molecules

MDPI

Supplementary Materials

Application of Super Absorbent Polymer and Plant Mucilage Improved Essential Oil Quantity and Quality of *Ocimum basilicum* var. Keshkeni Luvelou

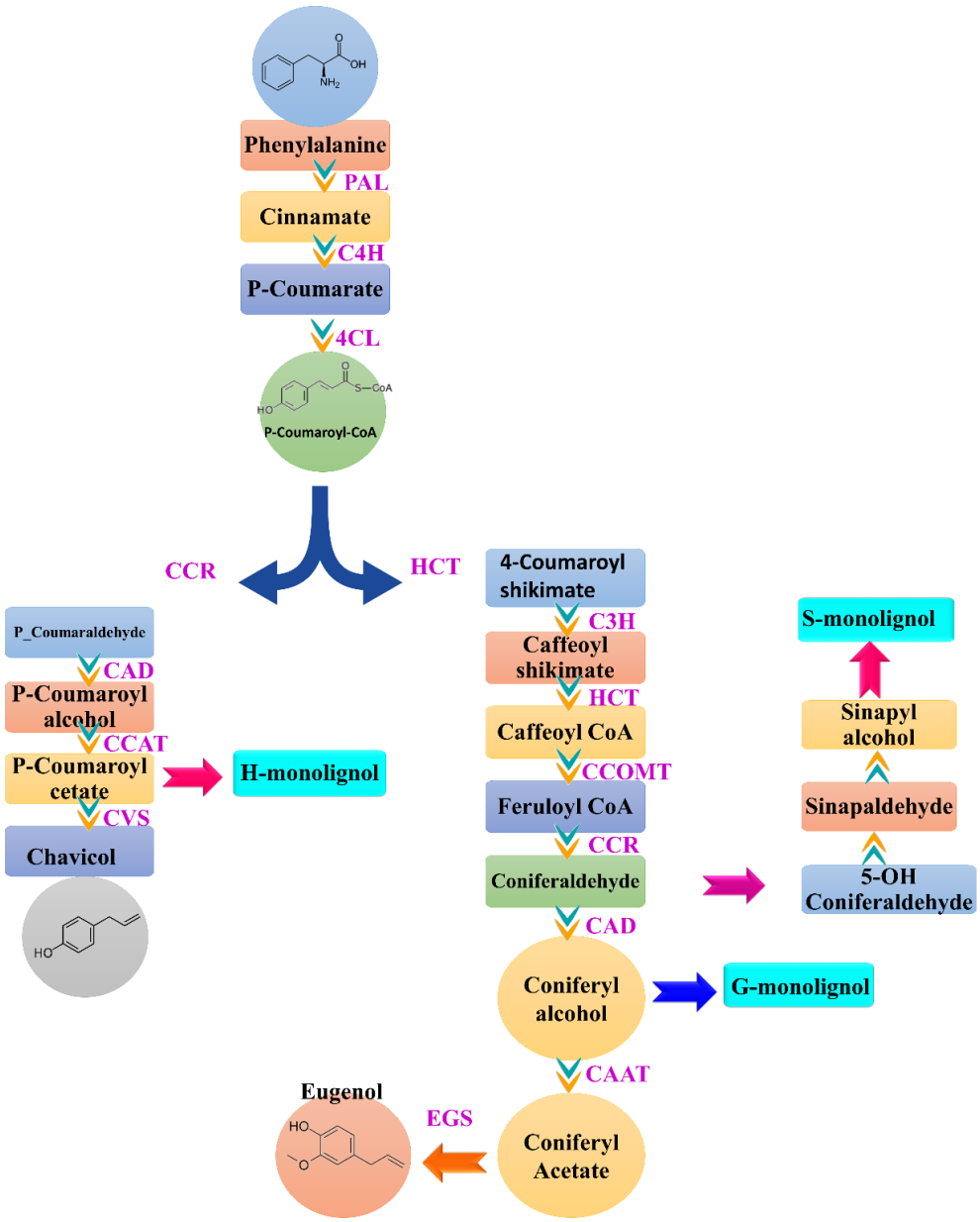
Somaye Beigi [1], Majid Azizi [2,*] and Marcello Iriti [3,*]

