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## Dietary Nitrates and Nitrites from Vegetables and Fruits: How Can Something So Bad Be So Good? (Part 1)

by Norman G. Hord, PhD, MPH, RD

*This is the first part of a two-part article. Part II will appear in the Winter 2013 issue of SCAN'S PULSE.*

The cardiovascular benefits associated with the consumption of vegetables and fruit have been attributed to their constituents, including vitamins, minerals, fiber, and plant secondary metabolites such as phenols, polyphenols, and tannins.<sup>1</sup> There is a consensus that the large amounts of vegetables and fruits in certain healthful diet patterns (e.g., Mediterranean-type diet<sup>2</sup>) explain their cardioprotective effects. Indeed, prospective epidemiologic studies have identified green leafy vegetables as especially associated with protection against coronary heart disease and ischemic stroke.<sup>3</sup> The Dietary Approaches to Stop Hypertension (DASH) studies found that diets rich in vegetables (i.e., 8-10 servings) and low-fat dairy products lower blood pressure to a similar extent as that achieved with single hypotensive medications.<sup>4</sup> It has been

proposed that the blood pressure lowering effect of this diet is most directly attributable to the inorganic nitrate content.<sup>5</sup>

Even though the cardiovascular benefits associated with vegetable and fruit consumption have been attributed to various constituents,<sup>1</sup> the potential role of the inorganic nitrates found in these foods has received relatively little attention. It has been demonstrated that inorganic nitrate (NO<sub>3</sub>) in certain vegetables and fruit can provide a physiologic substrate for reduction to nitrite (NO<sub>2</sub>), and subsequently to metabolites, including nitric oxide (NO), nitrosothiols, and nitrated fatty acids or nitroalkenes (collectively termed NO<sub>x</sub>).

This review provides a physiologic context for the potential cardiovascular benefits of dietary nitrite and nitrate from plant foods, supporting a growing consensus for a comprehensive reevaluation of the health benefits and risks associated with dietary nitrates and nitrites.

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## Dietary Sources of NO<sub>x</sub>

Nitrate is available to plants via the action of lightning and nitrogen-fixing bacteria in the soil. Lightning oxidizes atmospheric nitrogen and combines with water to form nitrous acid, which is deposited into the soil by rainfall and then converted to nitrate by bacteria. Nitrate is a required nutrient for plants and an approved food additive.<sup>6</sup> Vegetables are the principal source of nitrate in the American diet (providing ~80% of the total), with smaller amounts provided by surface and ground water.

Nitrate intake from vegetables is determined by the type of vegetable consumed, the levels of nitrate in the vegetables (partly determined by the nitrate content of fertilizer and water supply), and the amount of vegetables consumed.<sup>7</sup> Sources of nitrites include vegetables, fruit, and processed meats. The array of metabolites derived from the metabolism of nitrate, nitrite, and NO are termed NO<sub>x</sub> (including nitric oxide [NO], nitrosothiols, and nitroalkenes).

## Physiologic Resilience: Redundant Systems of NO<sub>x</sub> Production in Vasculature and Tissues

Normal functioning of human vasculature requires the presence of nitrite and nitric oxide as well as the enzymatic machinery to generate these important signaling molecules and the ability to respond to them.<sup>8</sup> Indeed, oxidative stress and reduced NO bioavailability, including decreased ability of the vasculature to respond to the vasodilatory effects of NO, are critically linked to development of hypertension and other cardiovascular diseases. Mechanistically, the physiologic target for the metabolites of dietary nitrate is mitochondria, where nitrite exerts cytoprotective actions via post-translational modification of complex I of the electron transport chain, leading to decreased mitochondrial reactive oxygen species generation after insults such as ischemia/reperfusion injury.<sup>9</sup>

Depending on physiologic conditions, generation of up to about 70% of systemic NO may be accomplished by endothelial nitric oxide synthase (eNOS), one of three members of the NOS family of enzymes, in the vascular endothelium.<sup>10</sup> These enzymes synthesize NO from the amino acid L-arginine and molecular oxygen to help regulate vasodilation, blood pressure, inflammatory cell recruitment, and platelet aggregation.<sup>11</sup> As a result, the normal production of NO and nitrite and the ability of the endothelium to respond to these species may prevent various types of cardiovascular disease, including hypertension, atherosclerosis, and stroke.<sup>12</sup>

In the vascular wall, NO binds to and activates guanylyl cyclase. This enzyme catalyzes the dephosphorylation of GTP to cyclic GMP, which serves as a second messenger for important cellular functions, including smooth muscle relaxation associated with vasodilation.<sup>13</sup> Two other members of the NOS family have neuronal functions (nNOS) and inflammatory immune functions (inducible NOS or iNOS).<sup>8</sup> The function of iNOS is to generate essential signaling molecules in the innate immune response. In tissues experiencing chronic inflammation (e.g., inflamed bowel tissue in ulcerative colitis), iNOS can generate high concentrations of NO that can promote carcinogenesis by inhibiting apoptosis, enhancing prostaglandin formation, and promoting angiogenesis in the early stage of carcinogenesis.<sup>14</sup> In atherosclerosis, hypoxic conditions combined with an oxidative environment can limit eNOS-derived NO production, whereas nitrite can directly induce vasodilation in hypoxic endothelium.<sup>8</sup> Remarkably, a low concentration of sodium nitrite in drinking water (50 mg/L) can substitute for loss of eNOS-derived NO in eNOS deficient mice.<sup>15</sup>

Unlike the provision of eNOS-derived NO from arginine in the endothelium, nitric oxide production from nitrite occurs primarily in somatic tissues.<sup>11</sup> There are two systems of re-

# From The Editor

## No “Beeting” Around the Bush

by Mark Kern, PhD, RD, CSSD, Editor-in-Chief

I'm not going to beat around the bush to describe this issue of *PULSE*. Nope, I'm just going to come out and say it ... it's flat out good. As always, we have four terrific feature articles and our ever-informative book reviews, highlights from the recent American College of Sports Medicine conference, notable accomplishments of our members, the research digest from our Sports Dietetics-USA subunit, as well as plenty of other SCAN news.

To kick things off in this issue, on the cover you'll find Part I of an excellent article written by Norman Hord, PhD, MPH, RD. Many of you are probably familiar with some of the recent research on nitrates and beets as a key nitrate source. This article highlights the nutritive properties of nitrates and nitrites and their regulation in our food supply. Part II will appear in our upcoming Winter issue. Continuing with that theme, our free CPE article by Steven Hertzler, PhD, RD, discusses the implications of beets on exercise performance and cardiovascular health. You'll also find a superb article on the available evidence on cheese consumption and cardiovascular health contributed by Christopher Cifelli, PhD, and Keigan Park, PhD. Finally, a revolutionary new educational program for dietetic interns, The Emily Program, is described by its creators.

All-in-all, I don't think you can beat this issue as a source of up-to-date information on interesting and important topics. I hope you agree.

ducing nitrate to nitrite in mammals. The first is via the action of commensal gram negative bacteria on the tongue acting on salivary nitrate.<sup>16</sup> The second includes several mammalian enzymes and heme-containing proteins that accomplish nitrate and nitrite reduction.<sup>9,17</sup> Therefore, inorganic nitrate derived either from NO oxidation or dietary sources can serve as a storage form of nitrate that can be reduced back to nitrite and NO when physiologically required or in pathologic conditions.<sup>12</sup>

Nitrate is concentrated in saliva from plasma in the saliva as part of enterosalivary circulation of dietary nitrate.<sup>18</sup> Approximately 25% of nitrate in circulation is concentrated in the saliva, where some 20% of nitrate delivered to the tongue is reduced to nitrite by commensal bacteria. These anaerobic bacteria (e.g., sp. *Vionella*) on the tongue's dorsal surface use nitrate as an alternative electron acceptor to produce energy. Indeed, use of an antibacterial mouthwash after consumption of nitrate (10 mg/kg in water) attenuates the expected postprandial rise in plasma nitrite.<sup>19</sup> The nitrite supplied to the gastrointestinal tract (whether preformed in the

diet or converted from nitrates by tongue bacteria) enhances gastric mucin production and can serve as a substrate for generation of NO<sub>x</sub> for antimicrobial actions and supports gastric homeostasis.<sup>20</sup>

### Contribution of Dietary Constituents to NO Production

Endogenous reduction of nitrate to nitrite is the source of NO and NO<sub>x</sub> in tissues and, during hypoxia, in the vasculature.<sup>12,17</sup> As such, dietary nitrates and nitrites, via successive reduction by mammalian nitrate and nitrite reductases, serve as the source for more than 50% of NO produced in the human body, resulting in about 1 mmol NO per day in those consuming Western-type diets.<sup>21</sup> Dietary protein intakes of about 90 g/day (contributing ~14.5 g nitrogen) provides arginine, which serves as an organic substrate for NOS enzymes that produce about another 1 mmol NO/day.<sup>5</sup> It has been estimated that one serving of a high-nitrate vegetable (e.g., spinach) results in more NO production from the reduction of nitrate to nitrite and nitrite to NO than what is endogenously formed

by the all three NOS isoforms combined during a day.<sup>11</sup> Dietary compounds such as vitamin C and polyphenols can enhance the formation of NO from nitrite and prolong the half-life of NO in the stomach, respectively.<sup>22</sup>

### Biologic Actions of NO<sub>x</sub>

The metabolic disposition of plasma and tissue nitrates is dependent on local conditions, including tissue oxygenation, inflammatory state, and, in the skin, exposure to ultraviolet (UV) light.<sup>23</sup> The physiologic reduction of dietary nitrates to nitrite and subsequently to NO can lead, in a tissue-specific fashion, to the post-translational modification of proteins by nitration and S-nitrosylation (e.g., nitrosothiols) and nitration of fatty acids.<sup>11</sup> Dietary nitrate increases plasma and tissue levels of S-nitrosothiols and nitrosylation products; these bioactive compounds act as donors of the nitrosonium ion NO<sup>+</sup> and NO, which along with NO production from nitrite reduction, may mediate the vasodilatory and cytoprotective effects.<sup>24</sup>

## Liberation of NO<sub>x</sub> from Nitrate in Skin by UV Light

Dietary nitrate and nitrite as well as all three NOS isoforms contribute to a high concentration of NO<sub>x</sub> compounds in the skin.<sup>25</sup> Nitrite, nitrate, and S-nitrosothiols in the skin, so-called “dermal stores” of NO<sub>x</sub> nitrate concentrations in skin, are about 1- to 2-fold higher than plasma, whereas nitrite is approximately 10-fold higher than nitrite in blood.<sup>26</sup> Exposure of skin to whole body UVA irradiation (20 J/cm<sup>2</sup>) causes photodecomposition of nitrite and S-nitrosothiols in skin, leading to NO production. Whole body UVA exposure has been shown to cause a rapid, significant decrease (11% after 30 min of exposure) in systolic and diastolic blood pressure in healthy volunteers, which can last up to 60 minutes after UVA exposure.<sup>23</sup> Thus, sun exposure not only serves an important role in the activation of vitamin D3 but also in the production of NO<sub>x</sub> sufficient to transiently lower blood pressure.

