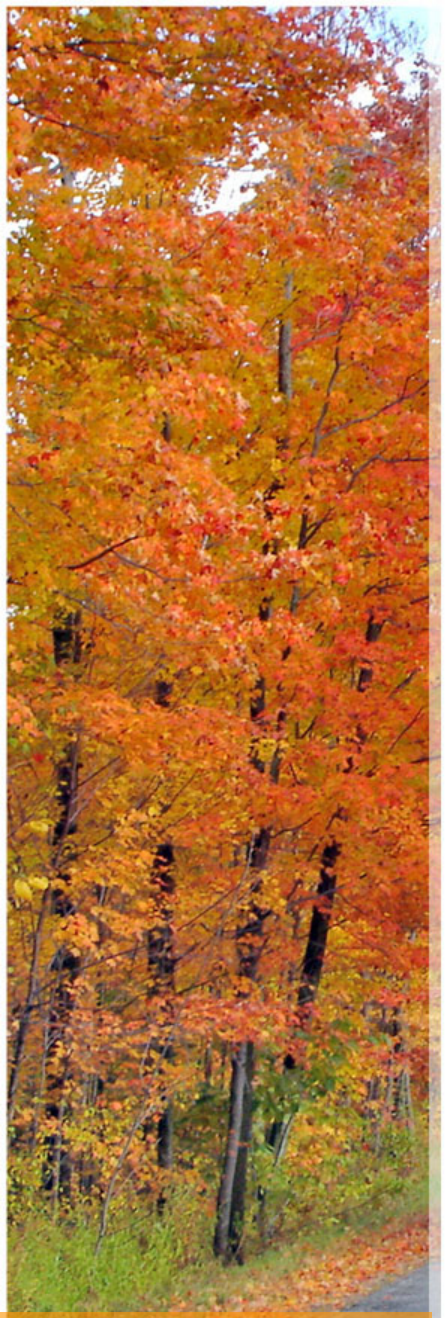
FRUCTOSE DAMAGE

Dr Georges MOUTON
www.gmouton.com

Kleinhoscheid, 06/04/2018



Medical Research Institute – Orlando

FRUCTOSE DAMAGE

Dr Georges MOUTON
September 2012

PANCREATIC SWEET TASTE RECEPTORS

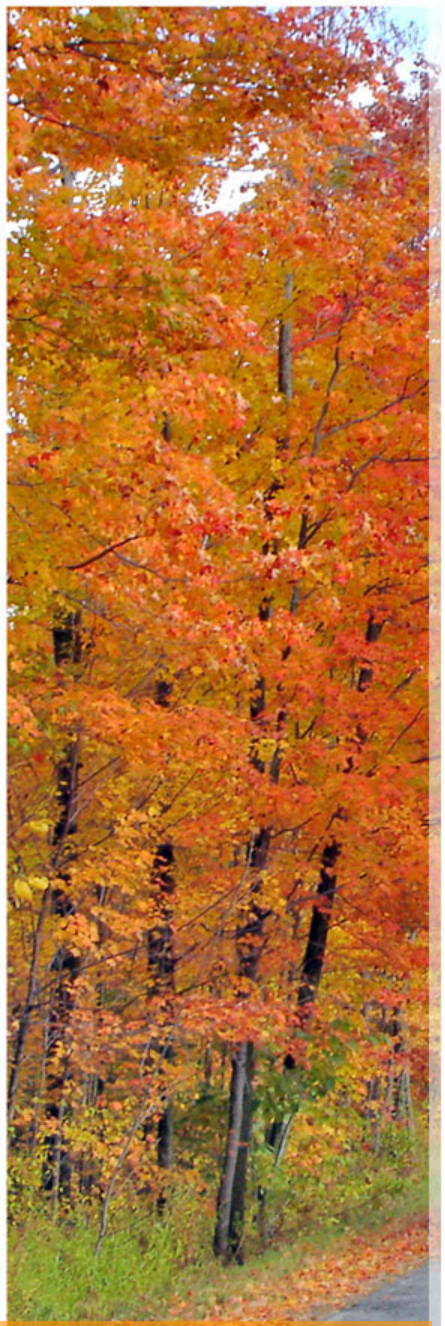
- We demonstrate that **fructose** activates **sweet taste receptors** on beta cells and synergizes with glucose to amplify **insulin release** in human and mouse islets.
- Genetic ablation of the sweet taste receptor protein T1R2 obliterates **fructose**-induced insulin release and its potentiating effects on glucose-stimulated **insulin secretion** *in vitro* and *in vivo*.

Proc Natl Acad Sci U S A. 2012 Feb 21;109(8):E524-32. Epub 2012 Feb 6.

Sweet taste receptor signaling in beta cells mediates fructose-induced potentiation of glucose-stimulated insulin secretion.

Kyriazis GA, Soundarapandian MM, Tyrberg B.

Metabolic Signaling and Disease, Diabetes and Obesity Research Center, Sanford-Burnham Medical Research Institute, Orlando, FL 32827, USA.



University of California
Los Angeles

FRUCTOSE DAMAGE

Dr Georges MOUTON
October 2010

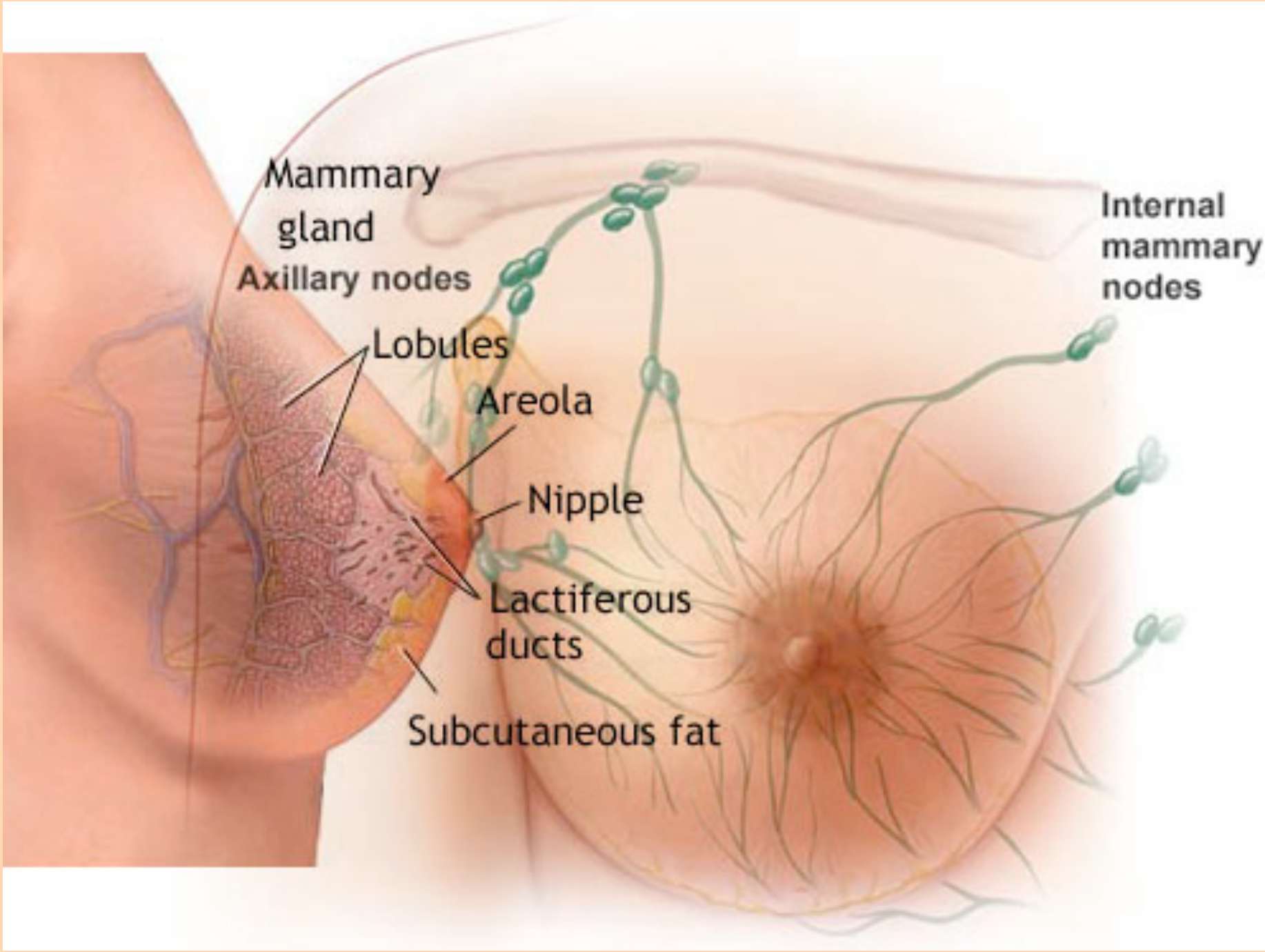
CANCER GROWTH

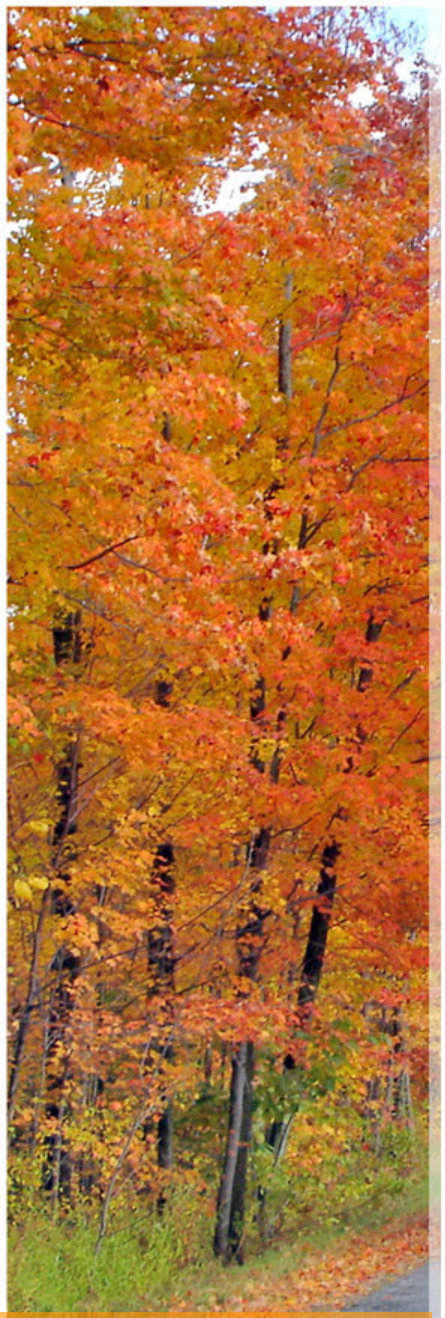
- These findings show that cancer cells can readily metabolize **fructose** to **increase proliferation**. They have major significance for cancer patients given dietary refined **fructose** consumption, and indicate that efforts to reduce refined **fructose** intake or inhibit **fructose**-mediated actions may disrupt **cancer growth**.

