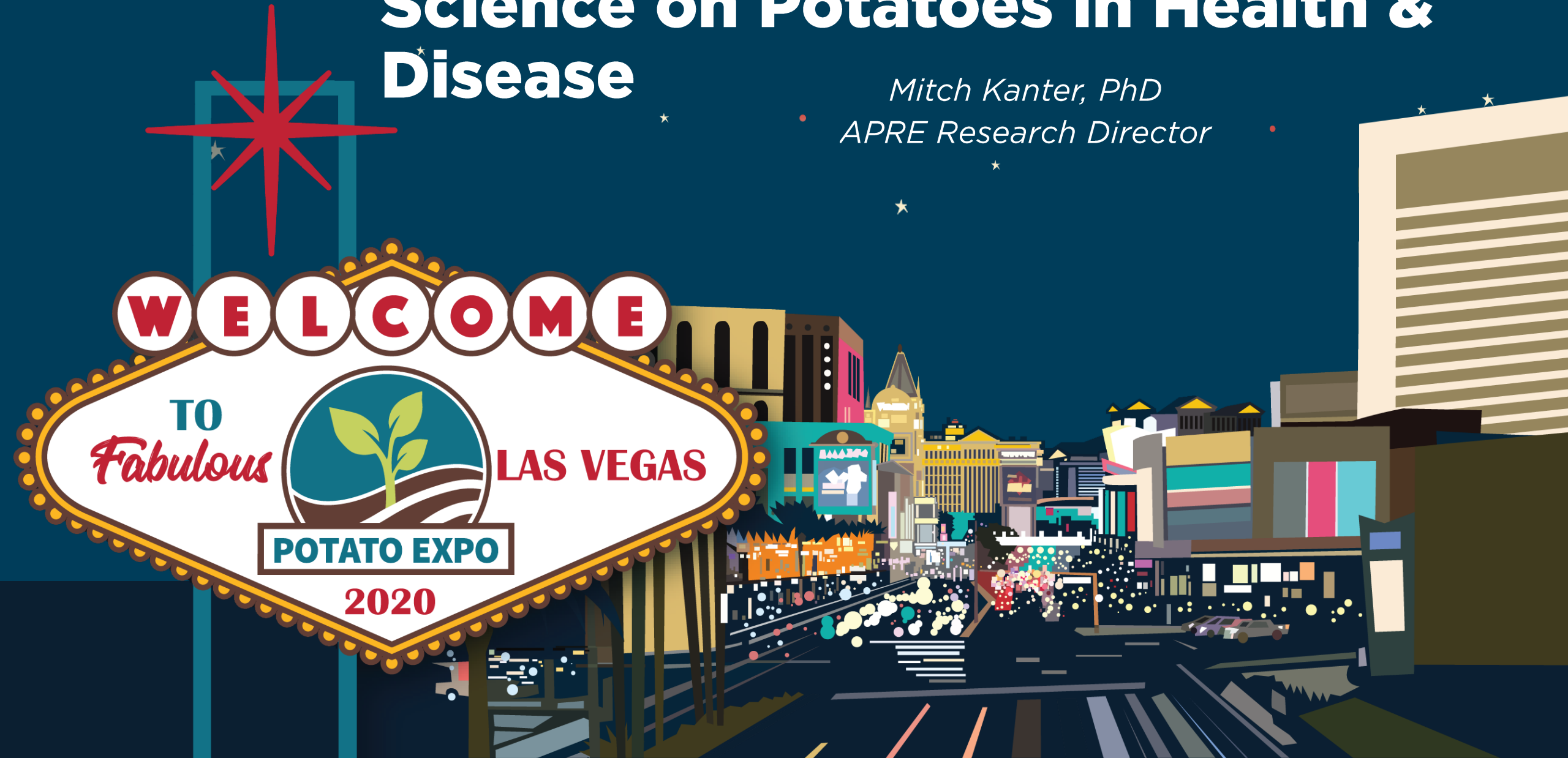


# APRE Research Program Update: Science on Potatoes in Health & Disease

*Mitch Kanter, PhD*  
*APRE Research Director*



# Alliance for Potato Research and Education (APRE)

## *Mission*

*APRE is dedicated to advancing scientific understanding of the role potatoes play in promoting the health of all people.*