Metabolism and regulation of NO and nitrite at the cellular and tissue levels is dependent on oxygen tension, cellular redox status, redox active metal, and thiol availability.<sup>27</sup> The production of these NO<sub>x</sub> species is associated with vasodilation, decreased blood pressure, and cytoprotective functions.<sup>28,29</sup> Despite the demonstrated vasodilatory and cytoprotective roles for nitrate and nitrite in the vasculature, consideration of the health consequences of foods as sources of nitrates and nitrites has received little attention. This lack of attention is likely due to the perceived negative health effects from drinking water containing nitrate and the use of nitrate and nitrite in processed meats.<sup>28</sup>

## Regulatory Limits on Nitrate in Drinking Water

There are no intake recommendations for dietary nitrates and nitrites except for regulatory limits in water and processed meats. The permissible concentration of nitrate in drink-

ing water is 50 mg nitrate/L in the European Union and 44 mg/L in the United States in accordance with World Health Organization (WHO) recommendations established in 1970 and reaffirmed in 2004. The wisdom of these regulations is challenged by growing evidence that ascribes essential functions of these dietary constituents to vascular and tissue homeostasis and immune function. Several accidental toxic ex-

“Consideration of the health consequences of foods as sources of nitrates and nitrites has received little attention.”

posures of nitrates and nitrites have been described,<sup>30</sup> yet the health risks of excessive nitrate and nitrite consumption such as methemoglobinemia appear only in specific population subgroups. The excessive concentration of nitrate in drinking water must be considered a serious health concern, particularly for infants.<sup>31</sup>

It is noteworthy that the few human nitrate and nitrite exposure studies, involving children and adults, have not produced methemoglobinemia. Infants exposed to 175 to 700 mg nitrate per day did not experience methemoglobin levels above 7.5%, suggesting that nitrate alone is not causative for methemoglobinemia.<sup>32</sup> A more recent randomized, three-way crossover study exposed healthy volunteer adults to single doses of

sodium nitrite ranging from 150 to 190 mg per volunteer to 290 to 380 mg per volunteer.<sup>33</sup> Observed methemoglobin concentrations were 12.2% and 4.5% for volunteers receiving the higher dose and the lower dose of nitrite ion, respectively. Recent nitrite infusion studies of up to 110 µg/kg/minute for 5 minutes induced methemoglobin concentrations of only 3.2%.<sup>34</sup>

These data have led scientists to propose alternative explanations for the observed methemoglobinemia in infants, including gastroenteritis and associated iNOS-mediated production of NO induced by bacteria-contaminated water.<sup>35</sup> The studies call into question the mechanistic basis for exposure regulations for nitrate and nitrite. At best, these findings highlight a serious but context-specific risk associated with nitrite overexposure in infants. Thus, although it is biologically plausible that methemoglobinemia is the result of dietary nitrite toxicity, current evidence suggests that enteric bacterial infection is the most likely culprit.<sup>30,31</sup>

## Environmental Concerns: Eutrophication

The growing appreciation of the many mechanisms by which nitrates and nitrite may benefit health must be balanced with environmental concerns. Environmental contamination with excess nitrate from fertilizer use is a growing problem. Nitrate and nitrite are naturally occurring ions that serve as nutrients for plants via fixation by soil bacteria. Enhancement of nitrogen fixation via nitrate-containing fertilizers has surpassed the amount that occurs naturally.<sup>36</sup> The resulting contamination of ground and surface water is a global concern. This type of pollution—eutrophication—is characterized by excessive development of certain types of algae in aquatic ecosystems and becomes a health risk for animals and humans. The possible cardiovascular health benefits that could be provided by drinking water “contaminated” with nitrates needs to be considered in any risk-benefit discussion.

## Dietary Nitrate and Nitrite Intakes: Estimates and Regulatory Limits

Human exposure to nitrates is subject to regulatory limits. The U.S. Environmental Protection Agency limits human exposure to inorganic nitrates to 0.10 mg/L (or 10 ppm nitrate nitrogen) and nitrites to 1 ppm nitrite nitrogen. The Joint Food and Agricultural Organization/WHO has set the Acceptable Daily Intake (ADI) for the nitrate ion at 3.7 mg/kg body weight and for the nitrite ion at 0.06 mg/kg body weight,<sup>6</sup> translating into about 222 and 3.6 mg/day, respectively, for a 60-kg person. These recommendations are higher than current intake estimates for nitrate and nitrite from food in the United States and Europe, which vary from about 40 to 100 mg/day and 31 to 185 mg/day for nitrate, respectively, and 0 to 20 mg/day, for nitrite.<sup>5</sup> Nitrate intakes from sources other than vegetables, including drinking water and cured meats, has been estimated to average 35 to 44 mg/person per day for a 60-kg individual.<sup>6</sup> On the basis of a conservative recommendation to consume 400 g of different fruits and vegetables daily at median nitrate concentrations, the dietary provision of nitrate would be about 157 mg/day.<sup>6</sup>

Vegetable and fruit consumption for one day was modeled using the DASH pattern to illustrate potential nitrate and nitrite exposure from food choices emphasizing high and low nitrate vegetable and fruit choices.<sup>5</sup> These estimates showed that nitrate intake when choosing high-nitrate vegetables and fruits could result in about 1.2 g nitrate and exceed the WHO intake limit by 550%. These data demonstrate that a dietary pattern widely recommended by federal agencies appears to be not only safe but also associated with blood pressure lowering in adults.<sup>5</sup> The authors conclude by ascribing at least a portion of the blood pressure lowering effect of the DASH diet to the nitrate and nitrite content of foods.

## Potential Negative Health Effects

Epidemiologic and clinical studies have reported that excessive nitrate and nitrite consumption in cured and processed meats is associated with increased risk of gastrointestinal cancers, thyroid dysfunction, and thyroid cancer,<sup>37</sup> chronic obstructive pulmonary disease in women,<sup>38</sup> and other conditions.<sup>39,40</sup> A recent meta-analysis challenged this association

“Sun exposure not only serves an important role in the activation of vitamin D3 but also in the production of NO<sub>x</sub> sufficient to transiently lower blood pressure.”

by concluding that available epidemiologic evidence is not sufficient to support a clear and unequivocal independent positive association between processed meat consumption and colorectal cancer risk.<sup>41</sup>

Nitrates added to meats serve as antioxidants, help develop flavor, and stabilize the red color, but they must be converted to nitrite to exert these actions. Sodium nitrite is used as a colorant, flavor enhancer, and antimicrobial agent in cured and processed meats. Nitrate and nitrite use in meat products, including bacon, bologna, corned beef, hot dogs, luncheon meats, sausages, and canned and cured meat and hams, is subject to limits set by Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA) regulations. The use of nitrites in bacon must be accompanied by the either sodium erythorbate or sodium ascorbate (vitamin C), antioxidants that inhibit the nitrosation effect of nitrites on secondary amines.<sup>42</sup> Clearly, more research is needed to address the potential interactions among food

constituents to affect cancer risk. (**Editor's note:** Part II will resume with a discussion of the potential positive health effects of dietary nitrate and nitrite consumption.)

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# Nitrate Supplementation for Cardiovascular Health and Exercise Performance

by Steve Hertzler, PhD, RD

*This article is approved by the Academy of Nutrition and Dietetics, an accredited Provider with the Commission on Dietetic Registration (CDR), for 1 continuing professional education unit (CPEU), level 1. The PULSE CPEU process is now automated! To apply for free CPE credit, take the quiz on SCAN's Web site ([www.scandpg.org/nutrition-info/pulse-newsletters/](http://www.scandpg.org/nutrition-info/pulse-newsletters/)). Upon successful completion of the quiz, a Certificate of Completion will appear in your My Profile (under the heading, My History). The certificate may be downloaded or printed for your records. You may also obtain the quiz by requesting it from the SCAN Office via phone: 800/249-2875, fax: 440/526-9422, or email: [scandpg@gmail.com](mailto:scandpg@gmail.com). However, we hope you will enjoy the convenience of the online quizzes.*

## Learning Objectives

After you have read this article, you will be able to:

- Discuss the effects of nitric oxide on cellular metabolism.
- Summarize the evidence on the impact of nitrate supplementation on performance.
- Provide recommendations to athletes regarding nitrate supplementation.

When most dietitians hear the word nitrate, they probably think “enemy.” The term may conjure up fears of cyanotic infants or maybe carcinogenic nitrosamines that could arise from eating diets high in processed meats containing nitrates or nitrites as preservatives. However, there is a rapidly expanding body of scientific literature on the potential benefits of nitrate consumption on cardiovascular health and sports performance. Further, much of the evidence sug-

gesting that nitrates are potentially harmful is being seriously questioned. This article addresses the confusion regarding dietary nitrates and discusses research linking nitrates to cardiovascular health and sport performance.

## Nitrate Metabolism and the Link to Nitric Oxide

Nitric oxide (NO) has long been recognized as a potent vasodilator, but it now appears to have several other important effects on cellular metabolism. A key site of NO production is the endothelial cells that line the interior surface of blood vessels. There, the enzyme nitric oxide synthase uses the amino acid arginine to produce NO in an oxygen-dependent reaction.<sup>1</sup> Under conditions of normal oxygen tension in the blood, the nitric oxide synthase reaction (often called the endogenous NO pathway) is the major source of NO production. Previously, circulating levels of nitrate (NO<sub>3</sub>) and nitrite (NO<sub>2</sub>) were thought to simply represent inert waste products resulting from the oxidation of NO. However, it is now known that nitrate and nitrite are not only NO metabolites, but they also contribute to its formation via an alternative “exogenous” pathway that is oxygen-independent.<sup>1,2</sup>

Some of the richest dietary sources of nitrate are dark leafy green vegetables and beets (see Table). When ingested, nitrate is rapidly absorbed from the gastrointestinal tract to enter the bloodstream. While the vast majority (75%) of absorbed nitrate is excreted in the urine, the

blood carries a portion of the nitrate to the salivary glands, which store and concentrate nitrate before releasing it into the oral cavity.<sup>1,2</sup> Anaerobic bacteria in the mouth convert nitrate to nitrite,<sup>2</sup> which is then swallowed. Absorbed nitrite can be reduced to NO by various compounds in blood and muscle, such as deoxyhemoglobin and deoxymyoglobin,<sup>2</sup> and is active at low oxygen tension in the blood. The NO produced can then contribute to vasodilation and exert other metabolic effects.

## Nitrate and Cardiovascular Health

In theory, food-based sources of nitrate boost NO in the bloodstream, resulting in vasodilation and lower blood pressure. Naturally occurring sources of nitrate (e.g., juice made from the root portion of the beet plant) have been studied in regard to effects on blood pressure and other cardiovascular parameters.

In one randomized crossover study, 14 young, normotensive subjects were fed a single dose of 500 mL

**Table. Nitrate content of selected foods<sup>30</sup>**

Source	Nitrate (mg/kg)
Rucola (rocket) or Arugula	4677
Rhubarb	2943
Butterhead lettuce	2026
Red beetroot	1379
Celery	1103
Spinach	1066
Iceberg lettuce	875
Turnip	663
Carrots	296
Broccoli	279
Potatoes	168

beetroot juice (~325 mg nitrate ion) or an equivalent volume of water 3 hours before measurement of various cardiovascular endpoints including blood pressure, flow mediated dilatation in the brachial artery, and platelet aggregation.<sup>2</sup> To further evaluate the cardiovascular impact of oral bacterial conversion of nitrate to nitrite, the study included an additional treatment arm in which subjects either swallowed or spit out all saliva in the 3 hours post-treatment ingestion period. Compared with control, nitrate supplementation significantly elevated both plasma nitrate and nitrite concentrations for at least 6 hours after ingestion. The spitting out of saliva did not affect plasma nitrate but did reduce plasma nitrite, demonstrating the importance of oral bacteria in this conversion. At 2.5 to 3 hours post-nitrate ingestion, peak reductions of 10.4 and 8.1 mm Hg ( $P < .01$  for both) occurred in systolic and diastolic blood pressure, respectively. Even at 24 hours post-ingestion, systolic blood pressure was 4 mm Hg lower for nitrate versus control, although the difference was no longer statistically significant. Nitrate supplementation also significantly improved flow-mediated dilatation in the brachial artery (e.g., increase in brachial artery diameter after temporary occlusion of blood flow) and in vitro measurements of platelet aggregation.

As indicated in this study, the “spitting” condition greatly reduced the bacterial conversion of nitrate to nitrite, which diluted the effects of beetroot juice ingestion on blood pressure. Thus, it appears that oral bacteria play a critical role in the metabolism of nitrates and potential subsequent cardiovascular benefits. Related to this, it should be noted that antibacterial mouthwashes virtually eliminate bacterial conversion of nitrate to nitrite.<sup>3</sup>

In another recent study, doses of 0 g, 100 g, 250 g, and 500 g beetroot juice were fed to 18 normotensive volunteers, and blood pressure was monitored for 24 hours post-dosing via continuous ambulatory blood pres-

sure monitoring (all doses were adjusted to 500 g with low nitrate water).<sup>4</sup> These doses contained <31, 143, 353, and 707 mg nitrate ion, respectively. The 500 g dose significantly reduced the 24-hour area under the curve (AUC) for systolic ( $P < .01$ ) and diastolic ( $P < .001$ ) blood pressure. The 100 g and 250 g doses also significantly lowered the 24-hour diastolic blood pressure AUC, but not quite as much as the 500 g dose. The authors also performed a separate study in 14 normotensive volunteers with bread enriched with 100 g of either red or white beetroot. The ni-

trate ion concentrations of the breads were <31, 99, and 112 mg for the control bread, white beetroot, and red beetroot breads, respectively. Both beetroot breads caused similar but nonsignificant reductions in 24-hour AUC for systolic blood pressure. Similarly, both breads also tended to decrease 24-hour AUC for diastolic blood pressure, but only the reduction from the red beetroot bread was significant ( $P < .05$ ). The authors concluded that it was the nitrate content and not the red pigmentation (i.e., betalain content) that was mainly responsible for blood pressure lowering effects.