Cancer Res. 2010 Aug 1;70(15):6368-76. Epub 2010 Jul 20.

Fructose induces transketolase flux to promote pancreatic cancer growth.

Liu H, Huang D, McArthur DL, Boros LG, Nissen N, Heaney AP.


Mammary gland
Axillary nodes
Lobules
Areola
Nipple
Lactiferous ducts
Subcutaneous fat
Internal mammary nodes



University of Arkansas Little Rock

FRUCTOSE DAMAGE

Dr Georges MOUTON
September 2012

CANCER GROWTH

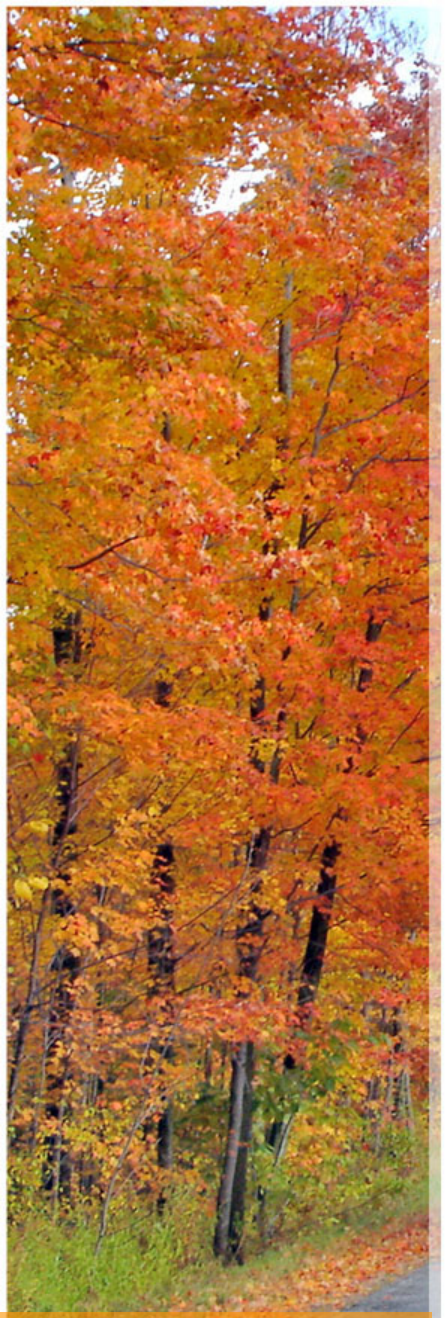
- Recent studies of **human breast tumor cell lines** indicate their ability to take up and utilize **fructose**. Here we tested the hypothesis that adding **fructose** to culture induces phenotypic changes in cultured human breast tumor cells that are associated with **metastatic disease**.

Int J Oncol. 2010 Sep;37(3):615-22.

Fructose as a carbon source induces an aggressive phenotype in MDA-MB-468 breast tumor cells.

Monzavi-Karbassi B, Hine RJ, Stanley JS, Ramani VP, Carcel-Trullols J, Whitehead TL, Kelly T, Siegel ER, Artaud C, Shaaf S, Saha R, Jousheghany F, Henry-Tillman R, Kieber-Emmons T.

Department of Pathology, University of Arkansas for Medical Sciences, Little Rock, AR 72205, USA. karbassi@uams.edu



University of Arkansas Little Rock

FRUCTOSE DAMAGE

Dr Georges MOUTON
September 2012

CANCER GROWTH

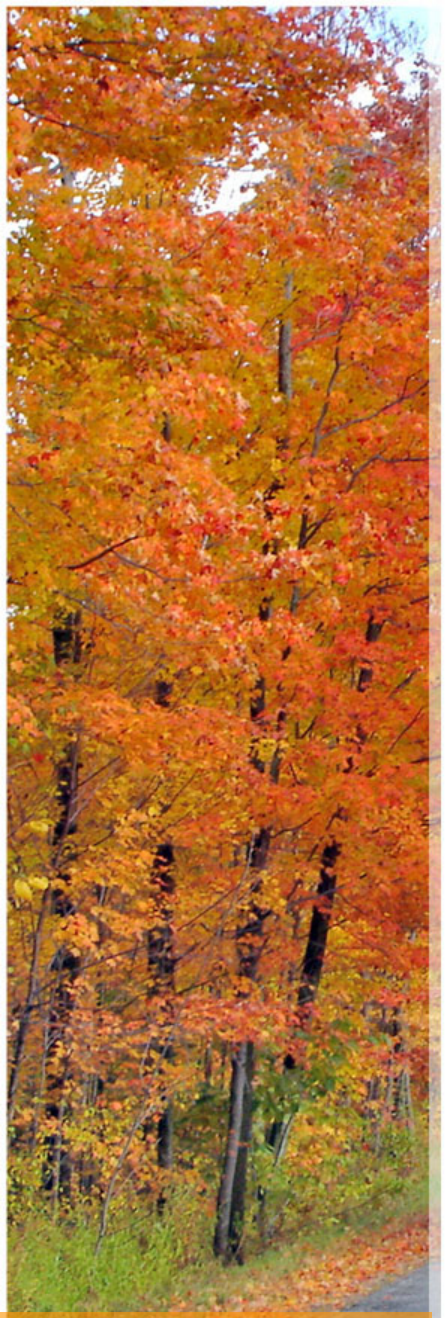
- Cells cultured in **fructose** expressed distinct cell-surface glycans. The addition of fructose affected sialylation and fucosylation patterns. **Fructose accelerated cellular migration and increased invasion.**

Int J Oncol. 2010 Sep;37(3):615-22.

Fructose as a carbon source induces an aggressive phenotype in MDA-MB-468 breast tumor cells.

Monzavi-Karbassi B, Hine RJ, Stanley JS, Ramani VP, Carcel-Trullols J, Whitehead TL, Kelly T, Siegel ER, Artaud C, Shaaf S, Saha R, Jousheghany F, Henry-Tillman R, Kieber-Emmons T.

Department of Pathology, University of Arkansas for Medical Sciences, Little Rock, AR 72205, USA. karbassi@uams.edu



University of Arkansas Little Rock

FRUCTOSE DAMAGE

Dr Georges MOUTON
September 2012

CANCER GROWTH

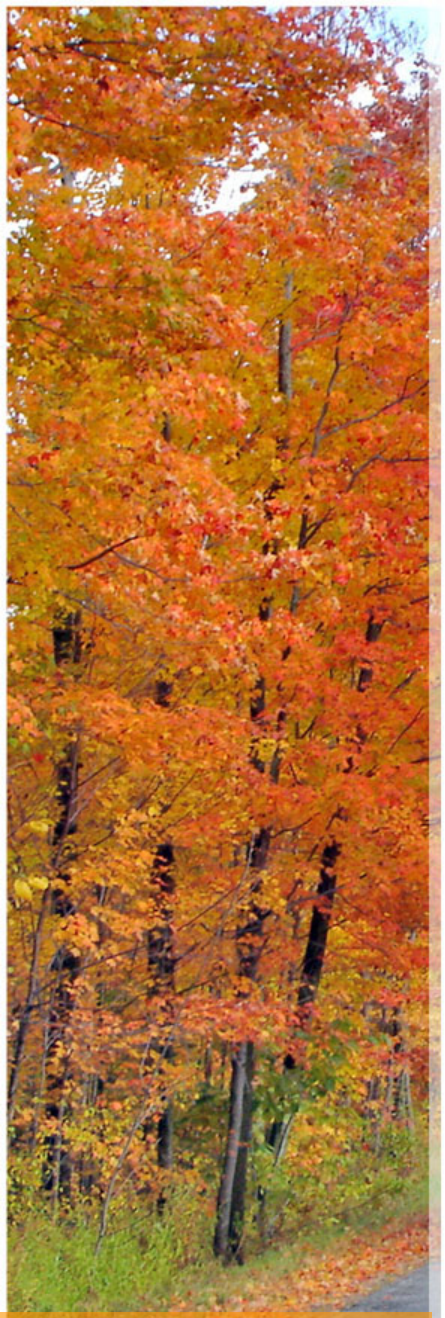
- These data could be of fundamental importance due to the markedly increased consumption of sweeteners containing free **fructose** in recent years, as they suggest that the presence of **fructose** in nutritional microenvironment of tumor cells may negatively affect the outcome for some **breast cancer patients**.

Int J Oncol. 2010 Sep;37(3):615-22.

Fructose as a carbon source induces an aggressive phenotype in MDA-MB-468 breast tumor cells.

Monzavi-Karbassi B, Hine RJ, Stanley JS, Ramani VP, Carcel-Trullols J, Whitehead TL, Kelly T, Siegel ER, Artaud C, Shaaf S, Saha R, Jousheghany F, Henry-Tillman R, Kieber-Emmons T.

