POTENTIAL UTILIZATION OF CITRUS PEEL AS A RICH SOURCE OF ANTIOXIDANTS

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Introduction

Thanks to their pleasant flavour and aroma, as well as the presence of vitamins, minerals, dietary fiber and antioxidants, citrus fruits are widely consumed all over the world. While the fruit is mostly consumed in the form of food or juice, the peel is often considered a by-product in food industry and generates large amounts of ecological waste.

Objectives

The aim of this study was to compare the chemical composition of the pulp and peel extracts and peel essential oil of grapefruit, orange, mandarin and lemon in order to evaluate the potential utilization of citrus peels in different industries.

Materials and Methods

Citrus peels and pulps were extracted with 80% ethanol, 3 times for 2h, after which the collected fractions were merged, filtered and dried under vacuum. Crude extracts were dissolved in 50% ethanol. Quantitative analysis of phenolic compounds was performed by the LC-MS/MS technique.[1] Essential oils were obtained by hydrodestillation of peels and characterized by GC-MS technique.

Results

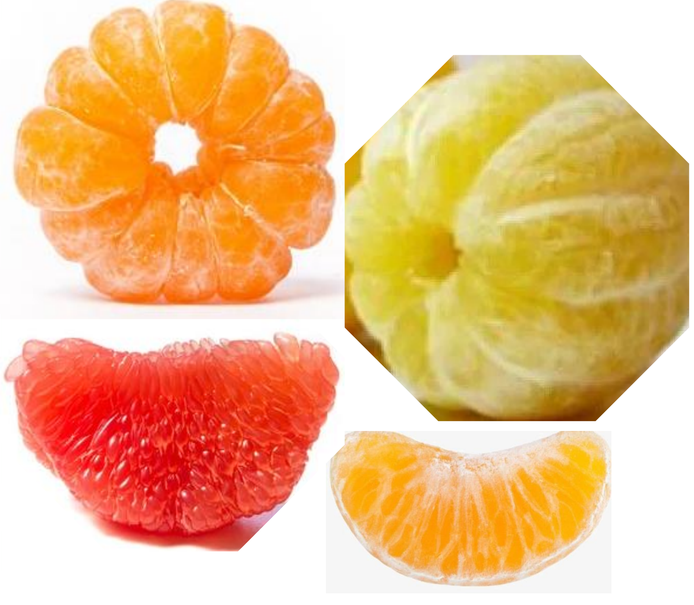
ESSENTIAL OIL (%)

	PEEL			
	grapefruit	orange	mandarin	lemon
pinene-like terpene	/	/	0.056	0.136
α-Pinene	0.161	0.209	0.577	0.808
β-Pinene	0.031	0.123	0.030	0.051
Sabinene	/	/	0.134	0.330
β-Myrcene	0.664	0.917	0.962	1.023
terpene	0.042	/	0.042	/
α-Phellandrene	/	0.043	/	/
δ-3-Carene	/	0.324	/	/
α-Terpinene	/	/	0.025	0.064
p-Cymene	/	/	0.034	0.723
Limonene	99.10	98.39	93.26	89.88
γ-Terpinene	/	/	4.762	6.634
Terpinolene	/	/	0.118	0.354

PHENOLIC ACIDS [ng/mL]

	PEEL				PULP			
	grapefruit	orange	mandarin	lemon	grapefruit	orange	mandarin	lemon
p–hydroxybenzoic acid	21.33	60.55	142.8	14.43	/	/	/	5.389
protocatechuic acid	6.402	5.701	4.417	20.82	3.368	2.668	4.417	8.271
p–coumaric acid	11.82	309.8	138.7	98.53	4.261	3.380	4.053	23.33
o–coumaric acid	/	/	/	1543	/	/	/	128.7
vanillic acid	37.70	88.04	43.25	/	/	/	49.92	/
caffeic acid	20.82	232.1	83.32	53.32	19.89	/	/	/
ferulic acid	202.3	889.9	623.2	136.6	24.19	8.536	20.36	44.73
chlorogenic acid	6.465	8.791	19.16	7.211	15.26	8.111	4.580	/
ellagic acid	94.71	516.8	455.4	675.2	125.2	621.9	691.1	449.5
sinapic acid	/	486.2	386.0	292.6	/	9.440	/	12.19
FLAVONOIDS [ng/mL]								
naringenin	26.40	13.16	4.755	/	8.181	4.626	3.492	/
vitexin	37.07	26.41	24.54	143.3	67.85	51.41	/	67.46
kaempferol–3–*O*–glucoside	25.90	/	/	/	32.37	1.736	5.729	5.729
quercetin–3–*O*–glucoside + hyperoside	10.30	39.25	202.6	170.7	20.18	9.467	34.32	65.78
rutin	159.8	259.6	3544	3166	160.0	386.9	1321	553.4
chrysoeriol	4.336	7.177	82.60	2.749	/	/	/	/
COUMARINS [ng/mL]								
umbelliferone	37.97	/	6.613	2.062	/	/	/	/
scopoletin	8.366	8.193	6.745	5.128	3.861	/	/	/
ABSCISIC ACID [ng/mL]								
	325.5	377.7	86.12	1442	165.6	322.9	300.8	259.0
VITAMIN C [µg/mg]								
	2.314	2.176	1.506	1.969	2.075	3.432	0.713	1.695

1. Peel extracts contained higher amounts of almost all analyzed compounds
2. Most abundant phenolics: ellagic, ferulic and sinapic acids and rutin
3. Orange peel was rich in phenolic acids, grapefruit peel in coumarins, lemon peel in *o*-coumaric and abscisic acids



4. Orange pulp contained the highest amount of vitamin C
5. Essential oil composition highlighted limonene as the main compound.

Conclusion

Obtained results support a more effective utilization of citrus peels as they are a rich and inexpensive source of neutraceuticals, antioxidants and aromatic compounds, that could be of great benefit to food, cosmetic and pharmaceutical industries.

References

1. Lesjak M, et al. (2011). Food Chem: 124:850–6.

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