COMPLIMENTARY 1-CEU WEBINAR PRESENTATION

Give Real Maple a Turn

The Science Behind Pure Maple Syrup and Why It Should Be a Pantry Staple for an Active Lifestyle

PRESENTED BY

Navindra P. Seeram, PhD, Jonathan Tremblay, PhD, and Elana Natker, MS, RD

May 17, 2021, 12–1 pm ET

Pure Maple from Canada was approved by the CDR to offer 1.0 CPEU for this webinar.

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maple FROM CANADA

Learning Objectives

1. Develop awareness of pure maple syrup's nutrition profile, including 67 plant polyphenols.
2. Understand current health research related to pure maple syrup and its bioactive compounds, including:
    - Anti-inflammatory properties
    - Antioxidant properties
    - Immunity properties
3. Describe emerging research on pure maple syrup and maple products as a viable source of energy during prolonged exercise in human subjects.
4. Apply the latest trends and culinary applications for maple syrup into menus and eating plans in alignment with current dietary recommendations and guidelines.

Agenda

- Welcome and introduction
- Overview of pure maple syrup's nutrition profile, polyphenol content and current research areas
- Research spotlight: Pure maple syrup and maple products as a viable source of energy during prolonged exercise in human subjects
- Pure Maple Syrup from Canada in culinary applications
- Summary and questions

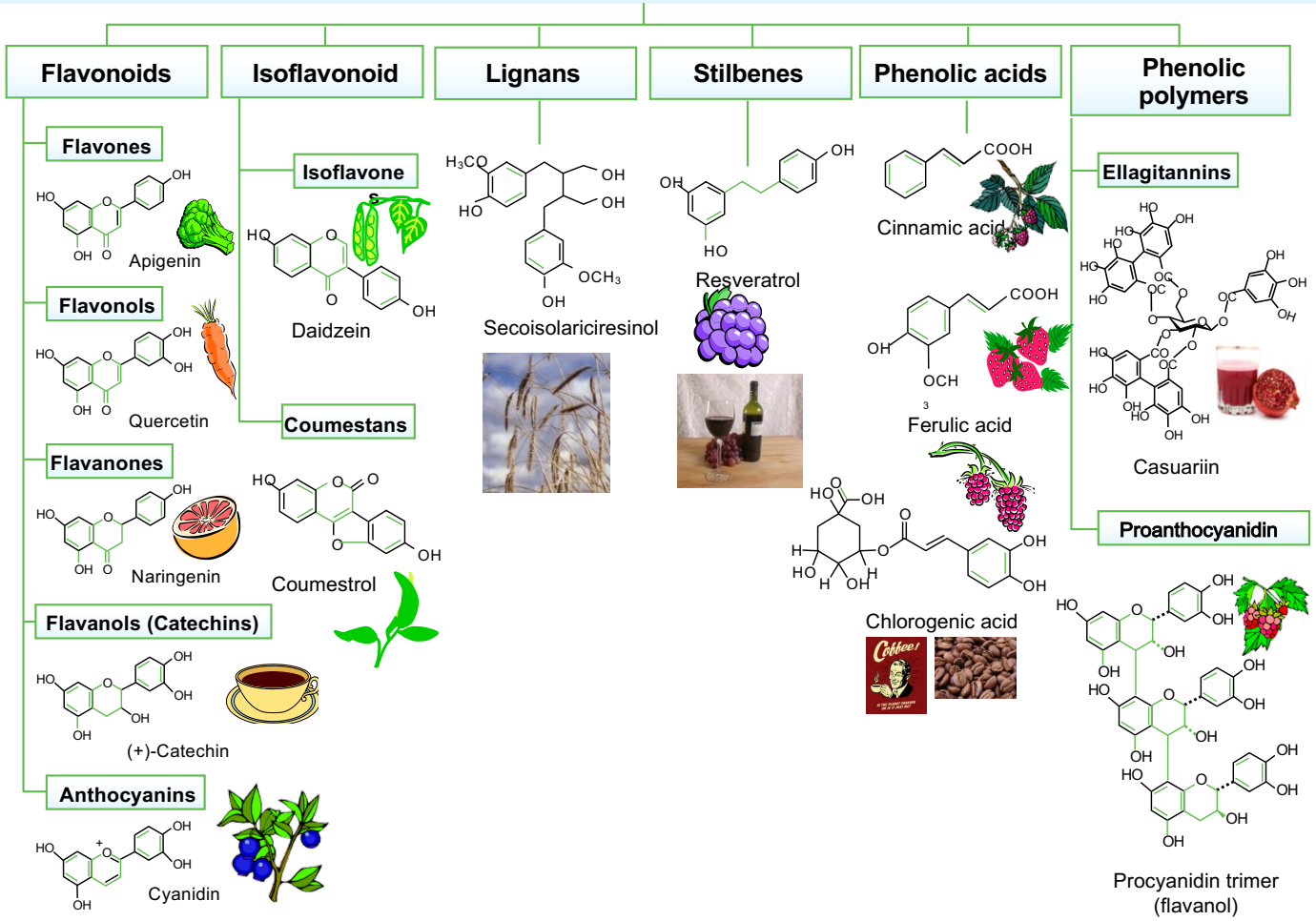
About Quebec Maple Syrup Producers

- Québec Maple Syrup Producers (QMSP) is the world leader in maple ingredients production (syrup and sap) and maple research.
- QMSP is committed to advancing the understanding and knowledge of the potential benefits of maple ingredients and maple compounds for health promotion and/or disease risk prevention and mitigation among animals and humans.
- Québec Maple Syrup Producers leads and directs the International Maple Research and Innovation Network which contributes to QMSP's Maple Research Program.

Chemistry and Health Benefits of Maple Food Products

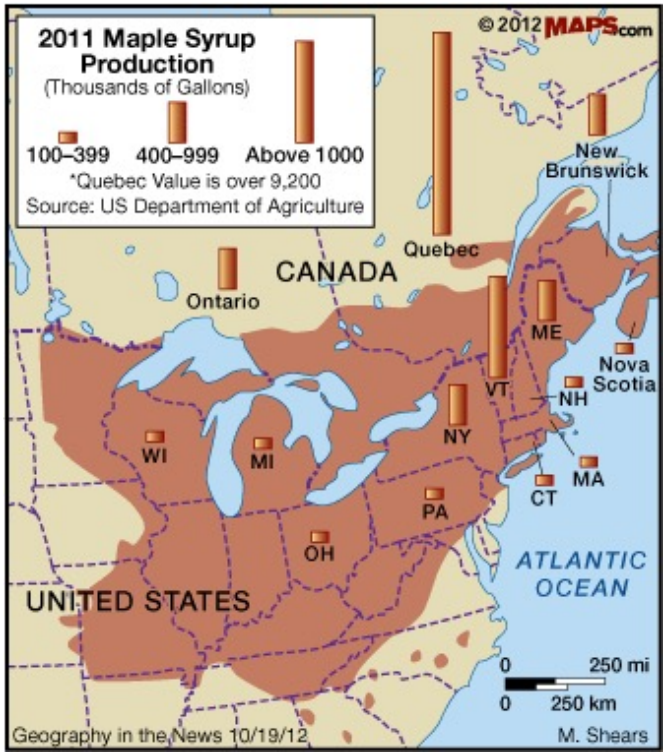
Navindra P. Seeram, Ph.D.
Bioactive Botanical Research Laboratory

(Poly)phenolics Found in Plant Foods



Eastern North America is the Maple Syrup Producing Region of the World

Sugar Maple Region



Maple Syrup: A Plant-Derived Natural Sweetener

- Largest consumed and commercially produced “tree sap” product in our food chain
- Boiling sap collected from sugar maple (*Acer saccharum*) and certain other *Acer* species

Production Maple Syrup

Trees tapped late winter-early spring
(cold nights-warm days)

40L of maple sap

required to produce 1L maple syrup

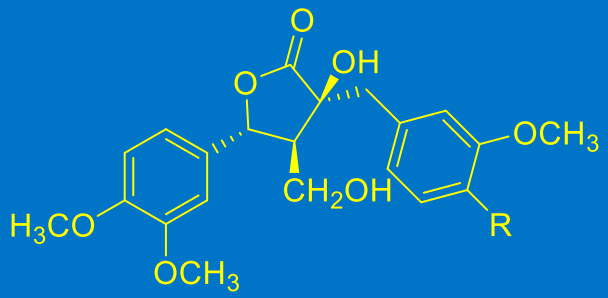
Previous Published Data on Maple Syrup

- **Carbohydrates** ca. 65 % primarily as sucrose and complex sugars
- **Amino acids** (arginine, threonine, proline, etc.)
- **Organic acids** (malic acid, fumaric acid, etc.)
- **Minerals** (K, Ca, Mg, Na, etc.)
- **Phytohormones** (abscisic acid, phaseic acid)
- **Phytochemicals:** (Poly)phenolic compounds

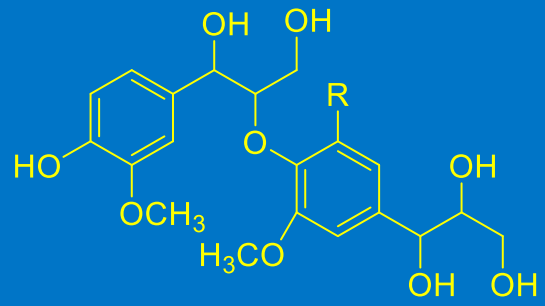
Ball, D. J. Chem. Education, 2007, 84, 1647-1650.
Abou-Zaid, M. et al. Pharmaceutical Biology, 2008, 46, 117-125.

Isolated & Identified 67 Compounds in Maple Syrup from Canada

Sub-Class: Lignans



*1 R= OH
*2 R= Rhamnoside



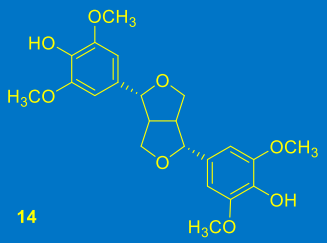
3* R= OCH_3 (erythron, erythron)
4* R= OCH3 (erythron, threo)
5* R=H (threo, erythron)
6* R=H (threo, erythron)

* First report in maple syrup; White are new compounds

23 Lignans

Lignans, cont.

7* threo R_1=H R_2=-$CH_2CH_2CH_2OH$
8* erythro R_1=H R_2=-$CH_2CH_2CH_2OH$
9* erythro R_1=OCH_3 R_2= -$CH_2CH_2CH_2OH$
10* erythro R_1=H R_2= -$CH{=}CHCH_2OH$



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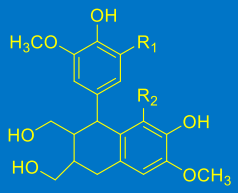
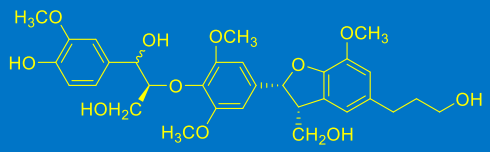
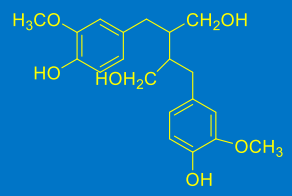


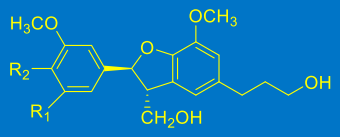
16* R_1=R_2=H
17* R_1=R_2=OCH_3



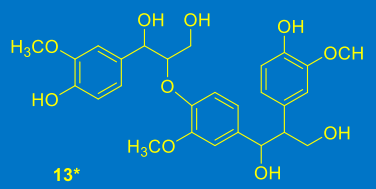
11 threo
12 erythro



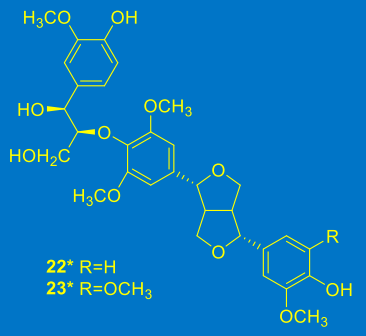
15*



***18** R_1=H R_2=Rhamnoside
***19** R_1=OCH_3 R_2=Isoglycerol
***20** R_1=H R_2= OH
***21** R_1= OCH_3 R_2=OH

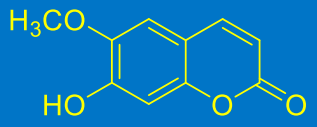


13*

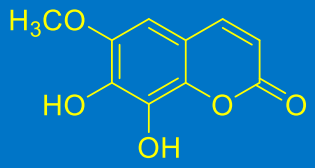


22* R=H
23* R=OCH_3

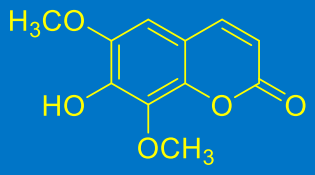
Coumarins & Gallic Acid Derivatives



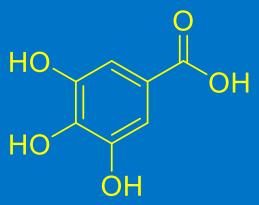
Scopoletin*



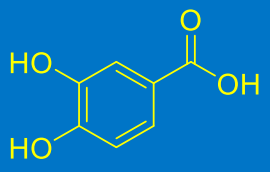
Fraxetin*



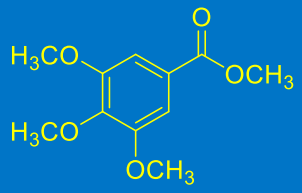
Isofraxidin*



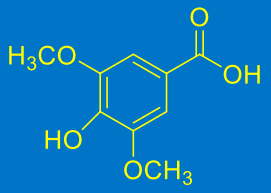
Gallic acid



Protocatechuic acid



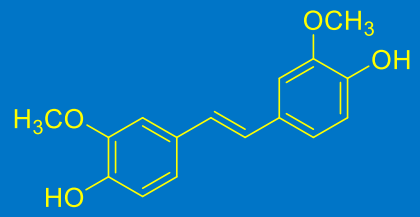
Methyl gallate trimethyl ether*



Syringic acid

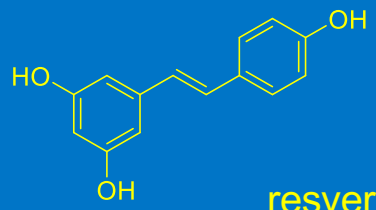
3 Coumarins and 4 gallic acid derivatives