Department of Pathology, University of Arkansas for Medical Sciences, Little Rock, AR 72205, USA. karbassi@uams.edu



FRUCTOSE DAMAGE

Dr Georges MOUTON
March 2016

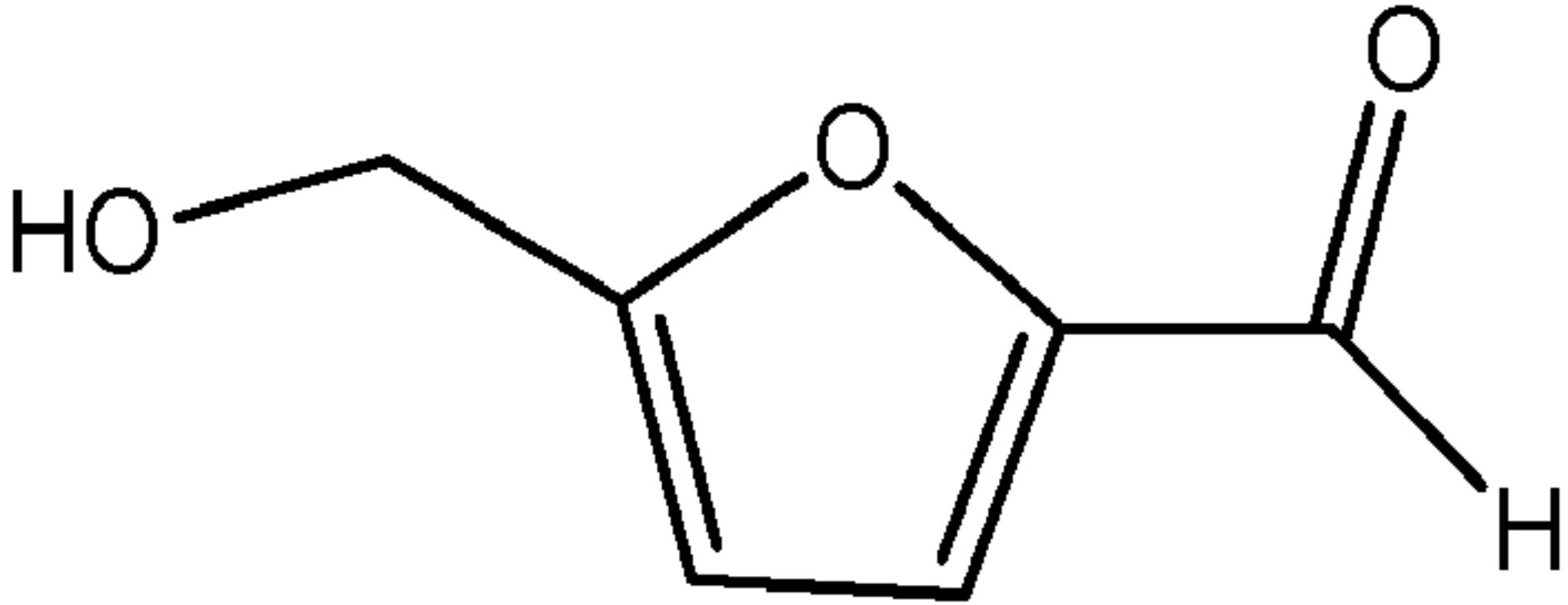
CANCER GROWTH

- Epidemiologic studies have shown that dietary sugar intake has a significant impact on the development of breast cancer. We determined that **fructose** derived from the **sucrose** was responsible for facilitating lung metastasis and 12-HETE production in breast tumours. Overall, our data suggested that dietary **sugar** induces 12-LOX signalling to increase risks of breast cancer development and metastasis.

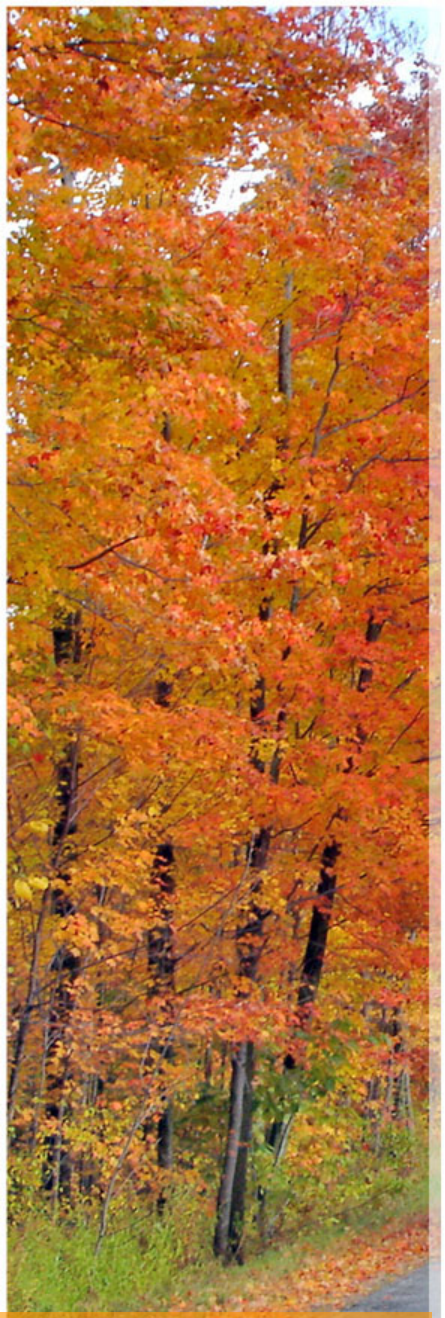
Yan Jiang[1], Yong Pan[1], Patrea R. Rhea[1], Lin Tan[1], Mihai Gagea[2], Lorenzo Cohen[1], Susan M. Fischer[3], and Peiying Yang[1,*]

Cancer Research
The Journal of Cancer Research (1916–1930) | The American Journal of Cancer (1931–1940)

A Sucrose-Enriched Diet Promotes Tumorigenesis in Mammary Gland in Part through the 12-Lipoxygenase Pathway



Hydroxymethylfurfural



Dhaka University
Bangladesh

FRUCTOSE DAMAGE

Dr Georges MOUTON
March 2014

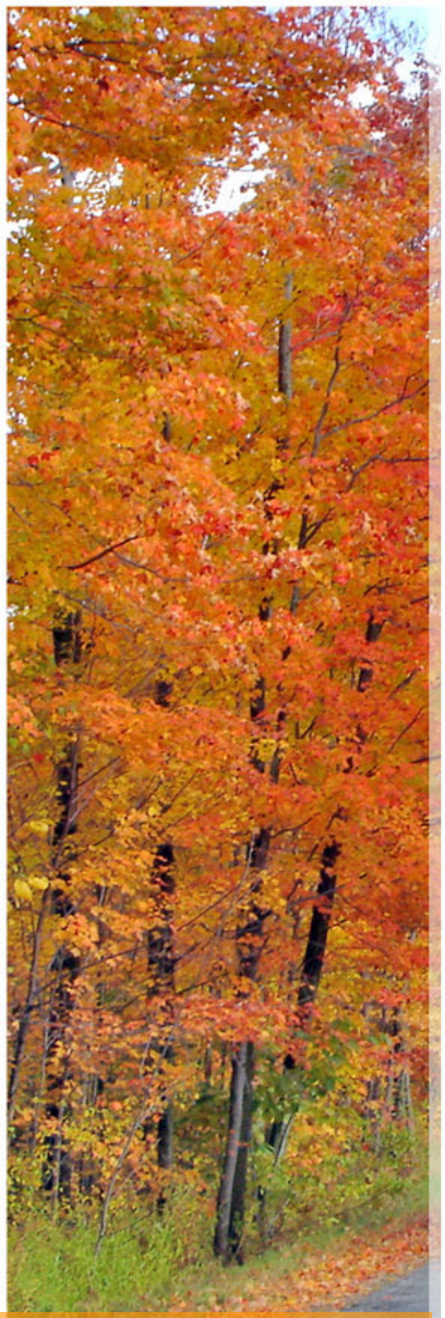
TOXINS IN HONEY

- Honey my contain compounds that may lead to toxicity. A compound not naturally present in honey, named 5-**hydroxy-methylfurfural** (**HMF**), may be formed during the heating or preservation processes of honey. (…)
- **HMF** is a compound that may be mutagenic, carcinogenic and cytotoxic.

J Appl Toxicol. 2013 Nov 11. doi: 10.1002/jat.2952. [Epub ahead of print]

Toxic compounds in honey.

Islam MN[1], Khalil MI, Islam MA, Gan SH.



US Department of Agriculture

FRUCTOSE DAMAGE

Dr Georges MOUTON
March 2014

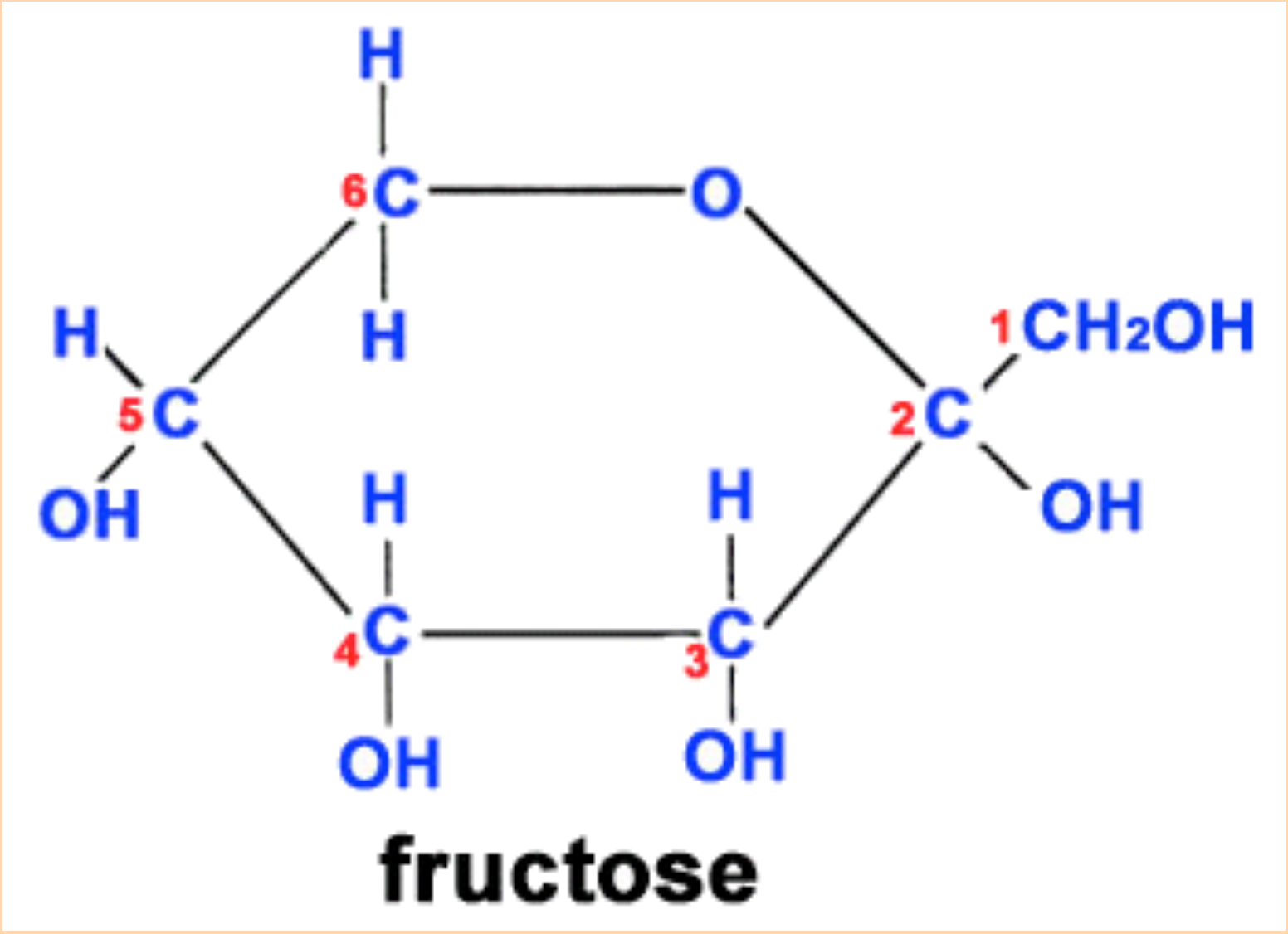
TOXINS IN HONEY

- In the United States, high-**fructose** corn syrup has become a sucrose replacement for honey bees and has widespread use as a sweetener in many processed foods and beverage for human consumption. (…) **Hydroxymethylfurfural (HMF)** is a heat-formed contaminant and is the most noted toxin to honey bees.