[1] Department of Horticultural Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad 9177948974, Iran; sbeigi61@gmail.com

[2] Department of Horticultural Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad 9177948974, Iran

[3] Department of Agricultural and Environmental Sciences, Milan State University, via G. Celoria 2, 20133 Milan, Italy

* Correspondence: azizi@um.ac.ir (M.A.); Tel.: +98-5138795618 (M.A.); marcello.iriti@unimi.it (M.I.); Tel.: +39-02-50316766 (M.I.)



Scheme S1. Plant phenylpropanoid pathway PAL, phenylalanine ammonia lyase; C4H, cinnamate 4-hydroxylase; 4CL, 4-coumaroyl-CoA ligase; CCR, cinnamoyl-CoA reductase; HCT, hydroxycinnamoyl-CoA shikimate/quinate hydroxycinnamoyl transferase; C3H, *p*-coumaroylshikimate 3'-hydroxylase; CAD, cinnamyl alcohol dehydrogenase; CAAT, coniferyl alcohol acetyl transferase; COMT, caffeic acid *O*-methyltransferase; CCOMT, caffeoyl-CoA.O-methyltransferase; F5H, ferulate-5-hydroxylase; CVS, chavicol synthase; EGS, eugenol synthase.

Table S1. Information about the main constituents of the basil essential oil in limit allowed.

Main Constituent in Basil	Safety Level	Toxicity/Chemical of Concern	Medicinal/Food Properties	Toxic Effects Overdose	References
Methyl chavicol (estragole)	<7.00 % About 260mg per kg on average (about 23 grams [about 25mL] of basil essential oil for a 70kg adult)	20–50% Dose of 35 grams per day-about 47 grams (about 50mL) of Basil essential oil for a 70kg adult 1–10 mg/kg body weight Oral LD50 in rats: 1230 mg/kg Oral LD50 in mice: 1250 mg/kg Intraperitoneal LD50 in rats: 1030 mg/kg Intraperitoneal LD50 in mice: 1260 mg/kg Topical LD50 in rabbits: >5 gm/kg	Used in perfumes and as a food additive for flavor Produces very mild sedative effects without any psychedelic effects	Skin irritant Suspected to be carcinogenic and genotoxic. Psychoactive Effects	[1] [2] [3]
Eucalyptol (1,8cineole)	0.002%	The acute oral LD50 is 2480 mg/kg (rat) 7.7–10%	An ingredient in many brands of mouthwash and cough suppressant as well as an inactive ingredient in body powder Used as an insecticide and insect repellent	Hazardous via ingestion, skin contact, or inhalation. Acute health effects on behavior, Respiratory tract, and nervous system. As a reproductive toxin for females and a suspected reproductive toxin for males.	[4] [1,3]
Methyl eugenol	0.5% in fragrances 20 ppm in flavors Oral-Rat: 1400.00 mg/kg	2% <6.00%		Potential carcinogenic activity	[1] [5]

	Oral: LD50: 1.40 (g/kg) Skin Rabbit: > 5000.00 mg/kg Dermal: LD50: >5.00				
		1%			[1]
Camphor	Doses in adults are in the range 50–500 milligrams per kilogram (mg/kg) of body weight.	2 grams (g) causes serious toxicity and 4 grams is potentially lethal	Readily absorbed through the skin and produces a cool feeling Acts as a slight local anesthetic and antimicrobial Effective as a cough suppressant An active ingredient (along with menthol) in vapor-steam products Administered orally in small quantities (50 mg) for minor heart symptoms and fatigue Used for the skin	Poisonous when ingested and can cause seizures, confusion, irritability Neuromuscular hyperactivity	[6]
Eugenol		< 4.00 %	Used in perfumes, flavorings Essential oils and in medicine as a local antiseptic and anesthetic which has restorative and prosthodontic applications in dentistry	Sensitizer (skin Irritant) Hepatotoxic, causing a wide range of symptoms from blood in the patient's urine Convulsions Diarrhea -Nausea -Unconsciousness -Dizziness -Rapid heartbeat	[5] [7]
Safrole				Carcinogenic (cancer causing–especially liver tumors)	[2]
α- and β-thujones	0.5mg/kg	<10 mg/L	Immune-system stimulation effects	Cause convulsions associated with lesions of the cerebral cortex Anxiety Sleeplessness Toxic to brain, kidney and liver cells and could cause convulsions	[8]

