen extraction during exercise  
   B. Increased pulmonary oxygen uptake during exercise  
   C. Increased tolerance to high-intensity exercise  
   D. Increased breakdown of phosphocreatine

6. Some studies have shown that beetroot juice can improve exercise tolerance in patients with peripheral arterial disease by as much as 20%. What is the mechanism for improvement in exercise tolerance?
   A. Increased tissue perfusion  
   B. Decreased hormonal response to exercise  
   C. Increased endorphin production  
   D. Decreased inflammation

7. The ingestion of dietary nitrates in the form of vegetables appears safe, but there is a safety concern when:
   A. Beetroot juice is processed to a commercially available form  
   B. Recreational athletes consume beetroot juice  
   C. Beetroot juice is consumed by athletes who take other ergogenic supplements  
   D. Nitrate intake is from consumption of vegetables

8. Which of the following is a side effect of beetroot juice ingestion?
   A. Nitrate breath  
   B. Reddening of the skin  
   C. Rapid heart rate  
   D. Beeturia

9. The dose of dietary nitrate used in the research to reduce the oxygen cost of exercise, improve performance and lower blood pressure is:
   A. 700 to 900 mg  
   B. 500 to 700 mg  
   C. 300 to 500 mg  
   D. 100 to 200 mg

10. Which of the following vegetables has a very high nitrate content (more than 250 mg/100 gm)?
    A. Onion  
    B. Tomato  
    C. Parsley  
    D. Arugula

Sent your completed quiz and application for CPE credit by email or mail to: Shari Pollack, MPH, RDN, 28x512 LDN, 4500 Keeney Street, Skokie, IL 60076, sbethp@gmail.com.
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CPE Level: 2

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Nutritional Genomics

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Introduction

Prior to the completion of the Human Genome Project in April 2003, the registered dietitian nutritionist’s (RDN) efforts to include genotypic information in the nutrition assessment relied on family history, except for rarer single gene mutation conditions like phenylketonuria, or PKU. For example, for a client with a family history of several siblings, parents, or grandparents diagnosed with celiac disease, one could identify increased risk of celiac and proceed with assessment by ruling out gastrointestinal tract issues, ruling out dermatitis herpataforme during a nutrition physical exam, and requesting a celiac panel test from their physician.

Roger J. Williams, the American biochemist who discovered pantothenic acid, authored the book *Biochemical Individuality* in 1956. His book catapulted the concept of biochemical individuality regarding nutrients and metabolism into the nutrition science community and offered early hints of today’s nutritional genomics science.

Currently the only “genetic” information received from most patients is not lab-based, but from their reporting of family history. RDNs need to be able to gather and interpret family history to incorporate into the nutrition care process.

With the fast-paced emergence of the science of nutritional genomics, new evidence is becoming strong enough to be used in some clinical applications. It is especially valuable for the dietitian practicing Integrative and Functional Medical Nutrition Therapy (IFMNT) considering its emphasis on biochemical individuality. This is a new science for all of healthcare. Educational programs for health professionals are beginning to add nutritional genomics to their curricula. Currently RDNs need to self-initiate additional study to enable them to practice with the necessary level of expertise.

The application of nutritional genomics in clinical practice is currently structured around some important principles in order to help ensure ethical and evidence-based practice. The following principles have been suggested by a few of the dietitians in the United States that have practice-based experience in clinical nutritional genomics. Practice-based dietetics acknowledges the client as the most effective teacher of the RDN during the assessment of each individual’s genotype and phenotype.

**IFMNT and Lifestyle Modifiable Factors of Genotype**

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Environment</th>
<th>Phenotype</th>
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<tbody>
<tr>
<td>Enzyme Efficiency SNePs</td>
<td>1. Initial status</td>
<td>2. Outcome status</td>
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**Principles of the Clinical Application of Nutritional Genomics in Dietetics**

- **Use of tests:** Recognize that nutritional genomic test results are not diagnostic.
- **Biochemistry:** Gain an understanding of nutritional biochemistry and biochemical pathways in order to apply genomics.
- **Start simple:** Begin learning one family of genes.
- **Find a mentor:** Study and seek mentors experienced in clinical nutritional genomics to aid learning skills of assessment and interventions including genomic testing.
- **Environmental influences on gene expression:** Become familiar with epigenetics, environmental messaging directing gene expression without changing the DNA.
- **TENET:** “Don’t treat the test result, treat the whole client.”

**Use of tests:** Recognize that Nutritional Genomic test results are not diagnostic.

Although genomic testing is relatively new, a growing number of labs are offering it, often direct-to-consumer. These factors present a challenge to healthcare professionals. These include interacting with patients who already have their tests, potentially without correct interpretation, clinical
relevance, and with no assessment of the validity of testing methods.

It is important for RDNs to keep genomic testing in perspective. These tests are not diagnostic for the nutritionist scope of practice. Genomic testing results are valuable additions to nutrition data as antecedents that are collected during the initial assessment to enhance the entire patient’s story; they help illuminate the patient’s biochemical capabilities.

**The knowledge gained from nutritional genomics requires an evidence-based approach to validate that personalized recommendations result in health benefits to individuals and do not cause harm. Whether or not the knowledge gained from nutritional genomics can be integrated into the everyday lives of consumers is yet unknown.**

*Academy of Nutrition and Dietetics 2014 Position Paper: Nutrigenomics*^2^  

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**Biochemistry: Gain an understanding of nutritional biochemistry and biochemical pathways in order to apply genomics.**

Simply described, genes direct associated enzymes. Thanks to the pharmaceutical industry, today we have descriptions of a large number of biochemical pathways, especially biotransformation, the process in which the body detoxifies waste molecules. The nutritional biochemistry content taught in a typical nutrition and dietetics program requires supplementation in the area of the gene-enzyme-nutrient co-factor association to be able to comprehend the genomics world.

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**Start simple: Begin learning one family of genes.**

The genomics science is accelerating; month-by-month the dietitian interested in nutritional genomics must have a system of keeping abreast of the new evidence. To begin training in nutritional genomics, learn one biochemical and gene pathway until comfortable identifying gene-enzyme-nutrient-diet intake relationships. By learning one pathway at a time, a dietitian's toolbox will soon include nutritional genomics.

Some gene groups to consider in beginning the study of nutritional genomics are: methylation, including Vitamin D Receptor (VDR); detoxification genes (which interact with some methylation genes) like Glutathione-S-Transferase genes; Cytochrome P450 genes; and Catechol-O-methyltransferase (COMT).

**Find a mentor: Study and seek mentors experienced in clinical nutritional genomics to aid learning skills of assessment and interventions including genomic testing.**

Although the hands-on experience of working with clients builds practical skills, nothing tops working with a mentor who can impart experience and expertise in this advanced field of dietetics. For example, working with a mentor by studying patient cases can accelerate the learning curve by incorporating single nucleotide polymorphism (SNP) information with biochemical, medical and patient history information.

Some excellent mentoring is currently available through the following links:

*Genetics and Nutrition: A Resource for Dietetic Faculty and Practitioners [http://www.nchpeg.org](http://www.nchpeg.org)*

Institute for Functional Medicine
Environmental influences on gene expression: Become familiar with epigenetics, environmental messaging directing gene expression without changing the DNA.

The science of epigenetics studies gene expression changes from environmental exposures without changing the DNA of a gene.\(^6,7\) It follows closely on the heels of nutritional genomics. This may be the most important aspect of how nutrient intake and environmental exposures direct gene expression. Randy Jirtle's experiment on Agouti Mice demonstrated the profound influence nutrients play on genes.\(^8,9\)

"Epigenetics exists at the intersection between genetics and the environment. The goal is to use epigenetics to anticipate health in the individual and, more importantly, the population."