### Nitrate Supplementation and Performance Benefits

Since 2007, two major research groups have published several papers demonstrating that nitrate supplementation, using either sodium nitrate (Karolinska Institute group) or beetroot juice (Exeter University group), can lower the oxygen cost of physical activity. Nitrate ingestion may lower oxygen cost by increasing metabolic efficiency, which reduces energy wastage and lowers the demand on the cardiorespiratory sys-

tem to sustain a given level of physical activity. This is potentially significant for athletes because delivery of adequate oxygen to exercising muscle tissue represents a key limiting factor in exercise performance.

In a randomized, double-blind, placebo-controlled crossover study, investigators supplemented 9 healthy, young, well-trained men with either 0.1 mmol/kg/day sodium nitrate or a similar dose of sodium chloride for 3 days prior to exercise testing on a cycle ergometer at varying work rates from 45% to

“Nitrate supplementation, using either sodium nitrate... or beetroot juice..., can lower the oxygen cost of physical activity.”

$VO_2$ max.<sup>5</sup> This dose would correspond to 434 mg nitrate/day for a 70-kg subject. Nitrate supplementation significantly increased both resting plasma nitrate and nitrite levels ( $P < .01$ ). At work outputs corresponding to 45%, 60%, 70%, and 80% of  $VO_2$ max, the oxygen consumption ( $VO_2$ ) was reduced on average by 0.16 L/minute in the nitrate-supplemented subjects ( $P < .02$  for main effect) versus control. Gross efficiency increased from 19.7% during control to 21.1% during nitrate supplementation over the four lowest work rates ( $P < .01$ ). Nitrate supplementation also decreased resting systolic blood pressure by about 8 mm Hg ( $P < .01$ ) and resting diastolic blood pressure by about 6 mm Hg versus control ( $P < .01$ ). There were no treatment-related differences in heart rate, serum lactate, or hemoglobin concentrations. No improvement occurred at the highest work rates (85% and max), when the subjects were in a more anaerobic state.

In a similar study of 8 healthy men that employed beetroot juice (500 mL/day for 6 days before exercise) as the source of nitrate (341 mg nitrate ion/day), beetroot juice supplementen-

tation versus control significantly reduced the amplitudes of fractional oxygen extraction (13%,  $P < .05$ ) and pulmonary  $\text{VO}_2$  (19%,  $P < .01$ ) during moderate intensity cycling exercise.<sup>6</sup> Systolic blood pressure was lowered by about 8 mm Hg in the beetroot compared with control treatment, and beetroot juice supplementation prolonged time to exhaustion in a cycling test by 16% versus placebo. In this study, the control beverage was a blackcurrant cordial with negligible nitrate content. In later studies, this research group improved the control beverage by developing a “de-nitrated” beetroot juice to further reduce placebo bias.<sup>7,8</sup>

Several other studies, including one from the Netherlands, have shown similar effects of either sodium nitrate or beetroot juice supplementation in improving overall efficiency of oxygen usage during mainly submaximal exercise at comparable nitrate doses.<sup>7-13</sup> These studies typically involved short duration of nitrate supplementation, primarily male cyclists, and fewer than 15 subjects. No studies have been conducted to determine whether nitrate supplementation has a dose-response effect on oxygen consumption or exercise performance.

Investigators have reported that a single dose of nitrate (384 mg nitrate) given as beetroot juice to male cyclists nearly 3 hours before either a 4-km or 16.1 km cycling time trial significantly improved times by 2.8 ( $P < .05$ ) and 2.7% ( $P < .01$ ), respectively.<sup>7</sup> Similarly, supplementing male cyclists with 140 mL/day of concentrated beetroot juice (496 mg nitrate) for 6 days shaved 12 seconds off a 10-km time trial ( $P < .005$ ) compared with placebo and increased power output.<sup>9</sup>

Given the positive performance effects of beetroot juice feeding observed in short-distance time trials,<sup>7</sup> researchers sought to replicate these results in a longer time trial with better-trained cyclists. The study involved 8 well-trained cyclists who cycled at least 1 hour for a minimum

of 4 days per week and had competed in at least one organized cycle race during the preceding 12 months.<sup>14</sup> Subjects completed two 50-mile cycling time trials on separate occasions. In one trial, they were fed 0.5 L beetroot juice 2.5 hours before the time trial; in the other, they received an equivalent amount of de-nitrated beetroot juice 2.5 hours before the time trial. The beetroot juice supplement significantly improved the power output/ $\text{VO}_2$  ratio versus placebo ( $67.4 \pm 5.5$  vs.  $65.2 \pm 4.8$  W L  $\text{min}^{-1}$ ,  $P < .05$ ). However, the 0.8% improved completion time with the beetroot juice versus placebo was not statistically significant ( $P > .05$ ). It is unclear whether the failure of beetroot juice to improve performance was due to the higher training status of the subjects, the greater length of the time trial ( $> 2$  h), or some other factor. However, there was a significant inverse correlation ( $r = -0.83$ ) between post-beverage plasma nitrite concentration and completion time.

One study not involving cycling was of runners who consumed 200 g baked beetroot (at least 500 mg nitrate) or cranberry relish placebo 45 minutes before a 5-km running time trial.<sup>15</sup> Average running velocity was not significantly faster for beetroot supplementation (12.3 km/h) versus placebo (11.9 km/h) ( $P = .06$ ). However, running velocity during the last 1.8 km of the trial was 5% faster ( $P = .016$ ) for beetroot compared with placebo. Similarly, 6 days of beetroot juice supplementation (500-mL/d) improved 500-m rowing performance versus placebo in well-trained rowers.<sup>16</sup>

At present, it is unclear whether supplementation with arginine, a precursor in the synthesis of NO, or nitrate has the potential to improve athletic performance. One study reported that arginine supplementation, like nitrate, can reduce the oxygen cost of moderate-intensity exercise and improve tolerance to high-intensity exercise.<sup>17</sup> Arginine-based “NO boosters” have been widely marketed to strength and physique athletes for pre-workout use, promising benefits

such as increased muscle blood flow and pump, as well as elevated strength and muscle mass gains. Numerous recent studies, however, have disputed the efficacy of arginine supplementation for these purposes.<sup>18-22</sup> It is likely that bodybuilders may resort to nitrate supplementation as an alternative to arginine, but there are no studies on the efficacy of nitrate supplementation for these types of outcomes in this population.

## Nitrate Supplementation and Impaired Tissue Oxygen Availability

Improved oxygen economy could be of particular benefit to those with cardiovascular disease and reduced exercise tolerance. In patients with peripheral artery disease, a single feeding of 500 mL beetroot juice (564 mg nitrate) significantly increased walking time to onset of claudication pain by 18% ( $P < .01$ ) and time to exhaustion by 17% ( $P < .05$ ) versus placebo.<sup>23</sup>

Those who exercise at altitude (reduced oxygen tension) may also be aided by nitrate supplementation. In one study, beetroot juice supplementation (750 mL beetroot juice, or 577 mg nitrate) in subjects exposed to 14% oxygen in their inhaled air resulted in exercise performance (knee extensions) that was comparable to that observed under normal oxygen concentration (~20%), but without nitrate supplementation.<sup>24</sup> Such findings may have relevance for the military and other populations exposed to some degree of environmental hypoxia.

## Proposed Mechanisms

While NO-induced vasodilation represents one potential mechanism of action for nitrate, additional metabolic effects could potentially explain its cardiovascular effects. Mitochondria from nitrate- or placebo-supplemented individuals obtained via muscle biopsies were examined in a respiratory chamber, revealing that nitrate-supplemented muscle exhibited more efficient coupling of

mitochondrial respiration and adenosine triphosphate (ATP) synthesis (e.g., more ATP production per unit of oxygen consumed).<sup>25</sup> The expression of one mitochondrial protein, the adenosine nucleotide translocator (ANT), was significantly reduced by nitrate supplementation ( $P=.009$ ). The ANT site is a commonly identified location for proton leakage through the mitochondrial membrane. Proton leakage would reduce the ATP production per unit of oxygen consumed, so reducing proton leakage via nitrate supplementation may be one explanation for the exercise benefits observed.

The authors also measured the expression of uncoupling protein 3 (UCP-3), another potential site of proton leakage. The change was non-significant ( $P=.17$ ). However, 6 of the 8 samples measured showed a decrease in UCP-3 expression from nitrate supplementation, while one showed no change and one had a large (2-fold) increase. It is possible that this outlier inordinately influenced the data. A reduced level of UCP-3 expression by nitrate supplementation would have also indicated more efficient coupling of oxidation and phosphorylation (i.e., ATP synthesis).<sup>25</sup>

Beetroot juice supplementation was reported to reduce ATP turnover during both low- and high-intensity knee extension exercise by 35% and 28%, respectively.<sup>10</sup> That same study also found that phosphocreatine depletion during high-intensity exercise was decreased 59% by beetroot juice supplementation. These findings suggest that nitrate, via conversion to NO, may lower the actual ATP cost of muscle force production, thus increasing an athlete's metabolic efficiency and requiring fewer resources for the same amount of work. In support of this, Hernández and colleagues<sup>26</sup> recently reported that nitrate supplementation in mice for 7 days increased myoplasmic free calcium ion concentration and contractile force in fast twitch muscle.

## Safety of Nitrate Supplementation

Historically, dietary nitrates have been viewed primarily as detrimental to health, mainly due to the potential relationships of dietary nitrate to methemoglobinemia and increased risk of gastrointestinal cancers. In the case of methemoglobinemia, the concern is that conversion of nitrate to nitrite leads to the subsequent nitrite-induced oxidation of the ferrous form of iron in hemoglobin to the ferric form, thus impairing the ability of hemoglobin to bind oxygen. Some cases of cyanosis ("blue baby syndrome") due to methemoglobinemia were reported in the 1940s in infants consuming formula made from well water with a high concentration of nitrate.

Several recent reviews of these cases have determined that nitrate exposure alone<sup>27-29</sup> does not cause methemoglobinemia but, rather, must be accompanied by bacterial contamination of water or infection that dramatically increases the conversion of nitrate to nitrite. It is conceivable that an athlete experimenting with sodium nitrate supplementation could inadvertently consume sodium nitrite instead, which would increase risk of methemoglobinemia. However, there is minimal risk when naturally-occurring sources of nitrate in food are used.

The potential concern regarding increased risk of gastrointestinal cancer centers on the reaction of nitrite in the stomach with secondary amines to form carcinogenic nitrosamines. However, numerous scientific expert panels have reviewed both the epidemiologic data on nitrate intake and cancer incidence as well as the laboratory evidence on nitrosamine formation, concluding that there is no convincing evidence of an association of nitrate intake with gastrointestinal or other cancers.<sup>30,31</sup> Given that diets high in fruits and vegetables, which also tend to be high in nitrate, generally decrease rather than increase cancer risk, there seems to be little cause for concern for athletes

supplementing with high-nitrate foods such as beetroot juice and leafy green vegetables.

## Summary and Recommendations

Short-term supplementation of 300 mg to 500 mg nitrate per day (0.5 L beetroot juice) reduces the oxygen cost of physical activity and has been shown to enhance endurance performance (cycling and running) in some studies. There are currently no data to indicate additional performance benefits with doses above 300 to 600 mg nitrate per day. The duration of supplementation before exercise ranges from a single dose about 3 hours before exercise to daily doses given for up to 15 days prior to exercise.

Supplementation with natural forms of nitrate, such as beetroot juice or green leafy vegetables, is safe for most athletes and avoids potential problems associated with athletes accidentally ingesting nitrite salts when nitrate salts were the intended supplement. Athletes taking nitrate-containing medications should be aware of potential additive cardiovascular effects (e.g., hypotension) that might occur with additional food-based nitrate supplementation. Finally, athletes with active gastroenteritis should avoid nitrate supplementation due to potentially excessive bacterial conversion of nitrate to nitrite and greater risk for methemoglobinemia.

