## **HEALTH & WELLNESS WEBINAR**

# **EXPLORING THE POWER OF FLAVONOIDS:** The Latest Research, Health Benefits and Practical Applications









## **KATIE CALLIGARO**

Director, Have A Plant<sup>®</sup> Marketing & Communications



# ABOUT HAVE A PLANT® PROGRAMS

Have A Plant<sup>®</sup> Programs can help you achieve your strategic goals all while growing a healthier world. Now a part of The International Fresh Produce Association's <u>Foundation For Fresh Produce</u> (FFP), Have A Plant Programming remains committed to helping consumers live happier, healthier lives by creating compelling content and distributing science-based, consumer focused resources and food, nutrition and health influencer engagement throughout our social media channels.



TOGETHER, we will forge alliances, increase access, and grow appeal to increase fruit and vegetable consumption for a healthier world.



## THE AWARD-WINNING HAVE A PLANT® MOVEMENT REACHES MILLIONS

The award-winning Have A Plant<sup>®</sup> Movement is a way to inspire lasting behavior change by tapping into the emotional connection consumers have to the fruit and vegetable eating experience.

Have A Plant<sup>®</sup> Programs are an undeniable resource for health & wellness professionals, given its trusted thirdparty credibility, breadth of nutrition and behavioral research, and strong consumer, influencer and industry reach.

#### **3.86 Billion**

social media impressions & traditional media impressions since the 2019 launch





Promoting excellence in agricultural public relation





#### Have A Plant<sup>®</sup> Programs deliver innovative research as well as unique fruit and veggie insights and communication tools.



#### **Educational Resources**

fruitsandveggies.org/educational-resources









# HOUSEKEEPING

1 CPEU available through the Commission on Dietetic Registration (CDR) You will receive a link to the certificate of attendance, the webinar recording and PDF of the presentation within 48-72 hours.

Type your questions and/or comments into the Q&A section located at the bottom of your screen at any time during the webinar.

# **TODAY'S PANELISTS**



#### Aedin Cassidy, PhD

Queen's University Belfast, Ireland Mascha Davis, MPH, RDN

Nomadista Nutrition



## **EXPLORING THE POWER OF FLAVONOIDS:** The Latest Research, Health Benefits and Practical Applications

## **AGENDA**

- Introduction: The importance of bioactives •
- Overview of new flavan-3-ol guidelines ٠
- Flavonoid gap •
- Types of flavonoid-rich foods •
- State of the research: Dietary flavonoids & • health
- Practical applications •
- Summary •
- Q&A ٠





## **LEARNING OBJECTIVES**

- Outline new research findings related to the association between eating flavonoid-rich foods and various health conditions
- Develop an understanding for the latest nutrition data and health benefits of flavonoid-rich foods
- Identify new strategies to incorporate flavonoid-rich foods, like blueberries, into menus and eating plans for clients and patients





## DISCLOSURES

#### Dr. Cassidy:

• Member of the USHBC Scientific Advisory Board

#### Mascha Davis:

- Forbes Health Advisory Board Member
- Former National Media Spokesperson for the Academy of Nutrition & Dietetics
- Author: Eat Your Vitamins, Simon & Schuster, 2020
- Founder and CEO of Nomadista Nutrition, Inc.
- Former & Current Brand Partnerships: Califia Farms, Align Probiotics,, Azuluna, Barilla, Carbon Health, Dutch Yellowtail, Goldthread, Jarrow, Kori Krill Oil, Life-force, Milton's, Nature's Logic, Pure Synergy, Quaker, RIND, Ritual, Silk, Sparkle Collagen, Teeccino, Troop, Whole Earth, Zing, Alliance for Food and Farming, NOW! Foods



# INTRODUCTION

## THE IMPORTANCE OF BIOACTIVES

**Bioactives:** "Constituents in foods other than those needed to meet basic human nutritional needs yet responsible for changes in health status."

