International Conference and Exhibition on Nutraceuticals and Functional Foods

2018

October 14-17, 2018

Sheraton Hotel (Richmond)

Vancouver, BC, Canada

ISNFF

WWW.ISNFF.ORG

O44. The emerging health effects of nuts

Bradley W. Bolling - University of Wisconsin-Madison (USA)

Nuts are a nutrient-dense component of the diet. The bioactives and favorable lipid profiles in nuts positively impact health. The objective of this presentation is to provide an overview of the pre-clinical bioactivity of tree nuts, focusing on recently published preclinical studies. Nuts or its fractionated components have been evaluated for antioxidant and anti-inflammatory activity in cultured cells and animal models of chronic disease. These experiments have described how nuts impact cardiovascular health, obesity, gut health, cancer, skin health, eye health, and cognition. Nut lipids, polyphenols, and proteins have demonstrated promising activity in these systems. With this knowledge, processing methods can be optimized to enrich the bioactive components of nuts or improve their bioaccessibility. Translation of pre-clinical studies to human intervention studies consider the metabolism and bioavailability of nut components. Furthermore, the human equivalency of doses employed in animal studies can inform intervention studies.

O45. Phenolic compounds in the edible seeds of *Brosimum alicastrum* Sw. (Maya nut) a traditional underutilized food resource from Prehispanic America

L.A. de la Rosa, A.A. Vazquez-Flores, R. Subiria-Cueto, E. Alvarez-Parrilla, N.R. Martínez-Ruiz, A. Larqué-Saavedra - Universidad Autónoma de Ciudad Juárez (Mexico)

Brosimum alicastrum (Ramón) is a tropical tree from the southeastern region of Mexico and Central America. Its seeds are well appreciated and consumed by Mesoamerican cultures. Recently, it has received renewed attention for its high nutritional value and has been suggested as a good source of antioxidant phenolic compounds. In this study, the nutritional composition and content of extractable and bound phenolic compounds, flavonoids and condensed tannins are reported for the Maya nut. Extractable compounds were obtained by sequential extraction with aqueous acetone followed by aqueous methanol; alkaline hydrolysis was used to extract bound phenolics. The nutritional composition was determined by standard analytical techniques. Results showed a high content of carbohydrates, especially dietary fiber. The acetonic extract was highest in phenolic compounds especially flavonoids; low contents of bound phenolics were detected. The phenolic profile of the acetonic extract was further characterized by HPLC-MS/MS.

ISNFF

The International Society for Nutraceuticals & Functional Foods

certifies that

Laura A. de la Rosa

Delivered a presentation entitled:

Phenolic compounds in the edible seeds of Brosimum alicastrum Sw. (Maya nut) a traditional underutilized food resource from Prehispanic America

at the:

2018 Annual Conference & Exhibition

Vancouver Airport Sheraton
October 14-17, 2018

Fereidoon Shahidi
Conference Organizer

Phenolic compounds in the edible seeds of *Brosimum alicastrum* Sw. (Maya nut) a traditional underutilized food resource from Prehispanic America

L.A. de la Rosa,[1] A.A. Vazquez-Flores[1], R. Subiría-Cueto[1], E. Alvarez-Parrilla[1], N.R. Martínez-Ruiz[1], A. Larqué-Saavedra[2]

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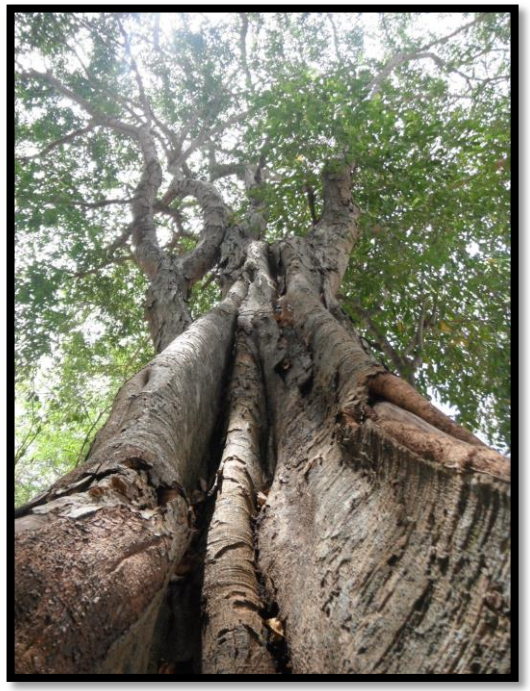
Contents