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# Cheese and Cardiometabolic Health: New Findings for a New Canvas

by Christopher J. Cifelli, PhD, and Keigan M. Park, PhD

Cardiovascular disease (CVD) is a foremost public health concern in the United States, resulting in more than 2,200 deaths each day.<sup>1</sup> The total fiscal costs associated with CVD in the U.S. were estimated to be \$286 billion in 2007.<sup>1</sup> It is hypothesized that the health and economic burden imparted by CVD will continue to rise because of the growing obesity epidemic, which is not only increasing the number of overweight older adults but also is beginning to seriously affect children, adolescents, and young adults. Therefore, it is important to identify and implement achievable behavioral and lifestyle modifications that can ultimately reduce the incidence of CVD.

Nutrition research and the dietary recommendations from key health professional and government organizations have tended to take a reductionist approach to preventing and mitigating CVD. The *2010 Dietary Guidelines for Americans*,<sup>2</sup> the American Heart Association,<sup>3</sup> and the American Dietetic Association (now the Academy of Nutrition and Dietetics) and the Dietitians of Canada<sup>4</sup> all recommend reducing saturated and *trans* fat intake, albeit to different degrees, to improve cardiometabolic health. Similar recommendations have been made for sodium, namely to reduce dietary sodium intake across the lifespan to reduce the risk of developing hypertension.<sup>2,3</sup>

Because we consume foods and not nutrients, broad recommendations to reduce sodium and saturated fat intake can result in unintended consequences. For example, a reductionist approach can lead to confusion and poor dietary choices among consumers, especially when recommendations limit the intake of nutrient-rich foods that also contain appreciable levels of sodium and saturated

fat. The complex etiology of CVD requires adoption of holistic approaches, both at the food and diet level, to reduce CVD risk. Accordingly, this review describes the relationship between cheese consumption and CVD risk, highlighting the important role of cheese in a healthful diet.

## Nutrient Contribution of Cheese

Cheese, a dairy food that is typically (but not always) fermented, is a convenient, well-liked, nutrient-rich food. While several factors influence the nutrient content of cheese (e.g., the type of milk used, the variety of

the calcium, 11% of the phosphorus, 9% of the protein, 9% of the vitamin A, 8% of the zinc, and 3% of the magnesium in their diets.<sup>6</sup> Food research has demonstrated that among middle school children, the ready availability (i.e. visibility) of cheese can encourage and increase the consumption of other food groups (e.g., fruits and whole grains) that may lead to an improvement in overall diet quality.<sup>7</sup>

## The Cheese Matrix

One of the reasons cheese should be incorporated into the diet, despite its high saturated fat content, is the

“The complex etiology of CVD requires adoption of holistic approaches, both at the food and diet level, to reduce CVD risk.”

cheese produced, and the length of aging), cheeses contribute important nutrients to the American diet. In addition, the aging or ripening of various cheeses can beneficially influence the nutritional value of cheese through the synthesis of several B vitamins via the cheese microflora, such as vitamin B<sub>12</sub>, folic acid, biotin, and riboflavin.<sup>5</sup> In particular, because most of the lactose found in milk is lost during the separation of the milk curds from whey, cheese can be a source of important nutrients for people with lactose malabsorption.

Data from the 2003-2004 and 2005-2006 National Health and Nutrition Examination Survey (NHANES) showed that while cheese contributed 5% of the calories, 8% of the sodium, and 16% of the saturated fat in the diets of Americans for 2 years or longer, it also contributed 21% of

unique form of fat that it contains. Milk fat is secreted from the mammary gland of cows through a budding process and is therefore surrounded by a phospholipid barrier that contains a multitude of bioactive proteins and signaling moieties.<sup>8</sup> Nearly all of the milk fat is packaged in triacylglycerol molecules and located within the core of the phospholipid layer. The triacylglycerol molecules contain many different types of fatty acids, which vary in their length and degree of saturation as well as their binding site on the glycerol backbone.<sup>9</sup>

Each of these fatty acids may have significant positive or negative effects on public health; however, due to both the number and complexity of the fatty acids found in milk fat, only a few have been studied in sufficient detail. In addition, as already

noted, cheese contains a variety of nutrients that are packed within its unique matrix. Both of these distinctive properties—the fatty acid composition and the variety of nutrients—may result in the fat component of cheese being absorbed differently than the fat in various other foods.<sup>10</sup> Furthermore, there is evidence to suggest that the fat absorbed may affect serum lipids differently than similar fats found in other foods, possibly resulting in a more favorable effect on cardiovascular health.<sup>11</sup> Additional evidence is needed on this topic as it proves to be an important piece in the understanding of cheese and cardiometabolic health.

## Evidence on Cheese and Cardiovascular Health

### *Cheese and Cardiovascular Risk: Results from Prospective Trials*

Prospective epidemiologic evidence has tracked the association between cheese consumption and coronary heart disease (CHD) and stroke. These results have suggested mostly a neutral association between cheese and CHD and stroke, indicating neither a negative nor a positive effect of cheese on cardiovascular health.<sup>12-14</sup> This is intriguing because some studies have reported that total dairy product intake has an inverse to neutral association with CHD and stroke.<sup>15,16</sup> However, the number of studies specifically examining cheese consumption as a primary variable are sparse, perhaps suggesting that as more evidence is collected cheese consumption may be shown to have a similar inverse to neutral association with CHD as that observed with total dairy intake.

It is also unclear from these studies whether different cheeses exert divergent effects. A close monitoring of specific cheeses is needed before conclusions on the heart health effects of cheese can be made.

### *Cheese and Blood Pressure: Results from the DASH Trial*

High blood pressure is a strong determinant of CVD and stroke. Obser-

vational and clinical studies have demonstrated that dairy foods are beneficially related to blood pressure, especially in those with prehypertension or stage 1 hypertension.<sup>17</sup> While few clinical studies have examined the effects of cheese on blood pressure, cheese was consumed regularly in the Dietary Approaches to Stop Hypertension (DASH) trial.<sup>18</sup>

In the DASH trial, subjects with high-normal blood pressure were randomized to one of three diets: a control diet that represented a typical American diet, a diet rich in fruits and vegetables, or a diet rich in fruits and vegetables that also contained low-fat dairy products (i.e., DASH diet).

“There is evidence to suggest that the fat absorbed may affect serum lipids differently than similar fats found in other foods.”

Subjects in the DASH diet were allowed to consume approximately 2 servings/day of low-fat or fat-free milk or yogurt as well as about 1 serving/day of full-fat or reduced fat cheese. A significant reduction in systolic and diastolic blood pressure was observed with the DASH diet compared with the control diet. Furthermore, the reduction in blood pressure observed with the DASH diet was nearly twice as great as the reductions observed in the diet rich in fruits in vegetables only.<sup>18</sup>

Subsequent studies using the DASH dietary pattern have confirmed and extended these findings.<sup>19</sup> These results have led various health professional and government organizations, including federal entities that

developed the *2010 Dietary Guidelines for Americans*,<sup>2</sup> to recognize the DASH diet as an important way to improve heart health. Together, the science around the DASH diet and the recommendations stemming from that science indicate that regular cheese consumption can be incorporated into a diet that promotes cardiovascular health.

### *Cheese and Serum Lipids: Results from Clinical Trials*

The preponderance of clinical studies has compared cheese versus butter in their effects on total cholesterol, low-density lipoprotein (LDL) cholesterol, and high-density lipoprotein (HDL) cholesterol. These studies have indicated that in most but not all cases cheese consumption has less of an impact on serum lipids than butter, with no significant changes from the baseline diet.<sup>19</sup> A likely mechanism of this neutrality is increased fecal fat excretion due to the calcium content of cheese; however, additional mechanisms are likely contributing to the observed outcomes.<sup>10</sup>

It is important to note that these studies fail to examine how cheese affects cardiovascular health compared with other commonly consumed foods, especially foods with similar saturated fat content. These results will be pivotal to understanding the cardiovascular effects of cheese consumption. It should also be noted that in the process of making cheese, additional complexity is obtained through the fermentation process in which bacteria utilize the fat, carbohydrate, and protein components of milk to synthesize several unique end products that may have significant effects on heart health.<sup>20</sup> These end products, as well as the matrix effects previously mentioned, may be beneficial for cardiovascular health by simultaneously decreasing the circulating amounts of small, dense LDL cholesterol particles and increasing the amounts of large, buoyant LDL cholesterol particles.<sup>11</sup>

Future clinical studies that examine

the effects of cheese intake on the entire spectrum of lipid biomarkers associated with CVD will allow for a more complete understanding of the molecular mechanisms by which cheese affects cardiovascular health.

## Conclusion

Cheese is a nutritious food that can be easily incorporated into a healthful eating pattern to improve overall diet quality. As illustrated in this review, there is evidence to indicate that cheese consumption may not be the cardiovascular villain it was once suggested to be. In recognition of these recent findings, the 2010 Dietary Guideline for Americans Advisory Committee stated that the “consumption of milk products may not have predictable effects on serum lipids, weight control and metabolic syndrome,” possibly due to the bioactive components that may be contained in milk fat.<sup>21</sup>

To more fully understand the impact that cheese consumption can have on health, additional research needs to be done on the individual fatty acids that a cheese contains, the cheese’s unique matrix and how that affects nutrient bioactivity, and the ability of cheese to effect novel biomarkers for cardiovascular disease risk. With this knowledge, a clearer picture of the role that cheese plays in a healthful diet can be painted for future generations.

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# Providing a Focus on Eating Disorders: The University of Minnesota – The Emily Program Dietetic Internship Program

by Val Schonberg MS, RD; Carrie Peterson, MS, RD, CSSD; and Doreen Lindblom, RD

How does one become a registered dietitian (RD) specializing in eating disorders (EDs)? According to the Accreditation Council for Education in Nutrition and Dietetics (ACEND), to earn the RD credential, students must complete a minimum of a bachelor's degree and an accredited didactic program, complete required competencies while enrolled in an accredited supervised practice program, and pass a national exam administered by the Commission on Dietetic Registration (CDR). However, while supervised practice programs include clinical, foodservice, and community requirements, they may not incorporate experiences in inpatient or outpatient ED facilities.<sup>1</sup>

Because nearly 15 million people in the United States struggle with anorexia nervosa (AN) or bulimia nervosa (BN), and/or compulsive overeating (COE)/ binge eating disorder (BED),<sup>2,3</sup> it is likely that most individuals know someone struggling with an ED. Often it is for this reason or due to one's personal experience and recovery that an individual might find a passion for working as an RD in the field of EDs. However, the lack of required experience with ED patients during training may not adequately prepare RDs for work with this specialized population, particularly in light of the many challenges presented with this demanding and often fragile clientele. To effectively work with ED patients, RDs find that they need additional skills, specialized training, and an increased awareness about themselves as a provider. Therefore, the opportunity to acquire professional experience with ED patients at the dietetic internship (DI) level may significantly benefit dietetic interns who wish to work with this patient population. Increasing opportunities for dietetic interns at

facilities that treat EDs may also provide great value for treatment centers seeking trained and specialized RDs for hire.

To allow for this specialized training for dietetic interns, the University of Minnesota (U of M) Dietetic Internship for Graduate Students (DIGS) recently transformed into a

“Opportunities for dietetic interns at these facilities may also provide great value for treatment centers seeking trained and specialized RDs for hire.”

collaborative DI with The Emily Program's eating disorders treatment program. The U of M DI, an accredited program established in 1990, offers non-credit, non-degree, supervised practice experiences for individuals with a nutrition/dietetics degree and prepares them to become eligible for the RD board exam. The Emily Program is a Minnesota-based agency that provides comprehensive psychological, nutritional, medical, and psychiatric care for eating disorders. The Emily Program and the U of M DI

recently completed their first year in a partnership program with an emphasis in EDs. This article describes this program and our experience with its first year in operation.

## Why the Partnership?

According to ACEND's guidelines, implemented in 2009, all DIs are required to provide: 1) at least 1,200 hours of supervised practice, 2) a concentration area, and 3) a full-time director. To meet these guidelines, the University of Minnesota's DIGS program needed to be revised, presenting the perfect opportunity for creative thinking that ultimately led to the involvement of The Emily Program, whose headquarters is located about one-quarter mile from the University of Minnesota St. Paul campus and the Department of Food Science and Nutrition. After brainstorming and arriving at some innovative strategies, Jillian Lampert, PhD, MPH, RD, FAED, director of communications, outreach and research, and Carrie Peterson, MS, RD, CSSD, director of the DIGS program, decided to move ahead with creating the University of Minnesota – The Emily Program (U of M-TEP) dietetic internship.