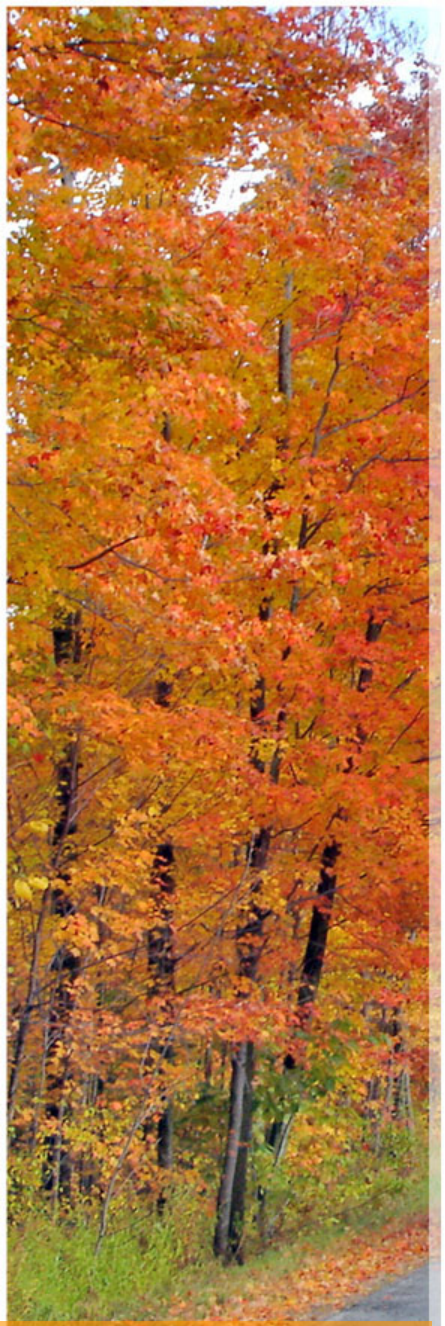
J Agric Food Chem. 2009 Aug 26;57(16):7369-76. doi: 10.1021/jf9014526.

Formation of hydroxymethylfurfural in domestic high-fructose corn syrup and its toxicity to the honey bee (Apis mellifera).

LeBlanc BW[1], Eggleston G, Sammataro D, Cornett C, Dufault R, Deeby T, St Cyr E.



fructose



University of California San Francisco

FRUCTOSE DAMAGE

Dr Georges MOUTON
September 2012

AVAILABILITY

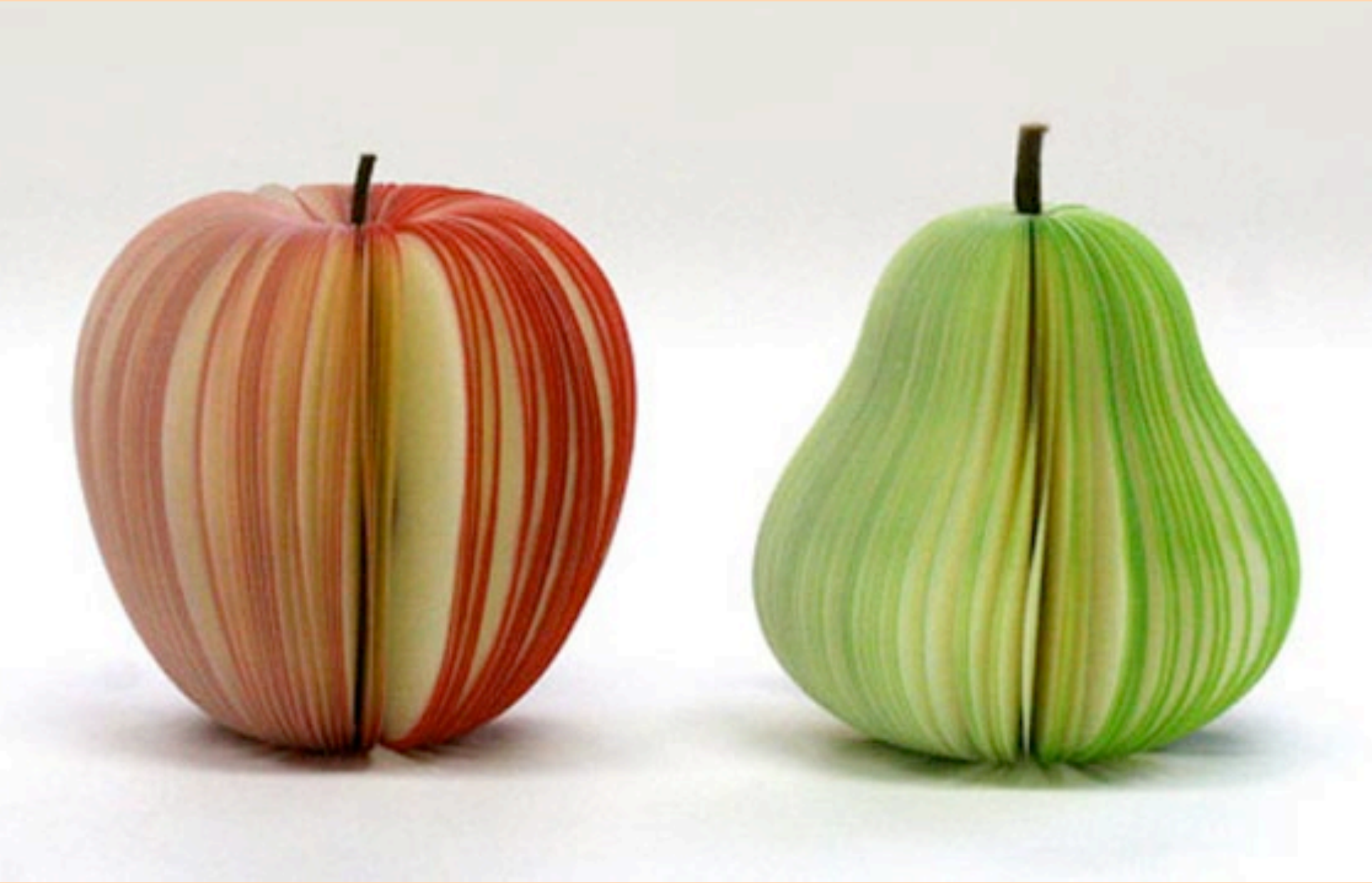
- Evolutionarily, sugar as fruit was available to our ancestor for only a few months a year (at harvest time), or as honey, which was guarded by bees.
- Nature made sugar hard to get; man made it easy.

Nature. 2012 Feb 1;482(7383):27-9. doi: 10.1038/482027a.

Public health: The toxic truth about sugar.

Lustig RH, Schmidt LA, Brindis CD.

Department of Pediatrics, University of California, San Francisco, California 94143, USA. rlustig@peds.ucsf.edu



Dr Georges MOUTON September 2012

FRUCTOSE DAMAGE

- CHRONIC KIDNEY DISEASE
- ELEVATED BLOOD PRESSURE
- HYPERURICEMIA
- HYPERTRIGLYCERIDEMIA
- INCREASED VISCERAL ADIPOSITY
- INCREASED ADIPOSITY GAIN
- DECREASED INSULIN SENSITIVITY
- NON ALCOHOLIC FATTY LIVER DISEASE
- METABOLIC SYNDROME
- IMPAIRED COGNITIVE FUNCTION
- FOOD INTAKE DYSREGULATION
- CANCER GROWTH

FRUITS

Fruit	Size or Quantity	Fructose (g)
Olives	10 olives (40g)	Trace
Avocado	1/2 fruit (100g)	0.2
Lime	1 fruit (65g)	0.2
Passion fruit	1 fruit (20g)	0.5
Damson	1 fruit (25g)	1.0
Apricot, fresh	1 fruit (35g)	1.0
Cranberries	1 cup (110g)	1.3
Guava	1 fruit (55g)	1.4
Lemon	1 fruit (110g)	1.7
Gooseberries	1 cup (150g)	1.9
Melon (Cantaloupe)	1 slice (125g)	2.0
Plum	1 fruit (65g)	2.0
Satsuma	1 medium (70g)	2.2
Fig, fresh	1 fruit (50g)	2.2
Sharon fruit	1 fruit (25g)	2.3
Melon (Galia)	1 slice (125g)	2.6
Tangerine	1 medium (90g)	2.7
Raspberries	1 cup (110g)	2.8
Grapefruit	½ fruit (120g)	2.8
Melon (Honeydew)	1 slice (125g)	2.9
Redcurrants	1 cup (110g)	3.0
Whitecurrants	1 cup (110g)	3.0
Clementine	1 medium (75g)	3.3
Loganberries	1 cup (145g)	3.5
Quince	1 fruit (90g)	3.6
Blackberries	1 cup (145g)	3.7
Strawberries	10 fruits (120g)	3.8
Kiwi	1 fruit (75g)	3.8
Greengage	1 fruit (66g)	4.0
Blackcurrants	1 cup (110g)	4.0

Fruit	Size or Quantity	Fructose (g)
Orange	1 fruit (130g)	4.1
Pineapple	1 slice (85g)	4.5
Kumquat	5 fruits (95g)	4.5
Lychee	6 fruits (60g)	4.6
Papaya	½ medium (150g)	5.0
Peach	1 medium (150g)	5.1
Blueberries	1 cup (150g)	5.2
Mulberries	1 cup (125g)	5.3
Pomelo	¼ fruit (150g)	5.3
Cherries	15 fruits (120g)	5.4
Nectarine	1 medium (140g)	5.7
Prickly pear	1 fruit (100g)	5.7
Watermelon	1 slice (285g)	6.6
Grapes	20 fruits (100g)	7.7
Banana	1 medium (120g)	8.3
Mango	½ fruit (105g)	8.4
Pear	1 medium (180g)	9.8
Pomegranate	1 fruit (280g)	9.9
Apple, fresh	1 medium (180g)	13.3
Dates, fresh	6 fruits (145g)	21.8
Dried Fruits		
Prunes	6 fruits (60g)	9.6
Apricots, dried	½ cup (60g)	9.8
Figs, dried	6 fruits (50g)	11.3
Dates, dried	½ cup (80g)	26.9
Currants	½ cup (80g)	27.5
Sultanas	½ cup (80g)	28.6
Raisins	½ cup (80g)	28.7
Apple, dried	1 cup (85g)	35.9

