Drink Your Fruits & Veggies Telling The Truth About 100% Juice Presented by Dr. Mario Ferruzzi and Diane Welland, MS, RD



PRODUCE FOR® BETTER HEALTH FOUNDATION



Moderator

Wendy Reinhardt Kapsak, MS, RDN President & CEO Produce for Better Health Foundation



PRODUCE FOR® BETTER HEALTH

Our Purpose

The Produce for Better Health Foundation (PBH), a 501(c)3, is the only national non-profit organization committed to helping people live happier, healthier lives by eating more fruits and vegetables in all their glorious forms every day.

> PRODUCE FOR® BETTER HEALTH FOUNDATION

Our Movement

Research shows, rather than a prescriptive recommendation to eat a certain amount of fruits and vegetables each day, consumers (particularly Gen Z and Millennials) want actionable, realistic and FUN approaches that make eating fruits and vegetables easy, helping them feel confident, happy and healthy.

That's where **PBH's Have A Plant® movement** comes in. It's a way to tap into the emotional connection consumers have to the fruit and vegetable eating experience while inspiring long-term, sustainable behavior change. And it does so with a no-nonsense approach that's simple, understandable, and, importantly for this audience, non-prescriptive.

have a

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! Type your questions into the Question box at the bottom of your Control Panel at any time during the webinar.



WEBINAR | Tuesday, August 25, 2pm EST

Drink Your Fruits & Veggies Telling the Truth About 100% Juice

Presented by Dr. Mario Ferruzzi and Diane Welland, MS, RD



PRODUCE FOR® BETTER HEALTH FOUNDATION

Today's Speakers





Diane Welland, MS, RD Director of Nutrition Communications Juice Products Association/Sip Smarter

Mario G. Ferruzzi, PhD Professor North Carolina State University



100% Juice Processing and Whole Fruit What Really Happens?



Mario G. Ferruzzi, PhD

North Carolina State University Department of Food, Bioprocessing and Nutrition Science Plants for Human Health Institute Kannapolis, NC

Disclosures: M.G. Ferruzzi

Financial Relationship (prior 12 months)	Commercial Interest
Grant/Research Support	Welch's Foods; PepsiCo; Pioneer Foundation
Scientific Advisory Board/ Consultant/Board of Directors	Florida Department of Citrus (Scientific Advisory Committee); Sensient Technologies (Board of Directors) International Life Science Institute-NA (Board of Trustees) Chlorox
Speakers	Unilever; Welch's Foods; Council for Responsible Nutrition; International Food Information Council; Tate & Lyle; Juice Product Association
Stock Shareholder	Sensient Technologies
Employee	None
Other	None

Dietary Guidance for Fruit and 100% Fruit Juice





- Dietary Guidelines for Americans recommends consumption of 2 cup equivalents of fruits per day from whole fruit or 100% juice
- Recommendation is that at least half of the servings come as whole or cut fruit
- Cup is equivalent to:
 - ~175 g of whole or cut fruit
 - ~240 mL of 100% fruit juice

Fruit and vegetable consumption is well known to provide many health benefits

Chronic disease	Fruit and vegetables						
	Strength of evidence ^b	Study type	Source				
Cardiovascular disease	Convincing	Meta-analysis	Zhan et al. 2017				
Coronary heart disease	Convincing	Meta-analysis	Gan et al. 2015				
Hypertension	Convincing	Meta-analysis	Wu et al. 2016				
Stroke	Convincing	Meta-analysis	Hu et al. 2014				
Asthma	Possible	Meta-analysis	Seyedrezazadeh et al. 2014				
Obesity	Possible	Meta-analysis	Schwingshackl et al. 2015				
Type II diabetes	Convincing	Meta-analysis	Wu et al. 2015				
		Critical review	Boeing et al. 2012c				
Cognitive impairment	Convincing	Meta-analysis	Jiang et al. 2017d				
Osteoporosis	Possible	Prospective cohort	McTiernan et al. 2009				
		Longitudinal cohort	Tucker et al. 1999				
Eye disease	Possible	Cross-sectional study	Moeller et al. 2004e				
		Case control	Seddon et al. 1994				
Arthritis	Possible	Prospective cohort	Cerhan et al. 2003				