- Introduction to *Brosimum alicastrum* Sw. (maya nut)
- Formulation and characterization of a traditional mexican food product (tortilla) containing maya nut flour
- Quantification and identification of phenolic compounds in maya nut flour

Brosimum alicastrum Sw.
(ramón, capomo, ojite, ojoche etc.)



Potential uses of *B. alicastrum* tree

FOOD

ANIMAL FEED

TRADITIONAL MEDICINE

WOOD

B. alicastrum seed: Maya Nut

Similar taste to chestnuts or coffee

Proximate composition of *B. alicastrum* seeds (maya nuts)

Component	Content in 100 g
Calories	281 – 363 (FW)
Moisture	6.05 – 12.17 g (FW)
Protein	8.80 – 12.13 g (DW)
Fat	0.49 – 2.02 g (DW)
Ash	3.08 – 4.68 (DW)
Carbohydrates	79.42 – 85.89 (DW)
Dietary fiber	4.91 – 21.71 (DW)
Crude fiber	4.10 – 8.90 (DW)
Total sugars	2.48 – 14.93 (DW)

Carter, 2015 Chemical and functional properties of Brosimum alicastrum seed powder (Maya Nut, Ramón Nut. All Theses. Clemson University.

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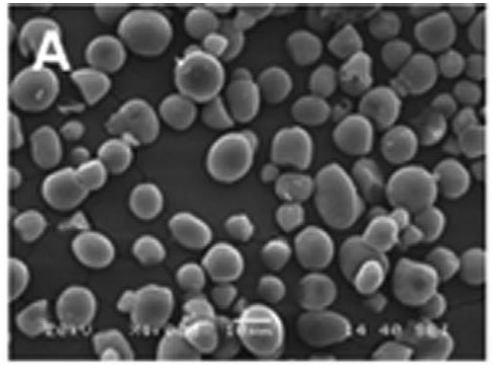
Starch in *B. alicastrum* seeds (maya nut)

Food Hydrocolloids 45 (2015) 48–54

Contents lists available at ScienceDirect

Food Hydrocolloids

journal homepage: www.elsevier.com/locate/foodhyd



Determination of some physicochemical and rheological characteristics of starch obtained from *Brosimum alicastrum* swartz seeds

V.M. Moo-Huchin [a], M.J. Cabrera-Sierra [b], R.J. Estrada-León [a], C.R. Ríos-Soberanis [b], D. Betancur-Ancona [c], L. Chel-Guerrero [c], A. Ortiz-Fernández [a], I.A. Estrada-Mota [a], E. Pérez-Pacheco [a, *]

Oxidation of starch-associated phenolic compounds increased starch whiteness..

25.36% amylose content.
Higher crystallinity than corn starch.
Simmilar viscoelatic behavior than corn starch.

Starch/Stärke 2017, *69*, 1600233 DOI 10.1002/star.201600233 1600233 (1 of 9)

RESEARCH ARTICLE

Partial characterization of starch obtained from Ramon (*Brosimum alicastrum* Swartz), oxidized under different conditions

Emilio Pérez-Pacheco [1], Raciel J. Estrada-León [1], Enrique Sauri Duch [2], Luis A. Bello-Pérez [3], David Betancur-Ancona [4] and Víctor M. Moo-Huchin [1]

Phenolic compounds in *B. alicastrum* seeds and leaves

INTERNATIONAL JOURNAL OF FOOD PROPERTIES
2017, VOL. 20, NO. 11, 2772–2781
https://doi.org/10.1080/10942912.2016.1252389

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Phenolic compositions and antioxidant activities of Maya nut (*Brosimum alicastrum*): Comparison with commercial nuts

Hatice Kubra Ozer

Table 1. Antioxidant capacities of Maya nut, walnut, almond, and peanut extracts.

