Total Phenolics in Sweet Sorghum Syrups Compared to Other Commercial Syrup Sweeteners: Antioxidant Activity and Color

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Abstract

Knowledge of the nutritional and dietary content of sweet sorghum syrups compared to other commercial food-grade syrups, will facilitate their large-scale marketing. Phenolic, antioxidant activity, and related color data for commercial high fructose corn syrup (HFCS), corn, honey, maple, agave, rice, and grain sorghum syrups (three brands) were compared to ten commercial sweet sorghum syrups. Sweet sorghum syrups contained dramatically higher ($P<0.05$) total phenolic contents TPC (6471 ± 1823 mg/L) compared to the other syrups (596 ± 497 mg/L). TPC variation among sweet sorghum brands was 28.2%CV which was much lower than 83.3%CV for the other syrups. Only maple syrups had 2,2-diphenyl-1-picryl hydrazyl (DPHH) radical scavenging (antioxidant) activities (RSA) that were *not* significantly different to sweet sorghum syrups at the 5% probability level. HFCS, corn, white grain sorghum and rice syrups had negligible RSA antioxidant values. TPC of all the syrups was highly correlated with the antioxidant capacity, particularly oxygen radical absorbance capacity (ORAC) values (R^2=0.968). Color of the syrups was measured at pH 4.0, 7.0, and 9.0 and wavelengths of 280, 320, 420, and 580 nm. Color was strongly related to the TPC of the syrups particularly at pH 9.0 (sensitive to phenolic colorants) and 320 nm (sensitive to hydroxycinnamic derivatives) closely followed by 420 nm. Color easily measured at pH 9.0 and 320 nm could be useful indirect measure of total phenolics and antioxidant capacity for industry and further studies are now warranted.

Collection and Storage of Commercial Syrups

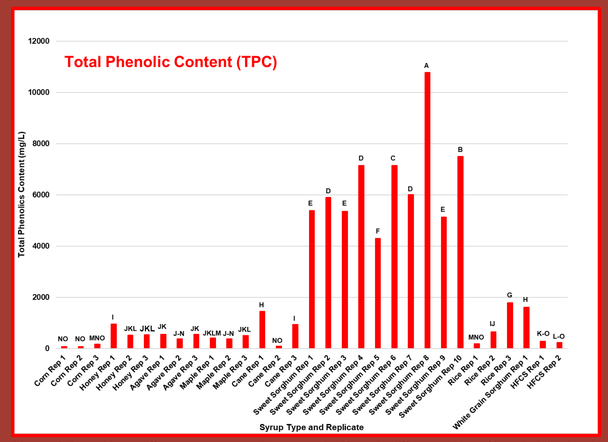
Syrups (Table 1) were mostly purchased from New Orleans, USA supermarkets or on-line. Only two brands of HFCS could be found to its decline in usage, and only one brand of grain sorghum syrup (for distillers use mainly) was found due to its limited production. All syrups were stored at room temperature (~25 C) except lower Brix maple syrups (4 C storage). Low Brix HFCS samples contained preservatives and did not need refrigerated storage.

Table 1. Commercial Syrups in Study: Soluble Solids and Simple Sugars (Mean Concentrations)