VEGETABLES

Vegetable	Size or Quantity	Fructose (g)
Seaweed	N/A	Trace
Mushroom	1 cup, sliced (70g)	0.1
Swiss chard	1 cup (35g)	0.1
Watercress	1 cup, chopped (35g)	0.1
Celery	1 stalk (40g)	0.2
Spinach	1 cup (30g)	0.2
Spring onion	1 medium (15g)	0.2
Chinese cabbage	1 cup, shredded (70g)	0.2
Radish	6 medium (25g)	0.2
Rhubarb	1 stalk (50g)	0.3
Endive	1 cup (50g)	0.3
Lettuce	1 cup, shredded (35g)	0.3
Shallot	2 tbsp., chopped (20g)	0.3
Cucumber	½ cup, slices (50g)	0.4
Kale	1 cup, chopped (65g)	0.5
Yam	1 cup (150g)	0.5
Radicchio	1 cup, shredded (40g)	0.5
Parsley	1 cup, chopped (60g)	0.5
Broad beans	½ cup (125g)	0.6
Potato (old)	1 medium (210g)	0.6
Artichoke (globe)	1 medium (125g)	0.6
Sweetcorn	½ cup (75g)	0.7
Lentil (green & brown)	½ cup, raw (95g)	0.7
Mangetout	1 cup (110g)	0.7
Broccoli	3 spears (90g)	0.8
Courgette	½ medium (100g)	0.9
Spring greens	1 cup, shredded (70g)	0.9
Pumpkin	1 cup (115g)	0.9
Fennel (bulb)	½ bulb (115g)	0.9
Tomatoes, sun-dried	½ cup (55g)	1.0
Sugar snap peas	1 cup (110g)	1.0
Tomato puree	1 tablespoon (15g)	1.1
Leek	1 medium (90g)	1.1
Cabbage, red	1 cup, shredded (70g)	1.1

Vegetable	Size or Quantity	Fructose (g)
Asparagus	6 spears (100g)	1.2
Purple broccoli	3 spears (90g)	1.2
Green bean	½ cup (90g)	1.2
Lentil, red split	½ cup, raw (95g)	1.2
Aubergine	¼ whole (135g)	1.2
Red kidney bean	½ cup, raw (90g)	1.3
Okra	1 cup (100g)	1.4
Hummus	½ cup (125g)	1.4
Chickpea	½ cup, raw (100g)	1.4
Cabbage	1 cup, shredded (70g)	1.4
Artichoke (Jerusalem)	1 cup, sliced (150g)	1.4
Runner bean	½ cup (90g)	1.5
Tomato	1 medium (90g)	1.5
Potato (new)	1 medium (210g)	1.5
Haricot bean	½ cup, raw (105g)	1.5
Celeriac	1 cup (155g)	1.6
Peas	½ cup (75g)	1.6
Carrot (young)	1 medium (60g)	1.6
Pepper, green	1 medium (120g)	1.7
Squash, spaghetti	1 cup, cubes (101g)	1.7
Cauliflower	¼ medium (145g)	1.7
Brussels sprouts	6 sprouts (115g)	1.9
Carrot (old)	1 medium (60g)	2.1
Kohlrabi	1 cup (135g)	2.3
Turnip	1 medium (120g)	2.4
Onion	1 medium (110g)	2.9
Beetroot	1 medium (80g)	2.9
Swede	1 cup, cubes (140g)	2.9
Squash, butternut	1 cup, cubes (140g)	3.2
Pepper, yellow	1 medium (120g)	3.6
Sweet potato	1 medium (130g)	3.6
Parsnip	1 cup, sliced (135g)	3.6
Pepper, red	1 medium (120g)	4.3
Plantain	1 cup (150g)	4.3

Dr Georges MOUTON April 2018

FRUCTOSE DAMAGE

SWEETENERS

Sweetener	Quantity	Fructose (g)
Molasses	1 teaspoon	**1.5**
Maple syrup	1 teaspoon	**1.5**
Honey	1 teaspoon	**2.1**
Agave Nectar	1 teaspoon	**2.8**

TABLE SUGAR

Sugar from cane or beet, saccharose, sucrose

(all synonyms) provide about

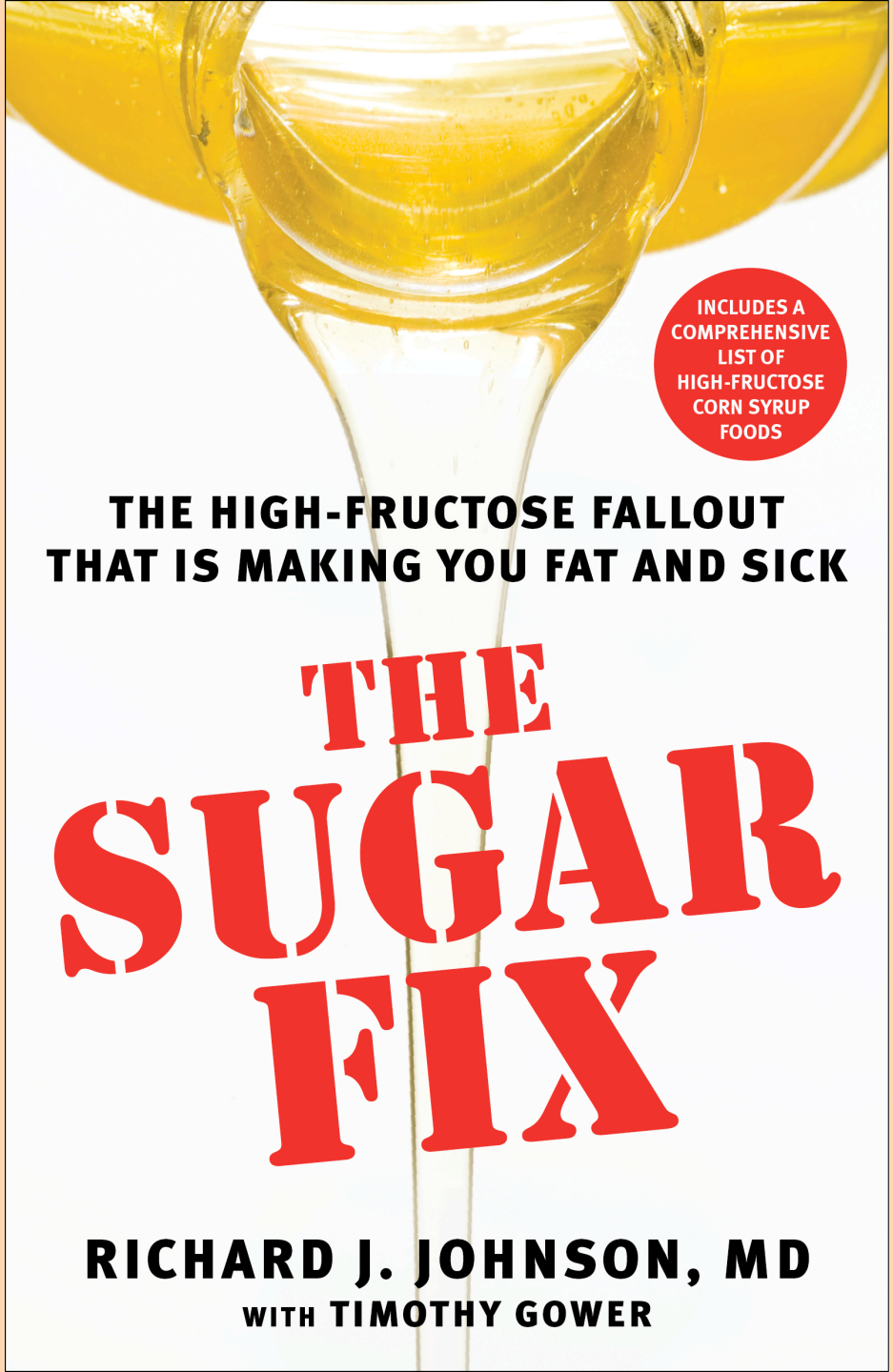
half glucose and half **fructose**:

see labels for "**sugars**"

DRINKS

Home-made juices & smoothies	According to the **fruits** and/or **vegetables** used (all the **fructose** is in the juice!)	Red wine Dry white wine Champagne Rose wine Cider (dry) Sweet white wine Cider (sweet)	**Trace** **0.5** g/glass **1.0g**/glass **3.0** g/glass **5.1g**/pint **6.0** g/glass **7.4g**/pint
Processed juices & smoothies	See labels for "**sugars**" (typically from **8** g/100ml to **14** g/100ml)	Tomato juice V8 Coconut water	**3** g/100 ml **3.5** g/100 ml **5** g/100 ml

Vegetable milks may contain added fructose (e.g. in the form of fructose syrup or within sugar): see labels!