		Total antioxidant activity		
	Phenolic content (mg GAE/100 g)	DPPH Scavenging activity (%)	FRAP (mmol Fe/100 g)	ABTS Inhibition (%)
Maya nut	2467 ± 85^{a}	79 ± 2.7^{a}	8.08 ± 0.8^{a}	92.5 ± 5.2^{a}
Walnut	812 ± 51^{b}	83 ± 0.6^{b}	22.64 ± 1.1^{b}	92.1 ± 3.5^{a}
Peanut	430 ± 18^{c}	45.5 ± 0.6^{c}	1.61 ± 0.3^{c}	91.1 ± 1.5^{a}
Almond	87.5 ± 2^{d}	42 ± 1.4^{d}	1.52 ± 0.9^{c}	59 ± 2.6^{b}

Total phenolic content (mg GAE/100 g extract), % DPPH free radical scavenging activity, FRAP ferric reducing antioxidant power (mmol Fe/100 g), and % ABTS inhibition calculated for the ethanolic extracts of Maya nut, walnut, peanut, and almond. Values are mean ± SD of three–four independent assays. Means with different letters in a column are significantly different ($p < 0.05$).

Individual phenolics in acid and basic hydrolyzed aqueous methanol extracts (HPLC-DAD): gallic acid, *p*-hydroxybenzoic acid, vanillic acid, caffeic acid, *p*-coumaric acid, epicatechin.

molecules

MDPI

Article

Optimization of the Ultrasound-Assisted Extraction of Phenolic Compounds from *Brosimum alicastrum* Leaves and the Evaluation of Their Radical-Scavenging Activity

Mariel Gullian Klanian * and Montserrat Terrats Preciat

Ultrasonic-assisted extraction in 80% methanol.

Total phenols	34 – 45 mg GAE/g
Total monomeric anthocyanins	1.9 – 15.2 mg CyE/100 g
ABTS	21 – 39 μmol TE/g
DPPH	14 – 67 μmol TE/g

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Formulation, sensory and chemical characterization of a traditional mexican food product (tortilla) containing maya nut flour

Final formulation:

25% maya nut flour, 75% regular wheat flour, water, salt, vegetable shortening, raising agents.

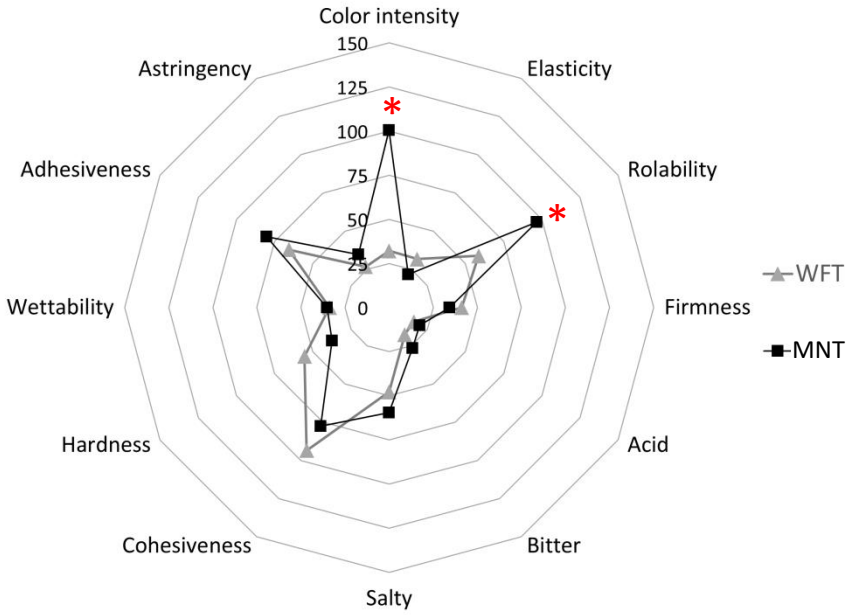
Patent request: MX/E/2018/070644

Flour tortilla:

25% maya nut flour,
75% regular wheat flour

100% wheat flour

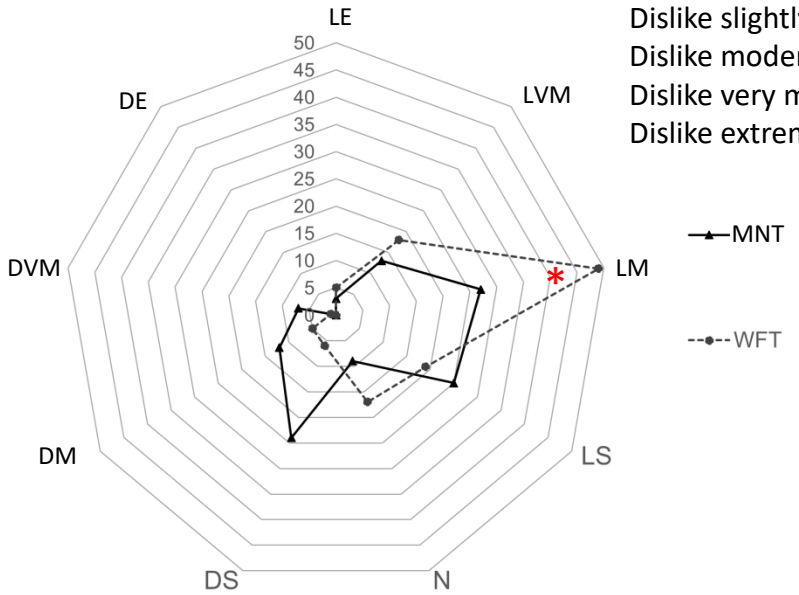
Sensory evaluation:

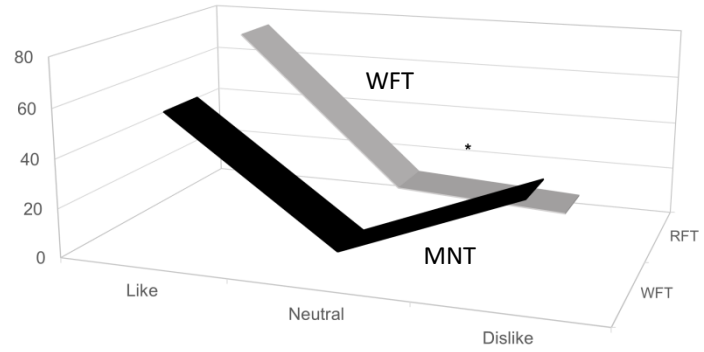


Sensory attributes

WFT: wheat flour (100%) tortilla
MNT: maya nut flour (25%) tortilla

Like extremely LE
Like very much LVM
Like moderately LM
Like slightly LS
Neither like nor dislike N
Dislike slightly DS
Dislike moderately DM
Dislike very much DVM
Dislike extremely DE





Acceptance test

Chemical characterization, content of phenolic compounds and antioxidant capacity of maya nut flour and tortilla

