Ultrasonic Extraction...

MPI Solution for YOU!

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1. The history of extraction:

- Vegetal materials are invaluable resources, useful in daily life as food, food activities, flavors, fragrances, pharmaceuticals, colors or directly in medicine.
- A herbal extract could be defined as the compounds and/or compound mixtures obtained from fresh or dried plants, or parts of plants: leaves, flowers, seeds, roots and barks.
- Medicinal and aromatic plants provide an inexhaustible resource of raw materials for the pharmaceutical, cosmetics and food industries and more recently in agriculture for pest control.

Entries on herbal drugs in pharmacopoeias

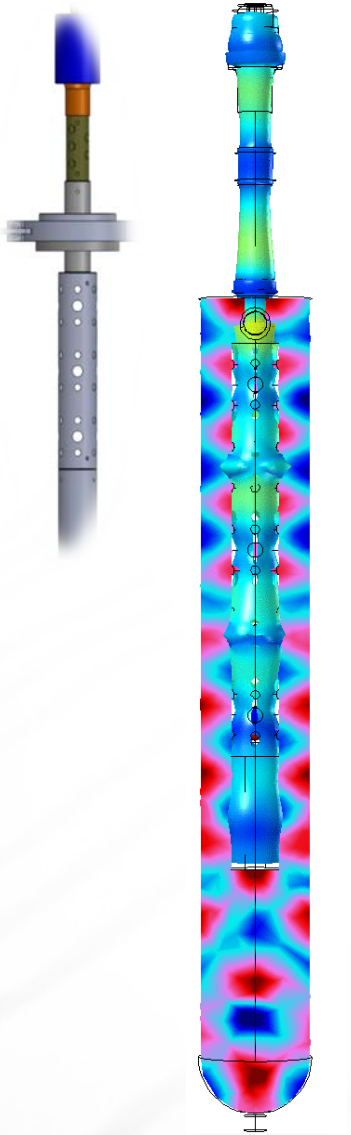
Country	Number of herbal drugs monographs
French pharmacopoeia	190
Switzerland pharmacopoeia	180
USSR pharmacopoeia	140
Polish pharmacopoeia	125
British codex	125
Belgian pharmacopoeia	120
Holland pharmacopoeia	120
Hungarian pharmacopoeia	110
Romanian pharmacopoeia	105
Italian pharmacopoeia	105
German pharmacopoeia	85
British pharmacopoeia	80
Scandinavian pharmacopoeia	80
International pharmacopoeia	45

2. Ultrasound assisted extraction (UAE)

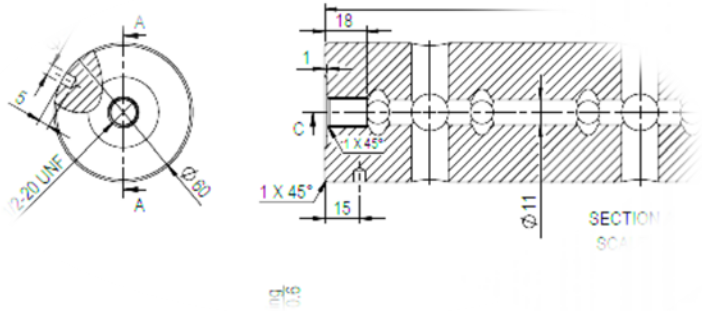
Advantages:

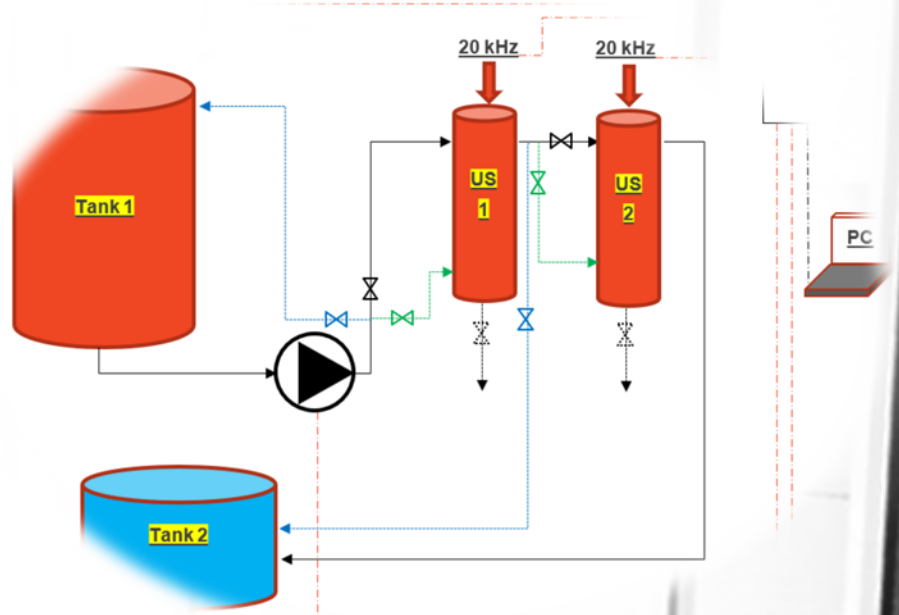
- Inexpensive, simple and efficient alternative to conventional extraction.
- Increase of extraction yield and faster kinetics
- Ability to reduce the temperature allowing extraction of thermo sensitive compounds

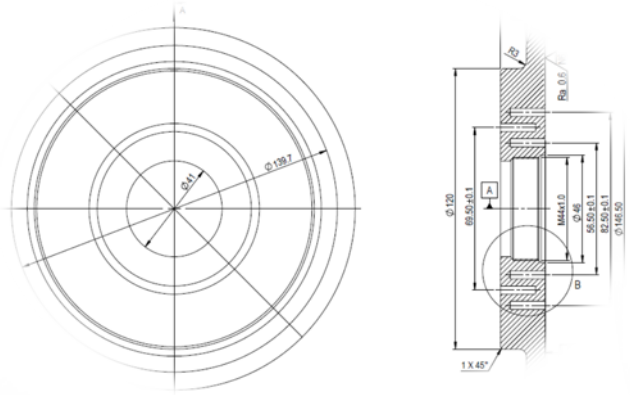
Sonotrodes Optimization – For Continuos Extraction



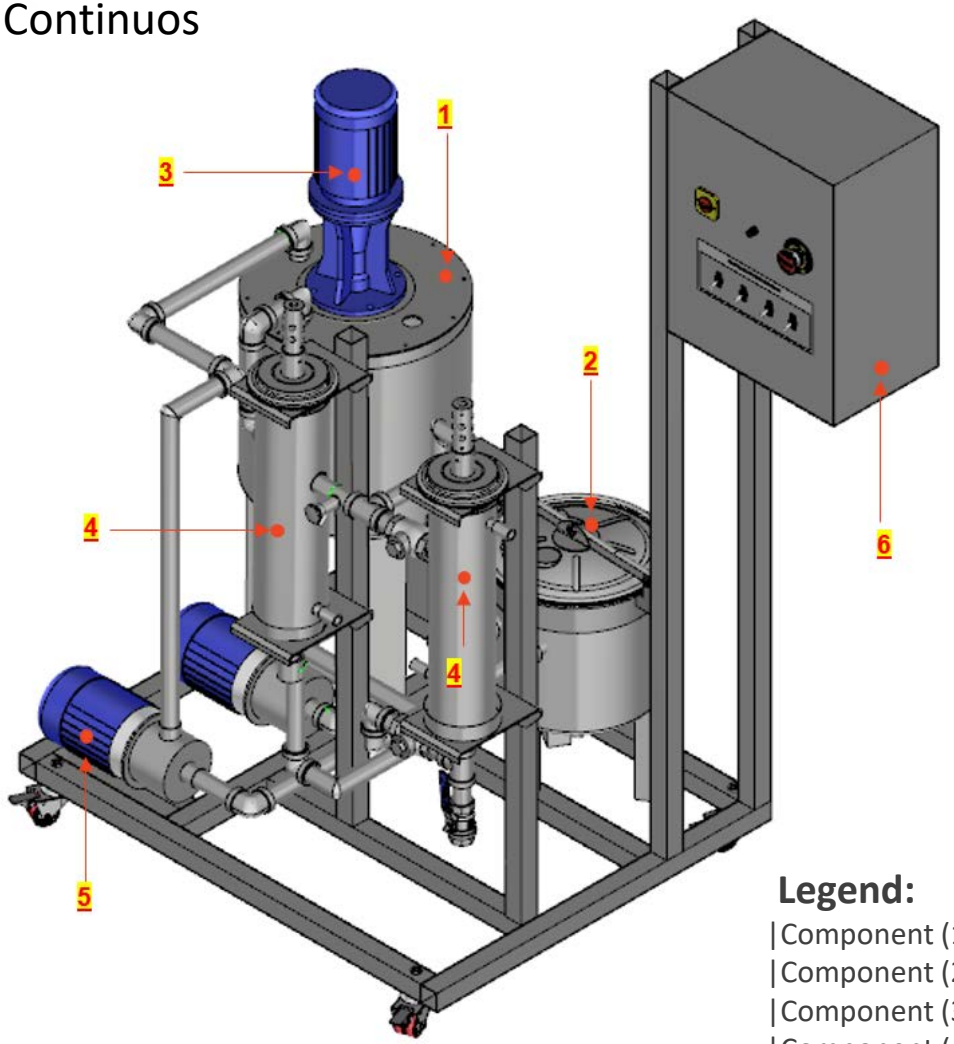
MPI Poposal, a novel and reliable solution for ingridientes extraction from several plants!