Stilbene



(E)-3,3'-dimethoxy-4,4'-dihydroxy stilbene*

First report from maple syrup; First report from *Acer* genus
Same chemical class as resveratrol

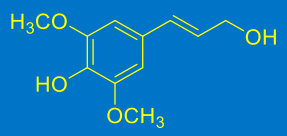


resveratrol

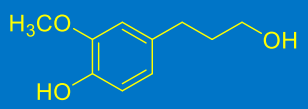
One Stilbene

Li, L.; Seeram, N.P. *J. Agric. Food Chem.* **2010**, *58*, 11673-11679.

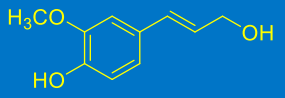
Phenyl-propanoids



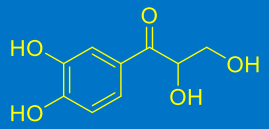
Syringenin*
(major component)



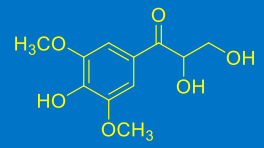
Dihydroconiferyl alcohol



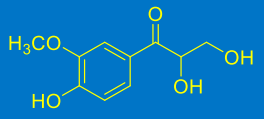
(E)-Coniferyl alcohol



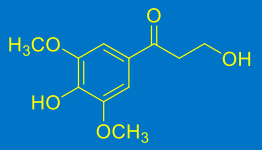
phenlypropanoid 2,3-dihydroxy-1-(3,4 dihydroxyphenyl) -1-propanone



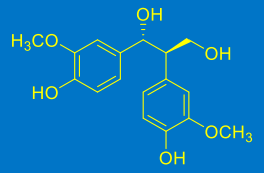
2,3-Dihydroxy-1-(4-hydroxy-3,5-dimethoxyphenyl)-1-propanone*



C-veratroylglycol*



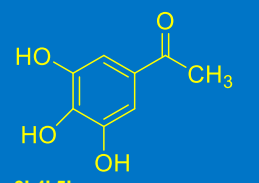
3-Hydroxy-1-(4-hydroxy-3,5-dimethoxyphenyl) propan-1-one*



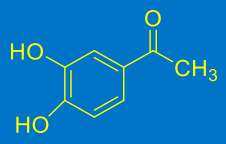
1, 2-Diguaiacyl-1,3-propanediol

8 Phenylpropanoid derivatives

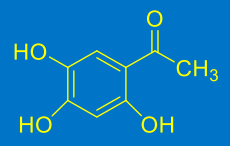
13 Other Phenolic Derivatives



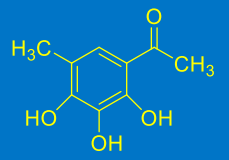
3',4',5'-Trihydroxyacetophenone*



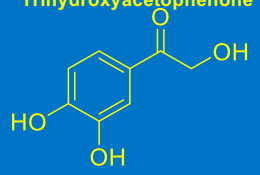
4-Acetylcatechol*



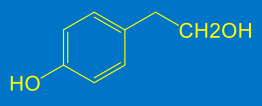
2,4,5-Trihydroxyacetophenone*



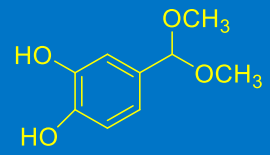
1-(2,3,4-trihydroxy-5-methylphenyl)-ethanone*



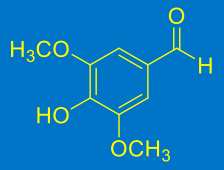
2-Hydroxy-3',4'-dihydroxyacetophenone*



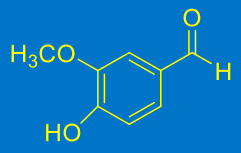
Tyrosol*



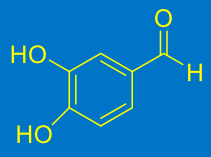
4-(dimethoxymethyl)-pyrocatechol*



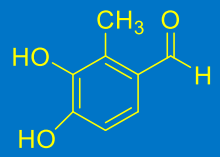
Syringaldehyde



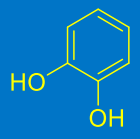
Vanillin



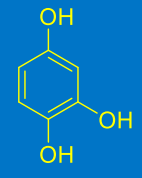
Catechaldehyde*



3,4-Dihydroxy-2-methylbenzaldehyde*

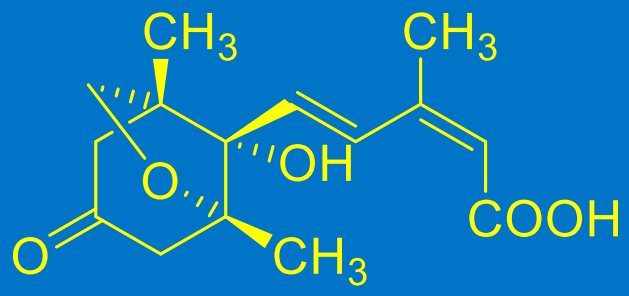


Catechol



4-hydroxycatechol*

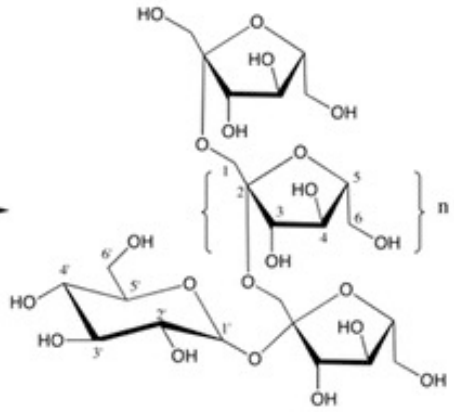
Sesquiter-pene



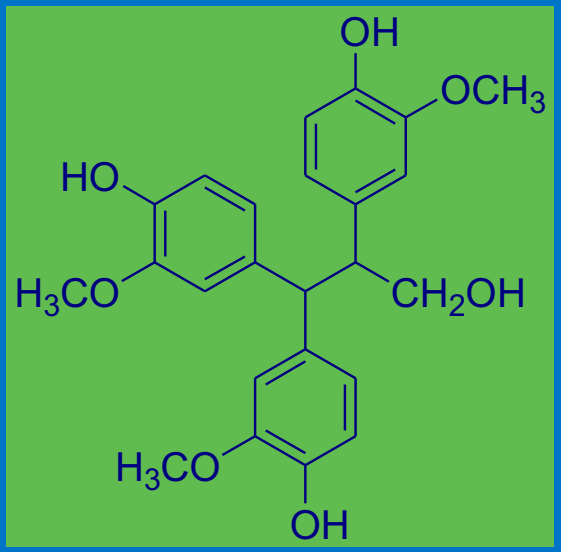
Phaseic acid*

Inulin:

a Prebiotic Poly-saccharide



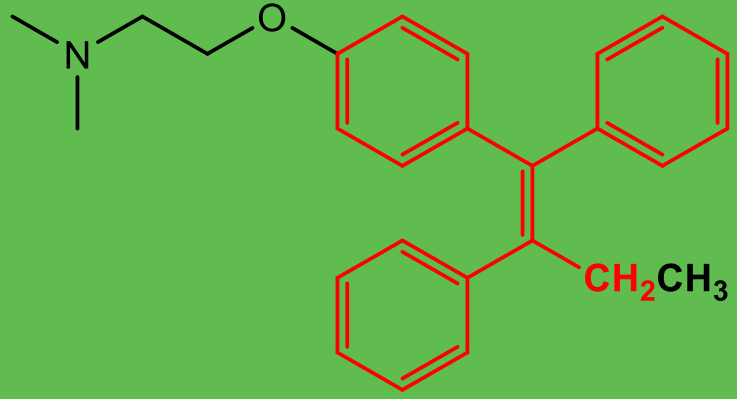
Isolated ‘Process-Derived’ Compound



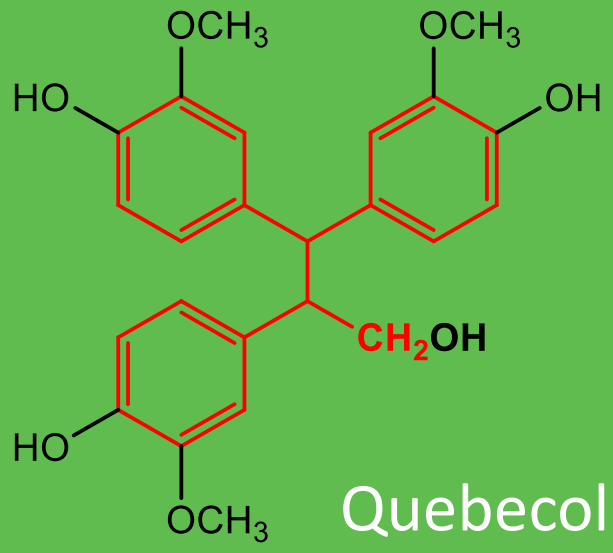
Quebecol

2,3,3-tri-(3-methoxy-4-hydroxyphenyl)-1-propanol

Structural Similarities with Tamoxifen

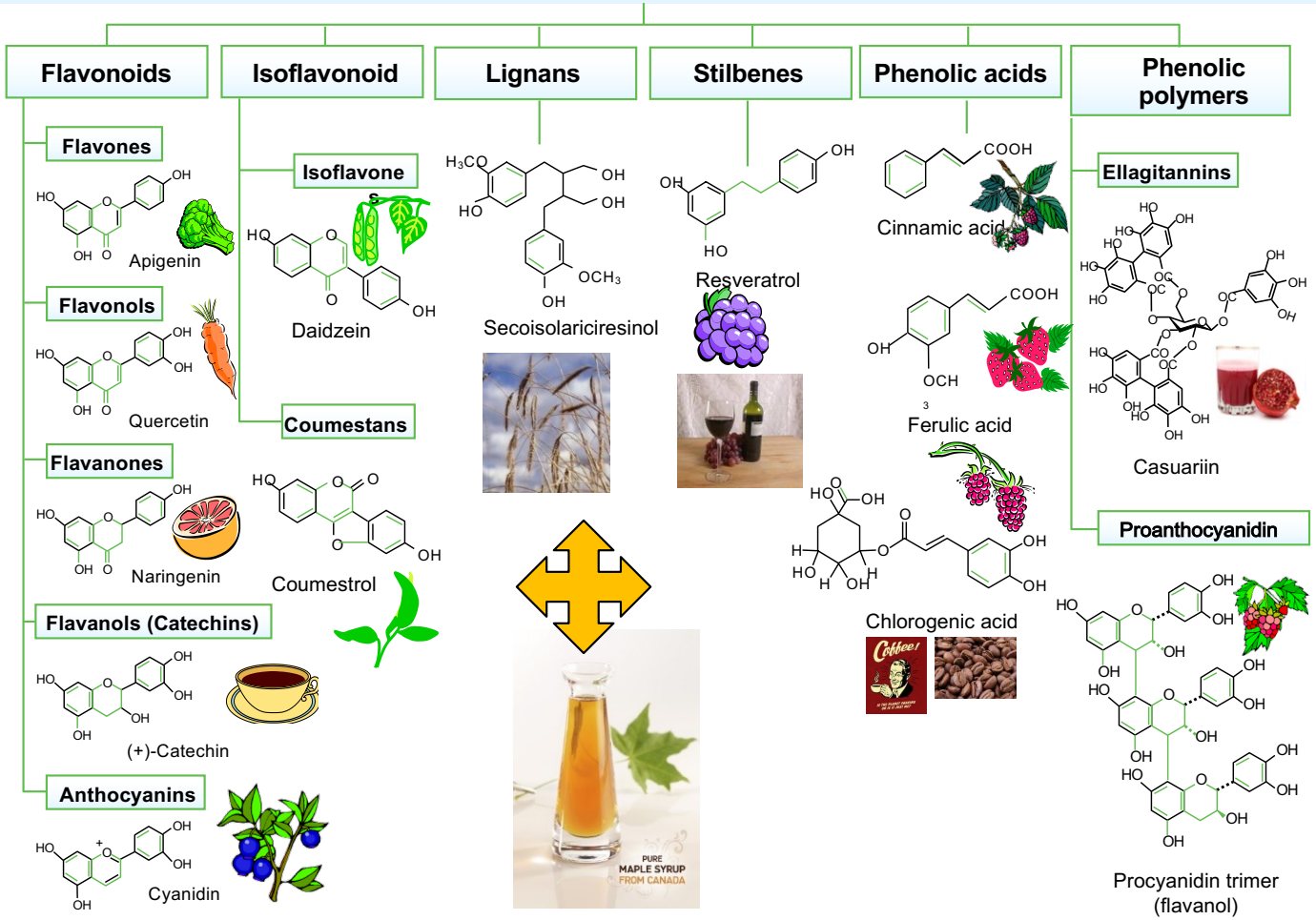


Tamoxifen



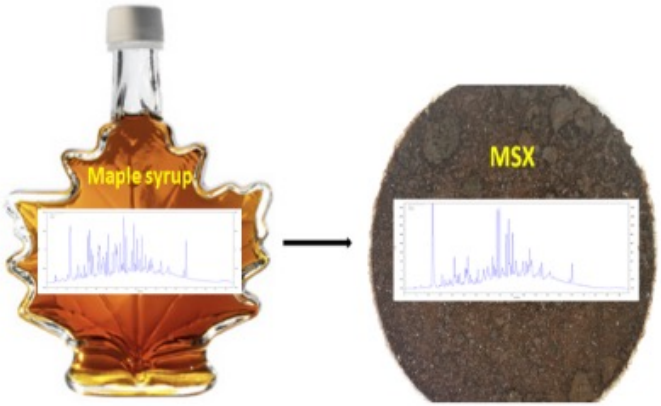
Quebecol

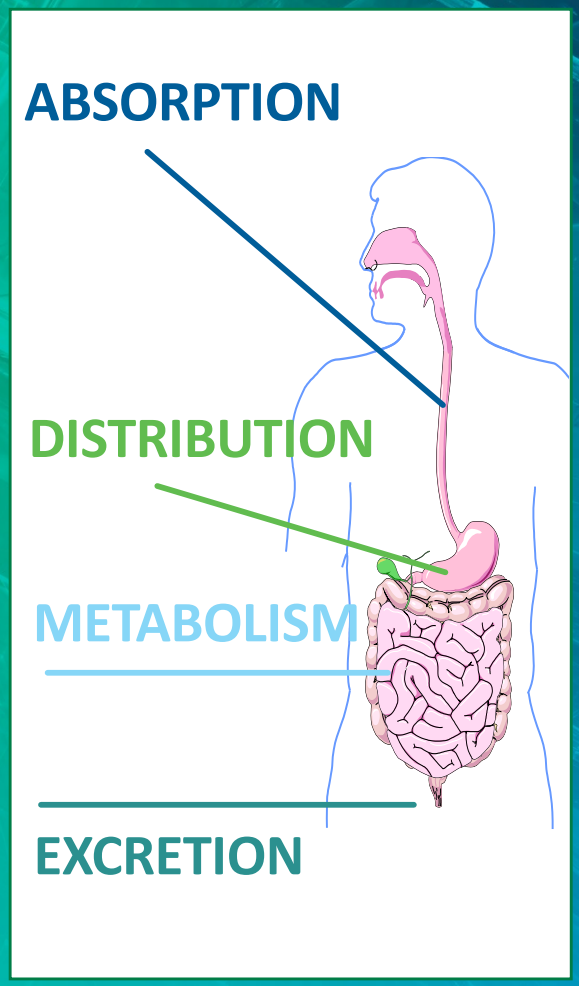
Maple Contains a Cocktail of Polyphenols



Standardized Maple Syrup Extract (MSX)

- Lab-grade (for *in vitro* studies) and food-grade for *in vivo* (animal and human studies)
- Standardized & chemically characterized
- Safe, non-toxic, and well-tolerated in rats at doses of up to 1000 mg/Kg/day for 7 days





In vitro vs. *In vivo*

- *In vitro* ('test-tube') studies commonly use high/ non-physiologically achievable concentrations
- Does not always translate into *in vivo* (living) situation

In vitro Studies on Maple Syrup Phytochemicals

- Anti-inflammatory studies in RAW264.7 macrophages and human keratinocytes[7, 13]
- Neuroprotective effects in human microglial cells and nematodes (C. elegans)[11]
- Inhibition of carbohydrate hydrolyzing enzymes relevant to type 2 diabetes[4]
- Inhibition of proliferation of human cancer cells[5]

Current URI Animal Study on MSX

- Anti-Inflammatory Effects of Maple Syrup Phytochemicals Against Inflammation Associated with Metabolic Syndrome
- Investigating maple syrup extract (0.5 and 0.05%) in a diet induced obesity mouse model of metabolic syndrome over 6 months treatment

USDA NIFA

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

Current Published Animal Studies Supporting Maple Syrup Health Benefits

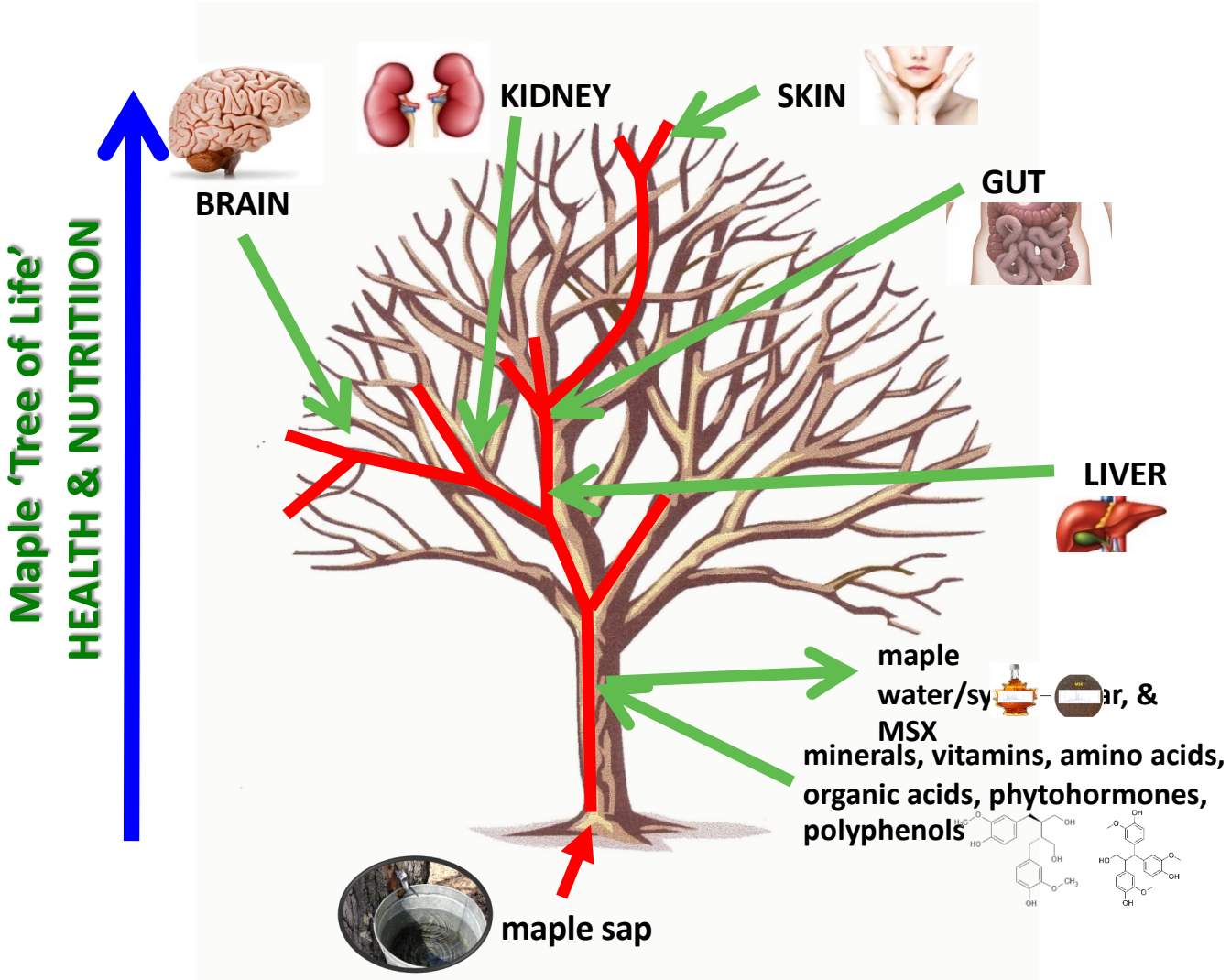
- Maple syrup evokes a 'liver-protecting effect' in rats.
  - Watanabe Y, et al., Biosci. Biotechnol. Biochem. 2011, 75, 2408-10
- Comparison of the enhancement of plasma glucose levels in type 2 diabetes Otsuka Long-Evans Tokushima Fatty Rats by Oral Administration of Sucrose or Maple Syrup.
  - Nagai N., et al., J. Oleo Sci. 2013, 62, 737-43
  - Nagai N., et al., J. Oleo Sci. 2015
- Comparative analysis of maple syrup to other natural sweeteners and evaluation of their metabolic responses in healthy rats.
  - Philippe St-Pierre, et al., J. Functional Foods, 2014, 11, 460-471
- Effects of maple syrup extract on hepatic gene expression of mice fed high fat diet.
  - Kamei, et al., Mol. Nutr. Food Res., 2017, 61, 1600477.

Current Published Animal Studies Supporting Maple Syrup Health Benefits (cont'd)

- Anti-neuroinflammatory effects of a food-grade phenolic-enriched maple syrup extract in a mouse model of Alzheimer's disease
  - Rose, Kenneth N., et al. Nutritional Neuroscience. 2019, 1-10
- Identification of a Novel Oligosaccharide in Maple Syrup as a Potential Alternative Saccharide for Diabetes Mellitus Patients
  - Sato, Kanta, et al. International Journal of Molecular Sciences. 2019, 5041.
- A maple syrup extract alters lipid metabolism in obese type 2 diabetic model mice
  - Toyoda, Tsudoi, et al. Nutrition & Metabolism. 2019, 1-8.
- A maple syrup extract alleviates liver injury in type 2 diabetic model mice
  - Toyoda, Tsudoi, et al. Nutrition Research. 2020, 97-101.

Summary & Conclusions

- 67 compounds isolated and identified from pure Canadian maple syrup
- First report of 40 of these compounds in maple syrup
- Several compounds are new, which include one process-derived compound, Quebecol
- Investigated maple syrup extract and isolates for *in vitro* and *in vivo* biological properties
- Maple syrup contains 'a cocktail' of chemical sub-classes of polyphenolic compounds found in other plant foods including berries, tea, red wine, flax etc.