	Units per 100 g (FW)	MN flour	MNT (25%)	WFT (100%)
Calories	kcal	336	350	357
Moisture	g	13.3 ± 0.14	25.0 ± 0.07	22.1 ± 0.1
Protein	g	11.5 ± 0.39	7.3 ± 0.11	7.6 ± 0.10
Fat	g	0.6 ± 0.00	9.6 ± 0.08	8.9 ± 0.02
Ash	g	3.4 ± 0.11	3.4 ± 0.06	3.1 ± 0.02
Carbohydrates	g	71.2 ± 0.56	54.6 ± 0.16	58.3 ± 0.15
Crude Fiber	g	3.9 ± 0.22	0.9 ± 0.15	0.2 ± 0.01
Dietary Fiber	g	13.0 ± 0.21	3.6 ± 0.20	0.8 ± 0.01
Total Phenols (Folin)	g GAE	6.58 ± 0.22	2.11 ± 0.15	0.18 ± 0.00
Total Flavonoids ($AlCl_3$)	mg CE	440 ± 18	70 ± 10	50 ± 10
DPPH radical scavenging	mmol TE	0.90 ± 0.09	0.30 ± 0.01	0.20 ± 0.01
$ABTS^+$ radical scavenging	mmol TE	14.3 ± 0.10	0.40 ± 0.01	0.20 ± 0.00

GAE: gallic acid equivalents; CE: catechin equivalents; TE: trolox equivalents

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Δ (MNT vs WFT):
4.5 times
4.5times
10 times

GAE: gallic acid equivalents; CE: catechin equivalents; TE: trolox equivalents

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Quantification and identification of phenolic compounds in maya nut flour

Extraction (1):

Extractable phenolics:

Ultrasound- assisted **<u>sequential</u>** extraction

1) 70% Acetone
2) 80% Methanol 80% in aqueous 1% HCl

Bound phenolics:

Alkaline hydrolysis (NaOH 3M, 80^{o}C, 4.5 h) of the residue of the soluble phenolic extraction

Perez-Jimemez et al., 2015, Food Res Int, 41:274.

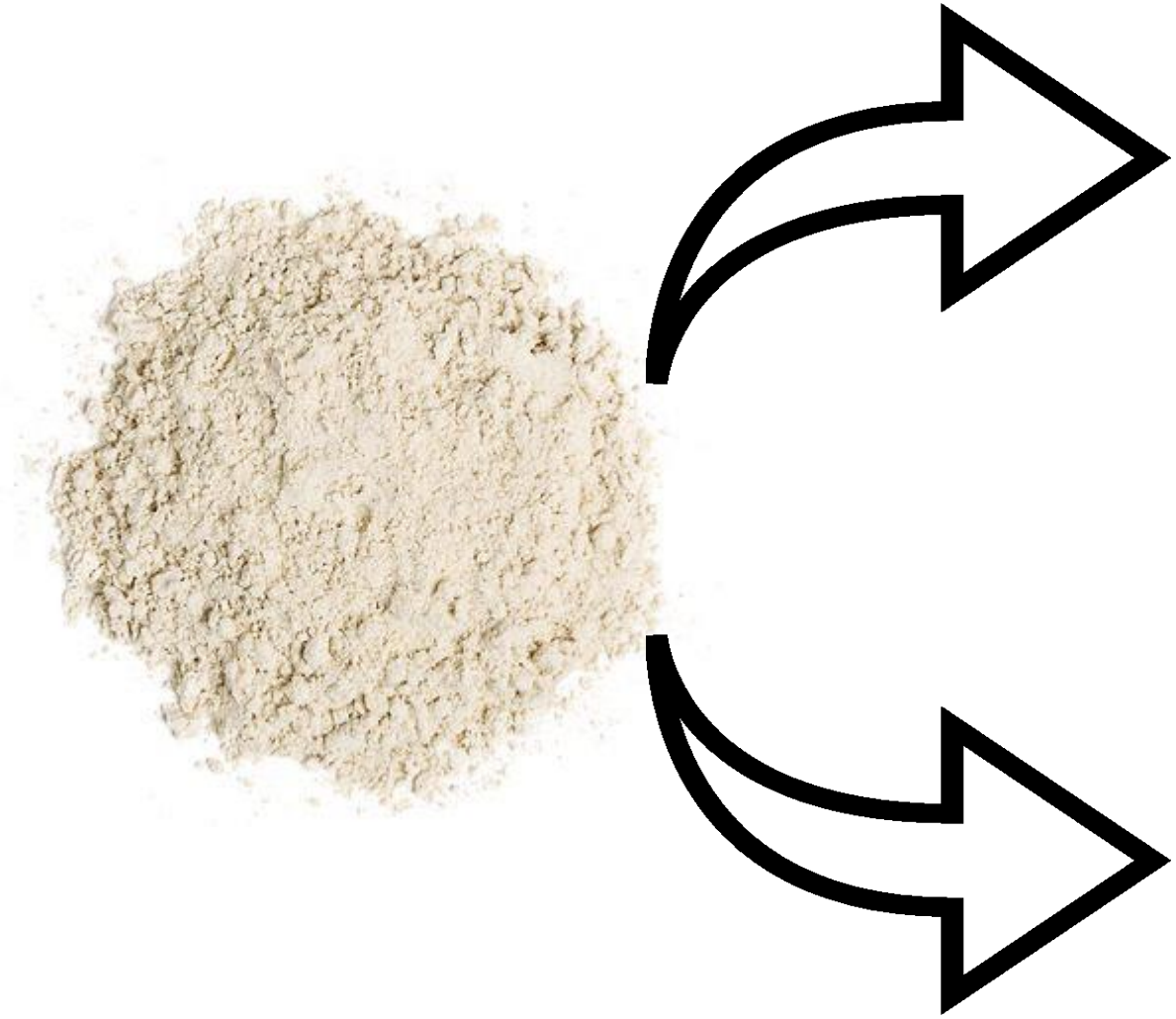
Extractable and bound phenolic compounds in maya nut flour