DIABETES

LOVE YOUR BONES



Fruit and fruit juices as a source of bioactive (example: phenolics)



Perceptions of 100% juice and processing influence the "perceived" healthiness of juice products



Whole food No additives Nutrient Dense Bioactive Rich

Unhealthy Higher in Sugar Poor source of nutrients Loss of health benefits

Fruit and 100% fruit juice consumption is associated with many health benefits

Special Article

Potential health benefits of (poly)phenols derived from fruit and 100% fruit juice

Kacie K.H.Y. Ho, Mario G. Ferruzzi, and JoLynne D. Wightman

(Poly)phenol-rich diets have been associated with reduced risk of various diseases. Coffee and tea are typically identified as dietary sources of chlorogenic acid and flavan-3-ols; however, 100% fruit juice greatly contributes to anthocyanin, flavonol, flavan-3-ols; and flavanone intake, making them complementary sources of dietary (poly)phenols. Thus, the aim of this narative review was to provide an overview of fruit (poly)phenols and their potential health benefits. Fruit (poly)phenols have been associated with several health benefits (eg, reduced risk of cardiovascular disease and neurocognitive benefits). Although perspectives on 100% fruit juice consumption are controversial due to the perception of sugar content, growing evidence supports the role of fruit in whole and 100% juice forms to provide consumer benefits in alignment with dietary guidance. However, differences in (poly)phenol profiles and bioavailability likely exist between whole fruit and 100% fruit juice due to processing and the presence/absence of fiber. Ongoing studies are better defining similarities and differences between whole fruit and 100% fruit juice to elucidate protective mechanisms and align with processing and consumer products.

General Conclusions

"dark-colored fruits and their corresponding 100% fruit juices contribute a unique array of (poly)phenols to the human diet that is not delivered by other commonly consumed (poly)phenol-rich sources (eg, coffee, tea, cocoa)."

"evidence suggests that consumption of approximately 1–2 cups/day of dark-colored whole fruit or 100% fruit juice provides potential benefits to human health"



What is 100% Fruit Juice Really?

• 100% Juice (Not from Concentrate)

Juices directly expressed from a fruit or vegetable (i.e., not concentrated and reconstituted) shall be considered to be 100 percent juice and shall be declared as "100 percent juice"

Reconstituted From Concentrate

FDA calculates the labeled percentage of juice from concentrate found in a juice or juice beverage using the minimum Brix levels listed below where singlestrength (100 percent) juice has at least the specified minimum Brix

21 CFR 101.30



Fruit	100% Juice Minimum Brix		
Apple	11.5		
Banana	22.0		
Blueberry	10.0		
Cranberry	7.5		
Grape	16.0		
Grapefruit	10.0		
Lemon	4.5		
Mango	11.8		
Orange	11.8		
Pear	12.0		
Pomegranate	16.0		

Unit operations in production of 100% fruit juices



Common themes in 100% fruit juice processing

- Obtaining mature and high quality fruit
- Efficient expressing of the juice
 - Enzyme Treatment (Extraction Efficiency)
- Clarification of the juice
 - Filtration
 - Enzyme Treatment (Clarification/Stabilization)
- Concentration (if needed)
- Thermal Processing-Pasteurization
- Packaging/storage



<u>Values</u>

Quality from the farm



Enhance yield to minimize waste

Preserve Product Quality

Provide Value and Convenience for Consumer



Comparing fruit and fruit juices as a source of nutrients

	Oranges			Apples		
	½ cup sections	½ cup FJ	1 small	½ cup slices	½ cup FJ	1 small
Servings (weight)	82.5 g	124.5 g	140 g	54.5 g	124 g	149 g
Energy (kcal)	40	61	69	28	57	77
Carbohydrate (g)	10.35	14.37	17.56	7.53	14.01	20.58
Sugars, total (g)	7.01	10.35	11.90	5.66	11.93	15.48
Dietary Fiber, total (g)	1.8	0.4	3.1	1.3	0.2	3.6
Calcium (mg)	35	14	60	3	10	9
Magnesium (mg)	9	14	15	3	6	7
Potassium (mg)	137	222	232	58	125	159
Vitamin A, RAE (mcg)	10	2	17	2	0	4
Vitamin C (mg)	48.8	41.8	82.7	2.5	47.7	6.9
Folate, DFE (mcg)	28	24	48	2	0	4