INCLUDES A COMPREHENSIVE LIST OF HIGH-FRUCTOSE CORN SYRUP FOODS
THE HIGH-FRUCTOSE FALLOUT THAT IS MAKING YOU FAT AND SICK
THE SUGAR FIX
RICHARD J. JOHNSON, MD
WITH TIMOTHY GOWER

Centers for Disease Control and Prevention, Atlanta, Georgia

FRUCTOSE DAMAGE

Dr Georges MOUTON
May 2014

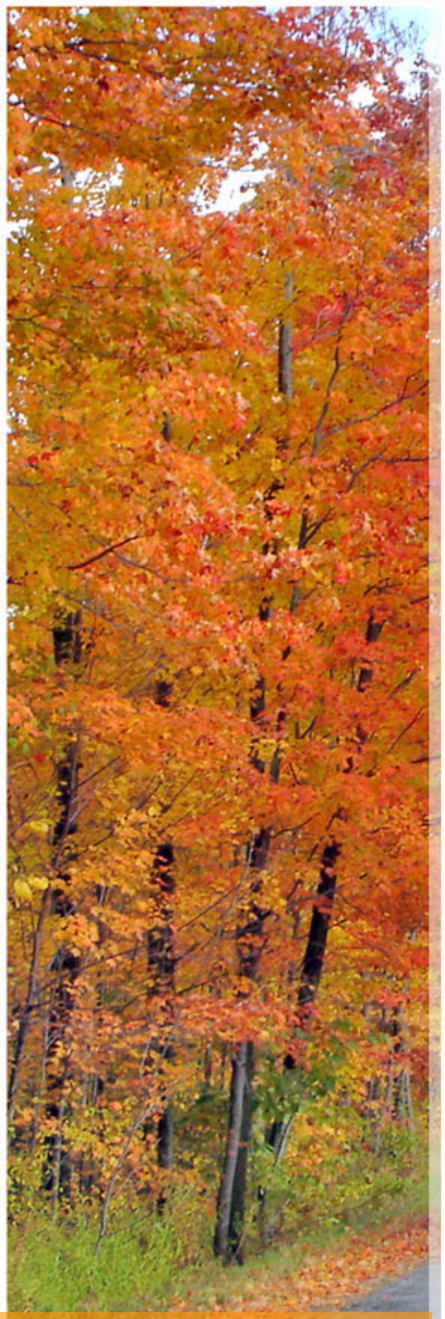
CARDIOVASCULAR RISK

- IMPORTANCE: Epidemiologic studies have suggested that higher intake of added sugar is associated with cardiovascular disease (CVD) risk factors.
- MAIN OUTCOMES: Adjusted hazard ratios were 1.30 and 2.75 respectively, comparing participants who consumed 10.0% to 24.9% or 25.0% or more calories from added sugar with those who consumed less than 10.0% of calories from added sugar. CONCLUSIONS We observed a significant relationship between added sugar consumption and increased risk for CVD mortality.

JAMA Intern Med. 2014 Apr;174(4):516-24. doi: 10.1001/jamainternmed.2013.13563.

Added sugar intake and cardiovascular diseases mortality among US adults.

Yang Q[1], Zhang Z[1], Gregg EW[2], Flanders WD[3], Merritt R[1], Hu FB[4].



University of California San Francisco

FRUCTOSE DAMAGE

Dr Georges MOUTON
May 2014

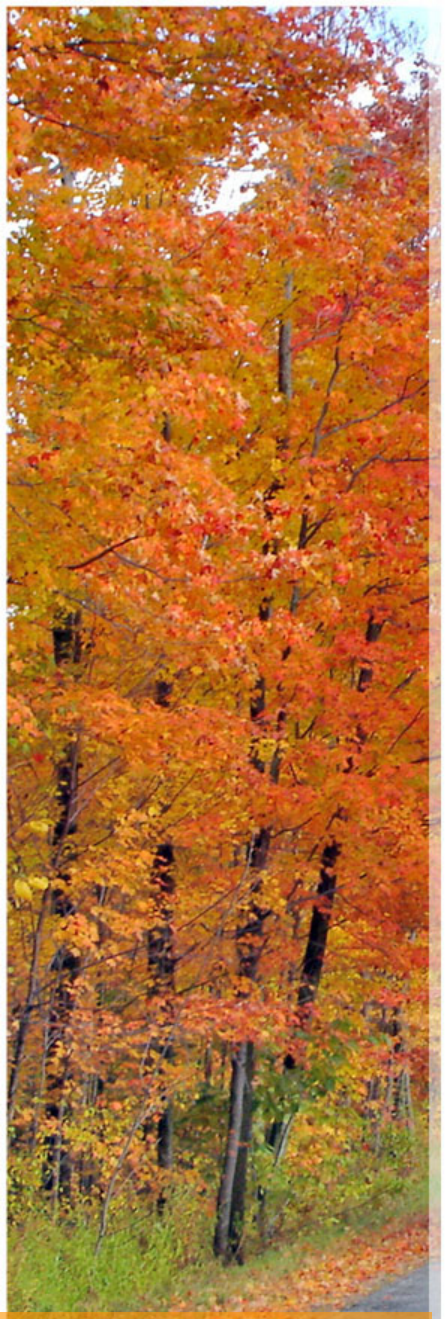
CARDIOVASCULAR RISK

- We are in the midst of a paradigm shift in research on the health effect of sugar, one fueled by extremely high rates of added sugar overconsumption in the American public. Past concerns revolved around obesity and dental caries as the main health hazards. Overconsumption of added sugars has long been associated with an **increased risk of cardiovascular disease (CVD)**. However, under the old paradigm it was assumed to be a marker for unhealthy diet or obesity.

JAMA Intern Med. 2014 Apr;174(4):525-6. doi: 10.1001/jamainternmed.2013.12991.

New unsweetened truths about sugar.

Schmidt LA.



University of California San Francisco

FRUCTOSE DAMAGE

Dr Georges MOUTON
May 2014

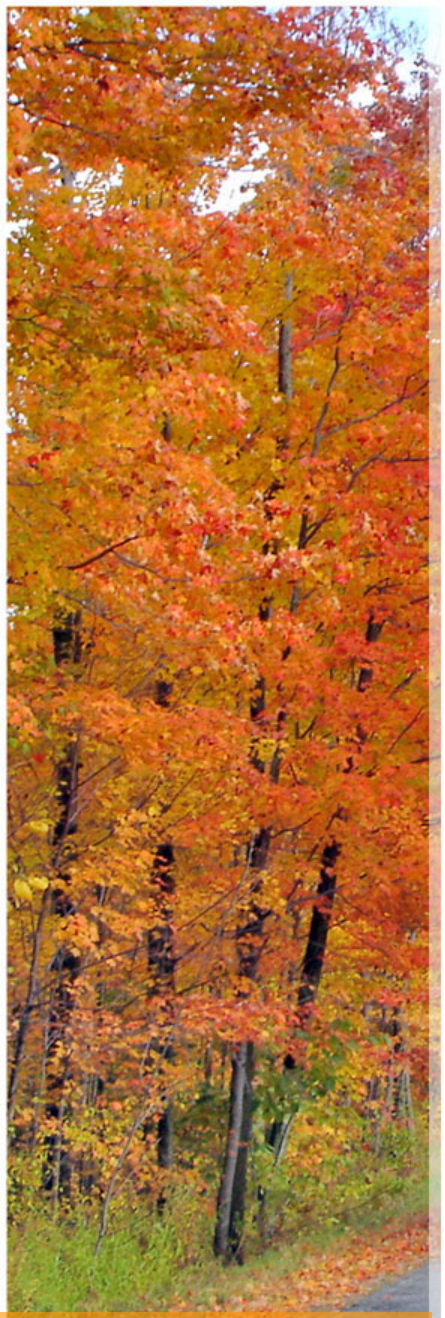
CARDIOVASCULAR RISK

- The new paradigm views sugar overconsumption as an independent risk factor in CVD as well as many other chronic diseases, including diabetes mellitus, liver cirrhosis, and dementia - all linked to metabolic perturbations involving dyslipidemia, hypertension, and insulin resistance.

JAMA Intern Med. 2014 Apr;174(4):525-6. doi: 10.1001/jamainternmed.2013.12991.

New unsweetened truths about sugar.

Schmidt LA.