This quote emphasizes the importance of connecting every test result with clinically relevant factors. This is especially true in the use of genomic testing for a nutrition assessment. An example of this is the methylenetetrahydrofolate reductase (MTHFR) 677C and MTHFR 1298C. A homozygous positive SNP implies reduced efficiency of the conversion of folate precursors to the bioactive form of 5-methylenetetrahydrofolate (MTHF). A responsible assessment would consider the genotype for MTHFR and then test functional markers related to the function of the MTHFR 677C/1298C genes: MCV/MCH (cofactors for RBC volume), homocysteine (5-MTHF dependent in the homocysteine metabolic pathway), the urine organic acid form formiminoglutamic acid (FIGLU) - a specific cellular functional marker for adequate 5-MTHF, and signs and symptoms related to poor methylation (medical symptoms questionnaire) are examples.\(^10\) If the clinical biomarkers indicate inadequate or insufficient 5-MTHF, then there is reasonable indication that the patient may benefit from increased folate foods in addition to supplementation with bioactive 5-MTHF. This intervention step would be monitored and evaluated for effective outcomes in the nutrition care process. Because methylation is ubiquitous to human metabolism, it can have broad beneficial effects in many conditions.

Considering genomic data in assessment related to health/disease associations and the ability of diet to modulate metabolism, nutritional genomics will become the basis of more robust research and will further strengthen the evidence for clinical application.
Nutritional Genomics References


The Roots of Herbalism

Lisa Murray, RDN, LD, a Medical Educator with Emerson Ecologics, answers practitioners’ questions coming to her through Emerson’s website feature “Ask Dr. Emerson” and provides evidence-based information on the use and protocols of botanical and nutrition therapies. Contact Lisa at Lemurray58@gmail.com or learn more about her by visiting https://www.emersonecologics.com/Custom.aspx?cid=8885.

It is because of the gentle yet powerful healing nature of herbs that I became an herbalist. Over 25 years ago, I met with an herbalist for the first time. He gave me the botanical medicine that cured my illness and changed my life. I decided I wanted to know more, and in 1989 I found a wonderful herbal training program offered by Rosemary Gladstar, who is considered the godmother of the herbal renaissance in the US. Rosemary brought in guest teachers from Bastyr National College of Naturopathic Medicine, both accredited medical schools that teach the science of botanical medicine. But primarily she shared her knowledge with her apprentices in traditional ways such as field identification, harvesting and medicine making. Like many herbalists, as my training advanced, I learned to love and respect grew for the healing power of the plants. All the powders and capsules, the extracts and syrups, the oils and the salves, the tinctures and teas of herbal medicine contain what was once living, breathing, growing, plant life. Intelligence has many forms, and most herbalists believe that a plant’s medicine comes from something more than just the sum of its chemicals.

Herbalism has deep roots in the traditional forms of medicinal practice within many cultures. The ancient Chinese, Indians, Egyptians, Babylonians, Greeks, Romans, and Native Americans all developed unique systems of plant medicine, each in accordance with their own indigenous plant populations. Approximately 75% of the world’s population continues to rely on traditional healing, including the use of herbal medications. This article explores the historical basis and current practice of traditional herbalism.

When plants were the only source of medicine, a doctor was considered an herbalist and often had a medicinal herb garden. Herbalists had knowledge of both botany and medicine, and their expertise included medicinal plant identification, use and physiological action, and optimal growing and harvest conditions for each plant. They understood that success in treatment was not only dependent upon knowing which herbs to use, but which part of the plant was best, when and how to harvest it for its greatest medicinal quality, and in what form to administer: as a tea, powder, tincture. The herbalist often had assistants or herbalists-in-training that tended the garden and learned to make the botanical medicines. This also ensured that knowledge would be passed on from generation to generation for the preservation and protection of the community. As herbalists developed the "germ theory," the modern medical establishment began to pursue science and evidence-based practice. Botanicals lost favor, not only because they lacked the potency of new pharmaceuticals, but validating patient outcomes with sufficient research was a complex undertaking. While pharmaceuticals are targeted to treat a specific disease or condition, herbalism remains an integrative systems approach to treating a person. Indeed it was Hippocrates, also an herbalist, who promoted a holistic healing system that treated the whole patient, not just the disease. This continues to be the primary philosophy of traditional herbal medicine.

Historically, the preparation and dispensing of herbal medicine to treat illness was usually the responsibility of the community herbalist or physician. However, it is important to remember that medicinal herbs and spices were incorporated into the daily diet to promote health and prevent disease. The most striking examples of this continue in India and China, where the herbs and spices consumed daily in food are an important part of their ancient systems of medicine. In India, turmeric, black pepper, cumin, coriander, cardamom and cinnamon are just a few of the herbs and spices used every day in foods and beverages, and for which research continues to validate wide-ranging health benefits. Likewise, Traditional Chinese Medicine (TCM) incorporates many different medicinal herbs and mushrooms into teas, soups and other dishes consumed daily to help support and maintain balance in physiological processes. Within both of these traditional medicine systems, it is the understanding that chronic imbalance over time can result in illness and that diet, which includes both food and herbs together, can help maintain a healthy balance. Treasured family recipes used today and handed down through generations include herbs and spices as a way to add seasoning and flavor, but interestingly, the original use of some common herbs was to help prevent foodborne illness. Garlic, thyme, oregano, sage and rosemary are just a few of the many herbs that have been heavily researched and show strong antimicrobial activity. They grow easily in most climates and can be dried for use in the winter, making them available year-round. Additionally, culinary herbs still used to stuff chicken or turkey or incorporate into sausage or stews also have a purpose beyond flavoring. These herbs function in two ways: their volatile oils actively work to minimize the growth of bacteria in uncooked or cooked food, while the phytochemicals continue to work in the gastrointestinal (GI) tract to kill bacteria that may have been ingested. The heavily spiced dishes of India, Africa and South America, believe their climate. With no relief from year-round heat spoiling their foodstuffs, the use of antimicrobial herbs helps prevent bacterial overgrowth in food and also in humans. Research shows these same herbs can be useful in helping to balance the microbiome, reducing candida and pathogenic bacteria so that beneficial microbes can flourish. Additionally, many of these same herbs have strong antioxidant, anti-inflammatory, and immune building properties.

Understanding the culinary use of herbs from historical, traditional and scientific perspectives helps illuminate the role of herbalism as it relates to functional nutrition today. Practicing culinary herbalism begins by learning about the medicinal and nutritive properties of the foods, herbs and spices used in the kitchen. For example, onions and garlic not only add flavor, they are antimicrobial, improve GI health and help heavy metal detoxification. During times when environmental and food-related toxins are of concern, herbs may be an additional tool for the integrative and functional RD. As dietitians, we understand the first part of Hippocrates’ words: “Let thy food be thy medicine,” and by incorporating medicinal plants into our daily diet, we fulfill the second part of that quote: “and thy medicine be thy food.” While clinical herbalists may play an important role within any system of integrative medicine, teachers of culinary herbalism in tandem with functional nutrition help patients to help themselves. Who is better suited to help people incorporate the benefits of herbs into their diet than a functional dietitian? Herbalists have retained and protected the knowledge of plant medicine throughout the ages and remain aware of the delicate and mutually beneficial relationship that exists between healing plants and humans. Herbalists remind us that plants not only provide food and sustenance, but also health and healing. As the evidence-based applications of botanical medicine become more mainstream, professional knowledge of both the science and the art of herbalism offers the promise of greater health to our patients and communities.
The Roots of Herbalism References and Additional Resources


Educational Resources:

Books by Rosemary Gladstar:


Books by David Winston:


Murray MT, Pizzorno J. The Encyclopedia of Natural Medicine.

Additional Education and Training:

While there is no standardized training to become an Herbalist, there are well established training programs to begin or advance training in herbalism. The American Herbalists Guild offers information on education, including qualified herbalists who provide mentoring. There are several online study resources available and Maryland University of Integrative Health now offers master's degree programs in herbal therapeutics in addition to post-baccalaureate certificates in herbal studies. For their websites, see the following list.