## *Research Imperative*

*Demonstrate that potatoes are a favorable vegetable and preferred source of quality carbohydrates in healthy dietary patterns.*



# Research Roadmap Priorities

## Potatoes and Cardiometabolic Health

**Diabetes**

**Gut Health**

**Heart Health**

**Healthy Weight**

## Potatoes in Healthy Dietary Patterns

**Diet Quality and Culturally Appropriate Food Patterns**

## Potatoes in Healthy Lifestyles

**Performance**

**Aging**



# Research Pipeline Recap

*30 Studies Funded*

*7 Manuscripts Published*


*4 Reviews and Commentaries Published*

*3 Manuscripts Submitted for Publication*

*9 Studies Completed or Near Completion*

*12+ Studies Presented at Conferences*

*13 studies have fry or chip component*



Alliance for Potato Research and Education  
Nutrition Research Program

CARDIOMETABOLIC HEALTH

The Alliance for Potato Research and Education (APRE) was established in June 2011 to advance the scientific understanding of the role potatoes play in promoting health, including the role of potatoes on cardiometabolic health, healthy dietary patterns, and healthy lifestyles (with an emphasis on athletic performance and life stages). These summaries highlight research currently underway.



Visit [apre.org](http://apre.org) for more information, including an overview of APRE's Research Integrity Guidelines.

November 2019 \*Indicates date funded

**Impact of a Low Glycemic Load (GL) Diet Containing Potatoes on Body Composition and Cardiometabolic Health in Subjects with Metabolic Syndrome (MetS) (2018\*)**  
*Jamie Baum, PhD, University of Arkansas*  
A clinical trial investigating the short- and long-term effects of consuming various forms of potatoes as part of low GL diets in MetS subjects on markers of cardiometabolic health, such as blood glucose and cholesterol levels. Participants will consume at least four potato meals per week as part of a low GL meal, either prepared white potatoes or processed fried potatoes.

**Cardiometabolic Benefits of Potatoes Mediated Along the Gut-Vessel Axis in Adults with Metabolic Syndrome (MetS) (2018)**  
*Richard Bruno, PhD, RD, The Ohio State University*  
A clinical trial examining potatoes in a dietary pattern based on the 2015-2020 Dietary Guidelines for Americans (DGA), in patients with MetS. The study will assess how potato resistant starch impacts the gut microbiome, which can impact cardiovascular health.