Commercial Syrup	Rep No.	Brand Name	Brand	Brix %	Glucose %*	Fructose %	Sucrose %
Corn	1	Light Corn Syrup	A	77.18 GH†	2.02 J	0 O	0 K
Corn	2	Light Corn Syrup	B	76.18 HI	2.79 I	0 O	0 K
Corn	3	Light Corn Syrup	C	79.89 BCD	3.52 H	0 O	0 K
Honey	1	Acadiana Honey	D	80.09 ABCD	4.07 G	3.49 JK	0 K
Honey	2	Orange Blossom Honey	A	81.10 A	4.18 FG	3.83 H	0 K
Honey	3	Clover Honey	E	80.14A BCD	4.47 M	4.06 C	2.90 J
Agave	1	Organic Blue Agave	F	75.35 IJ	0.02 LM	10.70 A	0 K
Agave	2	Organic Blue Agave	G	75.95 IJ	1.56 K	7.67 C	0 K
Agave	3	Organic Blue Agave	H	75.42 IJ	0.02 M0	9.40 B	0 K
Maple	1	Amber Color Maple Syrup	I	65.08 LM	0 M	0 O	15.20 C
Maple	2	Maple Syrup	J	66.00 L	0 M	0.02 O	15.01 C
Maple	3	100% Pure Maple Syrup	K	65.72 LM	0.04 M	0.05 O	15.22 C
Cane	1	100% Pure Cane Syrup	L	76.23 GH	3.40 H	3.79 H	8.20 F
Cane	2	Pure Cane Syrup	M	64.76 M	2.56 I	2.62 M	11.52 D
Cane	3	Golden Syrup	N	79.22 BCDE	3.49 H	3.44 K	6.67 GH
Sweet Sorghum	1	100% Pure Sorghum	O	80.24 BCD	5.11 C	4.54 F	8.90 EF
Sweet Sorghum	2	Sorghum Syrup	P	77.49 FG	3.53 H	3.11 L	2.05 J
Sweet Sorghum	3	Sweet Sorghum Syrup	Q	77.27 FGH	5.08 C	4.90 E	2.03 J
Sweet Sorghum	4	Sorghum	R	78.38 EF	3.38 H	2.37 M	7.73 FG
Sweet Sorghum	5	Sweet Sorghum Syrup	S	74.80 J	4.32 EFG	3.88 H	21.59 A
Sweet Sorghum	6	Sweet Sorghum (Honey Drip cv.)	T	67.20 K	4.18 FG	2.55 L	17.76 B
Sweet Sorghum	7	Sweet Sorghum (Dale cv.)	T	76.29 HI	4.94 CD	3.61 IJ	4.46 I
Sweet Sorghum	8	Sweet Sorghum (Topper cv.)	T	63.33 N	4.33 EFG	2.61 M	3.21 IJ
Sweet Sorghum	9	Sweet Sorghum Syrup	P	75.63 IJ	4.15 FG	3.64 I	5.88 H
Sweet Sorghum	10	Sweet Sorghum Syrup	P	80.39 AB	4.15 FG	3.41 K	9.58 E
Rice	1	Organic Brown Rice Syrup	U	77.16 ABCD	1.45 K	0 O	0 K
Rice	2	Korean Rice Syrup	V	80.39 CDE	1.76 JK	0 O	0 K
Rice	3	Brown Rice Syrup	W	80.27 ABC	4.69 DE	0 O	0 K
White Grain Sorghum	1	White Grain Sorghum Syrup	X	79.06 DE	0.52 L	0 O	3.12 IJ
HFCS	1	Original White Syrup	Y	38.93 P	6.73 A	6.54 D	0 K
HFCS	2	Lite Syrup	Z	41.16 O	5.70 B	4.84 E	0 K

†Means followed by a different upper case letter are significantly different at the 5% probability level for a column only

- Corn syrups are mostly constituted of maltose sugars
- Agave syrup contains more fructose than HFCS
- Sucrose, glucose, and fructose in sweet sorghum syrups vary significantly due to brand and cultivar differences



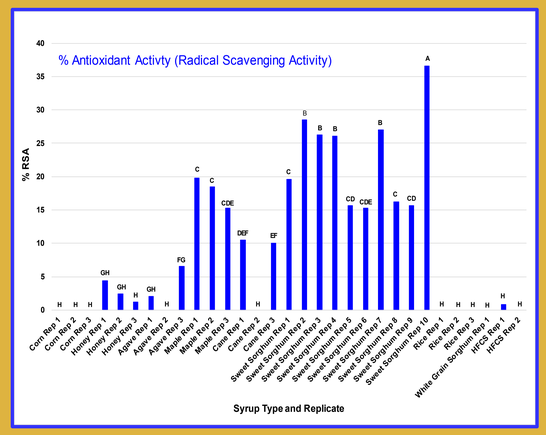
Means followed by a different upper case letter are significantly different at the 5% probability level