Extraction Capacity 50 L – Continuos



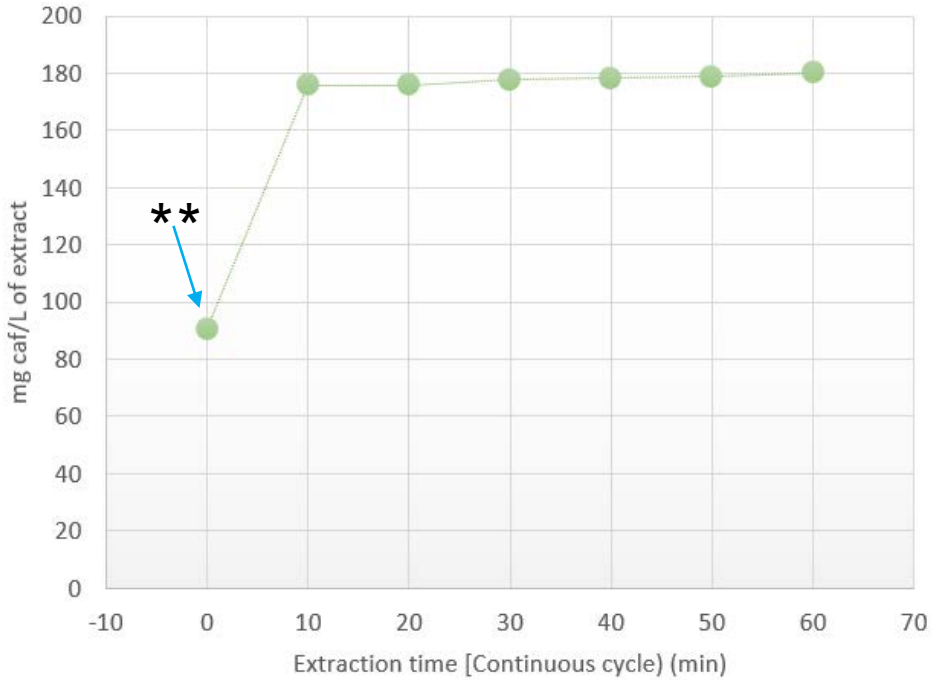
Legend:

|Component (1)| --- Capacity --> 50 liters
|Component (2)| --- Capacity --> 25 liters
|Component (3)| --- Mechanical Agitator
|Component (4)| --- Chamber for Ultrasound Systems
|Component (5)| --- Pumps
|Component (4)| --- Device Control

Test 1

Product:

Extract caffeine from coffee beans [**silver skin**] at low temperatur



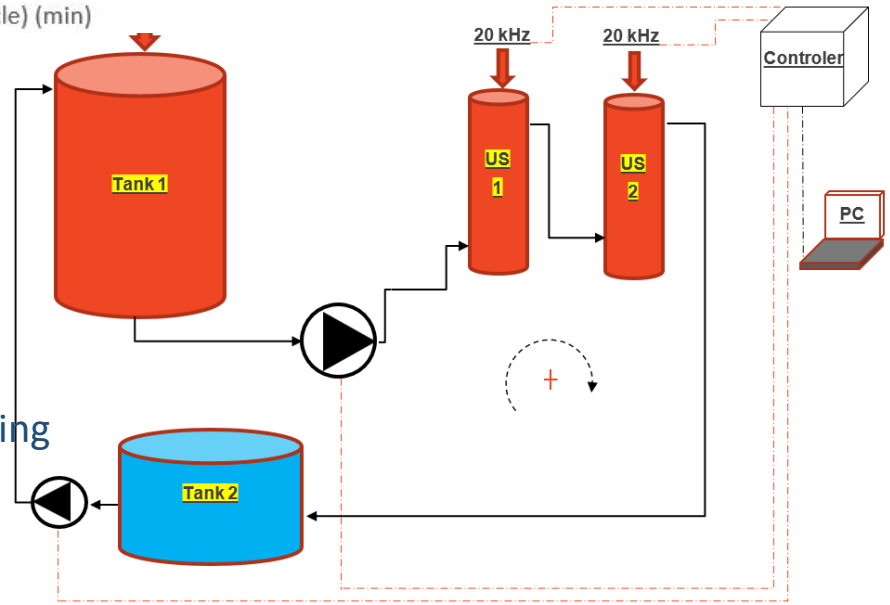
Study: Evolution of ultrasonic caffeine extraction vs. time.

Total Cycle time = 60 minutes

Mixture = > 50 L of water + 1.0 kg of Silver Skin

Samples were collected at each 10 minutes

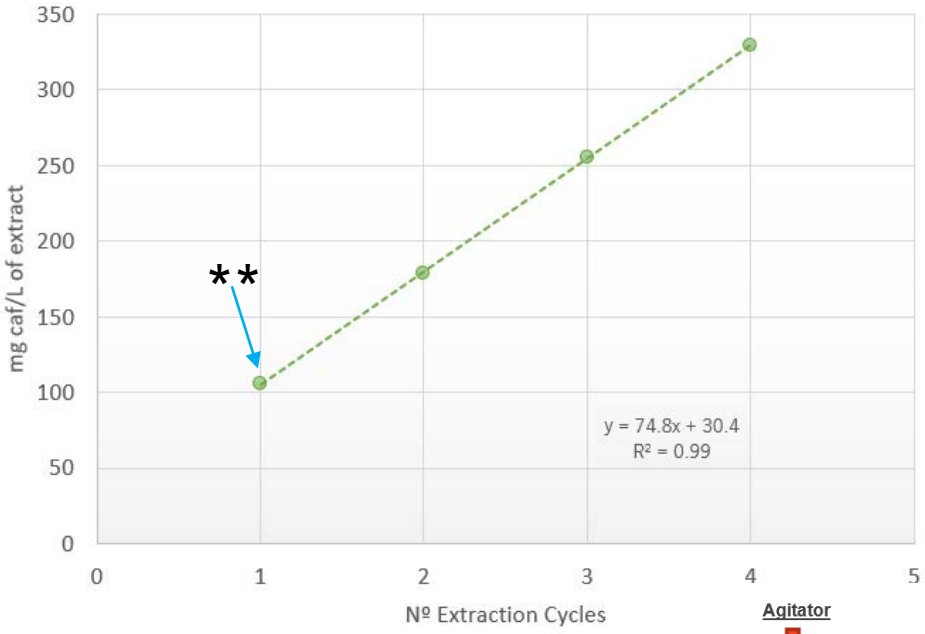
** mg of caffeine per liter of extract after mechanical mixing



Test 2

Product:

Extract caffeine from coffee beans [**silver skin**] at low temperatu



Study:
Evaluation of maximal saturation of caffeine in the medium.