The Academy of Nutrition and Dietetics supports the essential role of RDs in providing nutrition therapy for patients with EDs. However, because EDs are a complex bio-psychosocial disorder, the Academy recommends that RDs collaborate effectively with an interdisciplinary team, including medical and mental health personnel.<sup>4</sup> Patients with EDs are often influenced by other psychological conditions such as depression, anxiety, substance abuse, borderline personality disorder, and obsessive compulsive disorder.<sup>5</sup> Therefore, the roles and responsibilities of the RD

include components of the nutrition care process, while also considering any psychological factors that may affect treatment.<sup>6</sup>

The Academy recommends that entry-level RDs know the essentials that pertain to assessing clients, analyzing anthropometric data, and understanding when to recommend treatment. However, RDs who are most effective in working with patients with EDs also need to have strong counseling skills and, depending on a patient's cognition, need to understand various behavioral strategies, motivational interviewing, and mindfulness-based strategies. Thus, advanced training is recommended for individuals interested in working in this field.<sup>6</sup> By providing specialized experience at the internship level, the U of M TEP DI program provides an excellent opportunity for introducing skills and education that can provide a framework for further advancement.

### **Components of the Internship Program**

The U of M TEP DI accepts 15 interns for a 35-week program extending from August to April. This full-time, competency-based program provides more than 1,300 hours of supervised learning. The clinical, community, and foodservice experiences entail more than 15 rotations at 35 sites under the supervision of highly qualified preceptors. The program provides a variety of supervised experiences, training opportunities, and affiliations involving 9 medical centers, 4 long-term care facilities, 11 foodservice management sites, and 7 community nutrition locations. Additional internship classes enhance the intern's knowledge in other specialty areas such as pediatrics, dysphagia, and sports nutrition. Interns also have an opportunity to research or further explore a nutrition-oriented area of particular interest.

Each intern is scheduled for a 9-week rotation through The Emily Program in various locations in the Twin Cities metropolitan area. During this time,

interns learn to provide recovery-minded support to clients in both outpatient and intensive treatment programs who struggle with any of the DE/ED diagnoses, including AN, BN, COE/BED. After orientation and training are completed, an intern's typical day begins with observation of and participation in therapeutic client meals, goal setting, and ED behavior identification, in either one-to-one appointments or any one of the intensive treatment programs. Each week, rotation sites may vary from the Intensive Day Program to the COE Intensive Outpatient Program (IOP).

**“An important part of the training process has been the use of motivational interviewing and nutrition counseling at an individual and group level.”**

Interns then may spend 2 weeks in an AN/BN IOP, where they have opportunities to lead meals, provide group nutrition education, and assist in group outings. An important part of the training process has been the use of motivational interviewing and nutrition counseling at an individual and group level. To provide support in this area for interns, the program utilizes “Step-by-Step,” a program developed by Molly Kellogg, RD, LCSW, that offers online podcasts for reviewing basic nutrition counseling skills.<sup>7</sup> Interns are also offered opportunities to role play with each other in such areas as nutrition assessment.

Two weeks of the interns' experience

is spent at the Anna Westin House, The Emily Program's 16-bed, 24/7 adult residential treatment program. During this time, interns participate in therapeutic meals and activities with residents. Part of this rotation also offers a foodservice component that includes such experiences as food portioning, menu planning, catering, temperature control, food inventory, recipe development and execution, and preparation and service of meals. In addition, interns are able to get firsthand experience with family-based treatment and services provided at The Emily Program's 10-bed Anna Westin House-Adolescent residential program and the adolescent outpatient program.

Interns are expected to model normal eating, which includes being flexible and willing to eat a variety of foods. In the process, interns learn to coach clients through challenging situations that arise during therapeutic meals. Modeling balanced eating is key to the client's recovery, providing a safe place for the client to challenge ED thoughts and beliefs.

During the final week of the internship, interns come together to develop and present a special final project for The Emily Program. This final project involves collaborating and working creatively in teams, using their skills and talents. In the program's first year of operation, interns worked together on projects supporting The Emily Program Foundation (TEPF) and also developed resources for use with clients. The first two teams collaborated with the Community Outreach Coordinator from TEPF to develop an adolescent-focused curriculum and toolkit that could be accessed online by middle school and high school teachers. The third team researched and developed nutrition fact sheets for use by The Emily Program in individual and group sessions. The projects were presented to The Emily Program's team of RDs, the community outreach coordinator, and DI team. Overall, the feedback from the RDs and TEPF indicated that the material created by the interns would be very useful for The Emily Program.

In addition to these activities, interns attend state-wide nutrition meetings, conferences, and symposiums, and participate in projects that include public relations/fundraising/mass media, legislative, and public policy initiatives.

## Feedback from the First Year

The U of M-TEP dietetic interns had an opportunity at the end of the internship to evaluate the ED rotation orientation and training, supervised practice experiences, supplementary learning experiences (e.g., case studies and the final project), program evaluation, and RD preceptors. Also, interns offered suggestions for program improvements.

Overall, the feedback showed that 100% of the interns either “agreed” or “strongly agreed” that they felt competent to begin work as an ED dietitian. Among the aspects reported by interns to be the most valuable part of the internship were the following: “participating in therapeutic meals,” “each RD has a different style, which enabled me to learn so much,” and “being immersed in the ED world for 9 weeks and the exposure to so many clients and so many ED professionals.” One intern related the internship experience to learning a new language, noting that she found the immersion in the ED environment provided significantly more information than reading about EDs in a text.

Interns worked on the final project throughout the internship, enabling them to develop skills related to teamwork and collaboration, time management, creative thinking, and organizing a professional presentation. The project was presented to the DI team, TEP RDs, and TEPF staff. From the interns’ self-evaluations, peer evaluations, and feedback form, it was clear that the final project allowed for a high degree of creativity, independence, and problem solving, as well as a chance to craft professional tools for “real life” use. We plan to use this feedback to create more opportunities for interns to “give

back” as well as to develop skills they can apply in their professional practice and overall understanding of EDs.

Interns also expressed that the most helpful opportunities were those that allowed them to work with individual clients or groups. Although specific time was allotted for this in their rotation, interns commented that additional opportunities to coach clients would enable them to further practice their skills and, in turn, receive feedback from clients. Interns also

“...it was clear that the final project allowed for a high degree of creativity, independence, and problem solving, as well as a chance to craft professional tools for ‘real life’ use.”

expressed that role-play opportunities were helpful and they desired more built-in time for role-play scenarios (i.e., during meals and meal outings). Other suggested areas for improvement included additional education about EDs and comorbid psychiatric issues, such as personality disorders, anxiety, and depression.

## Program Development

The U of M-TEP dietetic internship is addressing the areas mentioned in the dietetic intern evaluations by developing a summer reading list, adding a mid-year ED class, enhancing projects and assignments, and assessing the quality of our training and staff relief. In addition, we are working with the staff at each site to ensure we are meeting intern competencies while respecting the integrity of our program. We are also reviewing the Standards of Practice (SOP) and Standards of Professional Performance (SOPP) for Registered

Dietitians in Disordered Eating and Eating Disorders, published in August 2011 by the Academy of Nutrition and Dietetics.<sup>8</sup> This document may provide additional support for planning and preparing skill development experiences for the dietetic interns. In turn, it is useful reading material for individuals entering the field of EDs, as it allows them to better understand: 1) what to expect as they begin their work in this field, and 2) the amount of time it takes to develop the skills to become a “proficient” ED dietitian.

The dietetic internship program of the University of Minnesota and The Emily Program strives to continue training interns to graduate as capable RDs who are confident in their professional skills and their ability to contribute to the profession. Although the U of M-TEP dietetic internship has an emphasis in EDs, the interns graduate with a solid, diverse, and well-rounded knowledge and skill foundation that equips them to handle ED-related issues no matter where their career takes them.

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*Val Schonberg, MS, RD, is the coordinator of the dietetic internship program at The Emily Program. Carrie Peterson MS, RD, CSSD, is the director and Doreen Lindblom RD, is the assistant director of the dietetic internship at the University of Minnesota.*

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## From The Chair

by Ingrid Skoog, MS, RD, CSSD

### Blazing New Trails and Making a Difference

*"... Two roads diverged in a wood, and I took the one less traveled by, and that has made all the difference."*

These are the last three lines from my favorite poet Robert Frost in *The Road Not Taken*, written in 1920. I love this poem and it is how I have tried to live my life. It is also the philosophy that I associate with SCAN. SCAN as a dietetic practice group (DPG) is filled with trailblazers: We are open to and embrace new ideas, and we are always looking toward the future—and, as Robert Frost said, this has made all the difference.

What are the most recent "differences" for SCAN?

■ During the past 3 months we hired our new executive director, Athan Barkoukis, who has hit the ground running with new ways to keep the leadership and infrastructure of SCAN on the cutting edge.

■ We have taken on a new webinar company that enables SCAN to produce and offer more educational opportunities to our busy and talented members.

■ We are well along the way in planning our new approach to Symposium 2013. Imagine attending a conference where you leave with skills, tools, and techniques that you can immediately apply to your practice. Well, mark your calendars for April 26-28, 2013, when SCAN will be back in Chicago for *Tools & Techniques for Peak Professional Performance*. Just a few highlights include sessions on corporate wellness, media and social media, cultural literacy and counseling skills, and National Lipid Association training.

■ We also have many great events planned for the 2012 Food & Nutrition Conference & Expo (FNCE) in Philadelphia, where we hope many of you will join us for some great programming and our annual SCAN Reception brought to you via our tireless development director, Hope Barkoukis, PhD, RD, and our many amazing sponsors.

In June, I mentioned that SCAN is committed not only to providing members with the best DPG deal for their dollars but also to amplifying our member services through an increased focus on promoting the SCAN RD. To this end, we are in the final stages of recruiting a director of public relations and have been pleased to appoint Alisa Krisan, MS, RD, as our director of public policy. I believe that SCAN is the only DPG with these two positions, and we are already putting these to good use.

There is always more to write here, especially as it relates to our SCAN subunits. I hope you will make use of the new fact sheets, gain insights from the *Wellness/CV Connection and Score* e-newsletters, and learn more about our new Disordered Eating and Eating Disorders (DEED) subunit director, Therese Waterhous, PhD, RD.

Rest assured that SCAN will continue trailblazing. SCAN is committed to helping each of you achieve your professional goals, and showing the world that working with a SCAN RD will make all the difference.

See you at FNCE!

# Conference Highlights

## American College of Sports Medicine Annual Meeting

May 33- June 3, 2012  
Sam Francisco, CA

With more than 45,000 members and certified professionals, the American College of Sports Medicine (ACSM) is the world's largest sports medicine and exercise science organization. At ACSM's 59<sup>th</sup> Annual Meeting, more than 6,600 exercise scientists, sports dietitians, physicians, and other health professionals gathered to share the latest research. Shown here are a few of the nutrition-related highlights. The number in parentheses indicates the number of the abstract, which can be found in the supplement to the May 2012 issue of *Medicine and Science in Sports and Exercise*. (Additional highlights are available at [www.acsm.org](http://www.acsm.org); click on "news releases.")

### Foods and Phytochemicals for Performance

■ During a 75-km time trial, cyclists performed just as well by fueling with a banana versus a sports drink. The cyclists consumed 0.2-gm/kg carbohydrate (CHO) from banana or sports drink every 15 minutes during the 2.3-hour event. That equates to about 14 g CHO/15 min for a 70 kg-cyclist—about 8 oz of sports drink or half of a medium banana. (Abstract 1333)

■ Tart cherry juice contains numerous antioxidant and anti-inflammatory agents that can reduce pain and inflammation. When 20 women (ages 40-70) with osteoarthritis consumed 10.5 oz of tart cherry juice or a placebo twice daily for 3 weeks, their serum inflammatory biomarkers (TNF-alpha, C-reactive protein) decreased. This was particularly noticeable in the 12 women with the highest amount of inflammation. (Abstract 1389)

■ Tart cherries contain the phytochemical melatonin, which is associated with better quality of sleep. A study with 20 volunteers indicated total sleep time and sleep efficiency improved after 7 days of tart cherry juice consumption. Perhaps tart cherry juice could be helpful for traveling athletes? (Abstract 1390)

■ Pomegranate juice is a rich source of polyphenols, which can reduce delayed onset muscle soreness (DOMS). Healthy men who drank pomegranate juice for 8 days before muscle-damaging exercise experienced less

“Quercetin might be a new way to promote physical activity in older adults.”