Extractable phenolics were obtained by sequential extraction.

		Extractable phenolics		Bound phenolics
	Units per g of flour (FW)	70% Acetone	80% Methanol 1% HCl	Alkaline hydrolysis
Total Phenols (Folin)	mg GAE	10.35 ± 0.08	ND*	0.04 ± 0.00
Total Flavonoids ($AlCl_3$)	mg CE	0.30 ± 0.02	ND*	0.02 ± 0.00
Condensed tannins (vanillin HCl)	mg CE	0.28 ± 0.01	ND*	0.02 ± 0.06
Condensed tannins (DMAC)	mg CE	0.04 ± 0.0	ND*	ND

*High content of reducing sugars as detected by reduction of dinitrosalicylate (DNS). GAE: gallic acid equivalents; CE: catechin equivalents, ND: non-detectable.

Extraction (2):



Soluble phenolics:
Ultrasound- assisted
<u>independent</u> extractions
1) 70% Acetone
2) 80% Methanol

Bound phenolics:
Alkaline hydrolysis (NaOH 3M, 80^{o}C, 4.5 h) of the residue of the soluble phenolic extraction

Extractable and bound phenolic compounds in maya nut flour

Extractable phenolics were obtained by independent extractions.

	Units per g of flour (FW)	**Acetone extractable**	**Methanol extractable**	**Bound phenolics**
Total Phenols (Folin)	mg GAE	51.32 ± 0.80	48.28 ± 1.07	0.07 ± 0.00
Reducing sugars (DNS)	mg GluE	14.13 ± 0.05	13.30 ± 0.08	ND

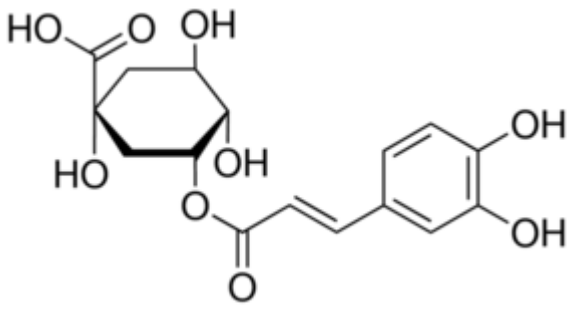
GAE: gallic acid equivalents; GluE: glucose equivalents, ND: non-detectable.