Acknowledgments

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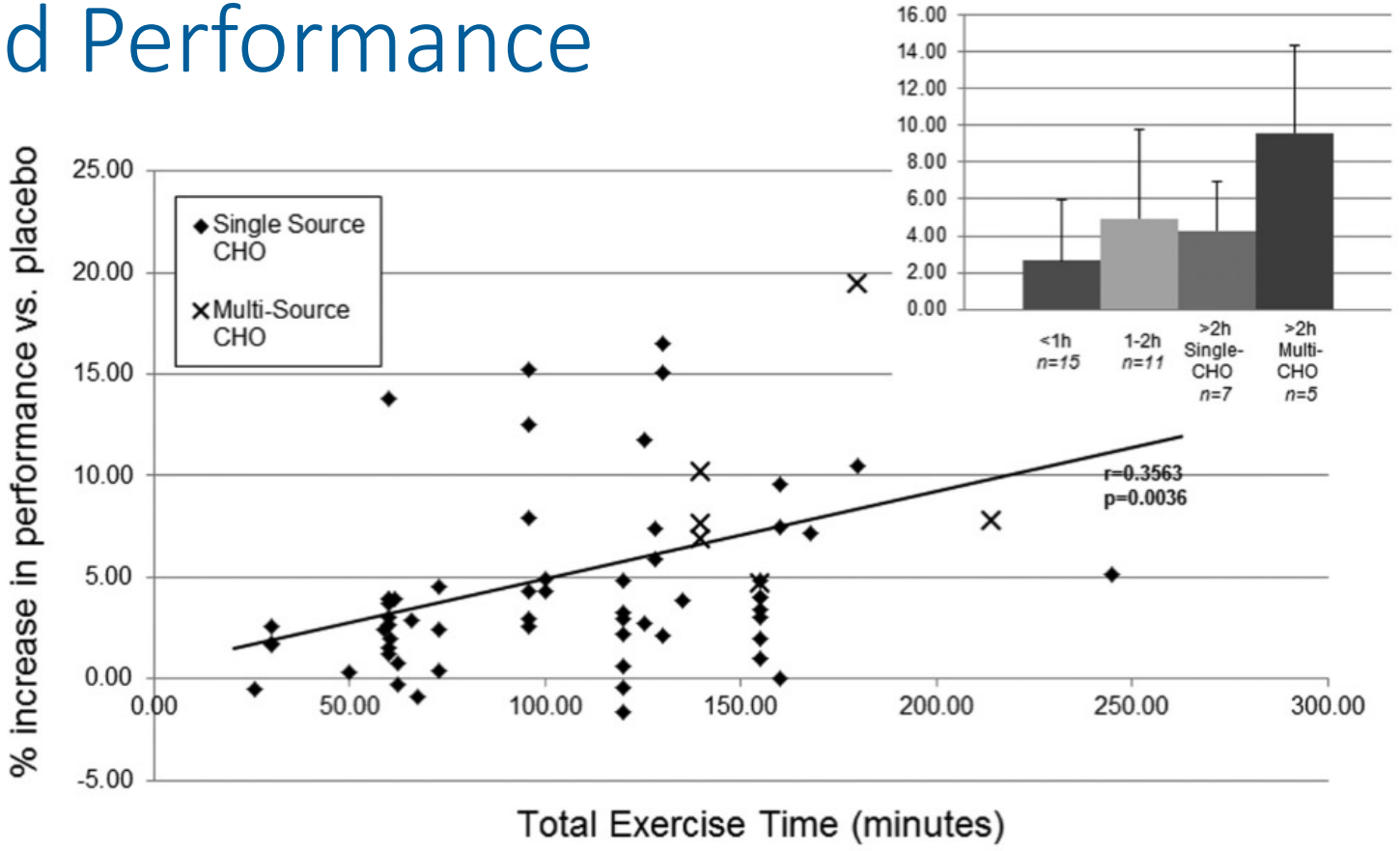
Maple Syrup as a Substitute for Commercial Sports Drinks: Can It Be a Viable Solution for Recreational and Elite Athletes?

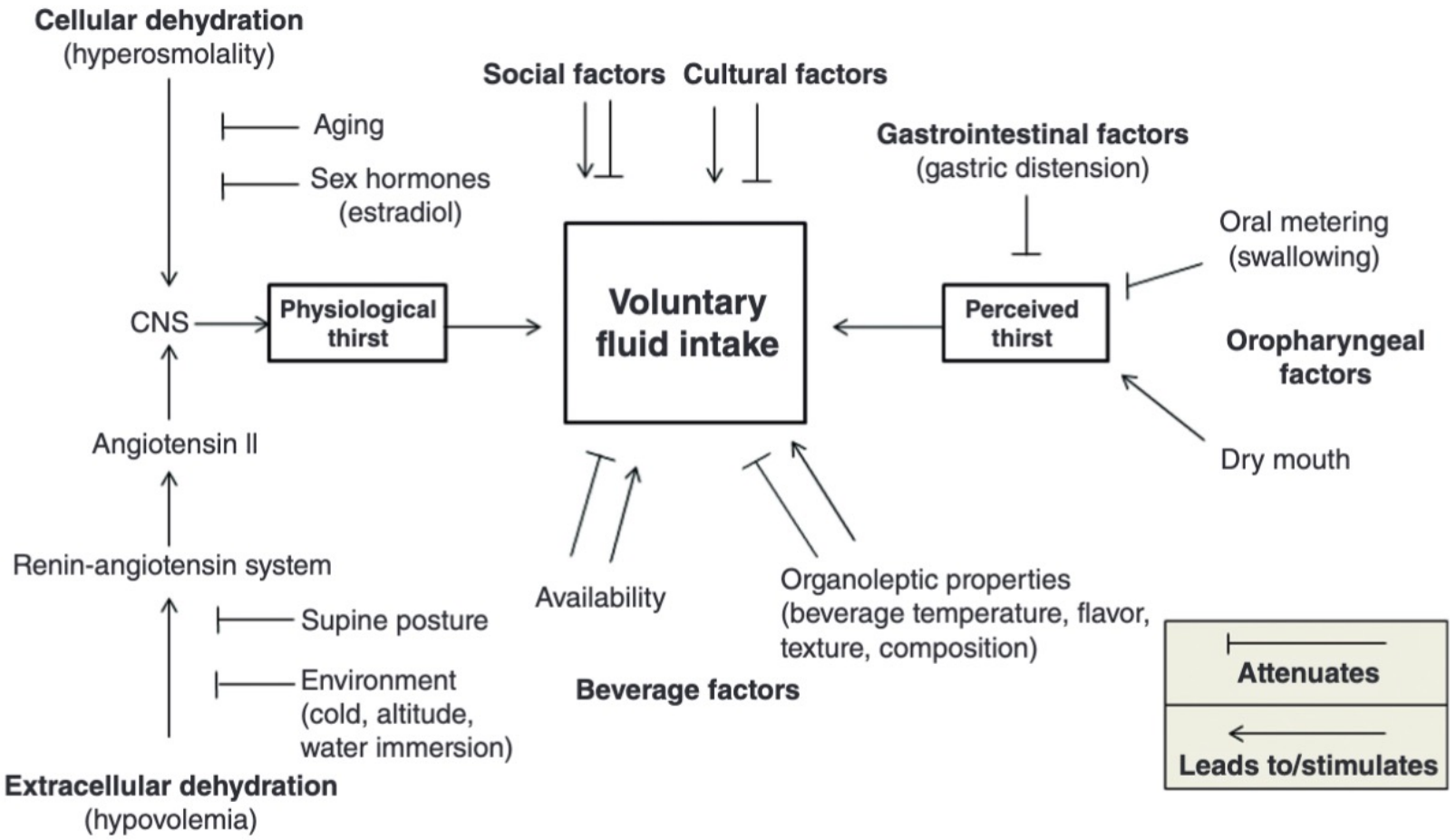
Jonathan Tremblay, PhD

Université de Montréal

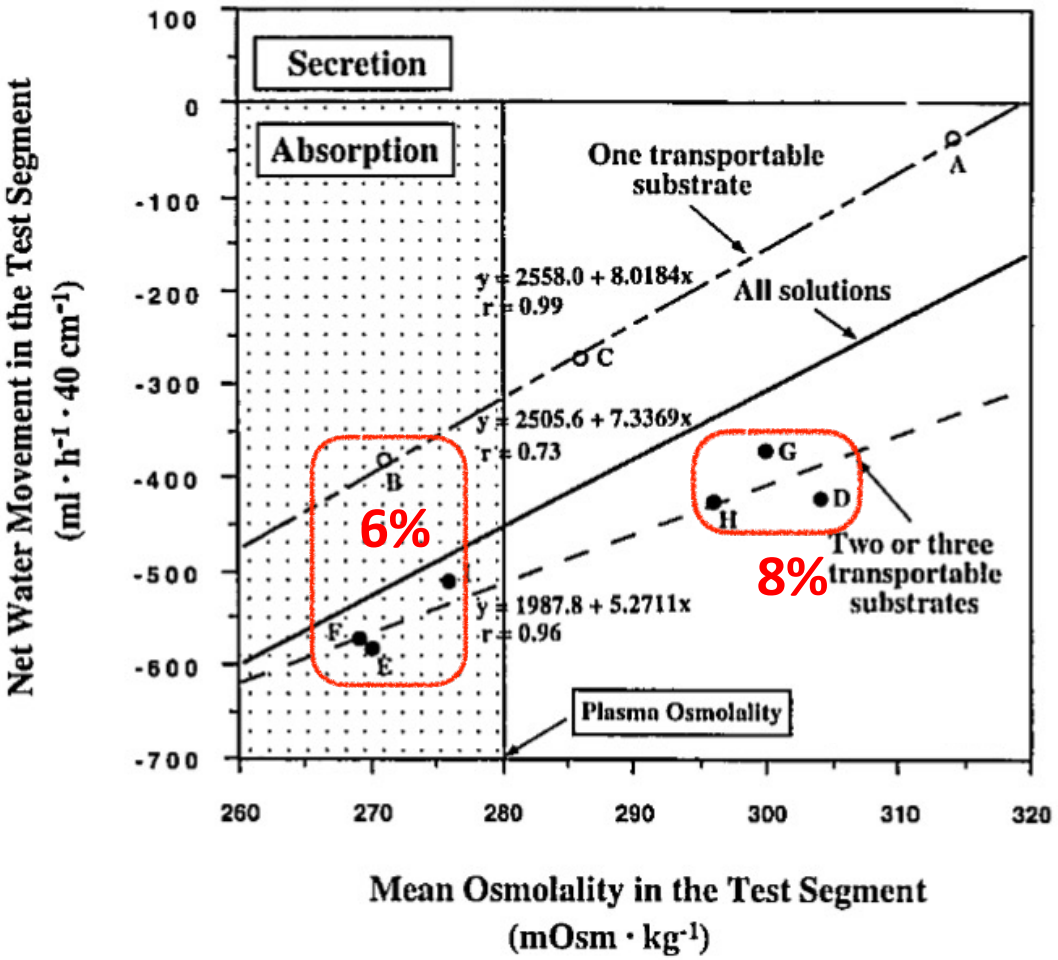
Exogenous CHO Oxidation and Performance



Stellingwerff & Cox (2014) Appl Physiol Nut Metab, 39(9): 998–1011



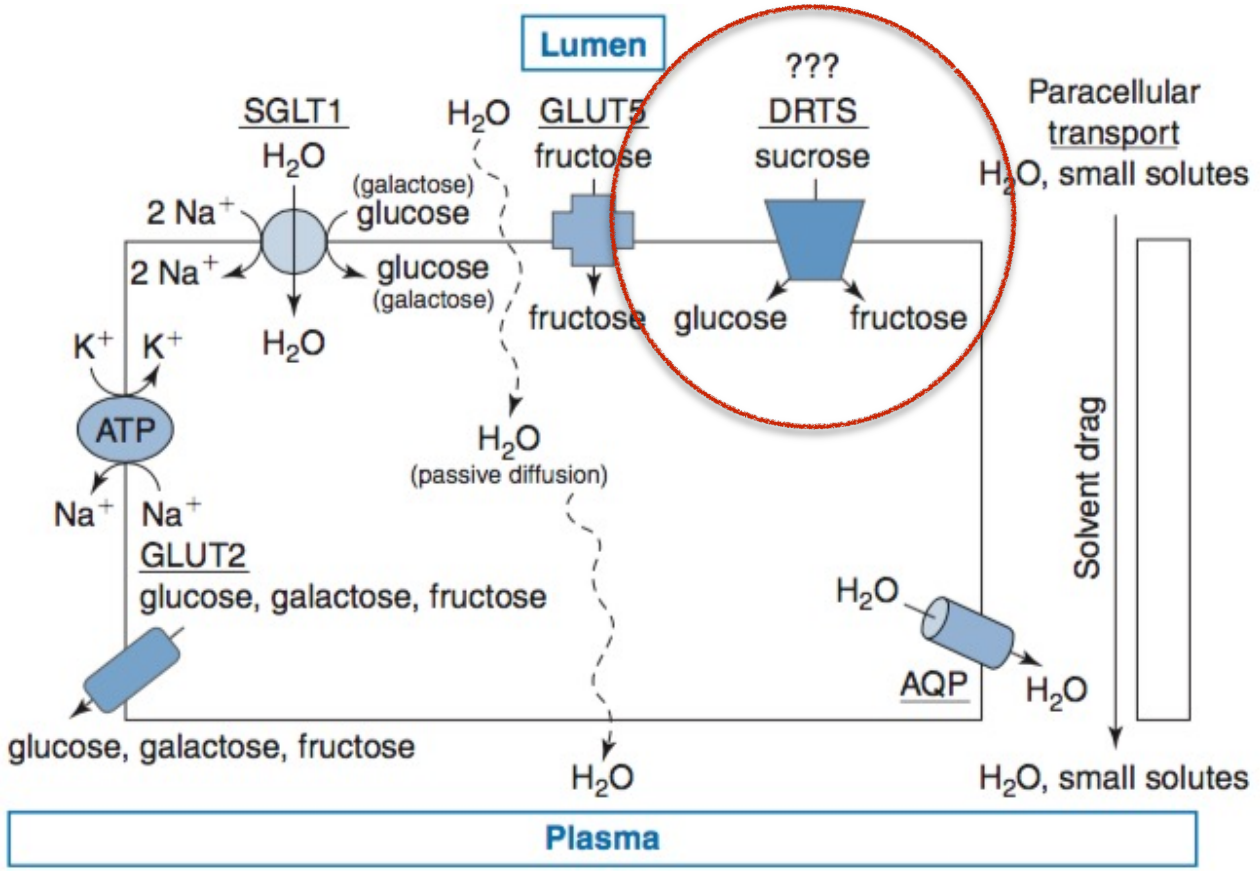
Baker & Jeukendrup (2014) Comp Physiol, 4(2):575–620