DOMS. A once-daily dose of POM Wonderful was as effective as a twice-daily dose. (Abstract 1391)

■ A proprietary blend of botanical concentrates that contains blue green algae, D-ribose, antioxidants, and enzymes showed no significant improvement in recovery from exercise-induced muscle soreness. (Abstract 1392)

■ Quercetin can enhance voluntary activity and endurance performance in mice. Healthy older people (ages 61 to 89) who received 1 g of quercetin for 14 days significantly increased their step counts by about 17% (compared with the control group). Quercetin might be a new way to promote physical activity in older adults. (Abstract 1386)

■ Nitrates in foods such as spinach (and beets) reduce the oxygen cost of exercise and enhance efficiency. Healthy young men (age 25) who consumed 0.5 L of spinach juice for 6 days enhanced their anaerobic performance. This was due to reduction of adenosine triphosphate (ATP) cost and increased ATP oxidative production. (Abstract 1823)

■ Dietary nitrate supplementation improved 4-km and 16-km time trial performance by about 2.7% in sub-elite cyclists. During a longer, 50-mile time trial, trained cyclists who consumed 0.5 L of beetroot juice (~6.2 mmol nitrate) 2.5 hours pre-ride rode 0.8% faster. This small improvement was not statistically significant, but to a cyclist the improvement would likely be meaningful. (Abstract 1824)

■ Among elite rowers, 6 days of consuming 5.5 mmol/day of dietary nitrates from beetroot juice contributed to improved erg tests, particularly in the later stages of exercise. (Abstract 1829)

■ Older men (ages 60-70) who consumed two 70-mL doses of concentrate beetroot juice/day (~600 mg nitrate) for 3 days reduced their blood pressure and the oxygen cost of moderate-intensity treadmill exercise. Dietary nitrates are an effective way to improve performance of older adults. (Abstract 1826)

■ Both beta-alanine and sodium bicarbonate can limit metabolic acidosis and enhance high-intensity exercise performance. In a 5-minute cycling test and a Wingate test, beta-alanine enhanced performance. Combining beta-alanine loading with sodium bicarbonate presented the highest improvements in performance. (Abstracts 1836, 1837)

### Caffeine

■ Most caffeine research is per-

formed using pure caffeine supplements. Does coffee offer the same ergogenic effect? Yes. In research with cyclists and triathletes, time trial results were as follows: 39.4 minutes with caffeine; 39.5 minutes with coffee; 41.4 minutes with instant decaffeinated coffee; and 40.3 minutes with the placebo. There was no difference in fat metabolism, so the researchers suggest the approximate 4% improvement was related to the central nervous system stimulus that makes exercise seem easier with caffeine. (Abstract 2781)

■ An extensive literature review indicates that caffeine has little physiological effect on hydration status and heat tolerance. Hence, athletes need not worry about using 3 to 9 mg caffeine/kg body weight when exercising in the heat. (Abstract 1584)

■ While low levels of caffeine do not have a diuretic effect over the course of the 24-hour day, what happens in the short term? In 3 hours, habitual coffee drinkers who consumed 200 mL of coffee (with 250 mg caffeine) voided 316 mL of urine 3 hours later, a nonsignificant difference from the group that consumed plain water and voided 290 mL of urine. However, the high caffeine group (550 mg caffeine) produced 630 mL of urine. The data suggest that high caffeine intake can induce an acute diuretic effect. (Abstract 2791)

■ When cyclists were given either 3 or 6 mg caffeine/kg body weight 1 hour prior to a 40-km time trial, they performed equally well regardless of the dose. However, the athletes who responded best to pre-exercise caffeine during a time trial had a specific polymorphism that was missing in the nonresponders. When the data were analyzed by genotype, the AA homozygote group was 4.6% faster at 6 mg/kg compared with the 2.6% improvement that occurred in the C allele group. Genetic polymorphisms influence the ergogenic effect of caffeine. (Abstract 2778)

■ In a cycling time trial, Red Bull enhanced performance similarly to caffeine. Red Bull's "added ingredients" offered no additional benefits. (Abstract 2789)

## Supplements

■ Of 390 soldiers in the 101st Airborne Division, 58% took a multivitamin supplement, 32% took whey, 16% consumed energy drinks, and 10% took creatine in the hopes of achieving optimal military readiness. They could more appropriately be taught to use foods and nutrient timing as a safer and more effective alternative to dietary supplements. (Abstract 3231)

"Pre/post-exercise weights can be a helpful way to teach athletes about their need to hydrate."

■ In an online survey sent to triathlon clubs, 126 triathletes reported the most common reasons for taking supplements were to prevent injury and illness. Accordingly, 80% consumed a multivitamin supplement, 65% consumed whey, and 66% took fish oil. (Abstract 3234)

## Female Athlete Triad

■ Cognitive restraint is a risk factor for the female athlete triad. Women who tested high as restrained eaters were more likely to limit their energy intake and experience amenorrhea due to low energy availability. (Abstract 931)

■ College-age dancers (n=11) had greater spine bone mineral density compared with runners (n=13) and controls, despite low energy availability. The loading nature of dancing might have greater positive impact on bone than running. (Abstract 2741)

■ Female cyclists (age 26) who trained about 10 hours a week had spine Z scores in the osteopenic range. Cyclists should cross train with weight-bearing exercise to improve their bone health. (Abstract 2733)

## Dehydration

■ Jockeys have a strict weight limit that commonly leads to poor dietary practices, compromised bone health, mood disorders, cigarette smoking, and extreme dehydration on both race and nonrace days. Analysis of the urine of 875 jockeys indicates that 48% were significantly dehydrated and another 27% were highly dehydrated on race day. (Abstract 1407)

■ A study with trained runners from the Southeastern U.S. showed they lost twice as much sweat during a 1-hour summer race than they predicted. As a group, they predicted losing about 750 mL of sweat in hot, humid conditions but they actually lost about 1,500 mL. Pre/post-exercise weights can be a helpful way to teach athletes about their need to hydrate. (Abstract 2288)

■ Researchers found that 13-year-old soccer players (n=107) in summer camps need to be educated about the symptoms of dehydration, given that 89% showed up dehydrated prior to practice and 96% ended up dehydrated at the end of the day. Advice to "drink to thirst" is inadequate for this population! (Abstract 2289)

■ The National Athletic Trainers' Association recommends that athletes consume 300 to 700 mg of sodium during the 2 to 3 hours of pre-exercise to help prevent sodium

depletion. Athletes need to be educated that standard sports drinks—and even sodium-enhanced sports drinks—do not provide this level of sodium intake. (Abstract 3026)

■ Among 207 finishers of the Western States 100-mile Endurance Run, 12 (6%) experienced hyponatremia. The only measurable difference between those 12 runners and the rest of the finishers was higher creatine kinase (CK) levels. Hyponatremia was not associated with sodium supplementation (or lack thereof) during the race, number of urinations, nor post-event sodium cravings and thirst ratings. (Abstract 1188)

■ Among 10- to 14-year-old boys at a summer soccer camp, cold fat-free chocolate milk was chosen more often than cold water or cold fat-free plain milk during exercise in the heat. The boys gave chocolate milk favorable palatability scores and reported insignificant gastrointestinal (GI) complaints. (Abstract 2291)

■ During a 100-mile trail run consisting of 6.5 loops, runners reported GI symptoms and food intake at the end of each loop. Nine of the 15 participants in the study had GI complaints; of these, 4 finished the event and 5 did not. Regardless of finishing status the GI complaints were similar, most commonly nausea (89%), cramps (44%), diarrhea (44%), and vomiting (22%). Those with GI problems consumed less fluid (6 vs. 11 mL/kg/h) and had a lower dietary fat intake (11% vs. 17% of energy consumed as fat). (Abstract 1191)

■ For every 1% loss of body weight pre-to-post exercise, body temperature increases 0.22° C. This information can be used to predict the rise in body temperature during exercise in the heat. (Abstract 3019)

## Body Composition

■ When using the Bod Pod, the instructions to not eat, drink, or exercise for 2 hours before the

measurement are imperative. Athletes who did 30 minutes of treadmill exercise prior to Bod Pod testing measured 21.3% body fat pre-exercise and 19.6% post-exercise; the 2% drop was not due to a loss of body fat, but rather to inaccuracy related to an elevated body-temperature. (Abstract 3036)

■ How much variation occurs among methods of body fat measurement? A lot! The following results for collegiate gymnasts were obtained using

“Employers who enable brief, periodic workday physical activity will help spare their employees from the health hazard of inactivity.”

different methods: Tanita BF-350, 21.7%; Tanita BF-522, 21.7%; Omron HBF-510W, 26.1%; Omron HBF-306C, 18.4%; skinfolds, 19.5%; and DXA, 21.06%. When using DXA as the gold standard, Omron was the least accurate! (Abstract 3040)

■ It's unlikely that aerobic exercise prior to resistance exercise compromises muscle size and strength gains. In a 5-week study, no interference from aerobic exercise was noted when athletes did exhaustive aerobic exercise using one leg in the morning, rested for 6 hours, and then did strength training using both legs. In the resistance-only leg, the quadriceps muscle volume increased by

only 8% compared with 11% in the leg that did both resistance and aerobic exercise. The combined approach offered a more robust increase in muscle size. (Abstract 597)

## Weight

■ Of 101 obese participants in a weight management program for an underserved rural population, 60% chose to meet face to face rather than join an Internet group. (No one selected the DVD option.) Self-efficacy was higher in the face-to-face group. The researchers suggest assessing a dieter's self-efficacy prior to enrollment to aid in tailoring an intervention that meets the participant's needs. (Abstract 583)

■ Should we treat workplace inactivity like an occupational hazard such as chemical exposure? After all, inactivity reduces fitness and contributes to obesity, sleep apnea, heart disease, diabetes, and osteoporosis. Employers who enable brief, periodic workday physical activity will help spare their employees from the health hazard of inactivity—a far more prevalent hazard than chemical exposure. Also, physically active workers are more productive, use less sick time, have fewer injuries, and lower medical costs. (Abstract 3241)

■ A health care model in the Netherlands predicts that if all Dutch workers did 30 minutes of moderate physical activity 5 days a week, the health care savings would be \$1.28 billion per year. More realistically, if only 20% to 25% of Dutch workers became more active, annual savings would be a substantial \$330 million. (Abstract 3243)

*Summarized by “Conference Highlights” editor Nancy Clark, MS, RD, CSSD, who has a private practice in the Boston area and is author of Nancy Clark's Sports Nutrition Guidebook. She can be reached via [www.nancyclarkrd.com](http://www.nancyclarkrd.com).*

## Nutritional and Gastrointestinal Problems in Endurance Athletes

Pfeiffer B, Stellingwerff T, Hodgson AB, et al. Nutritional intake and gastrointestinal problems during competitive endurance events. *Med Sci Sports Exerc.* 2012;44:344-351.

Current carbohydrate recommendations for endurance athletes promote the consumption of high amounts of carbohydrate during exercise. However, the potential gastrointestinal (GI) distress and performance implications of these recommendations should be considered. Thus, the aim of this study was to investigate the food and fluid intake and GI symptoms of 221 endurance athletes from two Ironman (IM) triathlons, a half-Ironman, a 100/150-km cycle race, and a marathon. Study participants completed a pre-race questionnaire to determine training, nutrition, and GI symptom history and a post-race questionnaire to determine fluid and food intake and GI symptoms during competition using a 10-point scale for various GI complaints. Carbohydrate intake varied greatly between events and between individual athletes (6-136 g/h). Marathon runners had the lowest CHO intake compared with IM athletes ( $P < .001$ ) and cyclists ( $P < .034$ ). The highest CHO intakes were reported in the IM races ( $62 \pm 26$ ,  $71 \pm 25$ , and  $65 \pm 25$  g/h, respectively). Higher carbohydrate intakes were not associated with higher scores for GI symptoms. However, nausea and flatulence were positively correlated with CHO intake in the IM races. Gastrointestinal symptoms were positively correlated with a history of GI symptoms, indicating a possible individual predisposition to GI distress. Despite potential GI concerns, high carbohydrate intakes were correlated with faster finish times ( $P < .01$ ). Based on these findings, carbohydrate recommendations for endurance athletes should be individually tailored according to tolerance, but should generally encourage

relatively high CHO intakes to support performance. This study was supported by a grant of Nestec Ltd.