Identification of phenolic compounds by HPLC/MS

Agilent HPLC series 1200 QTOF 6530

- C-18 column at 25°C, binary mobile phase gradient (A: 0.1% formic acid, B: acetonitrile), injection volumen 1 μL, flow rate 0.4 mL/min.
- Electrospray ionization, negative mode, drying gas N_2 at 340°C, nebulizer pressure 60 psi and capilary voltaje 175 V.
- Identification by Database Search algorithm in MassHunter Qualitative Analysis software.

Phenolic compounds in an acetonic extract (70% acetone) of maya nut flour

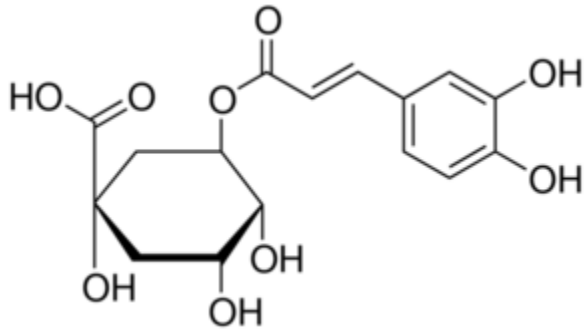


Neo-chlorogenic acid (5-caffeoylquinic acid)

Compound	RT	Name	m/z	Mass	Formula	Score	Relative Abundance
1	0.35	Quinic acid	191.055333	192.0634	C7 H12 O6	94.6	57.3
2	0.41	Citric acid	191.0195	192.027	C6 H8 O7	97.8	22.6
3	0.47	Vanillic acid glucoside	329.087967	330.0951	C14 H18 O9	89.0	3.2
4	0.47	Succinic acid	117.01925	118.0266	C4 H6 O4	82.7	4.4
5	0.47	**Vanillic acid**	167.0357	168.0423	C8 H8 O4	77.3	1.3
6	**0.66**	**Crypto or neochlorogenic acid**	**353.0878**	**354.0951**	**C16 H18 O9**	**96.1**	**4.3**
7	**1.15**	**Chlorogenic acid**	**353.087867**	**354.0951**	**C16 H18 O9**	**98.6**	**5.3**
8	3.36	Cinnamic acid	147.04505	148.0524	C9 H8 O2	81.6	0.8
9	4.41	Dicaffeoylquinic acid	515.120567	516.1268	C25 H24 O12	77.0	0.9

Phenolic compounds in a methanolic extract (80% methanol) of maya nut flour

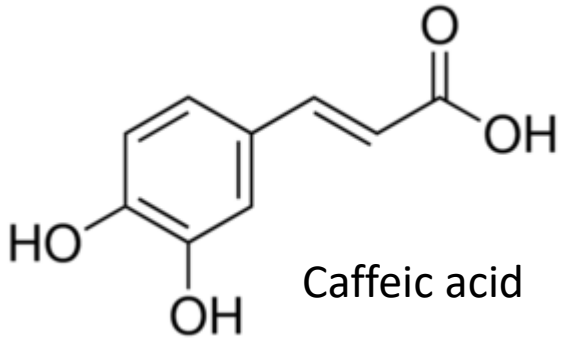
Compound	RT	Name	m/z	Mass	Formula	Score	Relative Abundance
1	0.35	Quinic acid	192.0634	192.0634	C7 H12 O6	98.1	50.5
2	0.41	Citric acid	191.02075	192.027	C6 H8 O7	92.0	36.2
3	0.47	Vanillic acid glucoside	329.088367	330.0951	C14 H18 O9	86.2	1.7
4	0.47	**Vanillic acid**	167.035067	168.0423	C8 H8 O4	79.3	0.5
5	0.47	Succinic acid	117.01935	118.0266	C4 H6 O4	85.1	2.6
6	**0.66**	**Crypto or neochlorogenic acid**	**353.088233**	**354.0951**	**C16 H18 O9**	**96.5**	**3.3**
7	**1.15**	**Chlorogenic acid**	**353.0877**	**354.0951**	**C16 H18 O9**	**98.8**	**4.0**
8	3.12	3-O-Feruloylquinic acid	367.10215	368.1107	C17 H20 O9	81.0	0.5
9	3.36	Cinnamic acid	147.04485	148.0524	C9 H8 O2	80.0	0.8



