Supplementary information to: Transforming orange by-products into high-value neuroprotective products: environmental and economic assessment of advanced green extraction methods

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Table S.1. Equipment cost for extraction processes.

Step	Equipment name	Design parameter*	Description	Equipment cost (USD)	Equipment installed cost (USD)
			Maceration		
Maceration and stirring	Vessel	49.88 m^3	V301; Vertical; carbon Steel	75,400	307,000
Filtering	Filter	36.13 m^2	FR-301; Cartridge	51,300	84,600
Drying	Heat exchanger	2.43 m^2	E-301; Double pipe;carbon Steel.	5,650	18,600
			Gas expanded liquids (GXL)		
GXL	Vessel	0.21 m^3	V301; Vertical; Stainles steel	182,000	340,000
Drying	Heat exchanger	0.025 m^2	E-301; Double pipe;carbon Steel.	4,500	14,800
			Pressurized liquid extraction (PLE)		
PLE	Vessel	0.018 m^3	V301; Vertical; Stainles steel	81,900	158,000
Drying	Heat exchanger	0.053 m^2	E-301; Double pipe;carbon Steel.	4,500	14,800

Table S.2. Raw materials cost for extraction processes.

Raw material name		Cost (USD/y)*
Maceration		
Orange residue		65,271
Ethyl acetate		2,251,842
	TOTAL	2,317,113
GXL		
Orange residue		8,107
Ethyl acetate		2,829
CO_2		64,545
	TOTAL	75,481
PLE		
Orange residue		456
Ethyl acetate		66,805
N_2		6,491
	TOTAL	73,752

*Considering that 90% of from ethyl acetate and CO_2 is recovered. Therefore, 10% is considered in the cost.

Table S. 3 Investment cost

Extraction process	Cost of investment (USD/y)
Maceration	480,000
GXL	420,000
PLE	200,000

Table S.4. Utilities cost for extraction processes.

Utility	Quantity	Cost (USD/y)
Maceration		
Low preassure steam	680 MJ/h	75,120
GXL		
Low preassure steam	0.8283 MJ/h	92
PLE		
Low preassure steam	20.3 MJ/h	2,240

Table S.5. Labour costs

Extraction process	Labour (USD/y)
Maceration	476,100
GXL	476,100
PLE	476,100

Table S.6. Operational costs

Extraction process	Cost of manufacturing (USD/y)
Maceration	4,342,882
GXL	1,482,591
PLE	1,443,506

Table S.7. Revenues for different selling prices (8321.16 Kg extract/y).

Sell price (USD/Kg)	Revenues (USD/y)
100	832116
200	1664232
300	2496348
400	3328464
500	4160580
600	4992696
700	5824812
800	6656928
900	7489044
1000	8321160

Table S-8. Results of environmental impact assessment.

Impact category	Unit	GXL	Maceration	PLE
Abiotic depletion (elem., reserve base)	kg Sb eq	6.94E-06	1.64E-04	1.67E-05
Land competition	m2a	9.70E-02	1.20E+00	2.23E-01
Human toxicity 100a	kg 1,4-DB eq	1.62E-01	2.29E+00	3.15E-01
Freshwater aquatic ecotox. 100a	kg 1,4-DB eq	6.58E-03	1.24E-01	1.62E-02
Marine aquatic ecotox. 100a	kg 1,4-DB eq	4.81E-02	8.46E-01	1.15E-01
Freshwater sediment ecotox. 100a	kg 1,4-DB eq	1.38E-02	2.37E-01	3.35E-02
Marine sediment ecotox. 100a	kg 1,4-DB eq	5.33E-02	9.51E-01	1.27E-01
Terrestrial ecotoxicity 100a	kg 1,4-DB eq	1.93E-04	2.33E-03	4.43E-04
Acidification (fate not incl.)	kg SO2 eq	1.06E-02	1.22E-01	2.42E-02
Eutrophication (incl. fate)	kg PO4--- eq	6.00E-03	6.97E-02	1.37E-02
Ionising radiation	DALYs	7.46E-09	7.82E-08	1.69E-08
Malodorous air	m3 air	6.35E+03	4.01E+05	2.26E+04
Photochem. oxid. (incl. NOx & NMVOC av.)	kg C2H4 eq	-4.94E-05	2.92E-03	-2.33E-05
Global warming 100a (incl. NMVOC av.)	kg CO2 eq	1.52E+00	1.88E+01	3.42E+00
Ozone layer depletion (incl. NMVOC av.)	kg CFC-11 eq	8.37E-08	1.39E-06	2.01E-07