University of California San Francisco

FRUCTOSE DAMAGE

Dr Georges MOUTON
May 2014

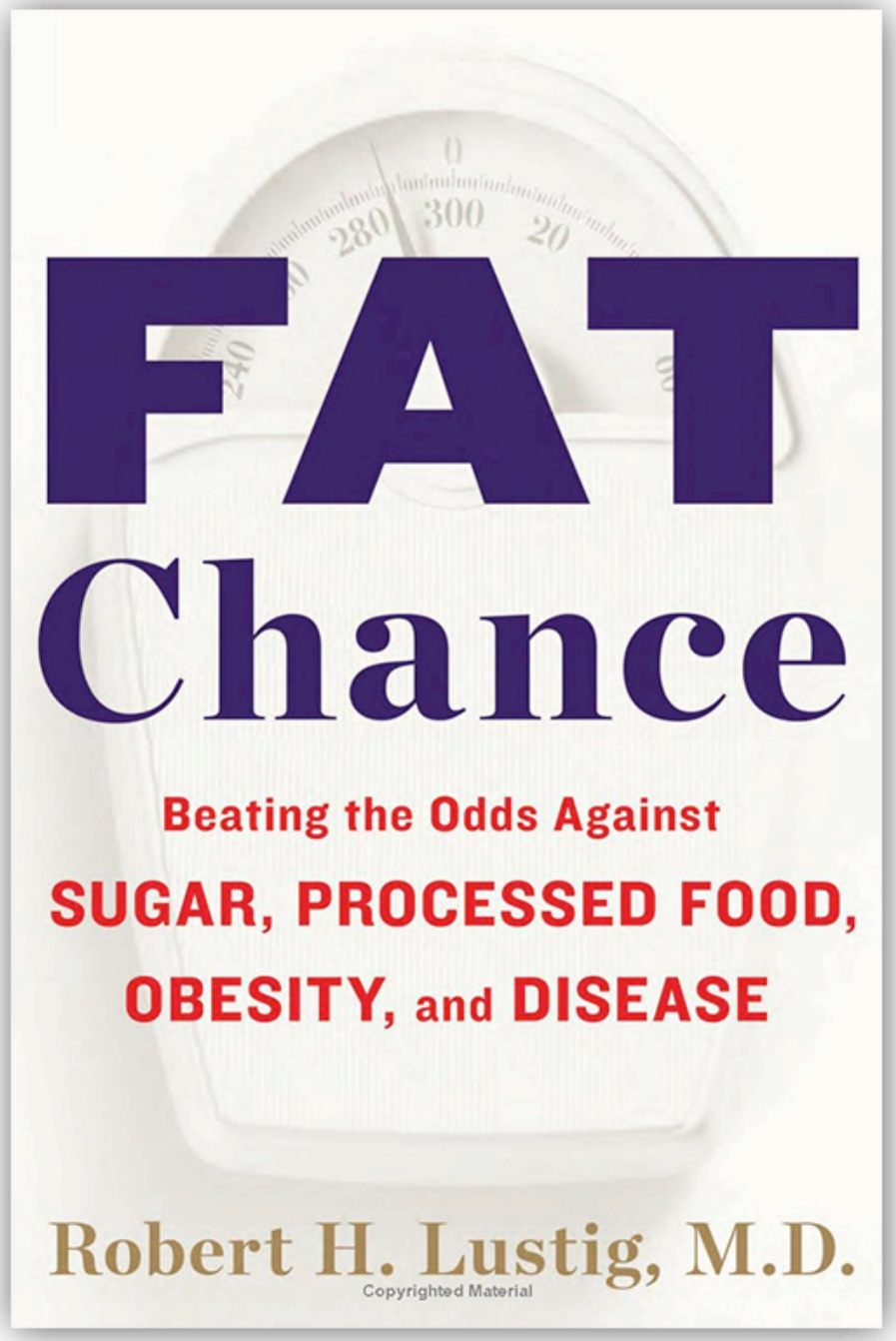
CARDIOVASCULAR RISK

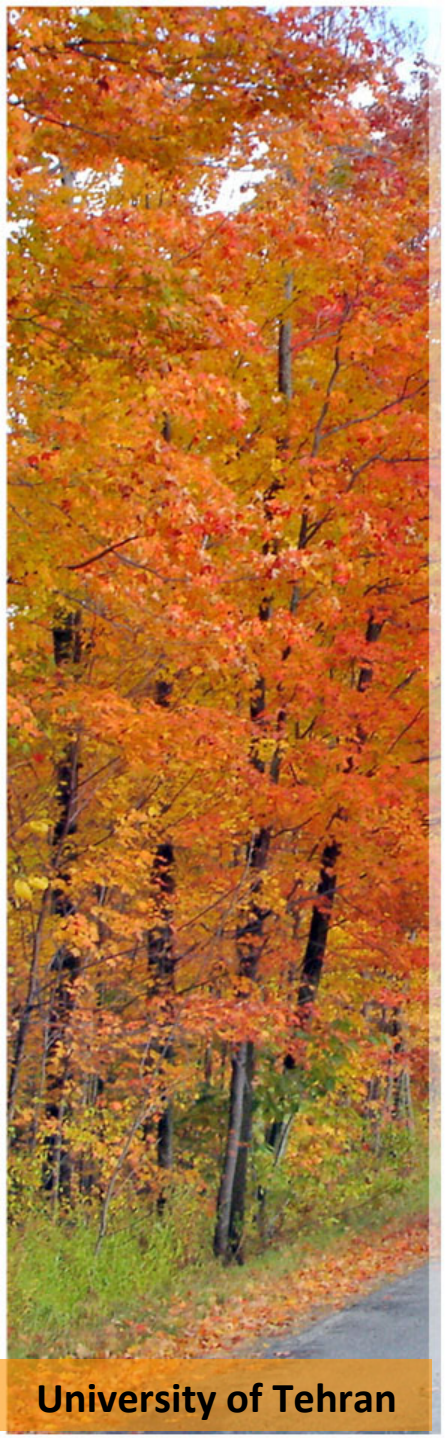
- The **new paradigm** hypothesis that **sugar** has adverse health effects above any purported role as "empty calories" promoting obesity. **Too much sugar** does not just make us fat; it **can also make us sick.**

JAMA Intern Med. 2014 Apr;174(4):525-6. doi: 10.1001/jamainternmed.2013.12991.

New unsweetened truths about sugar.

Schmidt LA.


FAT
Chance
Beating the Odds Against
SUGAR, PROCESSED FOOD,
OBESITY, and DISEASE
Robert H. Lustig, M.D.
Copyrighted Material



FRUCTOSE DAMAGE

Dr Georges MOUTON
April 2018

FRUCTATION

- Here we report that reactive oxygen species (ROS - H_2O_2) production occurred during **haemoglobin fructation** in vitro using chemiluminescence methods. Following accumulation of ROS, **heme degradation products were accumulated** reaching a plateau **along with the detected ROS**. Thus, **fructose** may make a significant contribution to the **production of ROS**, **glycation of proteins**, and **heme degradation** during diabetes.

Spectrochim Acta A Mol Biomol Spectrosc. 2014 Sep 15;130:561-7. doi: 10.1016/j.saa.2014.04.056. Epub 2014 Apr 20.

Hemoglobin fructation promotes heme degradation through the generation of endogenous reactive oxygen species.

Goodarzi M[1], Moosavi-Movahedi AA[2], Habibi-Rezaei M[3], Shourian M[1], Ghourchian H[1], Ahmad F[4], Farhadi M[5], Saboury AA[6], Sheibani N[7].

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy

Volume 130, 15 September 2014, Pages 561-567

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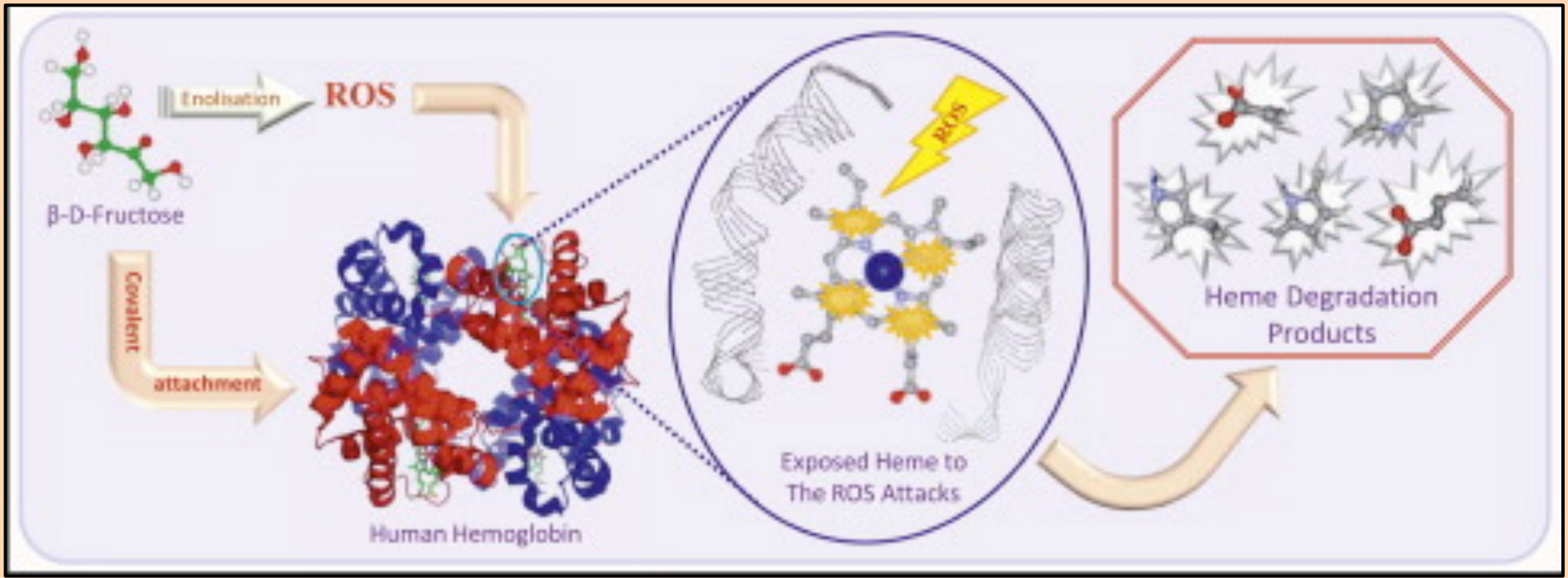
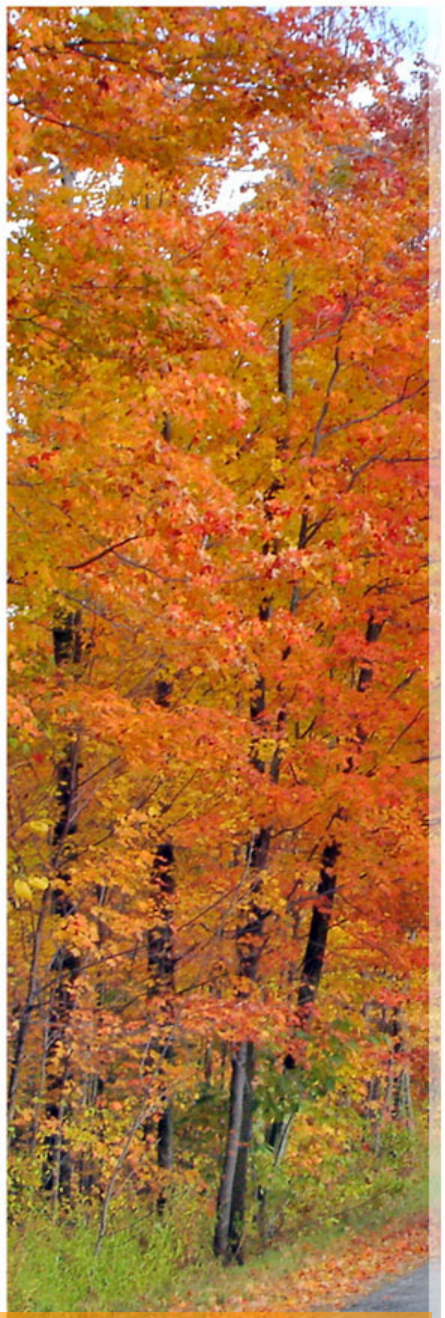
M. Goodarzi [a], A.A. Moosavi-Movahedi [a, b] ✉, M. Habibi-Rezaei [c, d], M. Shourian [a], H. Ghourchian [a], F. Ahmad [e], M. Farhadi [f], A.A. Saboury [a, b], N. Sheibani [g]





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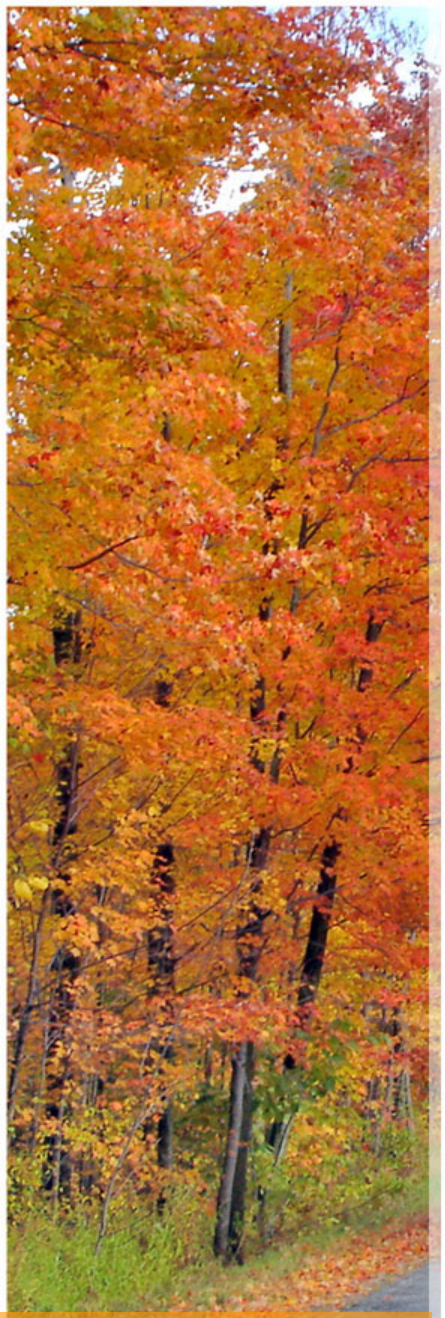
- **Fructose-mediated protein glycation (fructation)** has been linked to an **increase in diabetic and cardiovascular complications** due to over consumption of **high-fructose** containing diets in recent times.