Table S2. ANOVA for the traits evaluated in the manuscript.

S.O.V	d.f	Essential Oil Yield	Essential Oil Content	WUE	Dry Matter
Replication	2	0.0004^{ns}	0.0023^{ns}	0.0011^{ns}	0.0087^{ns}
Application method	1	0.0004^{**}	0.0038^{**}	2.4075^{**}	27.999^{**}
HPs type	1	0.0007^{ns}	0.0063^{**}	0.0841^{**}	0.8586^{**}
HPs concentration	3	0.0159^{**}	0.1100^{**}	1.7284^{**}	58.219^{**}
Application method× HPs concentration	3	0.0043^{**}	0.0048^{**}	0.4884^{**}	6.3073^{**}
HPs type× HPs concentration	3	0.0040^{**}	0.0132^{**}	0.3089^{**}	6.0609^{**}
Application method× HPs type	1	0.0011^{ns}	0.1530^{**}	0.9947^{**}	27.968^{**}
Application method× HPs type× HPs concentration	3	0.0080^{**}	0.0237^{**}	0.4195^{**}	5.8888^{**}
Error	30	0.002	0.0137	0.2645	6.1046

S.O.V: Sources of Variation; d.f: Degree of Freedom; HPs: Hydrophilic Polymers. ns and **: None significant and significant at 0.01 probability level respectively.

References

1. Silano, V.; Speijers, G.; Müller, U.B.S.; Dusemund, B.; Loulergue, M.H.; Lugasi, A.; Toth, J. EFSA Compendium of botanicals that have been reported to contain toxic, addictive, psychotropic or other substances of concern. *EFSA J.* **2009**, *7*, 281.
2. Gupta, Suresh, K. "Ocimum sanctum modulates selenite-induced cataractogenic changes and prevents rat lens opacification." *Curr. Eye Res.* **2005**, *30*, 583–591.
3. Speijers, G.; Bottex, B.; Dusemund, B.; Lugasi, A.; Tóth, J.; Amberg-Müller, J.; Rietjens, I.M. Safety assessment of botanicals and botanical preparations used as ingredients in food supplements: Testing an European Food Safety Authority-tiered approach. *Mol. Nutr. Food Res.* **2010**, *54*, 175–185.
4. Carratù, B.; Federici, E.; Gallo, F.R.; Geraci, A.; Guidotti, M.; Multari, G.; Sanzini, E. Plants and parts of plants used in food supplements: An approach to their safety assessment. *Ann. Dell'istituto Super. Di Sanita* **2010**, *46*, 370–388.
5. Dweck, A.C. Toxicology of essential oils reviewed. Person. *Care Mag.* **2009**, *2*, 65–72.
6. Chen, W.; Vermaak, I.; Viljoen, A. (2013). Camphor—A fumigant during the black death and a coveted fragrant wood in ancient Egypt and Babylon—A review. *Molecules* **2003**, *18*, 5434–5454.
7. Giuliani, F. The Composition, Structure, Sources, and Applications of Eugenol. *ESSAI* **2014**, *12*, 19.
8. Aqil, M.; Ahad, A.; Sultana, Y.; Ali, A. Status of terpenes as skin penetration enhancers. *Drug Discov. Today* **2007**, *12*, 1061–1067.

Sample Availability: Samples of the compounds are not available from the authors.