#### **Types of Bioactive Compounds**



#### Flavonoids

Biologically active compounds **found in plants** that have been associated with a **decreased risk of some age related and chronic diseases** in humans.

۶<sup>,5</sup>,5

#### **Flavan-3-ols Sub-group of flavonoids**, most widely consumed secondary plant metabolite in the flavonoid family.



#### Anthocyanins

A group of **deep red**, **purple and blue pigments** found in plants, also considered a sub-group of flavonoids.



Khoo, Hock Eng et al. "Anthocyanidins and anthocyanins: colored pigments as food, pharmaceutical ingredients, and the potential health benefits." Food & nutrition research vol. 61,1 1361779. 13 Aug. 2017, doi:10.1080/16546628.2017.1361779

Aron, Patricia M, and James A Kennedy. "Flavan-3-ols: nature, occurrence and biological activity." Molecular nutrition & food research vol. 52,1 (2008): 79-104. doi:10.1002/mnfr.200700137 S.E. Gebhardt, et al. USDA's Flavonoid Database: Flavonoids in Fruit. 2003. PDF.

## **NEW FLAVAN-3-OL GUIDELINES**

- First intake recommendation around a nonessential set of nutrients
- Not based on deficiencies, but rather an improvement in health outcomes
- Food-based guideline, does not apply to supplements

### **Advances in Nutrition**

AN INTERNATIONAL REVIEW JOURNAL A journal of the American Society for Nutrition

#### Flavan-3-ols and Cardiometabolic Health: First Ever Dietary Bioactive Guideline

<u>Kristi M Crowe-White</u> ♀ ⊠, <u>Levi W Evans, Gunter G C Kuhnle, Dragan Milenkovic, Kim Stote,</u> <u>Taylor Wallace, Deepa Handu, Katelyn E Senkus</u>

Based on moderate quality research, consumption of **400mg – 600mg daily** of flavan-3-ols may reduce the risk associated with cardiovascular disease and diabetes.



Crowe-White, Kristi M et al. "Flavan-3-ols and Cardiometabolic Health: First Ever Dietary Bioactive Guideline." Advances in nutrition (Bethesda, Md.) vol. 13,6 (2022): 2070-2083. doi:10.1093/advances/nmac105

## THE FLAVONOID GAP

## Average intake of total flavonoids in the U.S. lower than the UK and Australia





Bondonno, Nicola P et al. "Change in habitual intakes of flavonoid-rich foods and mortality in US males and females." BMC medicine vol. 21,1 181. 12 May. 2023, doi:10.1186/s12916-023-02873-z



## TYPES OF FLAVONOID-RICH FOODS





Haytowitz, David B., Wu, Xianli, Bhagwat, Seema. USDA Database for the Flavonoid Content of Selected Foods, Release 3.3. Database. Beltsville: U.S. Department of Agriculture, Agricultural Research Service, 2018. PDF.

## **A CLOSER LOOK AT BLUEBERRIES**

#### GET 4 ESSENTIAL NUTRIENTS.

#### Fiber

Heart health, feeling full, staying regular, keeping cholesterol in check

#### Vitamin C

A healthy immune system

Vitamin K Bone metabolism, regulating blood clotting

#### Manganese

Converting proteins, carbs and fats into energy, bone development

<b>Nutrition</b> F	acts
servings per container <b>Serving size</b>	(148g)
Amount per serving Calories	80
	% Daily Value*
Total Fat 0.5g	1%
Saturated Fat 0g Trans Fat 0g	0%
Cholesterol 0g	0%
Sodium Omg	0%
Total Carbohydrate 21g	8%
Dietary Fiber 4g	14%
Total Sugars 15g	
Added Sugars 0g	0%
Protein 1g	
Vitamin D 0mcg	0%
Calcium 10mg	0%
Iron 0.4mg	2%
Potassium 110mg	2%
Vitamin A 0mcg	0%
Vitamin C 14mg	15%
Manganese 0.5mg	20%
Vitamin K 29mcg	25%
* The % Deily Value (D)A talls you have	much a putrient





#### Good Source of Fiber



Good Source of Vitamin C



Excellent Source of Vitamin K



Excellent Source of Manganese



U.S. Highbush Blueberry Council. "Blueberry Benefits at a Glance." n.d. Health Benefits of Blueberries. https://healthprofessionals.blueberry.org/all-resources/health-benefits-of-blueberries/. 10 August 2023.