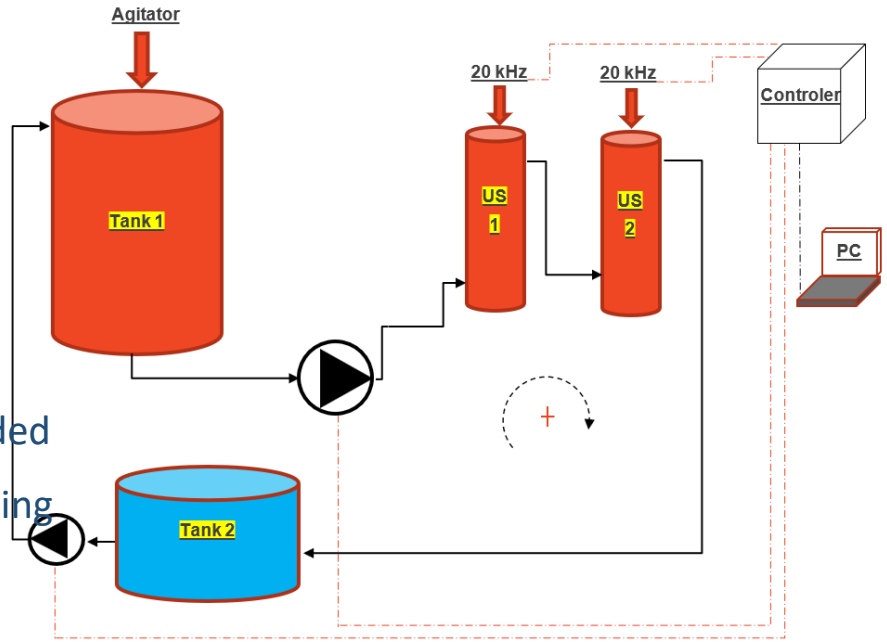
Cycle time = 10 minutes

Time between cycles= 10 minutes

Mixture = > 50 L of water + 2.5 kg of Silver Skin

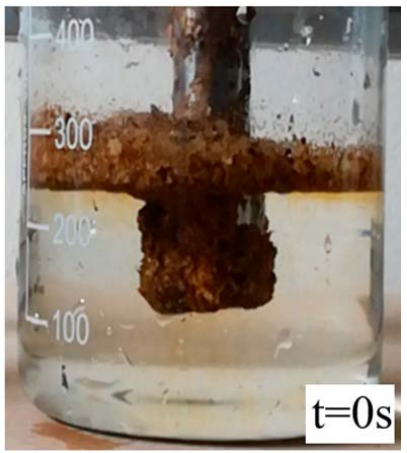
After each Cycle the waste was removed and new 2.5 kg was added

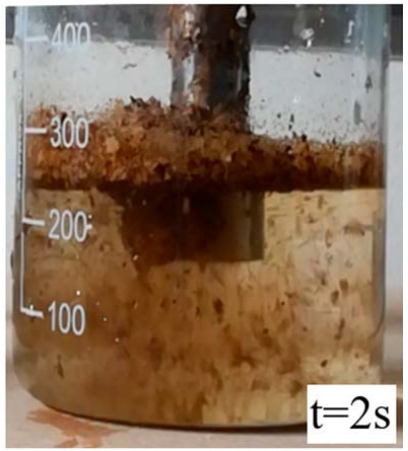
** mg of caffeine per liter of extract after mechanical mixing

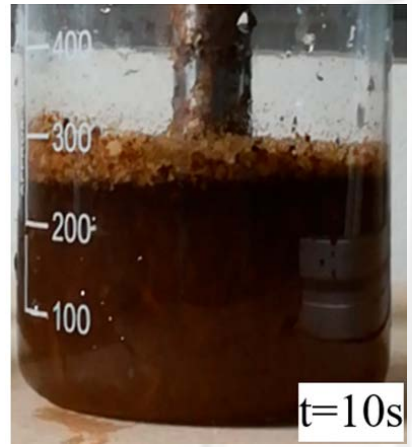


Comparative Study

US vs Solvent extraction







Product:

Extract caffeine from coffee beans [**silver skin**] at low temperature

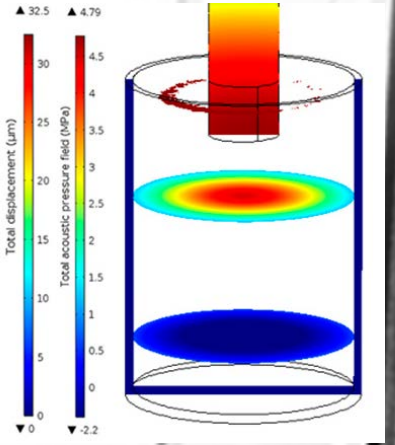
In this work, we intended to optimize the recovery of caffeine from this by-product, by comparing two different processes of extraction, namely, a classic solid-liquid method, and the physical processing based in MPI ultrasound-assisted technology.

Comparison of the extracts composition using different conditions of extraction.