- Combination of monosaccharides better than alone
- Sucrose (H): disaccharide which lowers osmolality and facilitates gut absorption

Shi et al. (1995) Med Sci Sports Exerc, 27(12): 1607–1615

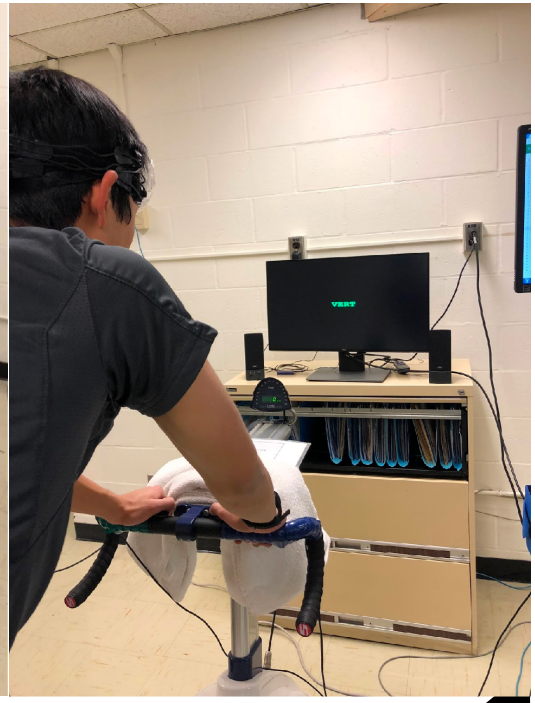
DRTS: Disaccharide Related Transport System



Murray et Shi (2012) ACSM's Advanced Exercise Physiology, p.354

Registered Clinical Trials

120 min + 20-km time-trial



6 x 3 min @ 95% PPO
w/ 3 min rest

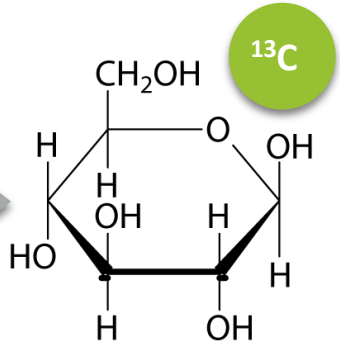
	n	Age (y)	Mass (kg)	Height (m)	VO_2max ($mL \cdot kg^{1} \cdot min^{-1}$)	PPO (W)
Water	15	29.7 ± 4.9	71.4 ± 10.8	1.77 ± 0.08	62.3 ± 9.8	310 ± 45
Glucose	15	28.1 ± 6.2	74.9 ± 7.4	1.78 ± 0.08	60.2 ± 7.9	316 ± 35
Sports Drink	15	27.9 ± 6.8	74.7 ± 11.9	1.80 ± 0.10	60.8 ± 7.4	307 ± 38
Maple Water	16	29.5 ± 8.9	72.0 ± 7.9	1.77 ± 0.06	59.3 ± 7.2	304 ± 52
Maple Syrup	15	32.3 ± 7.5	75.0 ± 12.7	1.80 ± 0.08	57.1 ± 6.4	301 ± 43

Standardized meals before experiment

Ingestion of 2L (120g CHO, 6%)

Cycling (120 min) @ 60% VO_2max

Placebo (stevia)