## BLUEBERRIES MAY CONTRIBUTE TO BENEFICIAL HEALTH OUTCOMES

## Know we're always learning more.

Blueberries may promote good health in additional ways. Areas of research:





Cardiovascular Health

Brain Health



**Healthy Living** 



Insulin Response



Gut Health





# STATE OF THE RESEARCH



## DIETARY FLAVONOIDS & HEALTH

The Emerging Role for Anthocyanins **Aedín Cassidy, PhD** 



#### **IMPORTANCE OF PREVENTIVE MEDICINE**

#### FOOD IS MEDICINE





# % of men and women worst-case projections

2010

Obesity trends and projections

10

1993

2000

Source: Health Survey for England

By 2050: 9/10 adults, 2/3 children



Not a longer life but a **healthy old age 18%** GDP spent on healthcare **3.5%** healthcare expenditure on prevention Time for shift in focus ... **importance of FOOD** 

2030



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Prevention nutritional deficiencies Over & under nutrition Reduction in risk of disease/Preventive Medicine Stratified nutrition Individual variability Life stage Develop food-based dietary guidelines



#### Integrating totality of evidence for policy

Mechanisms

#### **Evidence-based Nutrition Research**





THE INSTITUTE FOR GLOBAL FOOD SECURITY

#### SUB-OPTIMAL DIET – KEY FACTOR IN GLOBAL BURDEN OF DISEASE

## **11 million**

chronic disease deaths due to sub-optimal diet per year

# Do all fruits provide the same health benefits?





Afshin et al 2019 Lancet

#### SPECIFIC FRUIT INTAKE & TYPE 2 DIABETES

Reduction in risk for every 3 servings/week

Muraki et al BMJ 2013

## Total fruit – **2%** Blueberries – **26%**

187,382 participants





## SPECIFIC FRUIT INTAKE & WEIGHT MAINTENANCE

# Most adults gain weight with age

Small increase substantial impact on health/mortality

Strategies to maintaining a healthy weight key



# What constituents of these fruits is responsible?



HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

## **DIETARY FLAVONOIDS**







## **A CLOSER LOOK AT ANTHOCYANINS**



- Coloration: red/blue pigmentation, ٠ attract pollinators
- Role in stress defense ٠
- Flavor •







THE INSTITUTE FOR GLOBAL

#### WHAT HAPPENS WHEN WE EAT ANTHOCYANINS?

- Extensive metabolism (anthocyanins)
- Large % reaches gut
- Wide variability in metabolism
  - Microbial-metabolism and health





- Anti-inflammatory
- Improve insulin sensitivity
- Improve blood flow, blood pressure
- Weight maintenance

#### Metabolites, particularly gut-derived – key for biological effects?



## THE GROWING EVIDENCE-BASE FOR ANTHOCYANINS

#### **Population Studies**

Higher habitual intakes reduce risk

- CVD
- Type 2 diabetes
- Parkinson's

#### **Clinically Relevant Improvements**

Pooled data - 44 clinical trials

Supplement and food

- ✓ Improve cholesterol
- ✓ Lower inflammation
- Improve blood flow and elasticity of blood vessels







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## **PROSPECTIVE COHORT STUDIES**

#### Diet/Lifestyle Changes and Long-Term Health Outcomes

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**U.S. Highbush Blueberry Council** 