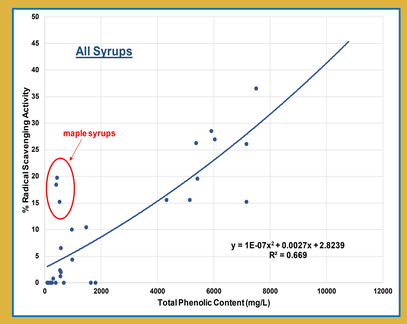
- Sweet sorghum syrups contained dramatically higher ($P<0.05$) total phenolics (mean 6471 mg/L ± 1823 std.dev.) compared to other syrups (596 mg/L ± 497)
- Overall, the mean total phenolic contents in all the syrups followed the following order:

sweet sorghum>>>white grain sorghum>brown rice>cane>honey>agave=maple>>HFCS>>corn

Antioxidant Activity of the Commercial Syrups

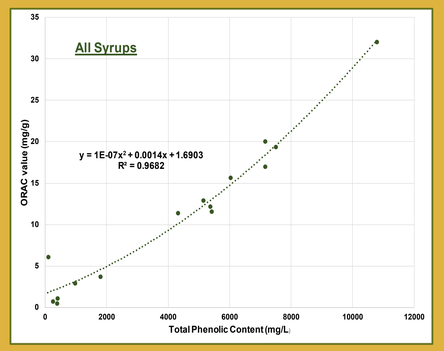
The antioxidant capacity of the syrups was first measured using the DPPH radical scavenging activity (RSA) assay:

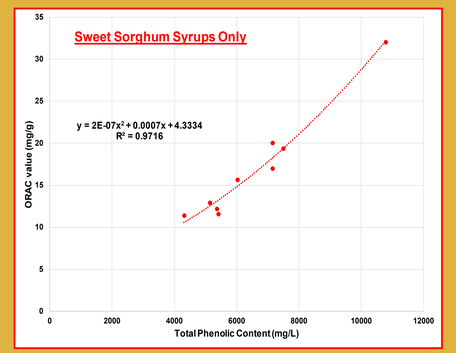




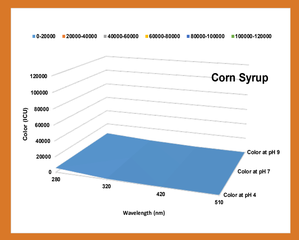
➢ **Maple syrups are known to contain unique phenolic compounds such as quebecol**

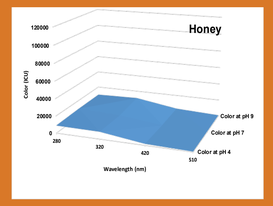
The antioxidant capacity of the syrups was also measured using the ORAC (Oxygen Radical Absorbance Capacity) assay and related to total phenolic cotnents (TPC) of the syrups:

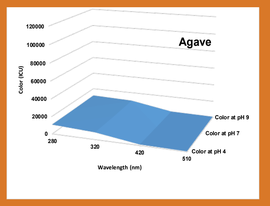


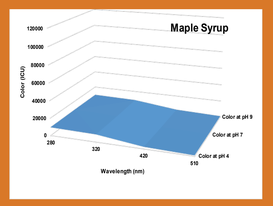


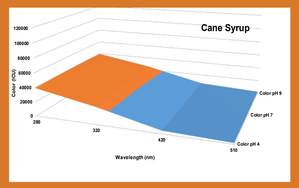
Color of Commercial Syrups

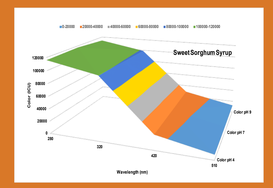


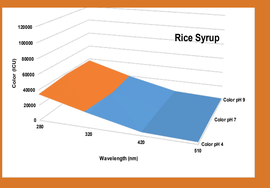


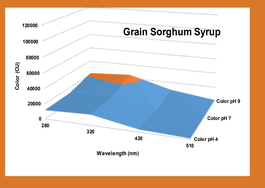


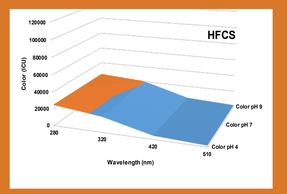












Total Phenolics were strongly related to the color especially color measured at pH 9.0 and 320 or 420 nm