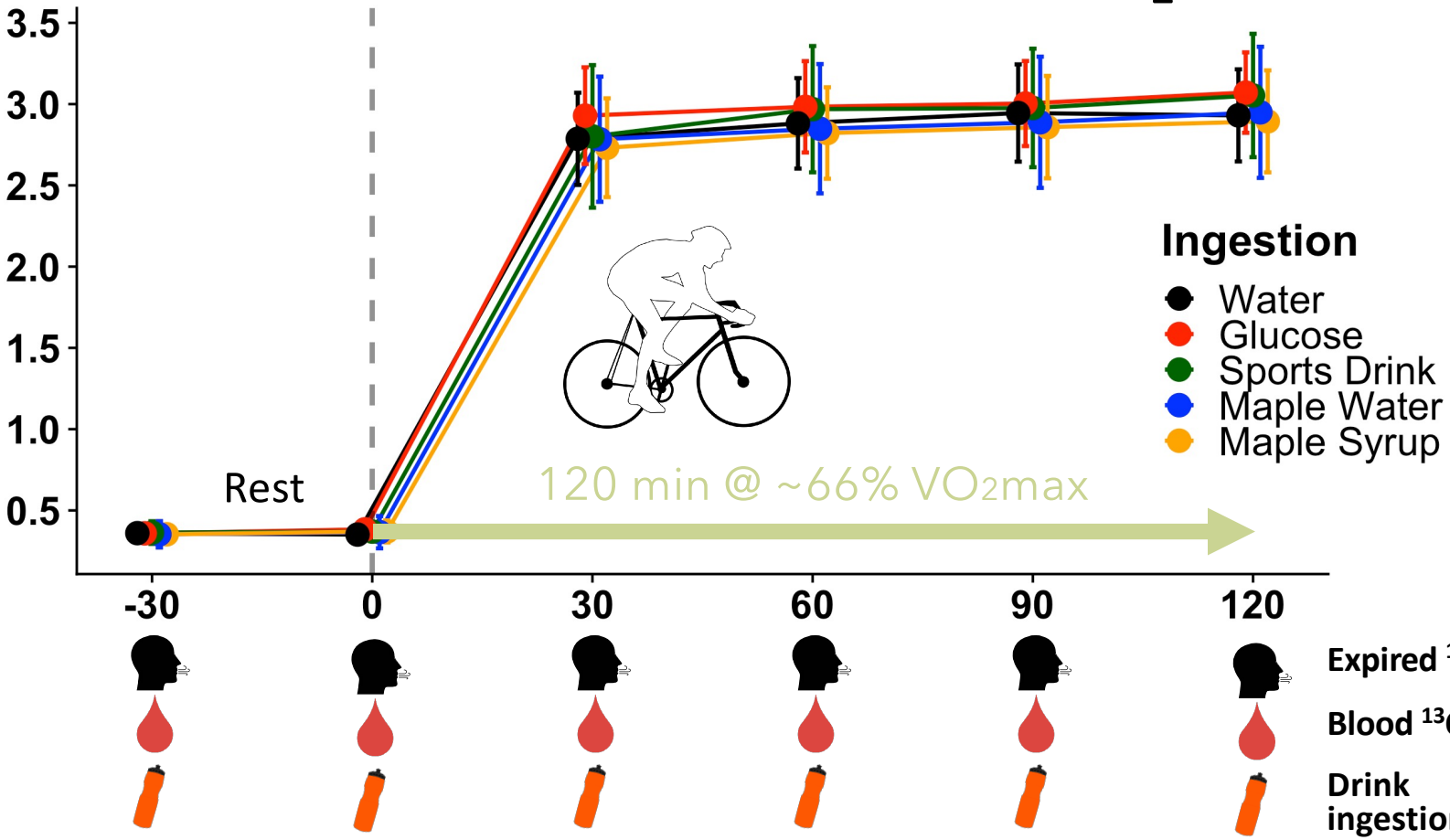
Glucose

Sports Drink

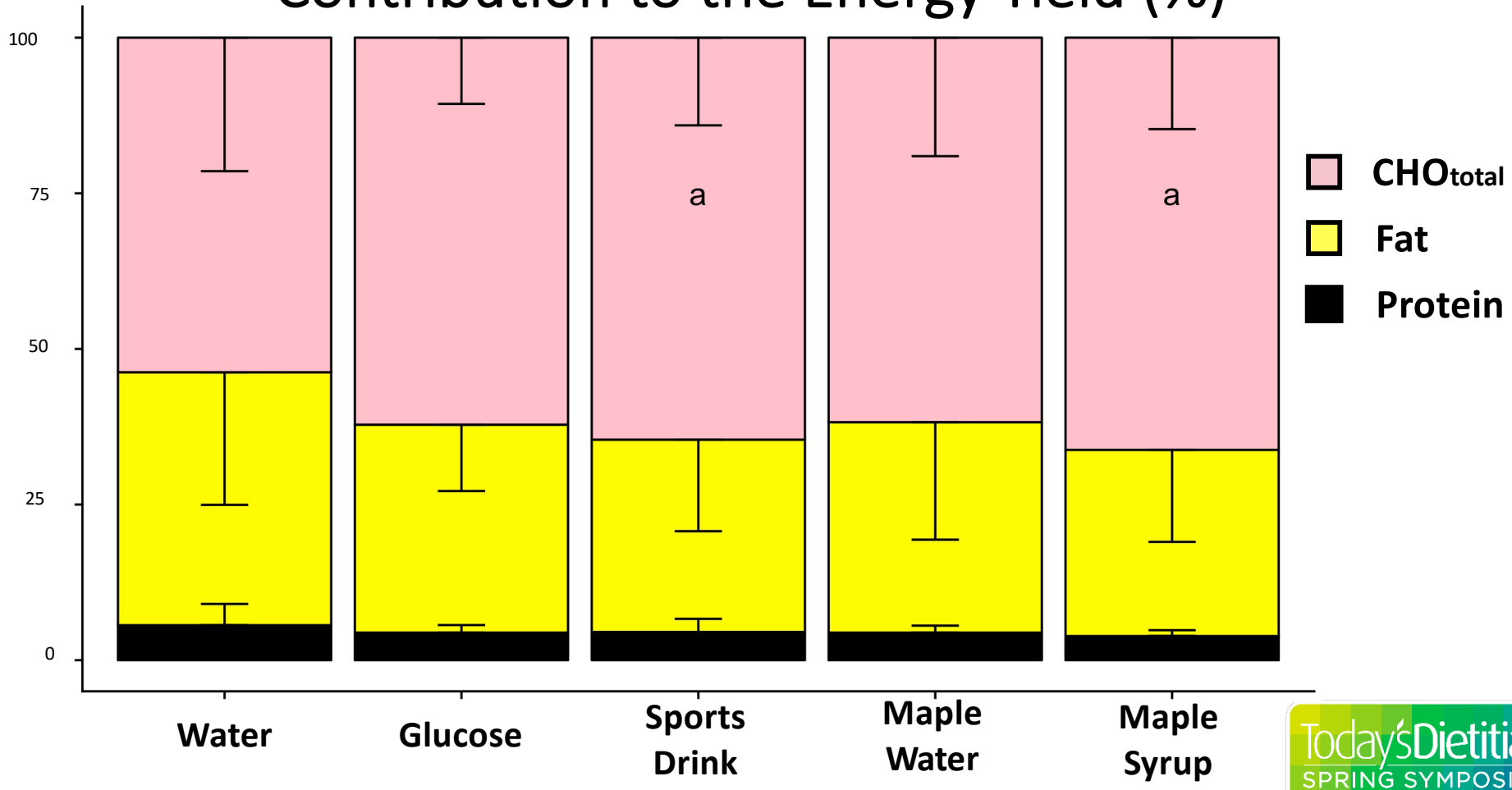
Maple Syrup

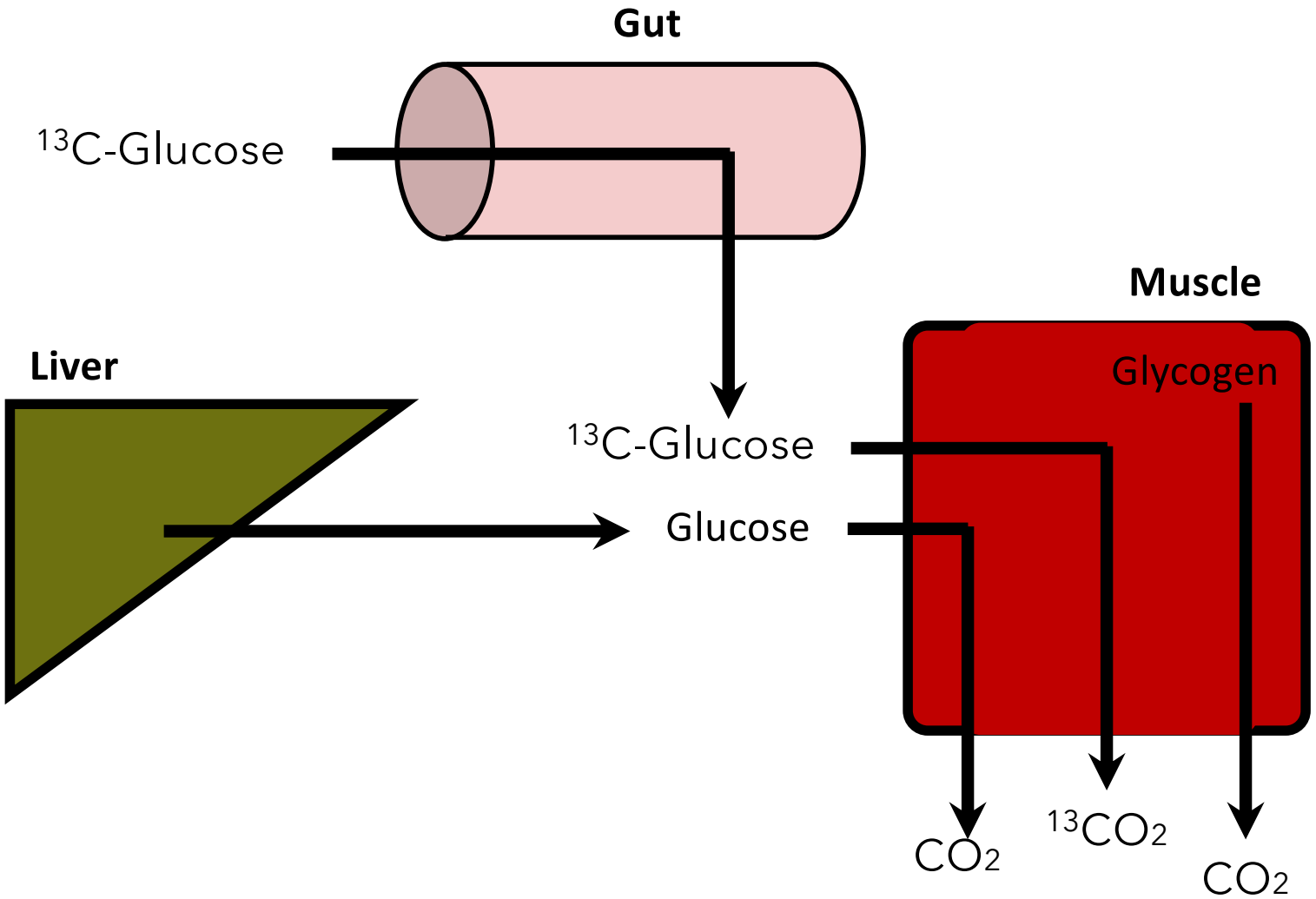
Maple Water

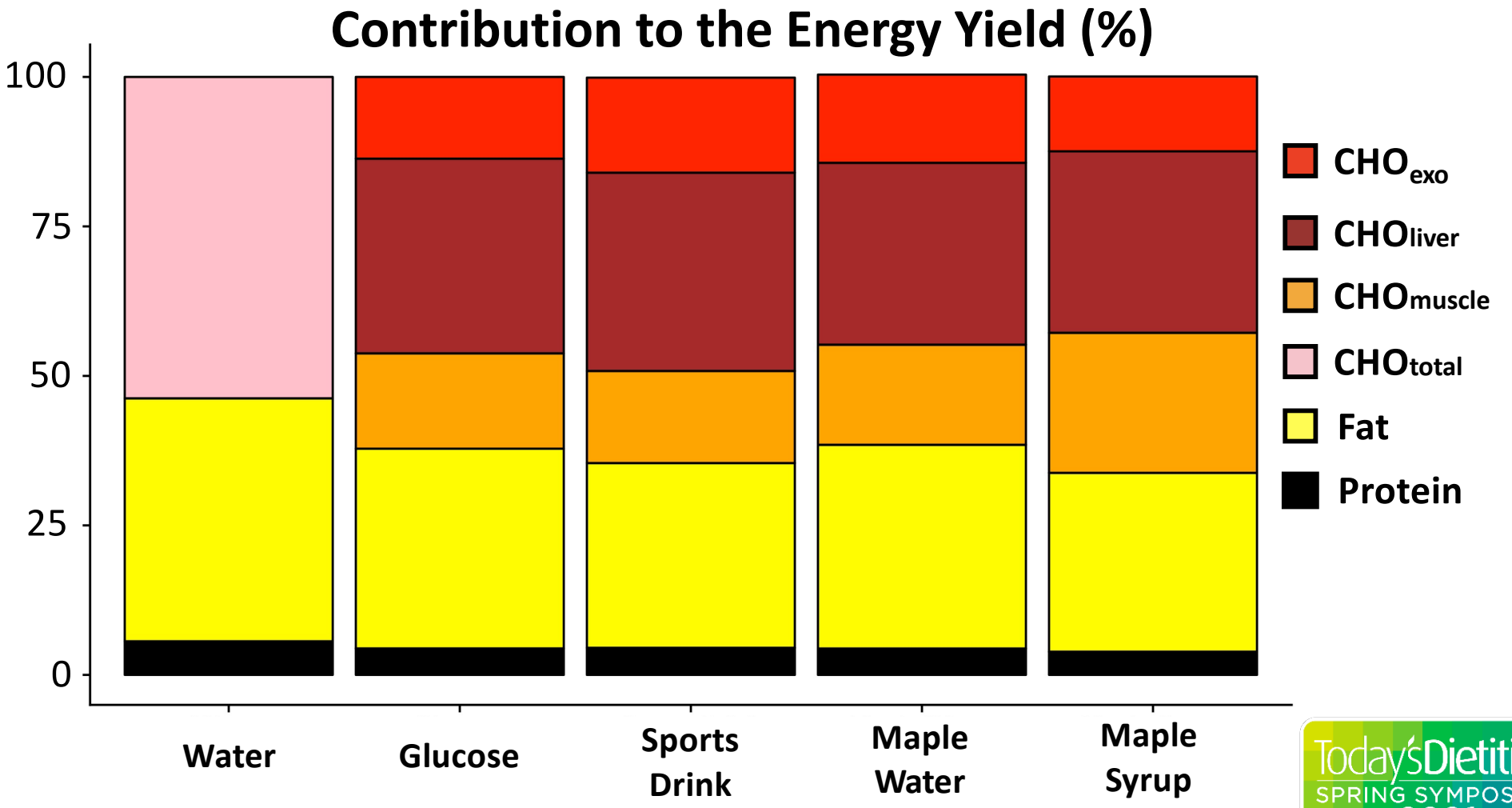
Oxygen Consumption (VO_2, L/min)



Contribution to the Energy Yield (%)

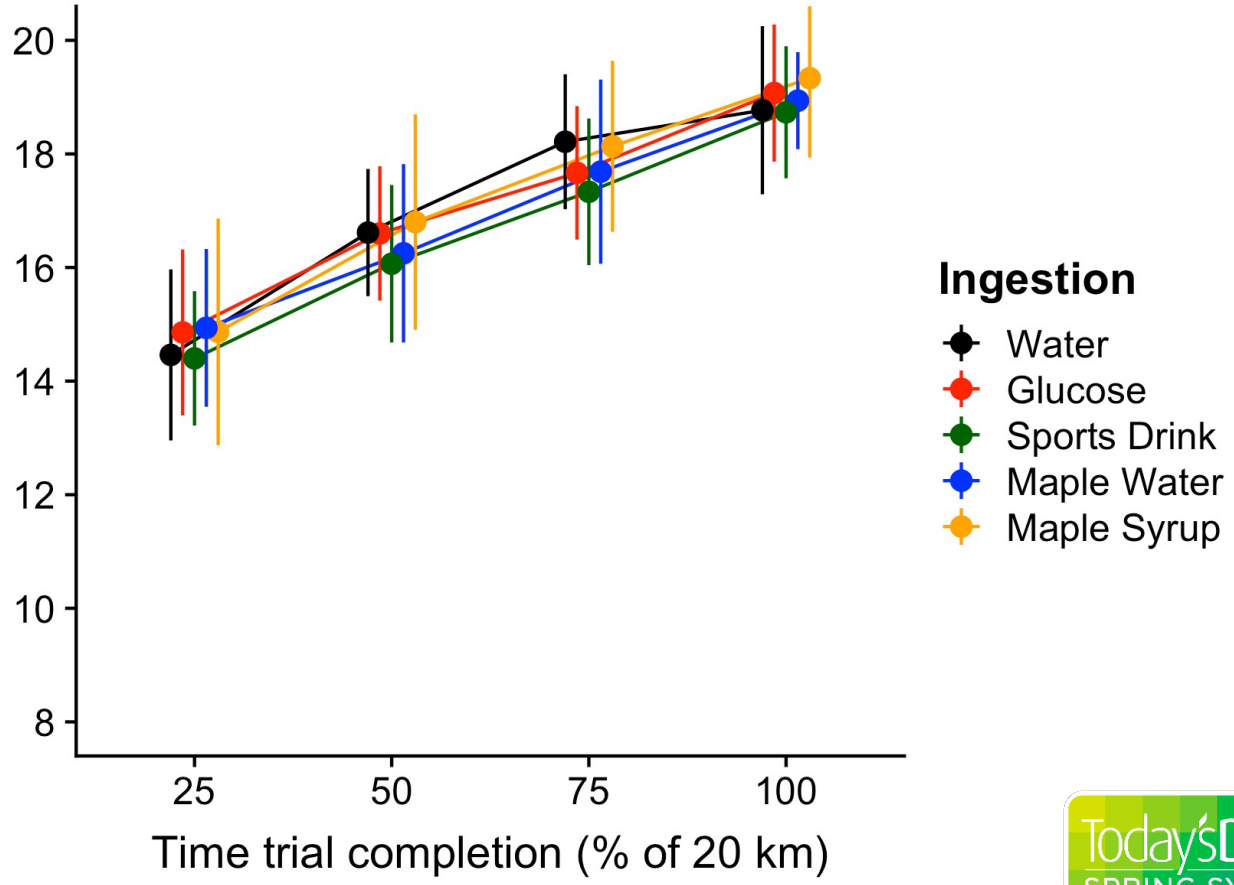






Rating of Perceived Exertion (RPE) During the 20-km time trial

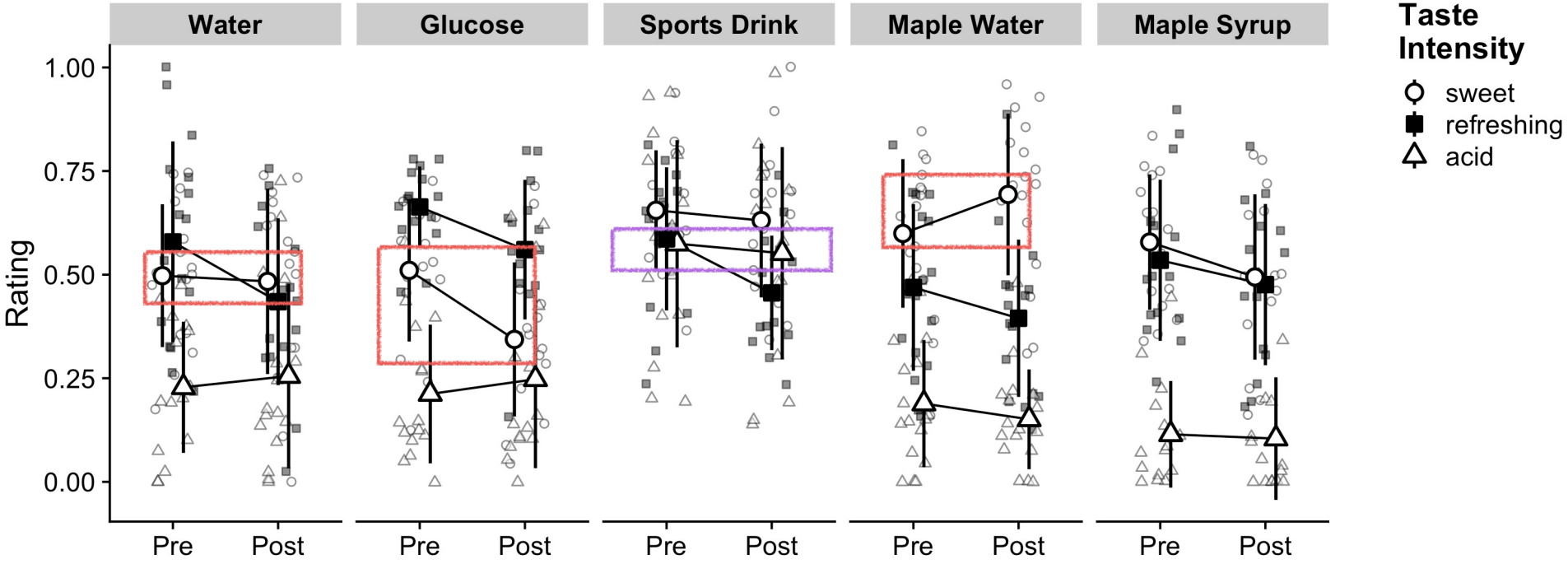
20	Maximal exertion
19	Very, very hard
18	
17	Very hard
16	
15	Hard
14	
13	Somewhat hard
12	
11	Fairly light
10	
9	Very light
8	
7	Very, very light
6	No exertion