Genetics, biomarkers, gut microbiome





## **POPULATION-BASED STUDIES: HABITUATED ANTHOCYANIN INTAKES & CARDIOMETABOLIC HEALTH**

#### **Reduction in Risk Comparing Q5 vs. Q1**



#### **Weight Maintenance**

- Over each 4-yr period, men gained 2.2 lbs, women 4.4 lbs
- Higher anthocyanin intake maintained weight
- Small increase in intake substantial weight change population level
- Maintenance important goal for health

#### **Higher Intake**

- Lower fat mass
- Discordant twins







Bertoia et al 2016 BMJ, Jennings 2018 AJCN

## ANTHOCYANINS & HEART HEALTH – SYSTEMATIC REVIEW





#### **44 Trials**

Clinically relevant changes

- LDL-Cholesterol: -5.4 mg/dL
- Triglycerides: -6.2 mg/dL
- HDL-cholesterol: 11.5 mg/dL
- Decreased proinflammatory cytokines (TNFa, CRP)
- No effect BP, FMD, BMI
- Dose important >200mg/d for LDL-cholesterol lowering





## CLINICALLY SIGNIFICANT IMPROVEMENTS IN ROBUST VASCULAR MEASURES

#### 1 Cup Per Day

- Sustained improvement in blood flow
- Arteries more flexible (arterial stiffness)
- HDL-Cholesterol increased
- 115 Overweight men and women metabolic syndrome 6-month intervention





Curtis et al 2019 Am J Clin Nutr

1. Rodriguez-Mateos (2013); 2. Hooper (2012); 3. Inaba (2010); 4. McAnulty (2014); 5. Riso (2013); 6. Zhu (2017).

## DO BLUEBERRIES REDUCE THE DELETERIOUS ACUTE POSTPRANDIAL EFFECTS OF ENERGY DENSE MEALS?

#### How Does the Body Respond After a High Fat Meal?

- Predominantly postprandial state during waking hours
- Postprandial increases in lipids/ glucose – raise heart disease risk



#### Single Cup Serving Blueberries Compared to a High Calorie, High Fat, High Sugar Meal

Reduced acute postprandial responses

- Improved glucose control
- Reduced insulin
- Improved HDL-Cholesterol







## **ANTHOCYANINS & TYPE 2 DIABETES**



#### Systematic Review of 3 Cohort Studies

Decrease in Risk of T2DM

Comparing highest vs. lowest intake quintile Biomarkers of Glycemic Control/Glucose Metabolism Systematic Review of Trials



Fasting blood glucose



2 hr. post prandial glucose



Fasting insulin and c-peptide – no effect

#### Intakes > 8 weeks, >300mg/d intake

In healthy participants, T2DM patients, overweight/obese



15%

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Guo et al 2016, Bondonno et al 2021, Fallah et al 2020

#### **DOES CHANGING YOUR DIET IN MID-LIFE MATTER?**

#### All-Cause Mortality



56,253 women, 30,182 men – 8-yr change in intake and subsequent 8-yr risk of all-cause mortality 23,545 deaths, compared to no change in intake

- Eating behaviors change over time
- Changing from low-high consumer has real impact on health even in mid-life
- Developed a novel 'Flavodiet' score



Bondonno et al 2023, BMC Medicine





#### **DOES CHANGING YOUR DIET IN MID-LIFE MATTER?**



56,253 women, 30,182 men – 8-yr change in intake and subsequent 8-yr risk of all-cause mortality 23,545 deaths, compared to no change in intake





**'Flavodiet' Score** 



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Eating More Anthocyanins Improves Survival Rate Effects more pronounced in men, Q4 vs. Q1

#### PARKINSON'S DISEASE

People With Parkinson's Who Eat a Diet Rich in Berries and Red Wine May Live Longer

TOPICS: American Academy Of Neurology Flavonoids Neuroscience Nutrition Parkinson's Disease