Websites:

The Science and Art of Herbalism - http://www.herbalhomestudy.com
David Winston's Center for Herbal Studies - http://www.herbalstudies.net
Learning Herbs - http://learningherbs.com
Maryland University of Integrative Health - http://www.muih.edu/
Bastyr University Bachelor of Science in Herbal Sciences - http://www.bastyr.edu/academics/areas-study/ba-major-herbal-sciences
International Herb Symposium - http://www.internationalherbsymposium.com
North West Herb Symposium “Botanicals at the Beach” - http://www.nwherbsymposium.com
Emerson Ecologics Ignite - http://eignite.com/educationalseries
Academy of Integrative Health and Medicine - http://learn.aihm.org/course-catalog
Overcoming A Knowledge Gap To Develop Competent Nutrigenomics Dietitians


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INTRODUCTION

The last decade and a half has seen the proliferation of nutrigenetic testing companies. The direct-to-consumer (DTC) model continues to grow; however, some growth has also come from companies selling tests through practitioners, many focusing their efforts on working with dietitians. The more reputable companies insist on dietitians completing an accreditation course before they are “certified” to sell the companies’ tests. Although an admirable insistence, the integrity and depth of these courses vary. In addition, dietitians vary in their undergraduate qualifications and experience.

This article does not address whether or not the field of nutritional genomics is ready for dietetic clinical practice. For this, we recommend as a starting point the article Nutrigenetics and personalized nutrition: are we ready for DNA-based dietary advice? This article addresses the dietitian’s “knowledge gap,” describing what knowledge may be missing. Further, for the purpose of this article we use the term nutritional genomics to include both nutrigenetics and nutrigenomics.

In 2005, a full decade ago, Dr. Ruth DeBusk published an insightful article with the title: Nutritional Genomics in Practice: Where Do We Begin? Since then, several studies have attempted to determine which factors affect dietitians’ knowledge, attitudes and confidence in utilizing genetics and nutritional genomics in practice. Morin found that only half of the dietitians, nutritionists and naturopaths included in a focus group study were even aware of the term “nutrigenomics,” compared to none of the surveyed physicians or pharmacists. Years later, a study by Collins et al. that included dietitians from the United States, Australia and the United Kingdom found that dietitians’ knowledge, involvement and confidence relating to genetics and nutritional genomics were low. More recently, Horne et al. conducted six 30-minute focus groups to explore dietetic students’ knowledge, attitudes and beliefs about personal nutrigenomics testing (PNT) and their perceived values regarding the incorporation of this topic into dietetic education and practice. The students believed that nutrigenomics is the future of dietetics and demonstrated a strong desire to learn more, seeing it as essential to include nutrigenomics in dietetic curricula. This is a summary of the points agreed upon:

- Knowledge of genetics and nutritional genomics among dietitians is currently low.
- RDs express interest in the knowledge and use of nutritional genomics in practice.
- Undergraduate dietetic students are motivated to increase their nutrigenomics-related knowledge.
- RDs felt they were lacking the background knowledge and expertise to apply nutritional genomics in their clinical practice.
- Consumers perceive RDs as the best source for the provision of nutritional genomics interpretation.
- Knowledge of nutrigenomics among RDs is positively associated with university education and continuing professional development.

There is little doubt that the future of dietetics is enmeshed with nutritional genomics. The 2014 Nutrigenomics position paper by the Academy of Nutrition and Dietetics stated that the use of nutrigenetic tests in clinical practice requires that dietitians have the knowledge and ability to “understand, interpret, and communicate complex test results.” To achieve this will require trained and knowledgeable dietitians in this area.

An excellent paper by Prasad et al. discusses the minimal learning objectives required to prepare undergraduate dietetic students in nutritional genomics. The authors identify four key learning areas:

- How dietary chemicals alter gene expression and modulate disease susceptibility.
- How nutrients may affect gene expression in utero.
- Do we have a sufficient genetic knowledge base to provide meaningful nutrition and health education?
- What are legal, social and ethical issues associated with genetic testing and counseling?

Prasad suggests that the reason university programs have been slow to deliver nutrigenetic-based nutrition education has been due to the complexity of gene-nutrient interactions, as well as the multi-disciplinary requirements of the field. One of the greatest challenges is in bringing together the fields of nutrition and genetics. Many dietitians are unable to differentiate between nutrigenetics and nutrigenomics (Figure 1).
Biochemical processes are driven and understood through nutritional biochemistry. It is imperative to understand the biochemical pathways and the disruption thereof, which contribute to perturbations in health and potentially the development of disease. Nutrigenomics provides information on genetic sequence variants — SNPs — as well as other variations such as copy number variants. These may (but do not always) alter gene expression or protein function. By understanding nutrigenomics (nutrient impact on gene expression), a dietician is able to identify and advise on nutrients and lifestyle changes that may alter gene expression. Put together, these three pillars of nutritional genomics will empower the practitioner to construct targeted and clinically useful dietary and lifestyle recommendations.

It should always be kept in mind that nutritional genomics is only one of the many "omics" being studied. A systems biology approach will include nutritional studies that may also utilize transcriptomics, epigenomics, proteomics, metabolomics, and microbiomics. An excellent example of this is the article by Zhao which uses type 2 diabetes to illustrate how a nutritional systems biology approach can be used to understand type 2 diabetes and guide disease management via nutritional interventions.14

Defining the Difference between Nutrigenetics and Nutrigenomics.

Genetic variability (nucleotide sequence change) influences how we interact with our environment. Nutrigenetics describes the influence of gene variants on our ability to interact with bioactive molecules in the molecular environment surrounding our cells and the consequences of that interaction.

In contrast to nutrigenetic interactions, where the gene variants act on the environment, with nutrigenomic interactions, the environment influences gene expression. Nutrigenomics is concerned with the influence of bioactive molecules on a gene, potentially influencing gene expression by either upregulating or downregulating the gene, or activating or silencing it. Nutrigenomic interactions may be direct or indirect. In a direct interaction, the molecules are of small molecular weight, carrier-mediated, and lipid-soluble. In an indirect interaction, the molecules are larger and hydrophilic. These molecules interact at the cell surface and initiate a cascade of signals that lead to the cell nucleus.EMPLOYING THE THREE PILLAR APPROACH IN CLINICAL PRACTICE

The Fundamental Strategy

A key consideration in the three pillar approach is the promotion of a greater understanding of the mechanisms cells use to maintain and/or establish homeostasis. Because bioactive food molecules are the primary intervention in a nutrigenomic prescription, knowledge of the means by which they impact on human biochemical processes is an important factor. For example, numerous phytochemicals are capable, to varying degrees, of activating the transcription factor, Nrf2, which in turn induces a large battery of cytoprotective genes. Nrf2 has been described as the "master regulator of oxidant defense"15 so that the ability to modulate this battery of genes provides a potentially valuable tool for nutrigenomic intervention. The comparative degree to which plant-derived bioactives can activate Nrf2 is becoming better understood16 so that meaningful dose-response data are now available.
Polymorphisms are known to exist for some of these cytoprotective genes with tests for a number of them appearing in typical nutrigenetic test profiles. Some of the more familiar polymorphisms exist for genes coding for the primary antioxidant enzymes superoxide dismutase (SOD), glutathione peroxidase (GPX1) and catalase (CAT). Others include the metal chelator metallothionein (MT), the Phase 2 detoxification enzyme quinone reductase (NQO1) and the vitamin D receptors (VDR). The rate-limiting enzyme in the transsulfuration pathway that converts homocysteine to cystathionine, a precursor to cysteine, is coded by the gene, cystathionine beta-synthase (CBS); polymorphisms in this gene affect not only levels of cellular homocysteine, but also the synthesis of the master antioxidant glutathione, of which cysteine is an important component.

These few examples of cytoprotective genes and their protein products are integral to the biochemical processes associated with cellular homeostasis. However, such biochemical pathways are not typically a focus of undergraduate biochemistry courses. In our three pillar approach, we consider a working knowledge of these fundamental biochemical processes an important key to the interpretation of nutrigenetic data. Knowledge of the pathways in a clinical context helps to draw direct links between the products of gene expression and cellular function.