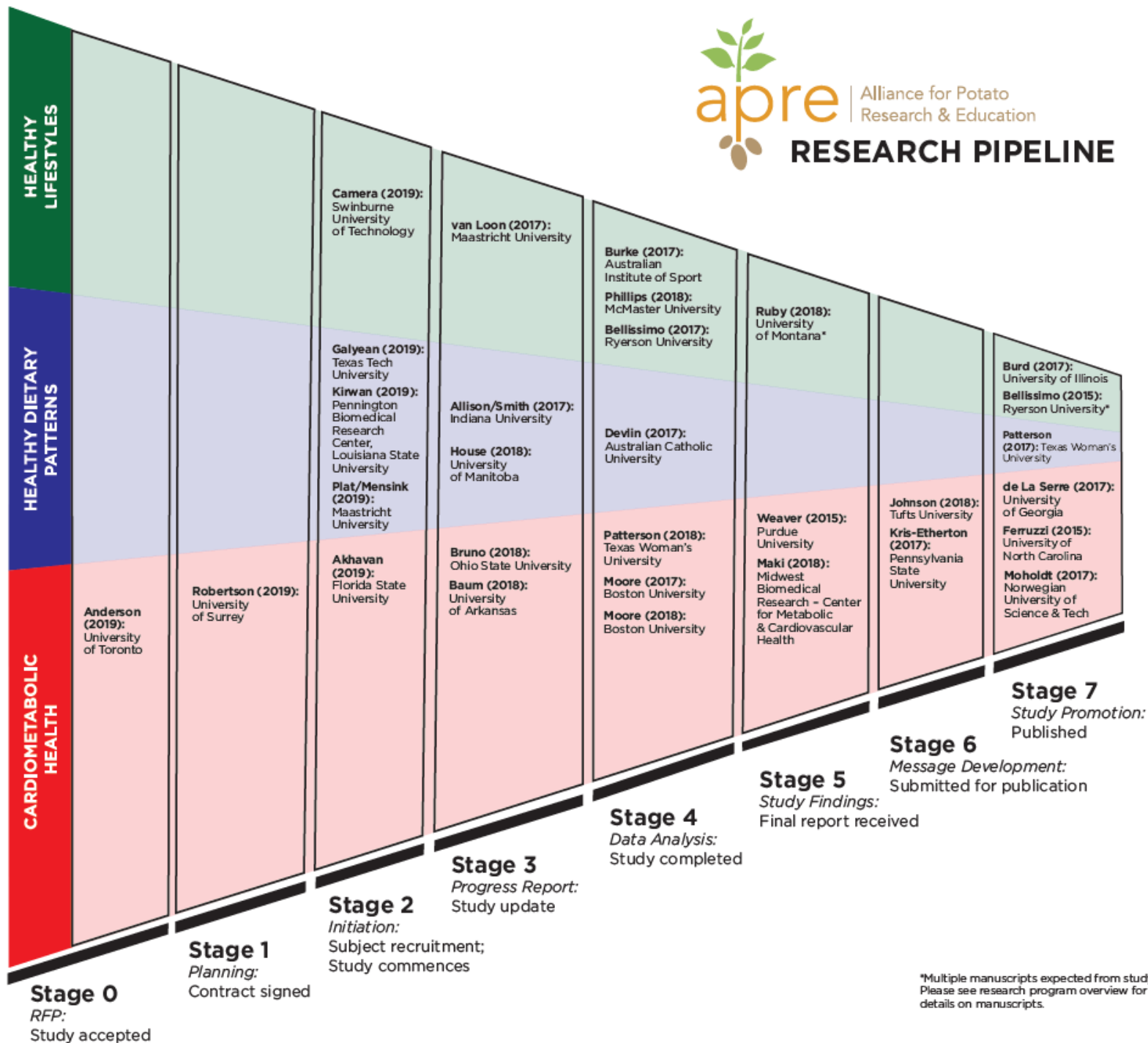
**Efficacy of Potato Resistant Starch (RS) on Improving Gut Microbiota Composition, Inflammatory Profile, and Insulin Signaling in High-Fat Fed Rats (2017)**  
*Claire de La Serre, PhD, University of Georgia*  
An animal trial conducted in rodents that will assess the impact of potato RS supplementation on changes in gut microbiota composition. The study will look at gastrointestinal function, inflammatory signaling and insulin function to understand the role of potato RS as a potent prebiotic, with potential therapeutic benefits against obesity and its associated comorbidities.  
[Published: Klingbeil, E.A., Cawthon, C., Kirkland, R., de La Serre, C.B. (2019) Potato-Resistant Starch Supplementation Improves Microbiota Dysbiosis, Inflammation, and Gut-Brain Signaling in High Fat-Fed Rats. *Nutrients*. doi:10.3390/nu11112710]

**Potato Product Form Impacts In Vitro Starch Digestibility and Glucose Transport but Only Modestly Impacts 24h Blood Glucose Response in Humans (Published)**  
*Mario Ferruzzi, PhD, North Carolina State University*  
A trial with pre-clinical and clinical components assessing the digestive release and accessibility of white potato phenols, as well as the ability of potato phenolics to impact starch digestion and glucose uptake and transport. The study will also assess the impact of potatoes on the gut microbiome.  
[Published: Min, L., George, J., Hunter, S., Hamaker, B., Mattes, R., Ferruzzi, M.G. (2019). Potato product form impacts in vitro starch digestibility and glucose transport but only modestly impacts 24h blood glucose response in humans. *Food & Function*. doi:10.1039/c8fo02530d]

**Potato Consumption and Risk of Chronic Disease: Qualitative Gap Analysis (2018)**  
*Liz Johnson, PhD, Tufts University*  
An evidence mapping project summarizing published data related to potato intake and biomarkers of health and disease over the past 10 years. The analysis will include interviews with key nutrition and health experts to identify gaps, strengths and weaknesses of currently published trials in an effort to make recommendations to help improve future studies.  
[Manuscript under review for publication in the journal *Current Developments in Nutrition*.]