All fruits, and forms of fruit contribute to recommended fruit servings and nutrient adequacy

There is natural variation in nutrient profiles based on (1) **fruit types** and (2) "typical" fruit serving sizes **vary in gram weights** by food form

On a per serving basis one small fruit, or ½ cup of whole fruit are consistent with ½ cup of 100% FJ.

Fruit and fruit juices as a source of bioactive (example: phenolics)

Database value	Unit	Apple ^a	Apple (1/2 cup, slices)ª	Apple juice (1/2 cup) ^b	Oranges, raw, navels (Citrus	Orange (1/2 cup sections w/o	Orange juice (1/2 cup) ^a	Grapes, red, raw ^{ac}	Grapes (16 grapes) ^{ac}	Grape juice (1/2 cup) ^a
					sinensis) ^a	membranes) ^a				
Weight	g	100	100	124	100	92.5	124.5	100	78.4 ^e	126.5
Anthocyanidins										
Cyanidin	mg	0-4.9	0-2.695	NA	0	0	0	0.08-1.16	0.06-0.91	0.05-1.13
Delphinidin	mg	NA	NA	NA	0	0	NA	2.27	1.78	0.13-2.43
Malvidin	mg	NA	NA	NA	0	0	NA	0.10-39	0.07-30.58	0.10-0.13
Pelargonidin	mg	NA	NA	NA	0	0	NA	0.02	0.02	0-0.03
Peonidin	mg	NA	NA	NA	0	0	NA	0.01-3.62	0.01-2.84	0.22-1.34
Petunidin	mg	NA	NA	NA	0	0	NA	1.97	1.54	0.13-1.29
Flavan-3-ols										
Epicatechin	mg	1.8-19.16	0.99-10.54	11.20	0	0	NA	0.01-0.96	0.01-0.75	0-0.71
Catechin	mg	0-3.4	0-1.87	5.72	0	0	NA	0.01-0.82	0.01-0.64	0.22-1.04
Gallocatechin	mg	NA	NA	0	0	0	NA	NA	NA	0
Procyanidins ^d	mg	14.56-93.96	8.01-51.68	11.91-27.02	0	0	0	46.69	36.60	59.06
Flavonols										
Kaempferol	mg	NA	NA	NA	0.13	0.12	NA	0.003	0.003	0.01
Myricetin	mg	NA	NA	NA	0.15	0.14	NA	0.01	0.008	0.89
Quercetin	mg	0.52-19.76	0.29-10.87	1.29	0.45	0.42	0.50	0.02-1.04	0.02-0.82	0.11-0.91
Flavanones										
Hesperetin	mg	NA	NA	NA	21.87	20.23	20.39	NA	NA	NA
Naringenin	mg	NA	NA	NA	7.1	6.56	3.187	NA	NA	NA
Naringin	mg	NA	NA	NA	NA	NA	NA	NA	NA	NA
Stilbenes										
Resveratrol	mg	NA	NA	NA	NA	NA	NA	0.001	0.00078	NA

^aPhytochemical values were derived from the USDA Database for the Flavonoid Content of Selected Foods¹¹

^bPhytochemical values were derived from Phenol-Explorer (<u>http://phenol-explorer.eu</u>)¹⁰

Values obtained from O'connor et al. (2013)129

^dValues obtained from the USDA Database for Proanthocyanidin Content of Selected Foods¹²

^eBased on MyPlate (<u>https://www.choosemyplate.gov/fruit</u>) which specifies that 16 grapes = ½ cup equivalent of fruit. USDA National Nutrient Database for

Standard Reference (https://ndb.nal.usda.gov/ndb/)¹⁸⁹ indicates that ½ cup of grapes is ~15.41 grapes.