Borg (1982) Med Sci Sports Exerc 14:337

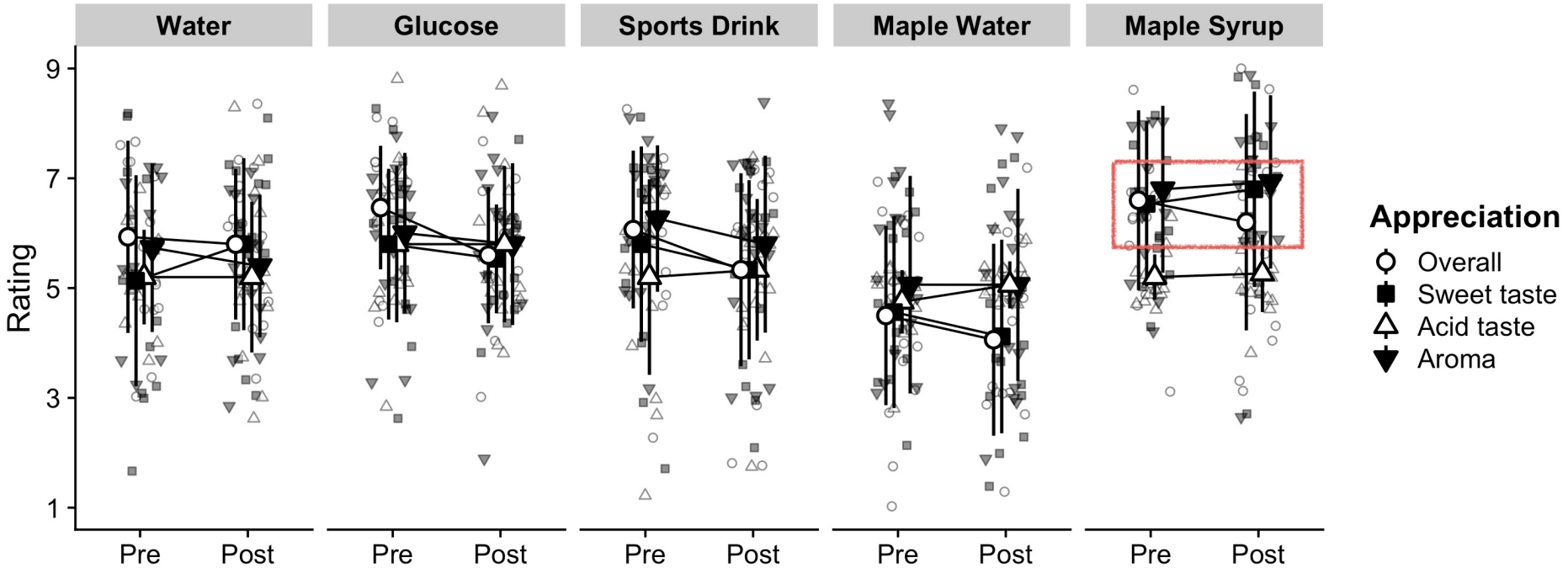
Taste Intensity Perception

(Visual Analogue Scale: 0=Not…; 1=Very…)

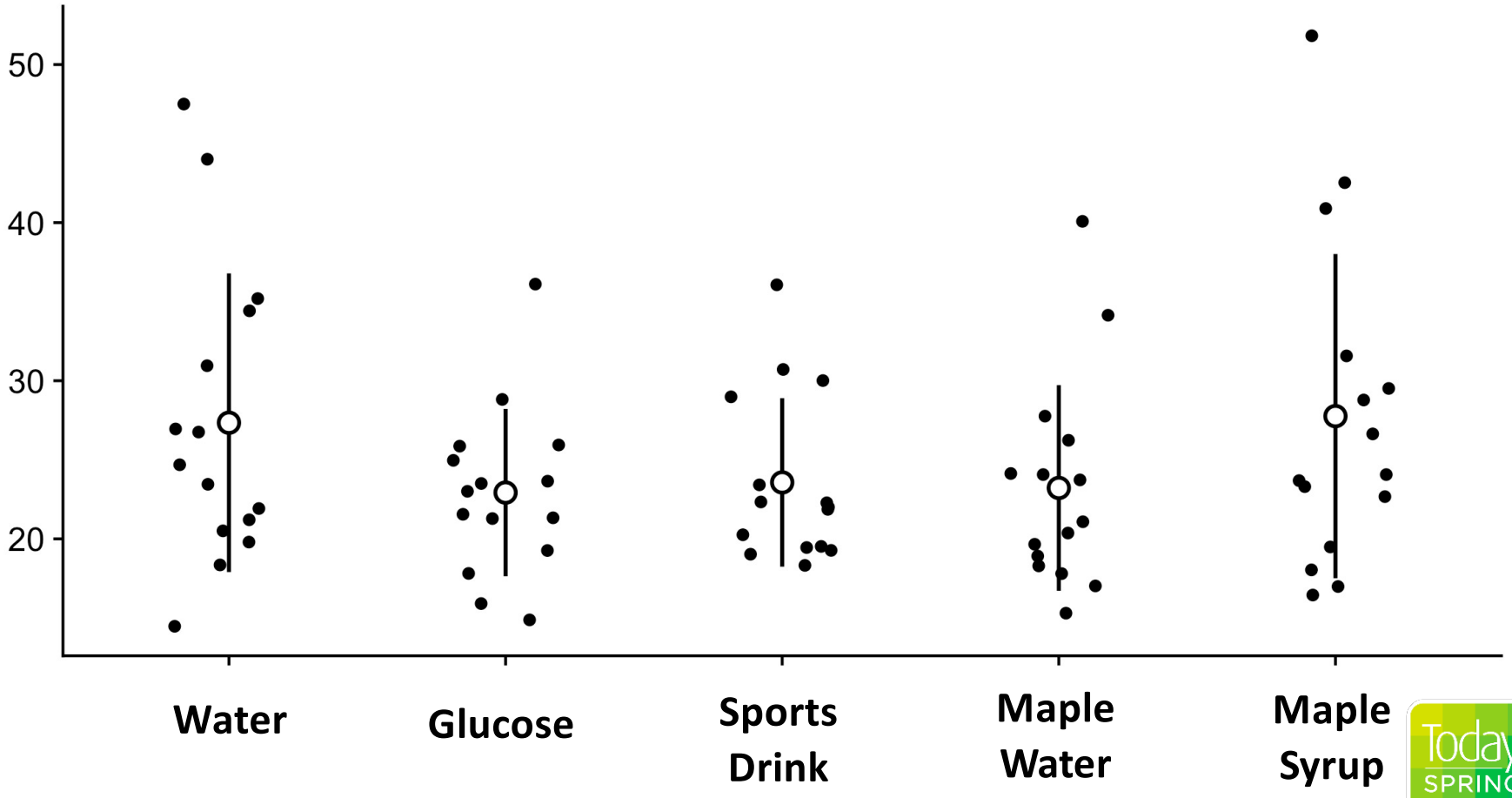


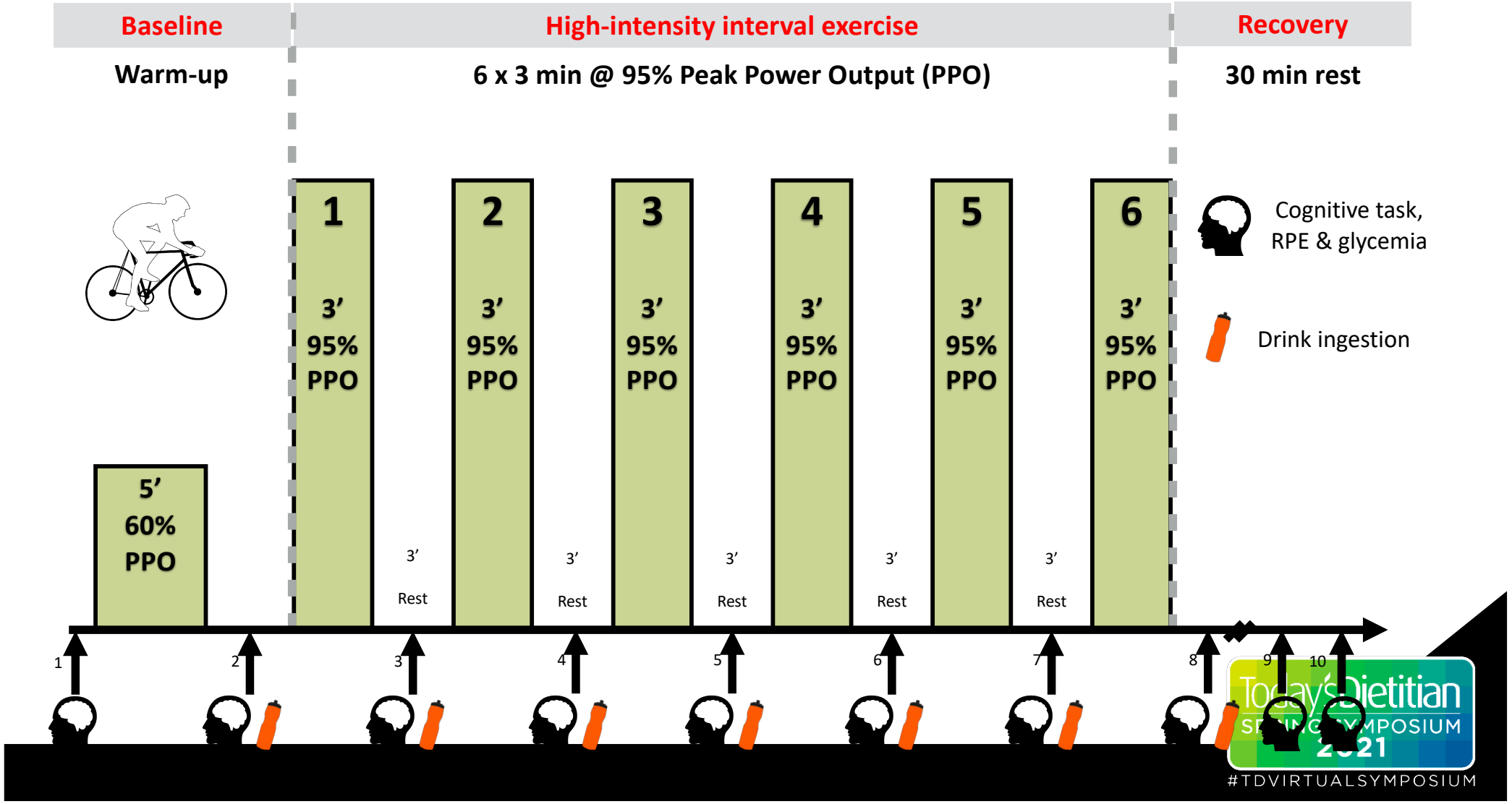
Sensory Appreciation

(9-point hedonic scale: 1=Dislike extremely; 9=Like extremely)

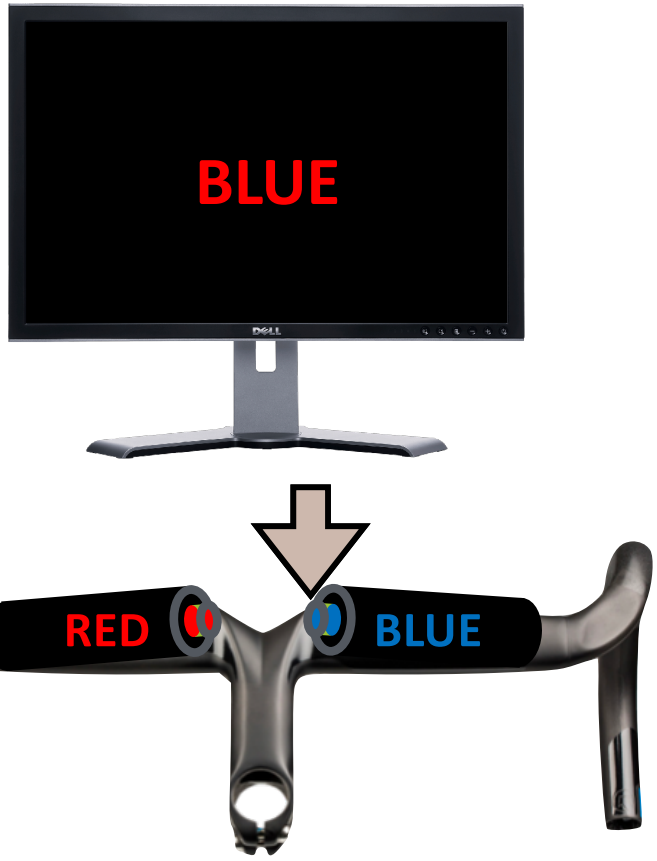


20-km Time-trial Performance (minutes)