# RESEARCH PIPELINE



\*Multiple manuscripts expected from study. Please see research program overview for details on manuscripts.





# 2019 Published Commentaries

## High-Quality Carbohydrates

*A Concept in Search of a Definition*

Mitchell M. Kanter, PhD

The terms "high- and low-quality carbohydrate" are often ascribed to individual foods as a means of describing the healthfulness of the food in question, without any empirical definition of what constitutes high or low quality. This article summarizes the views of experts on the concept of carbohydrate quality and the numerous factors that should be considered when assessing the quality of a carbohydrate-containing food or meal. *Nutr Today*. 2019;54(6):289–295

The implications of macronutrient intake on health and disease are controversial. In the late 1950s, Dr Ancel Keys and others<sup>1</sup> seemingly declared dietary fat "the enemy of the people," and fat consumption as a percentage of calories declined somewhat during the ensuing decades. More recently, fat's role in promoting obesity and chronic disease has been reevaluated, and advice to decrease total and saturated fat intake has been vigorously debated.<sup>2,3</sup> At the same time, some experts have questioned the overall volume of carbohydrate necessary in the diet based largely on observational data indicating a concomitant rise in carbohydrate intake (particularly low nutrient-dense carbohydrate sources) and overweight/obesity, as well as an increased prevalence in metabolic syndrome and type II diabetes.<sup>3</sup> Nevertheless, suggestions that the primary macronutrient concern should be the amount of carbohydrate one consumes are equivocal.<sup>4</sup> Those who support this perspective often do not consider data indicating calories from nearly all food groups with the exception of fruits and vegetables have increased in the recent past. Average energy intake in the United States is 700 calories per day higher than in 1950,<sup>5</sup> whereas energy expenditure has decreased.<sup>6</sup>

These issues are prompting nutrition experts to rethink the most desirable mix and volume of macronutrients for human health. Although most experts agree that a diet composed of 70% or more calories as carbohydrate is too high (this was the upper limit of recommendations often made

in the 1980s and 1990s), an "optimal" ratio of carbohydrate/fat/protein for health remains elusive. Carbohydrate intakes of 300 g/d, or approximately 40% to 60% of calories, are associated with the lowest body mass indices in adults,<sup>7</sup> and lower mortality has been associated with carbohydrate intakes providing 50% to 59% of calories.<sup>8</sup> At the same time, disappearance data from the US Department of Agriculture suggest an overall increase in caloric intake, and not the macronutrient mix, may have precipitated the rising obesity epidemic in the United States.<sup>9,10</sup>


Although much has been written in recent years about the benefits of low-carbohydrate, high-protein, and high-fat diets, most health experts continue to promote a more balanced approach with carbohydrates the predominant source of macronutrients. There seems to be no clear answer to this diet/health/disease conundrum, particularly as it relates to carbohydrate intake.<sup>11</sup>

When assessing carbohydrate needs, various factors must be considered.<sup>12</sup> Carbohydrates are not homogeneous entities, and carbohydrate-containing foods differ greatly in nutritional quality. The amount and type of sugar, starch, and fiber in a carbohydrate-containing food can greatly affect its physiological impact.<sup>13,14</sup> Lifestyle differences among people, as well as their state of health, can also affect the way that carbohydrates are assimilated and metabolized.<sup>15</sup>

With respect to carbohydrate quality, some nutritionists suggest that the glycemic index (GI), a highly labile measurement that can fluctuate based on various nutritional, lifestyle, and physiological factors, is a key metric of quality. Others have argued that nutrient density, or the chemical structure of carbohydrate foods, is more indicative of quality. This issue remains hotly debated. Does whole grain connote high quality? Quantity of fiber? Degree of processing? What role should the glycemic response play in determining carbohydrate quality? Are there other metrics that need to be considered?