Ho, et al. Nutrition Reviews, 78(2), pp.145-174.

Delivering fruit nutrients and bioactives from 100% juice



- *Bioaccessibility* is a predictor of micronutrient and phytochemical *bioavailability* in humans
- **Bioaccessibility** of phytochemicals can be highly influenced by food processing and matrix factors
- Potential exist for greater bioavailability of (poly)phenol from fruit juices relative to whole fruit remains and could provides consumers with products for broad delivery fruit benefits. (Ho et al., 2020)







In Vitro Bioaccessibility of Carotenoids, Flavonoids, and Vitamin C from Differently Processed Oranges and Orange Juices [*Citrus sinensis* (L.) Osbeck]

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Some key conclusions

(1) Bioaccesibility of flavonoids from fruit juice was higher than from fresh fruit presumably due to the lower fiber content and extraction.

(2) Lower flavonoid levels in orange juices compared to orange fruit might be less relevant, because low flavonoid solubility in the digestive fluids is considered to be the limiting factor in their overall bioavailability.

Aschoff et al. Journal of agricultural and food chemistry. 2015 Jan 8;63(2):578-87.

NC STATE UNIVERSITY

Similar comparison of whole fruit and 100% Juice Considering consumer choices for grapes



Concord Grapes



Niagara Grapes



Common Table Grapes





How do phenolic profiles and bioaccessibility from grape juices compare to whole juice and table grapes?

Food & Function

PAPER



View Article Online View Journal | View Issue



Cite this: Food Funct, 2020, 11, 6433

Comparative assessment of phenolic bioaccessibility from 100% grape juice and whole grapes†

Zulfiqar Mohamedshah,^{a,b} Sydney Chadwick-Corbin, ^{(b)a} JoLynne D. Wightman^c and Mario G. Ferruzzi^(b) *^{a,b}

Juicing of grapes includes contact with phenolic rich seeds and skins that otherwise rely on maceration for phenolic release. To understand if 100% grape juice can provide a matrix with highly bioaccessible phenolics relative to whole fruit, differences in phenolic content and bioaccessibility from commonly consumed table, Concord (CG) and Niagara (NG) grapes and their 100% juices were compared. Phenolic contents in whole grapes and 100% juices were assayed by LC-MS prior to in vitro digestion to determine phenolic bioaccessibility. Phenolic compounds were concentrated in CG and NG seeds as flavan-3-ols (222.2-285.5 mg per 100 g fw). CG skins were rich in anthocyanins (201.4 mg per 100 g fw) and flavonols (15.5 mg per 100 g fw). Product form had a significant impact on content (p < 0.01), relative bioaccessibility, and absolute bioaccessibility (p < 0.01). CG had a higher total phenolic content (21.9-50.7 mg per 100 g fw) compared to CGJ (5.8 mg per 100 g fw), though NG (4.9-10.8 mg per 100 g fw) was similar in phenolic content to NGJ (9.4-10.8 mg per 100 g fw). Absolute bioaccessibility of total phenolics from CGJ (5.2 mg per 100 g fw) was similar to CG (2.6-9.6 mg per 100 g fw), while NGJ (5.1-5.7 mg per 100 g fw) had higher bioaccessible phenolic content than NG (0.8-1.1 mg per 100 g fw). Differences in bioaccessible content were driven by high relative bioaccessibility of anthocyanins in CGJ (86-135%) compared to CG (14-39%) as well as for flavan-3-ols and phenolic acids from CGJ/NGJ (48-101; 39-85%) compared to CG/NG (0-3; 9-67%). Comparisons between juices and table grapes followed similar trends. A greater fraction of skin and seed phenolics was extracted through juicing and made bioaccessible, making 100% grape juice and whole fruit similar in phenolic delivery to consumers.