If a dietitian or other health professional understands the nature of a particular pathway when it is functioning normally, it is possible to predict what may happen when a gene variant produces a protein, such as an enzyme, with lower activity. Understanding the function of the biochemical pathways for which polymorphisms exist is at the core of this approach. Human cells utilize a number of core biochemical processes in maintaining homeostasis; these include but are not limited to redox regulation, detoxification, inflammation modulation, energetics and methylation.

It is well known that redox dysregulation and associated inflammation are common elements of numerous chronic diseases. Type 2 diabetes, for example, is associated with an increased flux of glucose, fatty acids and oxygen through the mitochondria with a resultant increase in superoxide radical formation. The primary antioxidant enzymes SOD, GPX and CAT play a key role in helping prevent superoxide radicals from leading to an uncontrolled oxidative assault. In cells where these antioxidant enzymes function normally, superoxide acts as a signaling molecule to upregulate the expression of the genes that code for these primary antioxidant enzymes. Where antioxidant enzyme activity is compromised, unregulated superoxide formation may lead to oxidative stress, a forerunner to chronic disease.

Nutrigenetic test profiles typically include tests for polymorphisms that impact the primary antioxidant enzymes and major inflammatory cytokines. Nutrigenomic interventions that influence the activity of a number of antioxidant enzymes are known, whereas little is currently known of ways to beneficially modify expression of disease-specific genes. Redox dysregulation is accepted as a fundamental contributor to both the onset and the progression of many chronic diseases. Examining the relevant gene variants in a nutrigenetic profile gives the dietitian a guide to the redox regulating potential of that patient. Following such an analysis, the appropriate nutrigenomic interventions can be selected in order to modify the expression of one or more genes. In the three pillar approach, it is considered more prudent to focus on genes for which known interventions exist.

The need to adopt a conservative approach

Recent times have seen the emergence of a trend regarding the inappropriate over-interpretation of nutrigenetics related to the methylation process; the methylenetetrahydrofolate reductase (MTHFR) gene sits at the center of this focus. It is not uncommon for individuals to obtain reports on their MTHFR genotype through direct-to-consumer test providers. The data are typically supplied without interpretation so that consumers rely on the recommendations provided in online forums; many claim to have been “diagnosed with MTHFR” and inappropriately self-medicate, often reporting severe adverse effects to large doses of recommended supplements. Of real concern is the nature of the information provided on these forums and the many related video clips and the assumption by many consumers that the presence of MTHFR polymorphisms explains all of the health issues experienced by that individual. The apparent relationship to the methylation process for depressive illness, autism, Lyme disease and infertility are recurring topics on these forums; therapeutic advice is freely given by members of the groups to those new to their MTHFR status. Consumer interest in this area is paralleled by the growing number of clinicians claiming expertise in this field. Particularly concerning is that their interpretations and recommendations frequently far outstrip the known science.

As a common example, MTHFR and related polymorphisms are used as the foundation for the treatment of neuropsychiatric illnesses. Essentially, clinicians “predict” the effect of the polymorphisms on the downstream expression of neurotransmitters. In order to consider the clinical
relevance of such an approach, it would be necessary to examine additional SNPs and other gene variants that affect neurotransmitter function, as well as innumerable factors associated with the synthesis and subsequent degradation of each neurotransmitter. Our current knowledge of elements such as transporters, receptors, enzyme cofactors, degradative enzymes and feedback mechanisms is incomplete. Clearly, consumers need access to better resources in order to avoid the pitfalls currently confronting them. With the necessary training, dietitians and nutritionists are ideally placed to provide more appropriate advice.

CASE STUDY: A 46-year old female presents with recently-diagnosed type 2 diabetes. Her diet is poor, and her BMI is 29. Nutrigenetic testing shows several SNPs in her Redox Panel (Table 1). Space does not permit a full nutrigenetic analysis.

### Table 1. Redox Panel

<table>
<thead>
<tr>
<th>GENE</th>
<th>VARIANT</th>
<th>GENOTYPE</th>
<th>GENE CODES FOR:</th>
<th>NUTRIENT COFACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOD2</td>
<td>Val16Ala</td>
<td>No variant impact</td>
<td>Superoxide dismutase</td>
<td>Manganese</td>
</tr>
<tr>
<td>(MnSOD)</td>
<td>(C&gt;T)</td>
<td></td>
<td>(mitochondrial) MnSOD</td>
<td></td>
</tr>
<tr>
<td>SOD3</td>
<td>760 C&gt;G</td>
<td>CC</td>
<td>Superoxide dismutase</td>
<td>Copper and Zinc</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(extracellular) CuZnSOD</td>
<td></td>
</tr>
<tr>
<td>GPX1</td>
<td>GPX1 Pro198Leu</td>
<td>CT</td>
<td>Glutathione peroxidase (GPx)</td>
<td>Selenium</td>
</tr>
<tr>
<td></td>
<td>(C&gt;T)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### The Biochemical Analysis

The superoxide radical is generated continuously by the mitochondria from inhaled oxygen. In circumstances such as during exercise, there is an increased flux of oxygen through the mitochondria. This increases the quantity of superoxide radical produced; this acts as the pro-oxidant signal needed to activate the cells’ endogenous defense mechanisms. Consequently, the expression of the MnSOD gene is upregulated to produce more MnSOD enzyme; the same applies to increased expression of the GPX gene. Just as exercise increases the flux of oxygen, glucose and fatty acids through the mitochondria, so too does over-eating. Several pathways in type 2 diabetes contribute further to this increased flux.²²

These two primary reactions constitute the first line of cellular defense against oxidative stress.²³ As shown in Figure 3, two superoxide radicals dismutate to produce hydrogen peroxide, a non-radical reactive oxygen species (ROS) which can readily react with metal ions to produce highly toxic hydroxyl radicals (OH·). If acted upon normally by GPx, hydrogen peroxide converts to unreactive water, removing the oxidative risk.

### Figure 3. Superoxide Redox Reaction

\[
\text{REACTION \# 1} \quad 2O_2^- + 2H^+ \xrightarrow{\text{SOD}} H_2O_2 + O_2
\]

\[
\text{REACTION \# 2} \quad 2H_2O_2 \xrightarrow{\text{GPx}} 2H_2O
\]

### The Nutrigenetic Profile

In our case study, the patient carries a normal MnSOD, and so the mitochondria are likely to perform Reaction #1 adequately, generating hydrogen peroxide. However, she carries a GPX SNP, thereby limiting the activity of the GPx enzyme. As a result, hydrogen peroxide will tend to accumulate at a rate faster than can be handled by the dysfunctional GPx enzyme. Hydrogen peroxide is then more likely to react with available heavy metal ions to produce the hydroxyl radical, capable of oxidatively damaging a range of proteins, lipids, DNA, RNA, and other biomolecules. What this tells us is that although the patient carries a normal MnSOD gene, the potential for oxidative damage is still increased. GPX1 has been implicated in the development and prevention of many common and complex diseases including cancer and cardiovascular disease.²⁴

### Nutrigenomic Interventions

The goal of a nutrigenomic intervention is to provide one or more food-derived compounds known to induce the expression of a specific gene for which increased enzyme activity is desirable. There are two fundamental aspects to consider: 1) is there an essential cofactor for the enzyme, and 2) are there food-derived bioactive compounds that can induce expression of the gene itself?

In our case study, the GPX1 variant produces the glutathione peroxidase enzyme that is suboptimal in its activity. The trace element selenium is an essential cofactor for the GPx enzyme activity and so the first approach is to evaluate the patient’s nutritional status of this nutrient and aim to increase dietary sources of selenium if necessary.