Extract	Sample		MMM technology parameters			5-Caffeoylquinic acid		Total phenolics				Ferric Reducing Antioxidant Power	
	Ground	Entire	Frequency (kHz)	Input electric power (W)	Time (s)	μg/ mL of extract	mg/g of CC	μg GAE/ mL of extract	mg GAE/g of CC	μg CAE/ mL of extract	mg CAE/g of CC	μg FSE/ mL of extract	mg FSE/g of CC
1	×		19.8	250	60	13.0 ± 2.2^{b}	0.64 ± 0.11^{b}	110.3 ± 15.7^{g}	5.5 ± 0.7^{g}	239.7 ± 29.2^{e}	12.0 ± 1.5^{e}	1349 ± 116^{e}	65.7 ± 5.8^{e}
2	×		19.8	250	180	18.2 ± 0.6^{a}	0.91 ± 0.03^{a}	148.7 ± 6.9^{ef}	7.4 ± 0.3^{ef}	311.5 ± 12.9^{d}	15.6 ± 0.6^{d}	1771 ± 21^{cd}	88.5 ± 1.0^{cd}
3	×		19.8	250	300	17.4 ± 1.6^{a}	0.87 ± 0.08^{a}	171.4 ± 7.1^{cd}	8.6 ± 0.4^{cd}	353.7 ± 13.3^{bc}	17.7 ± 0.7^{bc}	1862 ± 111^{bc}	93.1 ± 5.6^{bc}
4	×		19.8	500	60	17.2 ± 1.0^{a}	0.86 ± 0.05^{a}	137.1 ± 4.0^{f}	6.9 ± 0.2^{f}	289.7 ± 7.5^{d}	14.5 ± 0.4^{d}	1639 ± 43^{d}	81.9 ± 2.2^{d}
5	×		19.8	500	180	17.7 ± 0.6^{a}	0.88 ± 0.03^{a}	158.6 ± 4.2^{de}	7.9 ± 0.2^{de}	329.8 ± 7.9^{cd}	16.5 ± 0.4^{cd}	1853 ± 59^{bc}	92.7 ± 3.0^{bc}
6	×		19.8	500	300	17.6 ± 1.0^{a}	0.88 ± 0.05^{a}	174.1 ± 8.2^{cd}	$8.7 \pm 0.4\ b^{cd}$	358.6 ± 15.2^{bc}	17.9 ± 0.8^{bc}	1909 ± 35^{bc}	95.5 ± 1.7^{bc}
7		×	19.8	500	300	17.2 ± 1.9^{a}	0.86 ± 0.09^{a}	179.6 ± 1.7^{bc}	$9.0 \pm 0.1\ b^{bc}$	369.0 ± 3.1^{abc}	18.4 ± 0.2^{abc}	2014 ± 45^{b}	100.7 ± 1.1^{b}
8		×	19.8	500	420	17.2 ± 1.4^{a}	0.86 ± 0.07^{a}	180.8 ± 4.8^{abc}	$9.0 \pm 0.2\ ab^{abc}$	371.3 ± 9.0^{ab}	18.5 ± 0.5^{ab}	1992 ± 46^{b}	99.6 ± 1.8^{b}
9		×	19.8	500	600	18.9 ± 0.7^{a}	0.94 ± 0.03^{a}	203.8 ± 2.0^{a}	$10.2 \pm 0.1\ a^{a}$	410.6 ± 3.0^{a}	20.5 ± 0.2^{a}	2446 ± 7^{a}	122.3 ± 0.4^{a}
10	×		Classic solid-liquid extraction*			19.1 ± 0.2^{a}	0.96 ± 0.01^{a}	198.3 ± 2.6^{ab}	$9.9 \pm 0.1\ ab^{ab}$	403.9 ± 4.8^{a}	20.2 ± 0.2^{a}	2266 ± 22^{a}	113.3 ± 1.1^{a}

Each condition was tested in triplicate and each extract was analysed in triplicate ($n = 9$). Different letters within each column represent significant differences at $p < 0.05$.
*Extraction conditions: hidroalcoholic solvent (1:1), constant magnetic stirring (600 rpm), 60 min at 40 °C. CC, coffee chaff; GAE, gallic acid equivalents; CAE, chlorogenic acid equivalents; FSE, ferrous sulfate equivalents.

H. Puga et al. / Journal of Cleaner Production 168 (2017) 14–21



Main Conclusion:

In only 10 min, the sonication probe allowed a higher recovery of caffeine, without any need of sample preparation and using only water as extraction solvent!

Thank You.

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