*In determining carbohydrate quality, the context in which a food is consumed, its chemical composition, and its physiological impact are all important.*

## Potato as a Source of Nutrition for Physical Performance

Mitch Kanter<sup>1</sup> · Chelsea Elkin<sup>1</sup> 

Published online: 13 February 2019  
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### Abstract

Health professionals universally agree on the importance of a balanced diet, and the fallacy of relying on any one or two food groups, as the means of achieving peak physical performance and health. A review of the existing sports nutrition literature indicates that different types of athletes and physically active people may have slightly different nutritional requirements, but the main tenets of sports nutrition have not changed much over the last 25 years. The specific combinations may vary, but carbohydrates, protein, and fluids are vital components of an active individual's diet. Further, most available research supports the notion that optimal physical performance requires carbohydrate - and, specifically, high-quality, nutrient-dense carbohydrate from whole food sources, like potatoes. High-quality carbohydrate sources - foods that offer an array of macro- and micronutrients as well as energy, can help to build a strong nutritional foundation for the level of training, recovery, and adaptation that most physically active people seek to achieve. Low carbohydrate diets will not generally allow athletes to train at the intensity required to attain peak physical performance.

### Resumen

Universalmente, los profesionales de la salud están de acuerdo en la importancia de una dieta balanceada, y la falacia de confiar ya sea en uno o dos grupos de alimentos, como los medios para lograr el máximo de comportamiento físico y salud. Una revisión de la literatura existente sobre la nutrición en los deportes indica que diferentes tipos de atletas y de gente físicamente activa pudieran tener ligeramente diferentes requerimientos de nutrición, pero los principales postulados de nutrición en los deportes no han cambiado mucho en los últimos 25 años. Las combinaciones específicas pudieran variar, pero los carbohidratos, las proteínas, y los fluidos, son componentes vitales de una dieta de un individuo activo. Más aun, la mayoría de la investigación disponible respalda la noción que el rendimiento físico óptimo requiere de carbohidratos, y específicamente, de alta calidad, carbohidratos de densidad nutritiva de fuentes totales de alimentos, como las papas. Fuentes de carbohidratos de alta calidad, alimentos que ofrecen un rango de macro y micronutrientes, así como de energía, pueden ayudar a construir un cimiento fuerte nutricional al nivel de entrenamiento, recuperación, y adaptación que la mayoría de la gente físicamente activa busca lograr. Dietas bajas en carbohidratos no le permitirá generalmente a los atletas entrenar en la intensidad requerida para alcanzar el máximo de rendimiento físico.

**Keywords** High-quality carbohydrates · Potatoes · Performance

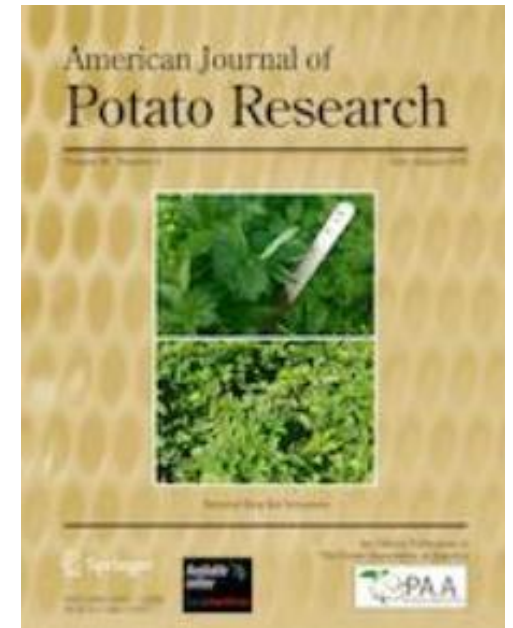
### Introduction

With increasing access to sports dietitians, personal trainers, nutrition trackers and online apps, today's athletes (from the

weekend warrior to the elite, competitive performer) are more in tune with dietary trends and open to modifying their nutritional intake than ever before. Simultaneously, low-carbohydrate diets continue to become more prevalent in mainstream conversations on nutrition. Limiting carbohydrate consumption (and total calorie intake overall) may make sense for those who are less physically active, but high-activity individuals like athletes still need high-quality carbohydrates to enhance muscle glycogen storage and to deliver carbohydrate to muscle and other organs during strenuous exercise (Helge 2017; Maughan and Shirreffs 2011).