By AMERICAN ACADEMY OF NEUROLOGY JANUARY 26, 2022



**blue**berries U.S. Highbush Blueberry Council Gao et al 2012, Zhang et al 2022 Neurology

## WHAT HAPPENS WHEN WE EAT ANTHOCYANINS?



- Extensive metabolism (anthocyanins)
- Large % reaches gut
- Wide variability in metabolism
- Microbial-metabolism and health

- Anti-inflammatory
- Improve insulin Sensitivity
- Improve blood flow, BP
- Weight maintenance





#### What is the role of the gut microbiome?

## DIET, GUT MICROBIOME & HEALTH

Minimally processed, plant-based diet is good for the gut microbiome and for reducing disease risk.







#### FLAVONOIDS, MICROBIAL DIVERSITY & BLOOD PRESSURE

15%





Higher Habitual Intake – Clinically Relevant Improvement in BP and Pulse Pressure Greater microbial diversity and lower abundance of Parabacteroides



1.5 portions per day 4mmgHg reduction SBP



3 g 3.

3 glasses/week 3.7mmgHg reduction SBP Microbial Diversity and Abundance of *Parabacteroides* Mediate the Associations Between Higher Intake of Flavonoid-Rich Foods and Lower Blood Pressure

Amy Jennings, Manja Koch, Corinna Bang, Andre Franke, Wolfgang Lieb, Aedin Cassidy Originally published 23 Aug 2021

PopGen cohort n >900

## FLAVONOIDS, MICROBIAL DIVERSITY & BODY COMPOSTION 18%





#### Higher Habitual Intake – Lower Abdominal Fat

18% of association between intake and abdominal fat explained by gut microbiome

PopGen cohort n=618 MRI determined visceral (VAT) and subcutaneous (SAAT) adipose tissue



Jennings et al 2020 Am J Clin Nutr



## **KEY TAKEAWAYS**

- Building a high-quality evidence base
- Mounting evidence for health effects: cardiovascular, type 2 diabetes, weight management (Population based data, predominantly short-term clinical studies, mechanism of action)
- Growing evidence neurological diseases, respiratory conditions
- Impact of interindividual variability in metabolism on clinical efficacy – next step
- Precision nutrition: Role of variation in microbiome on metabolism and health



Optimal dose for health benefit may vary



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# PRACTICAL APPLICATIONS

## **THE FRUIT & VEGGIE GAP**

9 out of 10 Americans are *not* eating enough fruit and veggies

Flavonoids are most prominent in plant-based foods

Perceived barriers to consumption include cost, availability and access



Seung Hee Lee, Latetia V. Moore, Sohyun Park, Diane M. Harris, Heidi M. Blanck. "Adults Meeting Fruit and Vegetable Intake Recommendations — United States, 2019." Morbidity and Mortality Weekly Report. 2022. https://www.cdc.gov/mmwr/volumes/71/wr/mm7101a1.htm?s\_cid=mm7101a1\_w.

## BERRIES, ESPECIALLY BLUEBERRIES, ARE UNIQUELY HIGH IN ANTHOCYANINS

Fruit	Anthocyanins (mg/100g)	Fruit	Anthocyanins (mg/100g)
Blueberries	163.3	Pears	2.1
Blackberries	100.6	Peaches	1.9
Raspberries	48.6	Apples	1.6
Grapes, red	48.0	Bananas	0
Cherries	31.9	Oranges	0
Strawberries	27.0	Cantaloupe	0



Haytowitz, David B., Wu, Xianli, Bhagwat, Seema. USDA Database for the Flavonoid Content of Selected Foods, Release 3.3. Database. Beltsville: U.S. Department of Agriculture, Agricultural Research Service, 2018. PDF.