The second important strategy is to provide an appropriate bioactive. One reported nutrigenomically-active compound is sulforaphane, derived from cruciferous vegetables and especially from young broccoli sprouts, shown to increase activity of a range of endogenous cellular defense mechanisms.²⁵

Where it was once thought that direct-acting antioxidant nutrients such as vitamins A, C and E and...
beta carotene would counter the elevated superoxide generated in type 2 diabetes, an analysis of studies including thousands of participants concluded that major clinical trials have failed to demonstrate beneficial effect of antioxidants on the prevention of type 2 diabetes. Altering the cellular redox milieu by increasing direct-acting antioxidant vitamins to supraphysiological levels may mask the subtle signals that cells rely on to activate endogenous defenses. For this reason, the nutrigenomics clinician seeks phytochemical interventions known to enhance expression of the cell’s own battery of cytoprotective genes.

**Further Implications**

The role of redox regulation cannot be under-estimated as a primary event in disease etiology. Redox imbalance and inflammation function in a self-perpetuating loop, so that to satisfactorily address inflammation, redox balance must also be considered. Similarly, elevated superoxide levels can inhibit the enzyme aconitase, the rate-limiting step in the generation of ATP via the Kreb’s Cycle. As ATP drives numerous enzyme systems, modulating redox balance is a logical first step, which also protects key biomolecules and delicate organelles from oxidative assault. Similar arguments can be mounted to show how methylation and redox imbalance are closely inter-related.

**Case Summary**

The approach described briefly here addresses just a few of the initiating factors contributing to type 2 diabetes and its progression in this patient. In the clinical environment, the nutrigenetic report would identify SNPs from other genes coding for inflammatory cytokines, other key protective enzymes such as antioxidant and detoxification enzymes and the non-enzyme antioxidant, glutathione.

In the three pillar approach, the dietitian would consider the possible effects of these SNPs in the relevant biochemical pathways, ordering biochemical tests where indicated. These tests are useful in assessing whether the particular SNP could be compromising biochemical function. Not all SNPs result in compromised biochemical function for two reasons: 1) there may be other genes which effectively substitute for the defective gene — for example, Quinone Reductase (NQO1), a Phase II detoxification enzyme, can quench superoxide radicals if SOD function is less than optimal — and 2) the patient’s diet and/or lifestyle may be such that the expression of that gene has been modified nutrigenomically. Where a patient carries a SNP and biochemical testing confirms compromised function, the dietitian may then provide dietary recommendations known to modify the expression of the aberrant gene(s).

**CONCLUSION**

What we have endeavored to describe is the knowledge gap that may be experienced by many dietitians who wish to include the field of nutritional genomics in their practices. We have also shared what we believe to be the knowledge required to integrate nutritional genomics into clinical practice. This relates only to understanding diet-gene interactions; we acknowledge that the legal, social and ethical issues associated with genetic testing and counseling must be taught and understood.

It is not enough to be told or even to know what impact a person’s genotype may or may not have on protein function and what disease associations have been reported in the scientific literature. Nutrigenetics must exist in the context of a nutritional systems biology approach that affects an individual’s phenotype through genomic, metabolomics and proteomic factors. An understanding of nutrigenomics and the interplay of these systems is the key to developing effective and meaningful dietary and lifestyle interventions. This three pillar approach demands that dietitians will acquire more in-depth, expansive training. It will also ensure that they will then be in a position to understand the biochemical environment of gene variants and have the skills and knowledge to independently construct dietary recommendations that surpass the recommendations offered by commercial nutrigenetic tests.

**References**


**Article adapted with revisions from Overcoming a Knowledge Gap to Develop Competent Nutrigenomics Practitioners, Joffe YT, Houghton CA. Townsend Letter, April 2016 available at http://www.townsendletter.com/April2016/overcome0416.html#.Vy0V4R9sVYM.linkedin. Reprinted with author's permission.**
Overcoming A Knowledge Gap To Develop Competent Nutrigenomics Dietitians

References


Recent posts discuss A2 milk, previously only found in Europe, which is now available here in America. A2 milk tends to be less allergenic and is tolerated by those with milk allergies or sensitivities; more information can be found at: www.betacasein.net. Alternative diets for individuals with ADHD include: the Feingold Diet, the GFCF diet and Dr. McBride's GAP book. Other topics include soy as treatments for estrogen and breast cancer, alternative treatments for ulcerative colitis, osteoporosis and canker sores, megadosing vitamin D, and fecal transplants. Join the EML here: https://groups.yahoo.com/neo/groups/DIFM_Listserv/info. Reviewed by Racquel Praino

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The above white papers are free, however, practitioners are asked to enter basic contact and work information to download as a PDF. Go to http://www.integrativepractitioner.com/Resources/White Papers and Reports.

Dark chocolate and Exercise Performance: It has been demonstrated that flavonols can increase the bioavailability and bioactivity of nitric oxide (NO); in turn, NO has been linked with reduced oxygen cost of exercise, as well as improved performance. In a randomized crossover trial, researchers examined the effect of dark chocolate, which is naturally rich in flavonols, on VO2 max, blood pressure, respiratory exchange ratio (RER), oxygen cost and lactate levels during a 20-minute cycling test at a moderate level, 80% of gas exchange threshold (GET), and a two-minute time-trial (TT) at all out sprint performance levels. Previous research has focused on the cardiovascular benefits of dark chocolate; there is limited research regarding its potential to improve athletic performance. Nine moderately trained young men (aged 20-22 years) participated in this study. Baseline testing was followed by 14 days of supplementation with 40 g of either dark chocolate (DC) or white chocolate (WC), with a seven-day washout period between switching interventions. Participants maintained their regular diets, and were instructed to avoid foods high in nitrate and other sources of chocolate. Subjects were not blinded to the intervention type, but were blinded to the study’s purpose. Compared to baseline and WC, DC consumption significantly increased TT performance and GET. GET was significantly increased by 21% when compared to baseline, and by 11% when compared to WC. VO2 max increased by 6% compared to baseline following DC consumption, but was not statistically significant compared to WC. After DC consumption, distance covered in the TT was significantly greater by 17% and 13%, compared to baseline and WC, respectively. Between conditions, there were no significant differences in blood pressure, lactate levels, RER and heart rate during the 20-minute cycling test. Patel RK, Brouner J, Spendiff O. Dark chocolate supplementation reduces the oxygen cost of moderate intensity cycling. J Int Soc Sports Nutr. 2015;12:47.

Seafood Consumption and Brain Neuropathology: The association between dietary neuropathologies with dietary n-3 fatty acids and brain levels of selenium and mercury were studied on 286 autopsied cases of deceased participants in the Rush Memory and Aging Project (MAP). Before death, the participants completed a semi-quantitative food frequency questionnaire to assess daily intakes of long-chain n-3 fatty acids and a-linolenic acids; evaluators of the neuropathological measures were blinded to this data. A board-certified neuropathologist determined the neuropathology diagnoses and pathologic evaluations of the autopsied brains. Through use of instrumental neutron activation analysis, the brain metal concentrations were measured by assessing 100 g tissue samples from the inferior temporal and mid-frontal regions (affected by Alzheimer disease neuropathy) and the cerebellum (unaffected by Alzheimer disease neuropathy). The diet and brain metal associations were examined with Lewy bodies, macroinfarcts, and microinfarcts in logistic regression models. The results indicated that brain cortical mercury levels were positively correlated with cortical selenium levels and with consumption of seafood meals. Dietary intake of a-linolenic acid was correlated with decreased odds of cerebral macroinfarcts and microinfarcts, but was not with other neuropathological markers. Further analyses showed those who were APOE
£4 positive with higher intakes of long-chain n-3 fatty acids had less Alzheimer disease neuropathology compared with those who consumed less. Despite the fact that higher intakes of seafood were correlated with elevated brain concentrations of neurotoxin mercury and antioxidant trace element selenium, there was no correlation between these levels and brain neuropathology. Morris MC, Brockman J, Schneider JA, et al. Association of Seafood Consumption, Brain Mercury Level, and APOE e4 Status With Brain Neuropathology in Older Adults. *JAMA*. 2016;315(5):489-97.

www.feelgoodbiochem.com is a free web-based book written by Amy Yasko, PhD, NHD, AMD, HHP, FAAIM and edited by Nancy Mullan, MD. The site is an interactive guide on various biochemical tests and explains the science and rationale behind them. Topics covered include: Hair Elements Analysis, Urine Toxic Metals and Essential Elements testing, Metabolic Analysis Profile, Urine Amino Acids and Intestinal Permeability testing.

www.knowyourgenetics.com is a free resource also created by Dr. Amy Yasko. Enter your nutrigenomic results for a Methylation Pathway Analysis and to receive supplement suggestions—both free of charge. Also available on the site are a nutrigenomics discussion group, CH3 Nutrigenomics, and PDF diagrams of the Methylation Pathway and Methylation Cycle.