2018 Harvest

Fruit from 2 Vineyards Table grapes from market

100% Concord Juice 100% Niagara Juice



Received 26th March 2020, Accepted 23rd June 2020 DOI: 10.1039/d0fo00792g rscli/food-function

Grape phenolics are primarily concentrated in the seeds and skins



Grape phenolics are primarily concentrated in the seeds and skins



Investigating products using an in vitro digestion with simulated oral processing



Whole Fruit and 100% Juice phenolic comparisons





Phenolic Relative Bioaccessibility

Phenolic Class	Concord Grape Fruit	100% Concord Juice
Anthocyanins	15-40%	61-81%
Flavonols	2-8%	36-43%
Flavan-3-ols	<2%	75-95%
Phenolic Acids	44-85%	70-85%
Stilbenoids	<0.1%	44-83%



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Whole Fruit and 100% Juice phenolic comparisons

Niagara



Phenolic Class	Niagara Grape Fruit	100% Niagara Juice
Flavonols	64-107%	22-34%
Flavan-3-ols	1%	48-76%
Phenolic Acids	21-32%	42-66%
Stilbenoids	<0.1%	25-53%



Table grapes versus 100% Juice phenolic content (by main class)





Take home messages on 100% Juice

- 100% Fruit Juice is Fruit
- Juice processing about extracting and delivering the quality and benefits from whole fruit including
 - Similar nutritional quality and density to whole fruit
 - Enhanced product consistency
 - Longer shelf-life
 - Limiting product waste
- 100% Fruit Juice efficiently delivers whole fruit nutrients and bioactives
 - 100% juice and whole fruit are similar in bioaccessible phenolics
 - 100% juice may be a more efficient vehicle for delivery

Ongoing efforts to improve the quality of fruit juice

- Potential for product innovations to enhance 100% fruit juice
 - Advances in fruit genetics and nutrigenomics
 - Process innovation
 - Formulation innovation



- Ongoing Food Science and Nutrition Research
 - Human studies on micronutrient/phytochemical bioavailability/metabolism
 - Comparisons between fruit juice and whole fruit on gut microbiota
 - Continue to pursue functional studies on health benefits



Thank you



What does the Science say about 100% Juice? Research, Recommendations & Resources

By Diane Welland MS, RD

August 25, 2020

Dietary Guideline Recommendations and Report

Juice is a nutrient dense 1/2 cup 100% Fruit Juice 1/2 cup Whole Fruit beverage Vitamin C • Potassium ۲ Folate • No added sugar ٠ Juice



Juice is a primary beverage choice

Milk

Water

What Does the Science Say?

Juice is Not Overconsumed



65% of total fruit intake comes from whole fruit and 35% comes from juice

Juice Drinkers Have Healthier Diets Than Non-Juice Drinkers



Drinking Juice Does Not Impact...



Weight status in children



Dental health



Research: Juice Drinking Consumption Patterns

Page 38 Part D. Chapter 1: Current Intakes of Foods, Beverages, and Nutrients – DGAC Report Figure D1-5



USDA Healthy U.S.-Style Eating Style recommended intake ranges, which vary based on age, sex, and activity level for recommended intakes. 2015-2020 Dietary Guidelines for Americans.



Serving Sizes

As part of a healthy diet pattern "**up to half of your daily fruit intake may come from 100% juice.**"





ASSOCIATION

New Research: Juice Drinking Shows Long-term Dietary Benefits in Children

<u>A longitudinal study of fruit juice consumption during</u> <u>preschool years and subsequent diet quality and BMI</u> By Li Wan, Lynn Moore et. al. **BMC Nutrition** May 2020

- Preschool children consumption of 100% juice is associated with higher intakes of whole fruit and total fruit and better diet quality through childhood and into middle adolescence without adversely impacting weight gain.
- Preschoolers who drank more 100% fruit juice were nearly 4 times as likely to meet current Dietary Guideline recommendations for whole and total fruit intake during adolescence than those preschoolers with low intakes.
- Juice drinkers also had higher HEI (Healthy Eating Index) scores compared to non-drinkers.