## **THE IMPORTANCE OF ANTHOCYANINS**

#### Anthocyanin intake is associated with numerous health benefits







Xu, Lin et al. "Anthocyanins, Anthocyanin-Rich Berries, and Cardiovascular Risks: Systematic Review and Meta-Analysis of 44 Randomized Controlled Trials and 15 Prospective Cohort Studies." Frontiers in nutrition vol. 8 747884. 15 Dec. 2021, doi:10.3389/fnut.2021.747884

## IMPORTANCE OF BERRIES RECOGNIZED IN GLOBAL GUIDELINES

- Nordic Nutrition recommendations were published on June 20th
- Recommends consuming a variety of vegetables, fruits, and berries, 500-800 grams, or more, per day in total
- Differentiates berries separately from the broader fruit and vegetable category

"Berries, such as blueberries, strawberries, blackberries, and cranberries, stand out with a particularly high content of phytochemicals such as flavonoids, ellagitannins, and phenolic acids."

NORDIC NUTRITION

RECOMMENDATIONS

INTEGRATING ENVIRONMENTAL ASPECTS

Nordic Council of Ministers

2023





Rosell, M., & Fadnes, L. T. (2023). Vegetables, fruits, and berries. Draft Background Paper. Nordic Nutrition Recommendations 2023. Nordic Council of Ministers.

## TIPS TO ENCOURAGE MORE FLAVONOID-RICH FOODS

Sip on Tea	<sup>555</sup>	Enjoy a daily cup of hot or iced black or green tea with or between meals
Frozen Blueberries		Picked at the peak of freshness and individually quick frozen to help preserve taste, durability and nutrition
Try a New Topping		Add fresh or frozen blues to plain yogurt, waffles or pancakes to reduce added sugar
Salad Dressings	$\bigcup^{}$	Mix pureed blueberries with olive oil and balsamic vinegar for a tangy dressing
Smush Up Your PB&J		Ditch the jelly and mash up fresh blueberries instead

### **MUST-TRY DELICIOUS RECIPES**



Easy Blueberry Cream Cheese & Bagels



No-Bake Blueberry Coconut Energy <u>Balls</u>



No-Bean Blueberry Chili



Salmon with Blueberry Balsamic Glaze

For more recipes visit: <u>https://blueberry.org/recipes</u>



## **SUMMARY / ACTIONABLE STEPS FOR RDs**

#### Raise Awareness/Educate Health Professionals

A dietary pattern higher in flavonoid-rich foods and beverages, including blueberries, can offer distinct health benefits



#### Encourage Small Shifts for Behavior Change

It is important to meet people where they are – making small positive shifts that can result in lasting dietary improvements

 $\longleftrightarrow$ 

#### Pick Actions that Build Upon Existing Routines

Being able to "piggyback" onto current habits can be more effective than promoting a brand-new behavior









# JOIN THE MOVEMENT



Show your support by joining the Have A Plant<sup>®</sup> community at <u>fruitsandveggies.org/jointhenetwork</u>

And don't forget to follow our social channels to keep up to date on all the insights and inspiration! #haveaplant September is National Fruits & Veggies Month (NFVM) and each year we celebrate Have A Plant<sup>®</sup> during this monumental moment as a way to elevate fruit and vegetable consumption to a national priority.

**SEPTEMBER IS NATIONAL** 

**FRUITS & VEGGIES** 

MONTH #NFVM2023 #HAVEAPLANT

Start planning for NFVM 2023 now! #NFVM2023



#### Looking For Additional FREE Continuing Professional Education Opportunities? <u>fruitsandveggies.org/educational-resources/webinars</u>

#### Visit PBH's on-demand catalog of webinars on various fruit and vegetable topics including:

- Hacks To Habits: Unpacking The Research For Retail, Foodservice & Communication Professionals
- Managing Scientific Whiplash: The Evolution Of Dietary Fat & Cholesterol Research
- Spreading The Sustainability Story: Plant, Packaging, Planet & People Perspectives
- And Many More!





# THANK YOU!

We live at the center of produce, partnership and passion.

## WE ARE SO HAPPY YOU'RE WITH US!