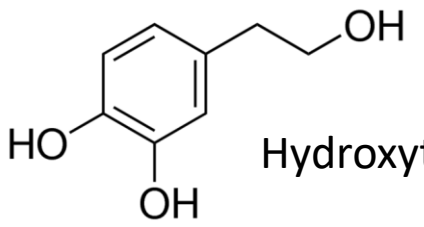
Chlorogenic acid (3-caffeoylquinic acid)

Bound phenolics extracted from maya nut flour by basic hydrolysis

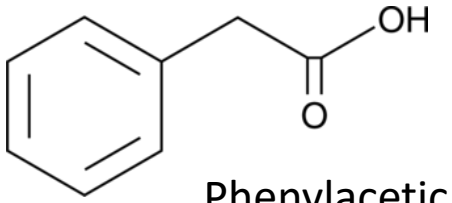
Compound	RT	Name	m/z	Mass	Formula	Score	Relative Abundance
1	0.48	Succinic acid	117.019667	118.0266	C4 H6 O4	82.8	1.45
2	0.54	Ethyl gallate	197.046	198.053	C9 H10 O5	84.8	3.62
3	**0.78**	**Protocatechuic acid**	**153.018867**	**154.0266**	**C7 H6 O4**	**85.3**	**7.35**
4	0.99	Catechol	109.0293	110.037	C6 H6 O2	84.7	3.73
5	**1.25**	**Hydroxytyrosol**	**153.0559**	**154.063**	**C6 H10 O3**	**98.5**	**15.54**
6	1.27	**Hydroxybenzoic acid**	137.024333	138.0317	C7 H6 O3	85.7	2.00
7	1.49	Dihydroxybenzoic acid	153.01865	154.0266	C7 H6 O4	75.7	0.65
8	**1.89**	**Caffeic acid**	**179.035067**	**179.0352**	**C9 H8 O4**	**99.2**	**42.14**
9	**1.89**	**Phenylacetic acid**	**135.0452**	**136.052**	**C8 H8 O2**	**99.7**	**17.13**
10	3.80	Ferulic acid	193.050267	194.0579	C10 H10 O4	83.3	0.52
11	4.04	**Vanillic acid**	167.034433	168.0423	C8 H8 O4	94.1	4.91
12	4.35	Hydroxyphenylacetic acid	151.0398	152.047	C8 H8 O3	81.3	0.95



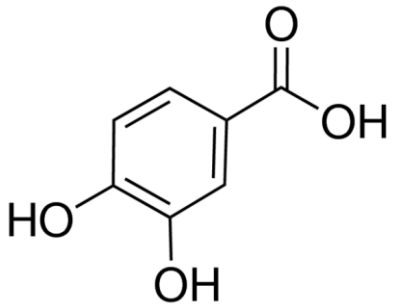
Caffeic acid



Hydroxytyrosol



Phenylacetic acid



Protocatechuic acid

Concluding remarks

- *Brosimum alicastrum* Sw. seed (maya nut) flour is a good source of nutrients and extractable phenolic antioxidants, especially chlorogenic acids and other phenolic acids.
- *B. alicastrum* Sw. seeds contain low quantities of bound phenolics which are derivatives of benzoic, cinnamic and phenylacetic acids.
- The flour of *B. alicastrum* Sw. seeds, for its nutrient and bioactive coposition, is well suited to be used in formulations of novel functional foods.

Thank you