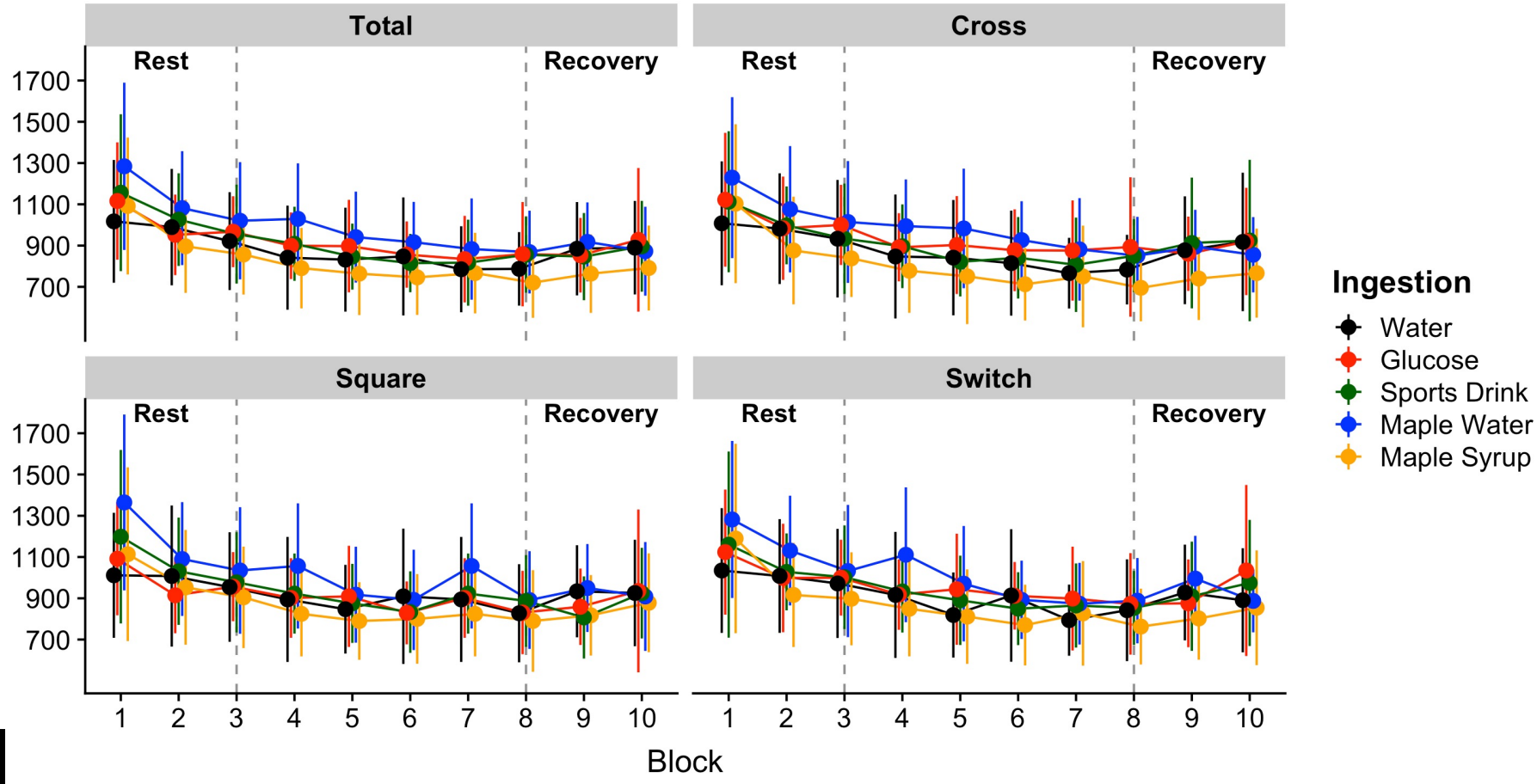

Baseline
High-intensity interval exercise
Recovery
Warm-up
6 x 3 min @ 95% Peak Power Output (PPO)
30 min rest
5’
60%
PPO
1
3’
95%
PPO
2
3’
95%
PPO
3
3’
95%
PPO
4
3’
95%
PPO
5
3’
95%
PPO
6
3’
95%
PPO
3’
Rest
3’
Rest
3’
Rest
3’
Rest
3’
Rest
Cognitive task,
RPE & glycemia
Drink ingestion
1
2
3
4
5
6
7
8
9
10
Today’s Dietitian
SPRING SYMPOSIUM
2021
#TDVIRTUALSYMPOSIUM

Stroop Color & Word Test



Colour of the WORDS

Mean Reaction Time (ms) in the Stroop Color and Word Test



Key Takeaways During Prolonged Exercise

- Maple Syrup can contribute to the energy supply similarly as other carbohydrate sources
- Maple Syrup's taste is less acid and similarly appreciated to other carbohydrate sources
- No adverse effects of maple products on perceived exertion or gastrointestinal distress*
- Maple Syrup contributes to improvements in brain executive functions during high-intensity exercise

*GI distress data not shown

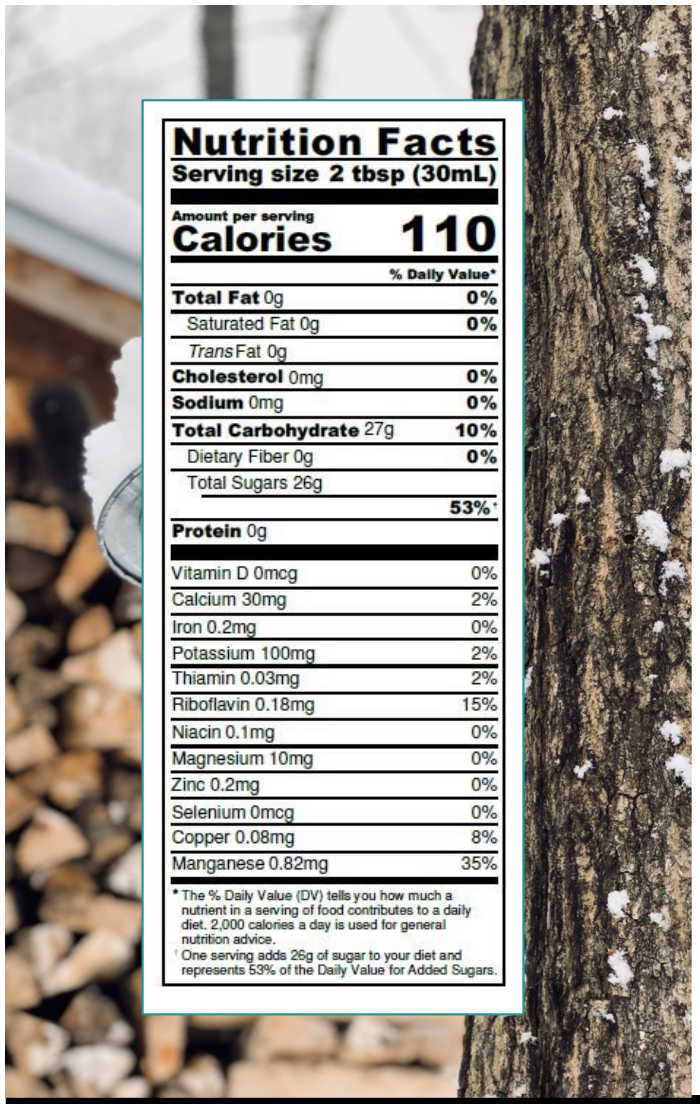
Limits to the Studies

- Cross-sectional: many conditions
- Sample sizes (n = 15 per group)
- Population sampling: recreational & elite athletes
- CHO dose could be greater

Thank you!

Pure Maple Syrup Nutrition and Culinary Applications

Elana Natker, MS, RD



Nutrition Facts
Serving size 2 tbsp (30mL)

Amount per serving	
Calories	**110**
	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 27g	**10%**
Dietary Fiber 0g	**0%**
Total Sugars 26g	
	53%†
Protein 0g	
Vitamin D 0mcg	0%
Calcium 30mg	2%
Iron 0.2mg	0%
Potassium 100mg	2%
Thiamin 0.03mg	2%
Riboflavin 0.18mg	15%
Niacin 0.1mg	0%
Magnesium 10mg	0%
Zinc 0.2mg	0%
Selenium 0mcg	0%
Copper 0.08mg	8%
Manganese 0.82mg	35%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.
† One serving adds 26g of sugar to your diet and represents 53% of the Daily Value for Added Sugars.

Nutrients in 100% Pure Maple Syrup

- 110 calories per 2 tbsp (30 ml) serving
- Excellent source of manganese (35% DV)
- Good source of riboflavin (15% DV)
- Other nutrients:
  - Calcium (2% DV)
  - Thiamin (2% DV)
  - Potassium (2% DV)
  - Copper (8% DV)

Pure Maple Syrup vs. Other Sweeteners

(per 2 tbsp/30 ml)	Maple Syrup	Honey	White Sugar	Brown Sugar	Agave Syrup
Calories	110	128	97	105	85
Sugars (g)	26	34	25	27	19
Calcium (mg)	30 (2% DV)	3	0	23 (2% DV)	0
Iron (mg)	0.2	0.2	0	0.2	0
Potassium (mg)	100 (2% DV)	22	0	37	0
Thiamin (mg)	0.03 (2% DV)	0	0	0	0.03 (2% DV)
Riboflavin (mg)	0.18 (15% DV)	0.02 (1% DV)	0	0	0.05 (4% DV)
Niacin (mg)	0.1	<0.1	0	<0.1	0.2 (1% DV)
Magnesium (mg)	10	0.84	0	2.5	0.28
Zinc (mg)	0.2	0.1	0	0	0
Copper (mg)	0.08 (8% DV)	0.02 (2% DV)	0	0.01 (1% DV)	0
Manganese (mg)	0.82 (35% DV)	0.03 (1% DV)	0	0.02	0

Source

Good Source

Source: FoodData Central, USDA

Label Claims: Canada vs. U.S.

Valeur nutritive
Nutrition Facts
pour 1/4 tasse (60 ml)
Per 1/4 cup (60 ml)

Calories 220	% valeur quotidienne* / % Daily Value*
Lipides / Fat 0 g	0 %
saturés / Saturated 0 g + trans / Trans 0 g	0 %
Glucides / Carbohydrate 54 g	
Fibres / Fibre 0 g	0 %
Sucres / Sugars 53 g	53 %
Protéines / Protein 0 g	
Cholestérol / Cholesterol 0 mg	
Sodium 0 mg	0 %
Potassium 200 mg	4 %
Calcium 75 mg	6 %
Fer / Iron 0,4 mg	2 %
Thiamine 0,05 mg	4 %
Riboflavine / Riboflavin 0,35 mg	27 %
Niacine / Niacin 0,2 mg	1 %
Magnésium / Magnesium 15 mg	4 %
Zinc 0,3 mg	3 %
Cuivre / Copper 0,15 mg	17 %
Manganèse / Manganese 1,65 mg	72 %

*5% ou moins c'est **peu**, 15% ou plus c'est **beaucoup**
*5% or less is **a little**, 15% or more is **a lot**

	Source	5-9% DV
	Good Source	10-19% DV
	Excellent Source	20% or more DV

Nutrition Facts
Serving size 2 tbsp (30mL)
Amount per serving
Calories 110

	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 27g	**10%**
Dietary Fiber 0g	**0%**
Total Sugars 26g	
	53%†
Protein 0g	
Vitamin D 0mcg	0%
Calcium 30mg	2%
Iron 0.2mg	0%
Potassium 100mg	2%
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* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.
† One serving adds 26g of sugar to your diet and represents 53% of the Daily Value for Added Sugars.

Polyphenol Claims: Canada vs. U.S.

VS

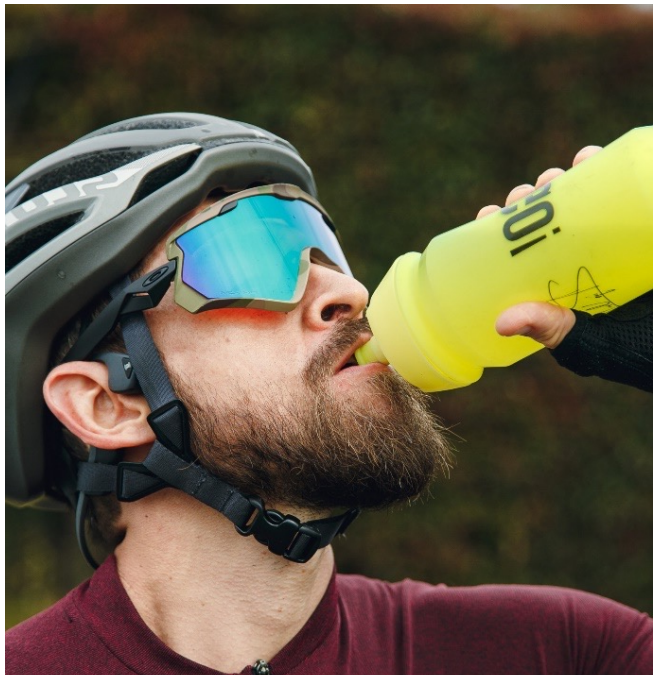
Pure Maple from Canada in Everyday Culinary Applications

Pure Maple from Canada Adds Sweetness

Pure Maple from Canada Adds Earthiness

Pure Maple from Canada for Grab-and-Go

Pure Maple from Canada for Sweetened Drinks



Give Real Maple a Turn

- 100% Pure Maple Syrup from Canada:
  - Is a natural sweetener
  - Is an excellent source of manganese, a good source of riboflavin, and contains other vitamins, nutrients and polyphenols, including Quebecol
  - Can help with stamina in athletic activities
  - Can be used in a variety of culinary applications, both sweet and savory

Questions?

Navindra Seeram, PhD
Jonathan Tremblay, PhD

web.uri.edu/maple/
Puremaplefromcanada.com

PureMaplefromCanada

PureMapleCanada

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