*Summarized by Jamie Saunders, MS, Division of Nutrition, University of Utah, Salt Lake City, UT.*

## Effects of Dilute Carbohydrate Beverages on Performance

Watson P, Shirreffs SM, Maughan RJ. Effect of dilute carbohydrate beverages on performance in cool and warm environments. *Med Sci Sports Exerc.* 2012;44:336-343.

In temperate environments, commercially available sports drinks (6-8% carbohydrate [CHO] concentration)

at a work rate of 60%  $VO_2$  peak in 30°C. Expired gas samples were collected at 15-minute intervals to determine rates of substrate oxidation and energy expenditure. In the cool environment compared with the 0% trial, time to exhaustion (TTE) was significantly longer in the 4% and 6% trials. In addition, TTE was significantly longer in the 6% trial than in the 2% trial ( $13.0 \pm 12.5$  min;  $P = .025$ ). In the warm environment, there was no significant difference between the 0%, 2%, or 4% trials. However, compared with the 0% trial, TTE was significantly longer in the 6% trial ( $P = .045$ ). In conclusion, this study demonstrates that a lower solution of 4% CHO may be beneficial in cool environments, whereas a 6% CHO

“...a lower solution of 4% CHO may be beneficial in cool environments, whereas a 6% CHO solution is more beneficial in a warm environment.”

have been shown to enhance performance. However, low concentration (0-6%) CHO solutions found in fitness waters may also be beneficial via enhanced water absorption, particularly when fluid intake as opposed to CHO intake is of primary importance. The objective of this study was to examine the influence of diluted CHO-electrolyte sports beverages on physical performance in cool and warm conditions. Two parallel experiments involving fixed-intensity exercise to volitional exhaustion were conducted. Twelve healthy males participated in each experiment, consuming 0%, 2%, 4%, and 6% CHO solutions pre-exercise and every 10 minutes of exercise. One group completed the exercise at a work rate of 70%  $VO_2$  peak in 10°C while the other completed the exer-

sion is more beneficial in a warm environment. Athletes should experiment with differing CHO solutions under a variety of environmental conditions.

*Summarized by Ema Thake, graduate student, Coordinated Master's Program, Sports Nutrition Emphasis, Division of Nutrition, University of Utah, Salt Lake City, UT.*

## Fluid Consumption Practices During Marathons

Beis LY, Wright-Whyte M, Fudge B, et al. Drinking behaviors of elite male runners during marathon competition. *Clin J Sport Med.* 2012;22:254-261.

It is widely believed that adequate fluid consumption during competi-

tion is a key determinant of athletic success. Current American College of Sports Medicine (ACSM) guidelines recommend ad libitum fluid intake from 0.4 L to 0.8 L per hour during exercise to minimize body mass (BM) losses to no more than 2%. However, data on the fluid practices of elite distance runners during marathon competition are limited. Thus, the objective of this study was to determine and assess the fluid intake of elite marathon runners in retrospective fashion. Video footage of 13 major marathons was thoroughly reviewed and total time spent consuming fluid calculated for 10 different male athletes. A separate simulation experiment determined an average flow rate of 45.2 mL/sec from a typical sports drink bottle. Total fluid intake was estimated by multiplying

### Call for Abstractors

You can contribute to the pages of *PULSE* by volunteering to abstract a recently published study on sports nutrition. For details on this opportunity, contact Stacie Wing-Gaia, PhD, RD, CSSD, co-editor of "Sports Dietetics-USA Research Digest" at [stacie.wing@health.utah.edu](mailto:stacie.wing@health.utah.edu).

total time spent consuming fluid by this average flow rate. Mean duration of fluid consumption was  $25.5 \pm 15.0$  sec resulting in a mean fluid consumption of  $0.55 \pm 0.34$  L/h consistent with ACSM guidelines. There

were no correlations between fluid intake and running speed, nor was ambient temperature correlated with total time spent consuming fluid ( $P = .77$ ). Adequate fluid consumption by athletes did not appear to prevent reduction in BM. For example, the winner of the 2009 Dubai marathon consumed 0.83 L/h of fluid but experienced a 9.8% reduction in BM, translating into an estimated sweat rate of 3.6L/h. Based on the results of this study, elite athletes should be encouraged to practice ad libitum drinking during the marathon event rather than attempt to replace all fluids lost through sweat.

*Summarized by James Stevens, MS, RD, affiliate faculty, Front Range Community College, Westminster, CO.*

## Reviews

### The Plant-Powered Diet: The Lifelong Eating Plan for Achieving Optimal Health

Sharon Palmer, RD

The Experiment

[www.theexperimentpublishing.com](http://www.theexperimentpublishing.com)

2012, softcover, 432 pp, \$15.95

ISBN: 978-1-61519-058-4

Susan Palmer should be able to change any carnivore into a plant-based foodie by her inspiring and enticing publication, *The Plant-Powered Diet*. This is an easy-to-follow guide for anyone interested in improving their health by incorporating more plant-based whole foods. Palmer presents research-based evidence on the health benefits of a plant-based diet and describes a simple approach to incorporating these wholesome foods into almost any lifestyle or meal plan. Rather than offering one plant-based approach, which may seem extreme and overwhelming, she presents meal plans for three different dietary preferences: vegan, vegetarian, and omnivore.

Palmer divides the book into seven plant-powered food categories: plant

"She provides detailed and research-based evidence behind the compounds found in each plant food. This is what differentiates this book from others."

proteins; whole grains; vegetables; fruits; healthful fats; spices, herbs, and chocolate; and coffee, tea, and wine. Within each chapter, she provides detailed and research-based evidence behind the compounds found in each plant food. This is what differentiates this book from others of its kind.

For example, Palmer suggests eating more green leafy vegetables but also describes the powerful nutrients found in these vegetables that deliver disease-fighting capabilities. The reader quickly gets to know unfamiliar terms such as betalains, chlorophyll, kaempferol, lutein, quercetin,

and zeaxanthin through Palmer's detailed descriptions and accompanied glossary.

For each plant-powered food category, Palmer presents a comprehensive table that lists the food item with its description, star nutrients, and culinary suggestions. For example, the plant protein chapter describes such foods as soy, seitan, chia, and hemp, then lists the benefits of each and suggests how they can be incorporated into various diets and lifestyles.

Palmer also spends time discussing the positive environmental impact

when following a plant-based diet. She uses colorful analogies such as “if you eat one less burger a week it’s like driving 320 miles less.” Palmer discusses how choosing local and organic foods may positively impact one’s health, the environment, and the farmer, but he also notes that more research is needed in the area of eating local and organic foods.

Readers will especially appreciate the last two categories in *The Plant Powered Diet*: spices, herbs, and chocolate and coffee, tea, and wine. Palmer explains the immune-enhancing compounds found in spices and herbs, and discusses how they offer an

will also find this book a nice addition to their library and a useful resource when talking about the benefits of a plant-based diet with their clients.

Sharon Palmer, RD, is a registered dietitian, editor of the award-winning health newsletter *Environmental Nutrition*, and a nationally recognized nutrition expert who has reached thousands of people through her writing and clinical work.

*Reviewed by Nichole Dandrea, MS, RD, a women’s health nutritionist and founder of Nicobella Organics, a healthful organic dark chocolate company based in Los Angeles, CA.*

The first and second chapters focus on calorie monitoring and determining a meal plan using appropriate ratios for carbohydrates, fats, and protein. Included are calculations used to design menus and daily intakes. A helpful resource in Chapter 2 is a 3-day detailed meal plan, which includes three meals and three snacks that contain the recommended ratios of macronutrients. Chapter 3 is devoted to exercise and physical activity. It promotes the importance of exercise in a lifestyle and weight management program, and further motivates the reader by outlining the health benefits of exercise and explaining how to time meals within an exercise program.

Hormonal imbalances and effects on weight are addressed well in Chapters 4, 5, and 6. The points made are not nutrition-related but are nevertheless relevant, because many people experience plateaus in their weight loss efforts and may want to explore issues with hormones. These well-written chapters do a good job in explaining complicated concepts regarding the thyroid gland, insulin, estrogen, and testosterone and their potential impact on weight gain. Early gives suggestions on laboratory tests to pursue, and also recommends that each individual review his or her needs with a primary care physician or endocrinologist.

The remaining Chapters 7 and 8 review nutrition supplementation and vibrational alignment. While these topics are not usually included in weight loss programs, Early offers a significant explanation regarding the purpose and role of these in weight management. Alternative approaches to managing stress and refocusing energy may, for some individuals, offer a valuable new approach to a healthful lifestyle change. For some of these issues, the author provides scant scientific bases for her recommendations.

In summary, *8 Ways to Lose Your Blubber* suggests other factors to consider and manage in a weight loss pro-

*“8 Ways to Lose Your Blubber suggests other factors to consider and manage in a weight loss program, where other diet books generally do not include this information.”*

abundance of health benefits while adding flavor and variety to any vegetable-based meal. She includes recent research on chocolate, coffee, tea, and wine and what portion sizes provide the greatest health benefit.

The final chapter, “14 Days of Powerful Plants,” offers a simple, realistic 14-day meal plan for vegan, vegetarian, and omnivore diets. Each day includes three creative meals and three energizing snacks with more than 75 original recipes. Pumpkin Spice Pecan Pancakes and Spiced Banana Avocado Bread are two examples of Palmer’s unique recipes that will certainly change the perspective that vegetable-based diets are bland.

*The Plant Powered Diet* is a great read and resource for vegans, vegetarians, and omnivores who are looking for a simple, effective, and creative guide to incorporating more plant-based foods into their lifestyle. Dietitians

### **8 Ways to Lose Your Blubber: Through Hormone Balancing and Lifestyle Changes**

Valerie A. Early, RD  
CreateSpace  
wwwcreatespace.com  
2010, softcover, 106 pp, \$13.99  
ISBN: I-451-53669-0

Weight loss books encompass more than just diet when they provide readers with weight management tips. In *8 Ways to Lose Your Blubber*, the author not only gives readers a unique, eye-catching title, but also provides alternative tips on issues surrounding weight loss. Through easy-to-read descriptions, Valerie Early, RD, breaks down each of her eight areas that range from diet and nutrition analysis to supplements and “vibrational alignment.” This book approaches weight management from a nutritional perspective and also introduces other factors that may influence weight and a healthful lifestyle.

gram, where other diet books generally do not include this information. Early presents a concise description of terms that readers can comprehend and potentially use in their quest to manage their weight and adopt a more healthful lifestyle.

Valerie Early, RD, is a dietitian as well as a registered pharmacy technician, certified health and fitness specialist,

and a Reiki Master. She currently counsels clients about the importance of nutrition and hormonal balance in her private practice (Nutrition, Connection, Balance, LLC).

*Reviewed by Heather Cunningham, RD, CNSC, a clinical nutrition manager and wellness consultant in Milltown, NJ.*

## SCAN Notables

by Sumner Brooks, MPH, RD, CSSD

■ **Erin Macdonald, RD**, and her business partner, also an RD, contribute monthly articles for two popular magazine columns, putting registered dietitians in the spotlight in mainstream nutrition media. "Easy Does It" appears in *Oxygen* magazine and "Ask the Dietitian" is being launched in *Clean Eating* magazine. Each article features a nutrition topic and corresponding recipe. Along with these magazine columns, the duo's Web site U Rock Girl.com provides health and wellness information for women. Erin runs a private practice and consulting business in Orange County, CA.

■ **Susan B. Dopart, MS, RD, CDE**, recently authored her second book, *Healthy You, Healthy Baby: A Mother's Guide to Gestational Diabetes*. The book was released in June 2012. Her first book, *A Recipe for Life by the Doctor's Dietitian*, published in 2009, is

available digitally at [www.SusanDopart.com](http://www.SusanDopart.com). Susan has a private practice in Santa Monica, CA, where she specializes in weight management and medical nutrition therapy.

■ **Christine M. Palumbo, MBA, RD**, was awarded the 2012 Alumnae Award from St. Catherine University in St. Paul, MN. The award is bestowed based on the criteria of demonstrating leadership, service, professional excellence, and the ideals of the university. In addition, Christine was named the 2011 Outstanding Dietetics Educator by the Illinois Dietetic Association. Among her current roles as a dietitian, she is an adjunct faculty member at Benedictine University, columnist for *Chicago Parent*, and a contributing editor for *Environmental Nutrition*. Christine runs her private practice in the Chicago, IL area.