**Precision Nutrition 4.0: A big data and ethics foresight analysis--convergence of agrigenomics, nutrigenomics, nutriproteomics, and nutrimetabolomics.** *OMICS.* 2016. [Epub ahead of print] (PubMed ID: 26785082) Innovation opportunities can emerge by combining multiple complementary technologies like proteomics and metabolomics along with nutrigenomics.


**The relationship between midlife and late life alcohol consumption, APOE e4 and the decline in learning and memory among older adults.** *Alcohol Alcohol.* 2014;49(1):17-22. doi:10.1093/alcalc/agt144. Epub 2013 Sep 18. (PubMed ID: 24049153) Although light-to-moderate alcohol consumption can be beneficial for many older adults with regard to learning and memory, this study did not find it to be helpful to those who carry one or two copies of the APOE E4 gene variant. Additional study about this relationship is recommended.

Copyright © 2016 Nutrigenetics Unlimited, Inc. Inquiries about above references? Contact Ron L Martin, MS, President, Nutrigenetics Unlimited, Inc.; ron@nutrigenetics.net. The database at Nutrigenetics.net is available to the public free on weekends (U.S. Central time) by using Free as the username, and Weekends as the password, as shown on the login page at https://nutrigenetics.net/Login.aspx. Check out www.Nutrigenetics.net to learn more about the ISNN membership discount for dietitians, which includes database access 24/7 as a benefit. Learn about the upcoming 10th ISNN Congress on May 22–26, 2016 in Tel Aviv, Israel, with optional “Translational Genomics” workshop and pre- or post-conference cultural tours: http://www.ortra.com/events/isnn2016/Home.aspx.
In the United States, Americans eat more packaged and processed foods and the government spends more on military research than in any other country in the world. This book connects these two seemingly unrelated facts by revealing the level of influence wielded by the Department of Defense Combat Feeding Directorate on the food Americans choose to eat. The military’s impact on the creation of cheap, non-perishable rations (read: energy bars, instant coffee, high-pressure processed deli meat, and single serve boxed juices, to name a few) has influenced the production and development of not only quick and easy-to-eat foods, but also on preservation, from tin cans and plastic film to high-pressure processing (HPP).

Fourteen chapters chronicle the development of ways to preserve, store, and transport food for battle, how this has influenced the production and development of not only quick and easy-to-eat foods, but also on preservation, from tin cans and plastic film to high-pressure processing (HPP).

It is estimated by the author that up to fifty percent of foods in the marketplace today have some relationship to the military. Ready to eat bagged salad, cold pressurized juices, enriched breads, instant soup, and cheesy snack foods from surplus processed cheese are many go-to staples—some healthy, some not so healthy. Another significant, yet out of sight, military contribution was the Hazard Analysis Critical Control Point (HACCP) protocol used for reducing contamination risks. Developed during the Space Race, it is widely used today in food production.

This fascinating book is a must-read for anyone interested in the history of food. Granted, the foods developed may not meet everyone’s criteria for healthy food, but it certainly describes the importance of this research and development to the health of the military. The not-so-obvious contributions such as the development of plastic wrap and HACCP are interesting in their own right. Although the last chapter, “Do We Really Want Our Children Eating Like Special Ops?” does not answer the question, it does offer food for thought about the role these foods play in everyday life and how they will be used in the future.

Reviewed by Sarah Harding Laidlaw, MS, RDN, CDE, Editor, The Integrative RDN. Contact Sarah at peaknut70@gmail.com.
Kristen Mancinelli’s book, The Ketogenic Diet: The Scientifically Proven Approach to Fast, Healthy Weight Loss is a well-thought-out and well-written look at the potential benefits and applications of the ketogenic diet for weight loss. It clearly outlines the metabolism of fats, carbohydrates and proteins in language that is accessible for the layperson (and is a great reminder for the practicing nutrition professional!). The ketogenic diet is defined as a significant restriction of carbohydrates to 25-50 grams/day where the majority of calories come from mostly fats and moderate amounts of protein as well as plenty of non-starchy vegetables. It is not, Mancinelli emphasizes, meant to be a starvation diet, nor a free pass to eat as much bacon and steak as possible, but a diet in which high quality foods like avocados, olives, grass fed meats, nuts, seeds and organic produce is strongly encouraged. By depriving the body of carbohydrates, she claims, the body shifts into ketosis, an “alternate state of metabolism” where the body is forced to use stored fats for energy (by producing ketones), which in turn lowers insulin levels, reduces fat storage, diminishes hunger, and speeds up weight loss. A low carbohydrate diet forces the body to use ketones rather than available carbohydrate for fuel. This approach is meant to be a short term 3-4 month resetting of the metabolism and not necessarily a complete lifestyle change forever, although reducing carbohydrates in general (particularly from refined and sugary treats) and focusing on healthy fat sources seems to be an overall recommendation.

The book is extremely user-friendly and helpful for someone who needs a bit of guidance in getting started. Not only does Mancinelli provide helpful charts that detail the amount of carbohydrates and fiber found in commonly consumed foods, she also highlights healthy items to include, such as Brazil nuts, salmon, and walnuts, and emphasizes important tips like staying hydrated, getting adequate sleep, exercising mindfully, reducing alcohol and consuming sufficient electrolyte sources. She also provides a host of recipe and meal ideas from Chimichurri Steak to Chia Chocolate Mousse and devotes an entire chapter to helpful resources and tools. The book includes a section that delves into helping the reader identify her/his readiness for change, goals and sense of motivation, even offering a worksheet entitled “Why Am I doing the Ketogenic Diet?” Mancinelli also addresses challenges someone might face when starting, such as side effects, eating out, social pressures, and emotions and mindful eating. She offers helpful tips to make the process easier, even referring to her own personal and beneficial experience with the ketogenic diet.

There are a number of claims made that might be supported with sufficient scientific references so that skeptics of the diet may rest assured that there is evidence to support them. A critic may be curious, for instance, how ketones increase the synthesis of GABA or which studies Mancinelli is referring to that dispel the myth between saturated fat and heart disease. While the excellent detailed biology and biochemistry lessons in the book help the reader understand why the ketogenic diet might work for weight loss, the lack of cited studies to support the claims may make her arguments less palatable for some.

Overall, the topic is fascinating and timely and Mancinelli makes a compelling case for the benefits that such an extreme dietary approach may have to offer. Stay tuned for more on this subject. It will no doubt be a hot topic in the months to come.

Reviewed by Mary Purdy, MS, RDN, 2015-2017 DIFM Communications Chair and 2016-2017 DIFM Chair Elect. Mary is Adjunct Professor at Bastyr University and Arivale Coach. Contact Mary at Mary@NourishingBalance.com.
Recipe: Sauteed Greens with Yellow Peppers

Kale is a powerhouse of nutrients—rich in folate, Vitamin K, and many disease fighting anti-oxidants like lutein and zeaxanthin. Coupled with yellow peppers, which are rich in beta carotene and Vitamin C, these greens are extremely beneficial for eye health and general immune system function.

Sauté garlic in olive oil for 1 minute. Add chopped peppers and continue to stir for 3 minutes. Add chopped kale and tamari sauce. Stir and then cover for 3 minutes. Add water, lower heat and cover for 5 more minutes. Sprinkle on a dash of pepper or sesame seeds if desired. Serve.