New Research:

Adults Can Benefit from Drinking Juice

Intake of 100% Fruit Juice Is

Associated with Improved Diet Quality

of Adults: NHANES 2013-2016

<u>Analysis</u>

Sanjiv Agarwal et. al. **Nutrients,** October 2019

- Adults Juice drinkers had better quality diets; significantly higher intakes of calcium, vitamin D, potassium, thiamin, folate, vitamin B6 and vitamin and lower intakes of added sugar, total fat and sodium.
- Lower body mass index, lower body weight, lower risk for being overweight or obese and lower risk of metabolic syndrome compared to non-consumers.





New Research: Dental Literature Review – Does Juice Drinking Cause Caries?

<u>100% Fruit Juice and Dental Health: A</u> <u>Systematic Review of the Literature</u> DeAnn Liska PhD, Michael Kelley PhD and Eunice Mah PhD, **Frontiers in Public Health**, July 2019

 No association between juice and tooth erosion and either no association or an inverse association between 100% juice intakes and the incidence of dental caries.





Overall Impact on Health

Drinking 100% Juice can:

- a. Help increase fruit intake
- b. provide valuable nutrients to diet
- c. Improve diet quality
- d. Provide beneficial bioactives
 - i. Cardiovascular disease
 - ii. Cognitive function
 - iii. Urinary tract infection
 - iv. Aid in Exercise performance

* Does not:

impact weight status increase risk of chronic illness

*in appropriate amounts





Top Reasons Consumers Choose Juice





Juice it Up

- Salad
 Dressings
- Marinades
- Baked
 Goods
- Dips and Sauces



PBH Ambassador Leslie Bonci

Click to play the video





Sip Smarter Resources

- Juice Processing
- Nutrition Information
- Press Releases

Juice Nutrition News

Along with providing important nutrients, certain types of 100% juices have been linked with additional health benefits. These include preventive effects against certain diseases, as well as overall improvements on your daily lifestyle and regimen. Browse the latest nutritional science news to learn more.



Eat Right, Sip by Sip March 17, 2020



Drinking 100% fruit juice associated with improved diet quality in adults

February 13, 2020





Sip Smarter Resources

- Scientific Research
- Educational Materials
 - Fact Sheets
 - Tool Kit
 - Consumer hand outs
- Healthy Recipes

All / Juice and Dental Health / Juice and Diabetes / Juice and Fruit Intake / Juice and Overall Diet Quality / Juice and Public Feeding Programs

/ Juice and Weight Status / Scientific Juice Reviews, Summaries and Commentaries / Consumption of Juice Data



Evaluating the Impact of the Revised Special Supplemental Nutrition Program for Women, Infants, and Children Fruit Juice Allotment on Fruit Intake, Dietary Quality, and Energy/Nutrient Intakes among Children 1-4 Years of Age



Review of 100% Fruit Juice and Chronic Health Conditions: Implications for Sugar-Sweetened Beverage Policy JNS JOURNAL OF NUTRITIONAL SCIENCE

100% Fruit juice and measures of glucose control and insulin sensitivity: A systematic review and metaanalysis of randomised controlled trials

December 1, 20



Find Your *Juice* Match

Pick your juice and see which nutritional superpowers it's packing.







Contact Information

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Sipsmarter.org

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Join the Movement



Show your support by taking and sharing the Have A Plant[®] pledge at fruitsandveggies.org. While you're there, check out the useful resources to equip you with the tools you need to enhance your nutrition knowledge and empower consumers to enjoy more fruits and vegetables every day.

Follow PBH's social channels to keep up to date on all the insights and inspiration. #haveaplant



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SEPTEMBER IS NATIONAL have a **FRUITS & VEGGIES G**n **MONTH** #HAVEAPLANTPLEDGE #HAVEAPLANT #NFVM2020

September is National Fruits & Veggies Month and this year we're celebrating Have A Plant® Nation alongside National Family Meals Month[™]! Take a moment to celebrate how we can enjoy more fruits and vegetables during the month of September and beyond to support your health and happiness! https://fruitsandveggies.org /nfvm-toolkit/



A catalog of PBH's past webinars is available at <u>fruitsandveggies.org/expert-professionals/webinars</u>.

Continuing professional education units (CPEU) are available for live and pre-recorded webinars.



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THANK YOU