*If you have an accomplishment that you would like to be considered for an upcoming issue of PULSE, please contact Sumner Brooks, MPH, RD, CSSD, at [sumner\\_brooks@yahoo.com](mailto:sumner_brooks@yahoo.com).*

### On the Web . . .

Go to [www.scandpg.org](http://www.scandpg.org) and reap the rewards of SCAN's interactive, updated Web site. You'll find many features there, including:

■ **SCAN's Blogs.** Read interesting posts from various RDs on a wide array of topics.

■ **Event Calendar.** Check out upcoming webinars and events—fantastic opportunities for you to learn and grow.

■ **Expert Nutrition Information.** Get authoritative information on the topics of interest to you: sports nutrition, wellness and cardiovascular health, and disordered eating and eating disorders.

■ **Free Fact Sheets and Webinars.** Enjoy free access to materials that will inform and equip you well professionally.

■ **Forums.** These enlightening discussions and networking opportunities will expand your mind and your network.

#### For More About SCAN's Web Site:

Find out more about [www.scandpg.org](http://www.scandpg.org) in this issue's "Of Further Information" (page 26)

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SCAN group

## Of Further Interest

### ■ Save the Dates for Symposium 2013!

Invigorate your practice by attending the 29th Annual SCAN Symposium, *Tools & Techniques for Peak Professional Performance*, on April 26-28, in Chicago, IL. Exciting learning opportunities addressing all four of SCAN's practice areas are planned, including:

- Skills-oriented tactics for improving your knowledge base and expanding your practice
- Take-home tools to use and share with clients, patients, colleagues, and students
- New research exploration, networking, and fun in The Windy City

The Academy is adopting a career development guide to provide dietetics professionals with a roadmap for excellence in practice. The skills-oriented sessions planned for Symposium will help SCAN members work on proficiency in practice. As the leader in sports, cardiovascular, wellness, and disordered eating practice, SCAN will equip members attending Symposium 2013 with cutting-edge strategies for gaining the clinical and professional expertise needed to advance their careers. Mark your calendars!

### ■ SCAN's Web Site: Your Go-To Resource

Be sure to go to SCAN's Web site ([www.scandpg.org](http://www.scandpg.org)) whenever you have a few free moments, or when you've got a specific need. Here's a sampling of what you'll find:

• **Ways to Stay Connected via our Member Forums.** Take advantage of the Members Only discussion forums that let you network, share, and learn. Current discussions include *Sports Nutrition Mentoring* and *House of Delegates Issues*, as well as forums with specific questions regarding about *Sports Nutrition*, *Cardiovascular*

*Health, Wellness and Weight Management*, and *Disordered Eating and Eating Disorders*. Join in on the discussion at [www.scandpg.org/forum/](http://www.scandpg.org/forum/).

• **Online Continuing Professional Education (CPE).** SCAN works hard to provide interesting and valuable topics for obtaining CPEs. Currently available online CPE opportunities include "Forks and Fate of Our Families Webinar," "Present Like a Pro in a Healthy Cooking Demo," and as always free CPE quizzes on selected *PULSE* articles. Go to [www.scandpg.org/cpe/](http://www.scandpg.org/cpe/) to get started.

• **Now Available: 2012 SCAN Symposium Recordings.** All Symposium 2012 workshops and presentations are now available in the SCAN Online Store. If you missed this event or want to revisit some of the talks, check out the store to obtain these recordings.

• **Natural Medicines Comprehensive Database.** You can tap into this comprehensive database, available for free to SCAN members, and take advantage of a great resource for information and education.

• **Foods Recommended by Members.** This list of food products, submitted by SCAN colleagues, is intended to complement an overall healthful, balanced diet of whole foods, including fruit, vegetables, whole grains, legumes, lean protein sources, nonfat dairy items, and heart-healthy fats. Access the list at [www.scandpg.org/nutrition-info/nutrition-info-for-consumers/foods-scan-rds-recommend/](http://www.scandpg.org/nutrition-info/nutrition-info-for-consumers/foods-scan-rds-recommend/).

• **Tools at Your Fingertips.** SCAN has an outstanding list of Web sites, presentations, and downloadable files to help you in your profession. Go to [www.scandpg.org/nutrition-info/professional-links-and-resources/](http://www.scandpg.org/nutrition-info/professional-links-and-resources/) to view the various options.

• **A Handy, Updated Guide.** SCAN is offering a free updated version of *10 Simple Steps to Make Good Habits More Delicious: The Dietitian-Approved Guide to Applying the 2010 Dietary Guidelines for Americans and MyPlate in 10 Simple Steps!* You'll find it in the SCAN Online Store.

### ■ News from Wellness/CV RDs Subunit

Here's an update on developments from the Wellness/CV RDs:

• **Share Your Favorite Foods.** Be sure to check out the list of newly updated *Favorite Foods Recommended by SCAN Members* on SCAN's Web site (see "Foods Recommended by Members" in the previous column.) This list saves you time as you navigate new heart-healthy products at the grocery store. Please send your "latest finds" to Georgia Kostas at [georgia@georgiakostas.com](mailto:georgia@georgiakostas.com). The update list is posted annually. The next list will be released in early 2013. Please send in your suggestions by November 30, 2012.

• **Wellness/CV Offerings at Symposium 2013.** Program planning for Symposium 2013, April 26-28, in Chicago, IL, is well on its way! Among the highlights: Advanced level lipid training that will include discussions on diet and pharmacologic parameters by renowned speakers as well as more wellness topics than ever before. Plan to attend!

• **Wellness/CV Connection e-Newsletter.** Trying to find a specific article that was in the *Wellness/CV Connection* but can't remember which issue it appeared in? You can check out all issues at [www.scandpg.org/cardiovascular/newsletters/](http://www.scandpg.org/cardiovascular/newsletters/).

• **Advanced Cardiovascular Certifications.** Interested in finding out more about advanced certifications in cardiovascular health? With SCAN's

new agreement with the National Lipid Association, we have added certification information to our Web site at [www.scandpg.org/nutrition-info/cardiovascular-health-professional-resources/](http://www.scandpg.org/nutrition-info/cardiovascular-health-professional-resources/).

• **Calling for Fact Sheet Topics.** Do you have an idea for a fact sheet you would like to see SCAN develop in the area of wellness or cardiovascular health? If so, please contact Karen Collins ([karen@karencollinsnutrition.com](mailto:karen@karencollinsnutrition.com)) or Rosie Gonzalez ([Rosie.Gonzalez@hfit.com](mailto:Rosie.Gonzalez@hfit.com)) with your ideas.

## ■ News from Sports Dietetics USA (SD-USA)

Below are some highlights from the SD-USA subunit:

• **New Edition of Sport Nutrition Practice Manual.** The Academy's *Sports Nutrition: A Practice Manual for Professionals*, 5th ed., can now be purchased at the Academy Shop. This is the new edition you've been waiting for—an indispensable source for specific evidenced-based sports nutrition information.

• **Revised CSSD Eligibility.** The Commission on Dietetic Registration (CDR) has revised the application form for CSSD certification, allowing continuing education (CE) to substitute for up to 75 hours of the required specialty practice hours. SCAN sports nutrition offerings will count toward the 75 CE hours. For eligibility information and applications from CDR, go to [www.cdrnet.org](http://www.cdrnet.org).

• **CSSD Recertification.** Five-year recertification is due for CSSDs certified in 2007. Check your certification year and be prepared to recertify. Eligibility includes documentation of 1,000 hours of specialty practice experience as an RD within the past 5 years by the application due date (effective until 2014).

• **The CSSD: Qualification Matters.** According to the 2011 Compensation and Benefits Survey (*J Acad Nutr Diet* -

January 2012), CSSDs earn the highest hourly wage per patient/client responsibility among all those who hold a CDR specialist credential. Overall, RDs with CDR specialty credentials earn higher compensation than RDs without specialist certification. Apply now for the CSSD credential!

• **IOC Diploma in Sports Nutrition.** SCAN member now qualify for a 10% discount off tuition and fees. For more information, visit [www.sportsoracle.com/ioc/](http://www.sportsoracle.com/ioc/).

• **Tout Your Expertise.** Let athletes and clients tout your expertise by adding the *Sports Nutrition—Who Delivers?* YouTube link ([www.youtube.com/watch?v=Ocz7P3A2rgU](http://www.youtube.com/watch?v=Ocz7P3A2rgU)) to your e-mail signature. Be sure to also upload this video to your Web site, Facebook page, and Twitter page, and show it before or after your presentations. It's an amazing marketing tool.

• **Follow SD-USA on Twitter @Sportsdiet\_USA.** The goal of *Sportsdiet\_USA* is to market the Sports RD to the public. If you have facts or accomplishments and would like to be included in one of our Tweets, contact us at [Sdusa.media@gmail.com](mailto:Sdusa.media@gmail.com). If you are interested in volunteering for this project, contact Kelly Devine Rickert at [nutritees@hotmail.com](mailto:nutritees@hotmail.com).

• **Be Business Savvy—Use the Sports Nutrition Fact Sheets.** Let these sheets serve as your “business card” and keep you front and center. Visit SCAN's NRG to customize SCAN's Sports Nutrition Fact Sheets with your own business information and message. Go to [www.scandpg.org/sports-nutrition/sports-nutrition-fact-sheets/](http://www.scandpg.org/sports-nutrition/sports-nutrition-fact-sheets/).

• **SCAN Student Corner.** View the latest sports nutrition interview at [www.scandpg.org/careers-and-students/students-and-scan/](http://www.scandpg.org/careers-and-students/students-and-scan/).

• **SCAN's e-Library Additions.** Visit [www.scandpg.org/e-library/](http://www.scandpg.org/e-library/) and explore the e-learning opportunities: 1.) In the **CSSD-Level Advanced Prac-**

## Call for Posters

### 2013 SCAN Symposium “Tools and Techniques for Peak Professional Performance” April 26-28, 2013

Student and professional SCAN members are invited to submit research and practical posters for presentation during the 2013 SCAN Symposium in Chicago, IL. The deadline for submission is **February 1, 2013**. For more information, visit [www.scandpg.org](http://www.scandpg.org).

**tice Series – Session 2: Analyze This! Evaluating Literature with a Critical Eye and an Open Mind; and Session 1: CSSD-Level Sports Nutrition Practice and the Diabetic Athlete; 2.)** The webinar **Peak Professional Performance: Growing a Successful Sports Dietetics Practice**; 3.) the flash video **Be Supplement Smart—Increase Your Value to Clients**, offering 2 continuing professional education (CPE) units; 4.) presentations from past SCAN Symposiums and Sports Dietetics Workshops: **Nutrition & Athletic Performance, The Cascade of Concussion**, and 5.) the webinar **Be Supplement Smart—Increase Your Value to Clients - Educators version** (\$39), for those showing this webinar to students or other groups (multiple viewing); CPE credit not available. To order, go to <http://www.scandpg.org/store/products/10085/>.

• **Sports Nutrition Care Manual**® (**SNCM**). The Academy's online *SNCM* contains research-based nutrition information written by authors who are CSSDs. The price is \$75 for Academy members. Preview the manual and selected pages at <http://sports.nutritioncaremanual.org/>.

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## Upcoming Events

### November 1-2, 2012

Annual AICR Research Conference on Food, Nutrition, Physical Activity and Cancer, Washington, DC. For information: American Institute for Cancer Research, [www.aicr.org](http://www.aicr.org)

### November 9-11, 2012

Annual Renfrew Center Foundation Conference, Philadelphia, PA. For information: [www.renfrew.org](http://www.renfrew.org)

### December 13-15, 2012

International Sports & Exercise Nutrition Conference, Newcastle upon Tyne, UK. For information: [www.isenc.org](http://www.isenc.org)

### February 8-9, 2013

Sport Nutrition Workshop: From Science to Practice, Indianapolis, IN. For information: Nancy Clark, [www.sportsnutritionworksop.com](http://www.sportsnutritionworksop.com)

### March 21-24, 2013

IAEDP Symposium 2013, Henderson (Las Vegas area), NV. For information: International Association of Eating Disorders Professional, [www.iaedp.com](http://www.iaedp.com)

### April 26-28, 2013

Join your colleagues at the **29th Annual SCAN Symposium, Tools and Techniques for Peak Professional Performance**, Chicago, IL. For more information: [www.scandpg.org](http://www.scandpg.org)

## SCAN'S PULSE

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