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Mitchell M. Kanter, PhD, serves as a technical consultant to FoodMinds and as the Chief Science Officer for the Alliance for Potato Research and Education. The author discloses that the panel and article development are supported by funds from the Alliance for Potato Research and Education. The author has no other conflicts of interest to disclose. Correspondence: Mitchell M. Kanter, PhD, Food Minds, 3285 Jefferson St, Ste 750, Chicago, IL 60661 (mikanter@foodminds.com). Copyright © 2019 Wolters Kluwer Health, Inc. All rights reserved. DOI: 10.1097/NT.0000000000000377



# Ongoing Research in Various Areas

- *Potatoes and Resistant Starch\*\**
- *Potatoes and Physical Performance\*\**
- *Epidemiologic Research: Potatoes in Various Human Populations*
- *Potatoes in Overweight/Obese Subjects*
- *Potatoes in Diabetes*
- *Potatoes and Blood Pressure*
- *Potatoes as Part of a Healthy Diet*



## **Program Highlights:**

# **Resistant Starch Studies**





# What is Resistant Starch?

- *A starch that is not digested and absorbed in the stomach or small intestine*
  - *Very similar to dietary fiber*
- *Can exist naturally in some foods*
  - *Can also be formed when starch-containing foods are cooked and cooled*
- *Health implications for body weight, diabetes, heart disease, inflammation, etc.*
- *Foods high in resistant starch include:*
  - *Oats*
  - *Rice*
  - *Beans*
  - *Bananas*
  - *Corn*



# Effects of Potato Resistant Starch Intake on Insulin Sensitivity, Related Metabolic Markers and Appetite Ratings in Men and Women at Risk for Type 2 Diabetes

*Kevin Maki, PhD*

*Midwest Biomedical Research*



- *Manuscript under development*
- *Study Question:*
  - *What are the effects of eating cooked then chilled white potatoes – containing 15 grams of resistant starch (RS) – on insulin sensitivity, breath hydrogen levels (a marker of intestinal fermentation), free fatty acid levels and appetite/fullness scores compared to control meals?*
- *Key Takeaway:*
  - *Although a number of biomarkers (gut fermentation, free fatty acid levels, insulin sensitivity) changed in a direction that suggested biological benefits, no statistical differences were demonstrated between the high RS and low RS treatments in this study. Parity may be beneficial in this case.*



# Influence of Resistant Starch in Baked and Boiled Potatoes on Glycemic and Satiety Responses in Overweight Females

*Mindy Patterson, PhD, RDN  
Texas Woman's University*



- *Manuscript published in the journal Nutrients, September 2019*
- *Study Question:*
  - *Does the amount of resistant starch (RS) in a Russet potato impact blood glucose and insulin levels or gastrointestinal hormone levels in overweight females?*
- *Key Takeaway:*
  - *YES – Consuming a Russet potato that contains a higher amount of RS can positively impact the glucose and insulin responses in overweight females who are trending toward pre-diabetes or diabetes, indicating potential benefits of potatoes in this population.*



# Efficacy of Potato Resistant Starch on Improving Gut Microbiota Composition, Inflammatory Profile, and Insulin Signaling in High-Fat Fed Rats

*Claire de La Serre, PhD  
University of Georgia*



- *Manuscript published in the journal Nutrients, November 2019*
- *Study Question:*
  - *Are there health benefits associated with potato resistant starch (RS) supplementation, as part of a high-fat diet in rats, on various gut microbiome markers (gut bacteria levels, short chain fatty acid levels, inflammation, insulin resistance, food intake and body weight)?*
- *Key Takeaway\*:*
  - *YES – Potato RS displayed a number of positive health benefits when consumed by rats, as a part of a high-fat diet.*

*\*Results from animal studies are not generalizable to humans*



# Impact of potato resistant starch on various cardiometabolic (diabetes/gut) indices

## *Overall Key Takeaway*

*Collectively, the Maki, Patterson and de La Serre trials strongly suggest the potential positive benefits of potato resistant starch on various health indices. In addition to positively managing blood sugar and insulin levels after a meal, changes in food consumption, body weight, inflammation, and gut bacteria levels were also noted.*