**Ingredients:**
- 1 ½ Tablespoons olive oil
- 3 cloves garlic - chopped
- ½ yellow pepper - chopped and seeds removed
- 2 cups kale - chopped (spinach or chard will also work - cut cooking time by 3 minutes)
- 1 Tablespoon organic tamari or soy sauce
- 1/8 cup water
- Black pepper or sesame seeds to taste

**Preparation time:** 5 minutes
**Cooking time:** 12 minutes
**Serves:** 2-3

Original recipe by Mary Purdy, MS, RDN

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Bytes of Color

In this issue, we include our first creative writing piece, by 2016-2017 DIFM chair Mary Purdy, MS, RDN.

How do you live #theDIFMlifestyle? Do you practice creative writing as well? Or perhaps another style of writing or artistic expression? If you would like your writing, photos, painting, drawing, creative digital image, etc. to be considered for a future publication, email your submission to Sarah Harding Laidlaw, MS, RDN, CDE, Newsletter Editor at peaknut70@gmail.com.

**BYTES OF COLOR**

By Mary Purdy, MS, RDN

RED wraps around the tomato in my salad, speckles my Fuji apple after lunch, blesses the strawberry in my morning smoothie and gives life to the cranberries in the freezer. It is bold and strong, bursting with lycopene and anthocyanins waiting to neutralize reactive molecules swarming my body. It reminds me of blood, of flesh that is ripe and vulnerable.

ORANGE wanders over my peach, shades my apricot, covers my carrot, and bathes my sweet potato in rich tones. The orange is so orange it has stolen the color’s name for itself! The pumpkin makes an advertisement for her pigment every October as she shines in the window presenting her fiery tint.

YELLOW ensconces my banana, marries my spaghetti squash, bequeaths itself to the yellow pepper and takes ownership of the yolk, aspiring to be as bright as it can be, sometimes melding with its auburn sister. It broadcasts its beta carotene shimmering like a sunbeam.

GREEN emanates from the kale in the garden, oozes out of broccoli stalks and pea pods at the farmers’ market and drips from the avocado just barely hanging on the branch. It shouts its shades from lime and olive to kelly and emerald, heralding its chlorophyll rich bounty. Even the simple sprig of cilantro gets a hit.

BLUE coats the berries which bear its moniker, canoodles the plum—both fresh and dried, envelops the elderberry, and often covets VIOLET’s status, wondering why there aren’t more natural hues of blue in the grocery aisles not defined as “dye # 1” on a children’s popsicle stick.

VIOLET is a true friend to the eggplant, passionately defends the blackberry, protects and shrouds the beet and emblazons itself upon the grape. It is known to dot the shirts of those consuming the fruitlets it paints as overzealous bites are taken or napkins go unused.
Affiliate News

Diana Noland, MPH, RD, CCN, LD is an adjunct faculty member, Dietetics & Nutrition, School of Allied Health Professions, University of Kansas Medical Center, Kansas City, KS and in private practice at FoodFax in Burbank, CA; www.sequoiamedicine.com. Contact Diana at Diana@diananoland.com.

IFM and IFMNT making news in California

California is a large state with five regions, each with a local California Academy of Nutrition and Dietetics (CAND) group. During the past six months, two of the CAND groups held quarterly meetings focusing on functional medicine. And, as important as the topic was, the attendance of each was record breaking—very exciting! Instead of the usual 20 or so attendees, the functional medicine sessions drew over 100 attendees. Even more, many RDNs expressed great interest in exploring further training and education in integrative and functional medicine. We played the DIFM website video and encouraged new members to join DIFM!

CAND OD (CAND Orange District) September 19, 2015

Thanks to the organization of Dr. Sangeeta Shrivastava, the day’s theme was Managing Chronic Diseases with Integrative and Functional Medicine/Nutrition. The four-hour session generated plenty of excitement from the audience and prompted many questions regarding the topics of Nutrigenomics and Functional Medicine for Chronic Disease. DIFM member Diana Noland, MPH, RD, CCN, LD, presented Keys for Managing Chronic Disease with IFMNT. The Q&A after the meeting prompted such a lengthy discussion that they had to refuse additional questions at the end.

CAND Coastal Tri-Counties Workshop, January 9, 2016

In Santa Barbara, CA, DIFM Executive Committee Member and Past-Chair Alicia Trocker, MS, RD and Diana Noland, MPH, RD, CCN, LD were the keynote speakers for the five-hour event titled “The World of Functional and Integrative Nutrition.” It was another event filled with record-breaking attendance and excitement, with Q&A again extended past the meetings’ expected end. The topics covered were “Keys for Managing Chronic Disease with IFMNT” (Noland) and “Mind-Body Foundations to Health” (Trocker). A beautiful healthy lunch was provided with whole, unprocessed foods.

Are you living it?

At DIFM, we look at the holistic pillars of our practice and the healing power of food as medicine. We get out in nature; we honor individuality. We practice or teach yoga, tai chi, and Qi Gong. We dance, sing, rap, run, hike, use aromatherapy, make wine, art, write, act, volunteer at food banks, rescue animals, cook, bake, travel, play, get massages, grow gardens, farm, and so much more. Join us in living #thedifmlifestyle! For a chance to win cool prizes, go to our Facebook page and tag yourself in a photo that shows you living it up, whatever that may mean to you. And if you are so inspired, don one of the DIFM tee-shirts that express this healthy lifestyle while you are doing what you love. For more information or to order a tee-shirt, go to: https://teespring.com/thedifmlifestyle?tsmac=%20marketplace&tsmic=search.
Dietary Supplements: An Integrative and Functional Approach

Dietitians in Integrative and Functional Medicine DPG Symposium

Saturday, October 15, 2016
8 am-3:30 pm
Westin Boston Waterfront

The Dietitians in Integrative and Functional Medicine (DIFM) DPG will host a full day symposium in Westin Boston Waterfront. This cutting edge event will focus on herbal and non-herbal dietary supplements in the application of specific health conditions, including cardiovascular disease, metabolic syndrome, inflammation, sleep/stress, and gut health. Therapeutic application will address dosing, delivery, current research, and safety concerns. Along with research to support their usage, there will be discussion regarding functional lab testing, nutritional genomics and the nutrition focused physical exam as it pertains to supplements.

Distinguished speakers Dr. Mary Bove, ND and Dr. Sheila Dean, DSc, RD, LD, CCN, CDE will focus on herbal dietary supplements and non-herbal dietary supplements, respectively. A lunch speaker is also being arranged. Application to the Commission on Dietetic Registration for six continuing education credits will be made.

Participant Objectives:

1. Enhance understanding of common herbal terms and definitions.
2. Apply specific herbal medicines for therapeutic application in cardiovascular disease, glucose issues, sleep concerns, stress modulation, and chronic inflammatory disorders.
3. Identify and review specific non-herbal dietary supplements for therapeutic application in cardiovascular disease and gut-related disorders.
4. Evaluate dosing and delivery systems of various non-herbal dietary supplements.
5. Identify the safety, quality, and efficiency of herbal and non-herbal dietary supplements in disease management.

Dr. Bove’s session is a foundation-building workshop on herbal medicine that will provide the clinician with a short and basic introduction to herbal medicine including terms and definitions, herbal delivery systems, safety, herb drug interaction, and quality concerns. This will set the stage for discussion on the application of botanical medicine in specific health concerns including cardiovascular disease, metabolic syndrome, sleep issues, stress modulation, inflammation, and general immune care. Therapeutic application, dosing, delivery form, current research, and safety concerns will be reviewed with each herb. Sample clinical cases will be presented to reflect the use of herbal medicines as therapeutic tools for the clinician.

Dr. Dean’s discussion on non-herbal dietary supplements will include a review of some of the most commonly used supplements involved in cardiovascular and gastrointestinal disorders. This includes betaine HCL, pre- and probiotics, glutamine, n-butyrate, CoQ10, and L-arginine to name a few. A review of both the scientific evidence for efficacy, safety and dosages along with case vignettes that demonstrate clinical utility using the nutrition care process will be addressed.