BMC Complement Altern Med. 2018 Jan 15;18(1):13. doi: 10.1186/s12906-017-2076-6.

(R)-α-Lipoic acid inhibits fructose-induced myoglobin fructation and the formation of advanced glycation end products (AGEs) in vitro.

Ghelani H[1,2], Razmovski-Naumovski V[1,2,3], Pragada RR[4], Nammi S[5,6].



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- CONCLUSION: These findings provide new insights into the anti-glycation properties of (R)-alpha-lipoic acid (ALA) and emphasize that ALA supplementation is beneficial in the prevention of AGEs-mediated diabetic and cardiovascular complications.

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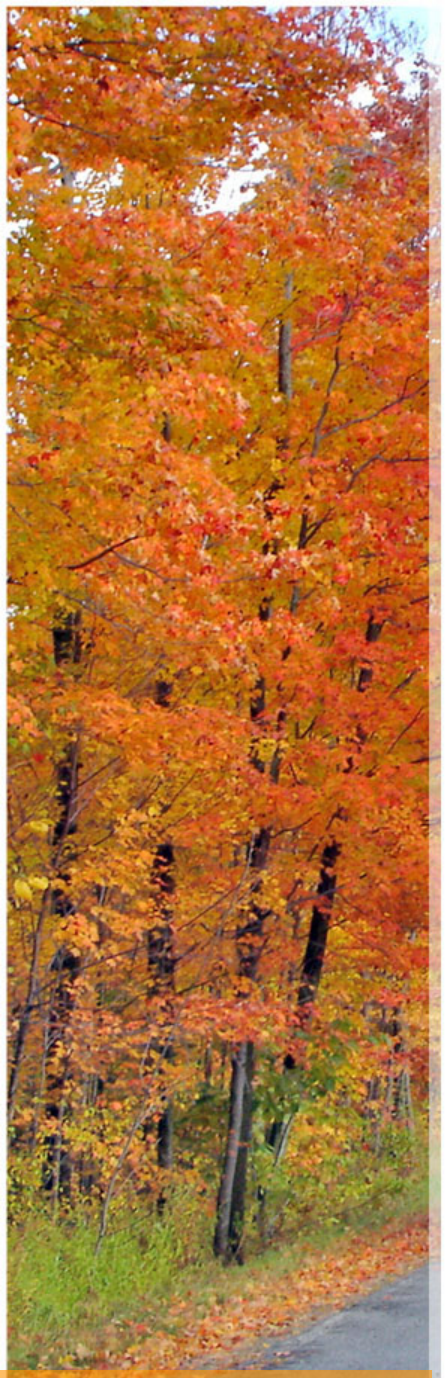

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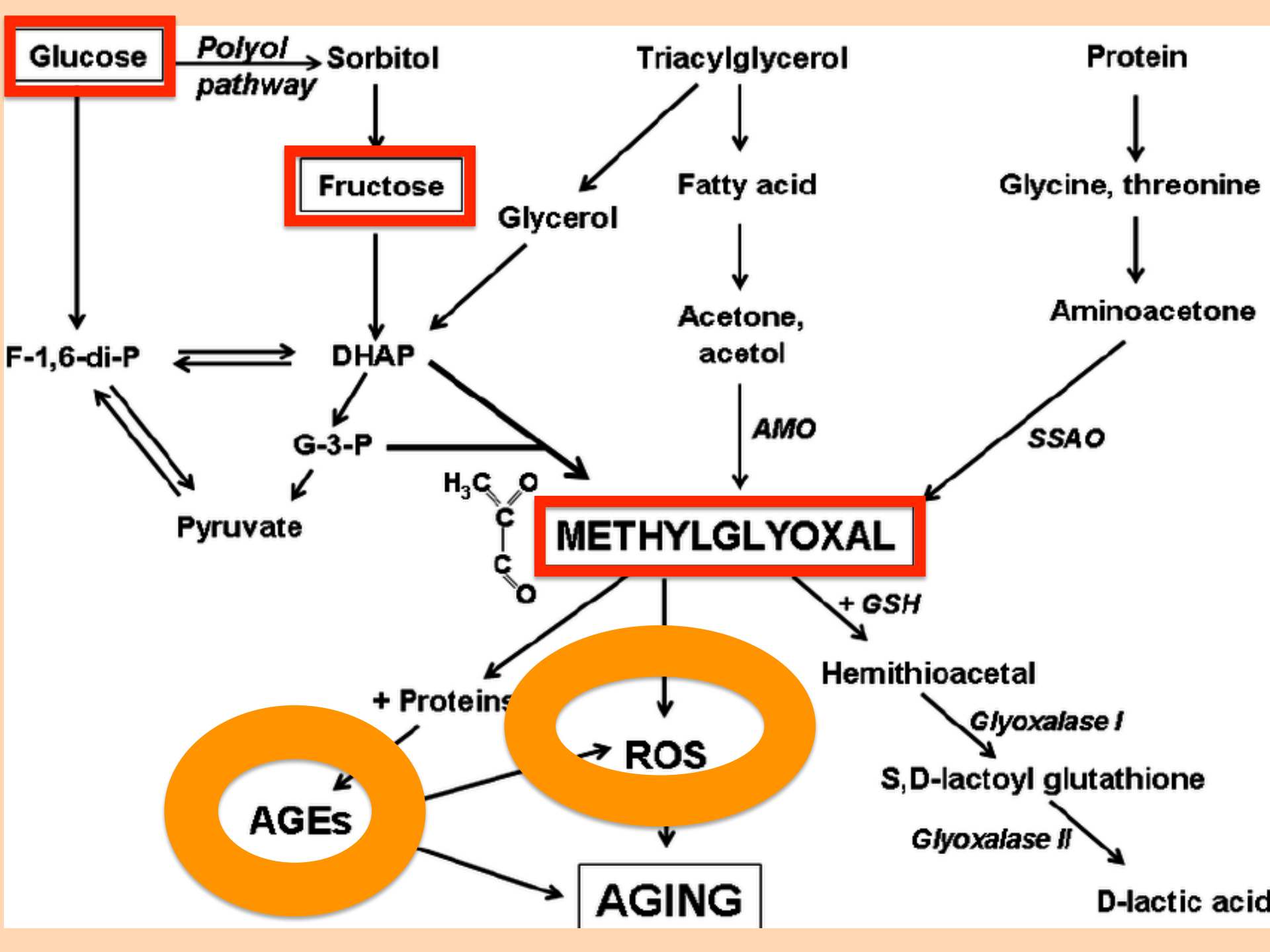
CONCLUSION

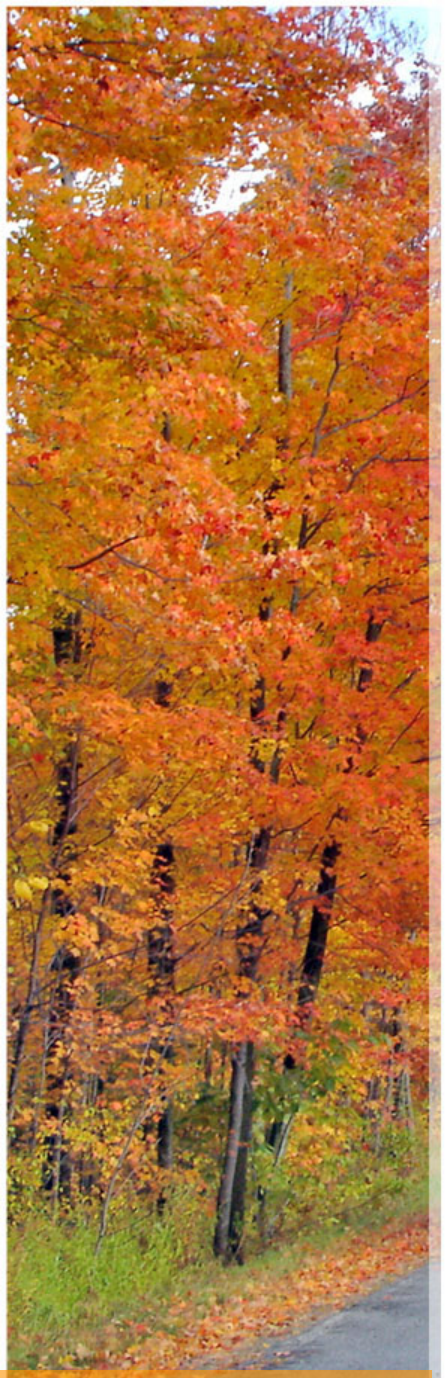
- **High dietary fructose** is a major contributor to **insulin resistance** and **metabolic syndrome**, disturbing tissue and organ functions. **Fructose** is mainly absorbed into systemic circulation by glucose transporter 2 (GLUT2) and GLUT5, and metabolized in liver to produce **glucose**, **lactate**, **triglycerides**, **free fatty acids**, **uric acid**, and **methylglyoxal**.

Nutrients. 2017 Mar 29;9(4). pii: E335. doi: 10.3390/nu9040335.

High Dietary Fructose: Direct or Indirect Dangerous Factors Disturbing Tissue and Organ Functions.

Zhang DM[1], Jiao RQ[2], Kong LD[3].


Glucose
Polyol pathway
Sorbitol
Fructose
Triacylglycerol
Protein
Glycerol
Fatty acid
Glycine, threonine
Acetone, acetol
Aminoacetone
F-1,6-di-P
DHAP
G-3-P
AMO
SSAO
Pyruvate
METHYLGLYOXAL
+ GSH
Hemithioacetal
+ Proteins
ROS
Glyoxalase I
S,D-lactoyl glutathione
AGEs
Glyoxalase II
AGING
D-lactic acid



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April 2018

CONCLUSION

- **Fructose** and its metabolites directly and/or indirectly cause **oxidative stress**, **chronic inflammation**, **endothelial dysfunction**, **autophagy** and **increased intestinal permeability**, and then **further aggravate the metabolic syndrome** with tissue and organ dysfunctions.

Nutrients. 2017 Mar 29;9(4). pii: E335. doi: 10.3390/nu9040335.

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