## **Program Highlights:**

# **Exercise/Physical Performance Studies**



# Potatoes and Physical Performance

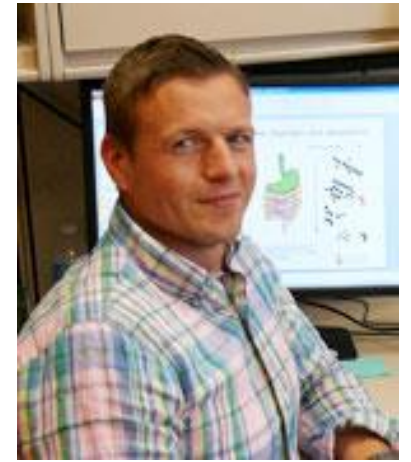
- *Research on carbohydrates and physical performance is solid*
- *Little question that carbs help fuel activity*

*...However, few studies have specifically looked at potatoes and performance*



# Ingestion of Potatoes as a Nutrition Strategy to Improve Cycling Time-Trial Performance in Endurance Trained Cyclists

*Nicholas Burd, PhD  
University of Illinois*



- *Manuscript published in Journal of Applied Physiology, October 2019*
- *Study Question:*
  - *Are potatoes as effective as a fuel source for trained cyclists during a time trial performance, compared to a commercial sports gel or water?*
- *Key Takeaway:*
  - *Yes, potatoes can be an effective fuel source and replenish energy stores as effectively as commercial sports gels and other sports nutrition products.*



# Males and Females Exhibit Similar Muscle Glycogen Recovery Across Varied Diets

*Brent Ruby, PhD, FACSM  
University of Montana*



- *Manuscript under development*
- *Study Question:*
  - *Can potatoes help the body replenish energy stores (glycogen) post-exercise as effectively as commercial sports nutrition oriented products?*
- *Key Takeaway:*
  - *Yes, potatoes can replenish muscle glycogen as effectively as commercial sports nutrition products.*



# Potato Protein Ingestion Stimulates Muscle Protein Synthesis at Rest and with Exercise in Young Women

*Stuart Phillips, PhD  
McMaster University*



## *Key Takeaways:*

- Purpose of study was to determine the effects of potato protein (PP) on muscle protein synthesis (MPS) with and without resistant exercise in healthy young women.*
- Twenty-four healthy younger women consumed either 25 g of PP twice daily or a non-protein-containing control for 3 weeks. Resistance exercise was performed thrice weekly with leg extension and leg press.*
- Consuming PP in addition to a habitual diet increased rates of MPS at rest and there was a further increase with REX.*
- PP may serve as a high-quality, vegetable-based protein supplement to augment muscle protein anabolism in healthy young women.*
- Study will be presented at American College of Sports Medicine meeting May 2020.*





# Looking Forward...

- *Multiple other studies in the pipeline looking at various aspects of potatoes on general health & disease.*
- *Will continue to publish data as it becomes available.*
- *Keep the industry apprised of updates.*



# Potatoes and Quality Carbohydrate Foods

## Addressing Misperceptions and Elevating Science on the Role of Quality Carbohydrates in Health



American Journal of Potato Research  
April 2019, Volume 96, Issue 2, pp 201-205 | [Cite as](#)

### Potato as a Source of Nutrition for Physical Performance

Authors Authors and affiliations

Mitch Kanter, Chelsea Elkin

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### Abstract

Health professionals universally agree on the importance of a balanced diet, and the fallacy of relying on any one or two food groups, as the means of achieving peak physical performance and health. A review of the existing sports nutrition literature indicates that different types of athletes and physically active people may have slightly different nutritional requirements, but the main tenets of sports nutrition have not changed much over the last 25 years. The specific combinations may vary, but carbohydrates, protein, and fluids are vital components of an active individual's diet. Further, most available research supports the notion that optimal physical performance requires carbohydrate - and, specifically, high-quality, nutrient-dense carbohydrate from whole food sources, like potatoes. High-quality carbohydrate sources - foods that offer an array of macro- and micronutrients as well as energy, can help to build a strong nutritional foundation for the level of training, recovery, and adaptation that most physically active people seek to achieve. Low carbohydrate diets will not generally allow athletes to train at the intensity required to attain peak physical performance.



2020 Session  
Proposals

Global Carb Expert  
Collaborations



# Quality Carb Scientist Engagement



- *Interviews*

- *Briefings*

- *AJCN Editorial (exploring)*







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NUTRITION SCIENCE

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Dedicated to advancing the scientific understanding of the role potatoes play in promoting the health of all people.

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# Thank You!