Registration is now open. For additional information, go to http://integrativerd.org/fnce-boston-2016/.

Mind Body Happy Hour
DIFM’s Third Annual Member Appreciation Event at FNCE®

Sunday, October 16, 2016
Renaissance Waterfront Hotel
5:30 pm-7:30 pm

Due to popular demand, the third annual Mind Body Happy Hour will return to FNCE® in Boston this year. After a bustling day of sessions and exhibits, you deserve some down time and we will be here to help you do so. Along with relaxing, you will learn about a new modality as well as tips on additional methods to use personally or with your clients. You will also have time to network with other DIFM members and our sponsors. This year’s modalities include:

- Energy Medicine: Plant Communication Demonstration
  Annie B. Kay, MS, RDN, RYT500

- Mindful Eating
  Mary Purdy, MS, RDN

- Yogic Breathing and Movement
  Aarti Batavia, MS, RDN, CLT, CFSP, IFMCP
  Monique Richard, MS, RDN, LDN
  Jessica Redmond, MS, RD, CSCS, RYT200

These events are being sponsored by:

- Gaia Herbs®
- Pure Encapsulations®

Nothing But Pure
Editor’s Notes

I t is hard to believe the Academy and DIFM membership year has come to a close. As Newsletter Editor I have the opportunity to follow the advancements of our DPG as well as the change in leadership and leadership styles. I must say that this year has been a year of unprecedented change for DIFM. As our mission and values are being embraced by more and more Academy members, our membership numbers have swelled greater than 500 during the past year alone, bringing the total to over 4200 members.

Integrative and Functional Medicine (IFM) appears to be taking hold within the conventional/traditional medical community, improving the health and lives of everyone who embraces it. As I review articles for this and future issues, I am in awe of how DIFM has advanced in the past 16 years. When I was in college, subjects that we consider mainstream now would have been scoffed at by my professors—something that I experienced first-hand when writing my master’s thesis. The topic of nutritional genomics is one area where significant strides have been made and where the sky—or higher—appears to be the limit. More physicians are experiencing the benefits of IFM, with many offering their knowledge by speaking at symposiums and writing articles for the newsletter.

Each year DIFM is fortunate to have forward thinking leaders who are members of mainstream medical practices, organizations, and progressive educational institutions. This past year (2015-2016) and the upcoming 2016-2017 year are no different, and with their guidance I am certain that DIFM will continue to grow and be the go-to DPG. The Certificate of Training program that is close to its final review by the Academy will offer members tools they can use to enhance their current and future practices. Our numerous and wonderful students are bringing unbridled curiosity and enthusiasm to the group and as they formally enter the profession, will propel us to new heights of knowledge.

This issue highlights the strides we have made in nutritional genomics, but also emphasizes how much more we have to learn. Botanicals, supplements, functional foods and mind body applications continue to play important roles in IFM. As you will note with this and future issues of the newsletter, we will be returning to our “roots” with columns on the various IFM areas. New columns may be added as the future issues of the newsletter, we will be returning to our “roots” with columns on the various IFM areas. New columns may be added as the research, knowledge and interest emerge. We are looking for a column editor for nutritional genomics and article authors as well. If you are interested, or know of anyone that might be, please do not hesitate to contact me.

As always, I appreciate all of our members’ contributions and input on The Integrative RDN.

Until summer,

Sarah

In seeking sponsors, DIFM has established product standards for products and services of value to the integrative and functional medicine field. We consider product quality, efficacy, manufacturing, and business practices among other criteria. We encourage all professionals and individuals to choose products aligned with their own specific standards.
Chair’s Corner

Spring has sprung and we are already well into 2016. What has your year been like? Are you where you want to be in your practice? Here at DIFM and as integrative RDNs, we recognize that “when you want something you’ve never had, you have to do something you’ve never done.” We challenge ourselves to explore dietetics at a deeper level and ask more questions to find more answers. We strive to think differently in order to yield different results. That exploration and advancement comes in the form of research questions, development of educational materials and more benefits for our members so that we may grow and advance dietetics together as the nutrition experts. Our newsletter authors and editors work diligently to provide the most up-to-date and advanced content on relevant and timely topics that are applicable to your practice.

We are excited to share our recently published research results in the February issue of the Journal of the Academy of Nutrition and Dietetics titled “Integrative Medicine: Education, Perceived Knowledge, Attitudes and Practice among Academy of Nutrition and Dietetics Members,” beginning on page 319, authored by DIFM members Mary Beth Augustine, RDN, FAND, Stephanie Harris, PhD, RDN, LDN and Kathie Swift, MS, RDN, LDN, FAND. It is an important step in our progression and enables us to identify the opportunities where further development could be initiated. We continue to put finishing touches on our Certificate of Training program and have many more ideas in the works to stay current in the evolving area of nutrition science.

A blog was recently added to our DIFM website; please check it out. We also invite you to participate if you have an area of interest or topic you would like to share. We have expanded some member benefits to further support our vision and mission, and most importantly, our valued members like you that are doing so much in this area of practice. We have added a DIFM Ambassador Speaker Stipend Application and Conference and Event Attendance Application. We are planning a symposium in Boston, MA Saturday, October 15, 2016 from 8 am-3:30 pm on dietary supplements and integrative and functional medicine. We continue to work hard to bring you more through social media, our website, webinars and the newsletter. DIFM is now 4200-plus members strong, and we are invested in further collaborations and enhancements to support each of you in all you do for your patients and clients. We have collaborated with the HEN DPG to offer our members a discount to attend the webinar series they will be offering on the critically important topic of Food Insecurity and Food Waste. DIFM collaborated with the non-profit 501c3, sponsor-free Plant-Based Prevention of Disease Conference, May 19th-22nd where integrative and functional medicine was a featured session track.

Past Chair, Mary Beth Augustine, RDN, FAND spoke at the Integrative Healthcare Symposium (IHS), and key members spoke with attendees. DIFM Executive Committee members will be featured as keynote speakers, presenters and moderators in a variety of affiliate, local and national meetings. See our website for specifics to see if one of us will be in your area. Will you be speaking on behalf of DIFM or IFM? Let us know.

Time quickly moves forward, making this my last Chair letter. Marie Curie said “One never notices what has been done; one can only see what remains to be done.” It has been a productive year, but there are still strides to be taken and together we can accomplish anything.

I want to extend a sincere thank you to my fellow zealous, steadfast, and inspiring DIFM Executive Committee members as well as to all of you. It has been a pleasure and honor to serve in this role. I have learned from so many of you as well as grown and deepened my appreciation for our profession and all we aspire to do and be. As Kelly Morrow, MS, RDN moves into DIFM’s Chair position in June, I look forward to continuing my theme of “Enhancing and Expanding DIFM” further while supporting her creative ideas and leadership agenda. We have a strong, enthusiastic and proactive group. We continue to strive to support you, elevate our profession, and enhance our skills as practitioners for the benefit of all we serve.

I encourage you to seize the moment this spring, to break new ground, learn something new, or do something differently. We’ll be here to cheer you on and lead the way.

Sincerely,

Monique Richard, MS, RDN, LDN

Join us on...

Twitter - https://twitter.com/integrativerdn
Pinterest - https://www.pinterest.com/integrativerdn/
Thank You!

Thank you to everyone who has helped make 2016-2017 a great year for DIFM! Thank you to those who have helped make The Integrative RDN a great publication by writing, editing, proofreading, and those who have helped with innumerable other tasks associated with the newsletter and DIFM DPG. All attempts have been made to identify everyone who has worked so hard on this publication and with the DPG; the omission of any name or individual from this list is not intentional.

A special thank you to DIFM’s Executive Assistant, Amy Jarck who provides hours of service to our DPG and the newsletter as well.

The Integrative RDN Editorial Team

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# Executive Committee List 2015-2016

<table>
<thead>
<tr>
<th>Name</th>
<th>Title and Affiliation</th>
<th>Contact Information</th>
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*Δ Indicates Voting Member*
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