

Development of new value-added products from processing waste streams



Rodolfo Juliani and Jim Simon. 2008.

A “natural” trend in natural products

- We find ourselves in a era of increased interest in plant-derived products
- This interest is due to:
 - the concerns generated by the negative effects of synthetic drugs and chemicals
 - published information devoted to the relationship between diet and health

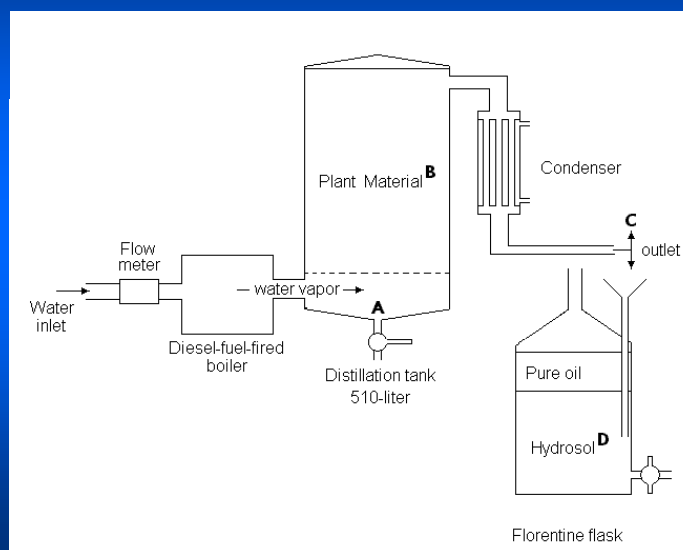


Implications for development

- Economic development:
 - driving a multibillion dollar market
- Era of innovation: natural product companies are looking for new products



Aromatic plants: multiple products



Redistillation

The distillate water can be:

- discarded after the prime oil is removed,
- or undergoes a secondary distillation to recover remaining essential oil in the distillate water.



Hydrosol as commercial products

Herbal Products | Hydrosols



Lavender Hydrosol

2 oz. brown glass bottle with dropper. (Lavandula angustifolia). Use as a toner or in lotions for rejuvenating and rehydrating the skin. Excellent daily skin care treatment for any skin type. Add to masks or use before and after shaving to prevent inflammation and ingrown hairs. Also useful as an after sun spray or in a cold compress for headaches and migraines.

PRICE: \$4.50

Add to Cart →

<http://www.darcyfromtheforest.com/>

The issue with organic hydrosols



Organic Consumers Association

*Campaigning for Health, Justice,
Sustainability, Peace, and Democracy*

Organic Consumers Association¹ is claiming that non-agricultural water is counted as "organic" by some body care companies to drastically inflate the weight of organic ingredients in their products to make the claim that they use "70 percent Certified Organic Ingredients."

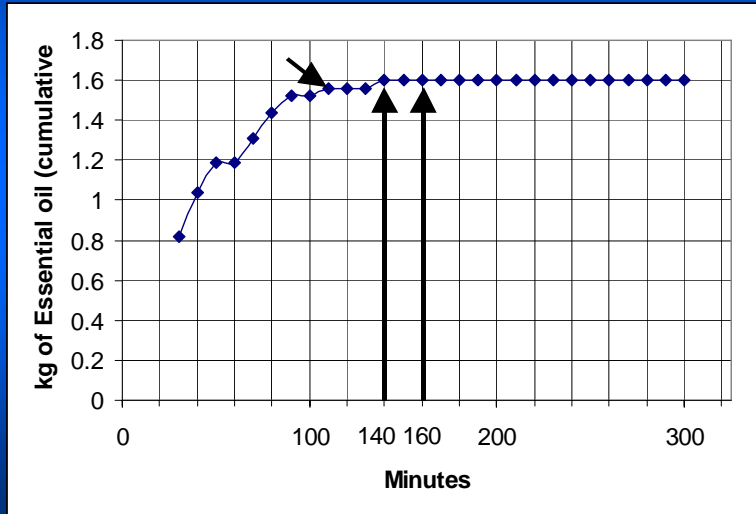
<http://www.organicconsumers.org>

Origin and Chemistry of the Hydrosol Produced via Steam Distillation of Mint (*Mentha* spp.)

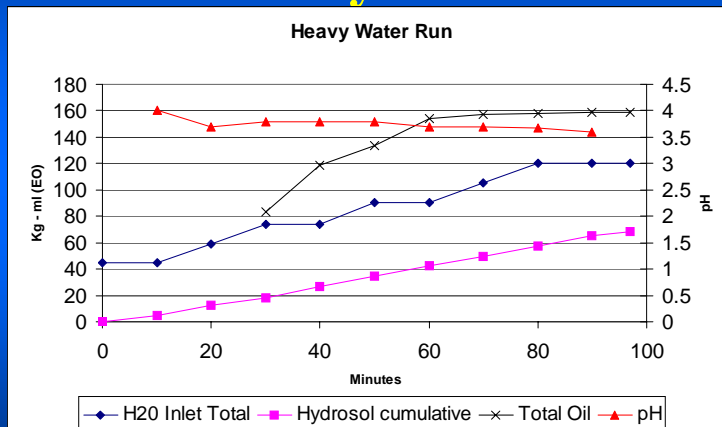
- 1) Determine the effective contribution of water from the plant material (*Mentha* sp) using deuterated water;
- 2) Examine the composition and chemical properties of the hydrosol derived from mint (*Mentha* sp) and compare it to the prime distilled essential oil.



Distillation time



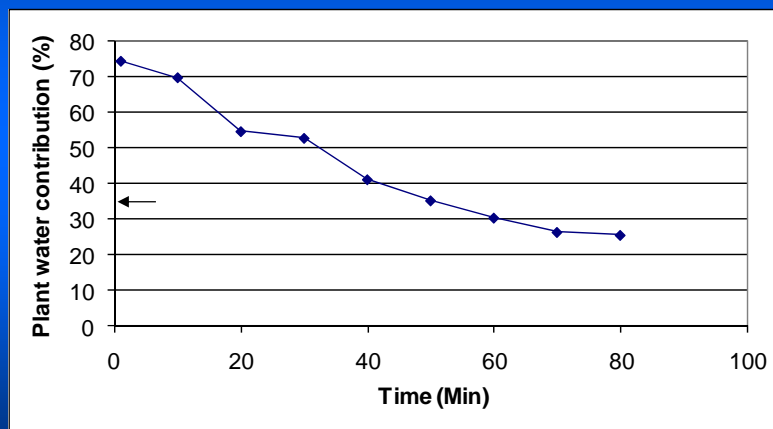
Steam distillation of mint using heavy water



Origin of water in the hydrosol

Distribution of water in the hydrosol	Absolute (kg)	Relative (%)
Coming from plant material (max.) ¹	32.2	54.1
Coming from tap water (min.)	27.3	45.9
Total hydrosol ²	59.5	100

Water coming from plant material into the hydrosol



Chemical properties of the hydrosol

	Tap Water ¹	Hydrosol ²	Distilled water ³
pH	5.4	3.8	2.9
Soluble solids (%)	0.02	tr ⁴	tr
Conductance	0.149	0.03	0.06
Essential oil (mg/100 ml of hydrosol)	-	0.75	-

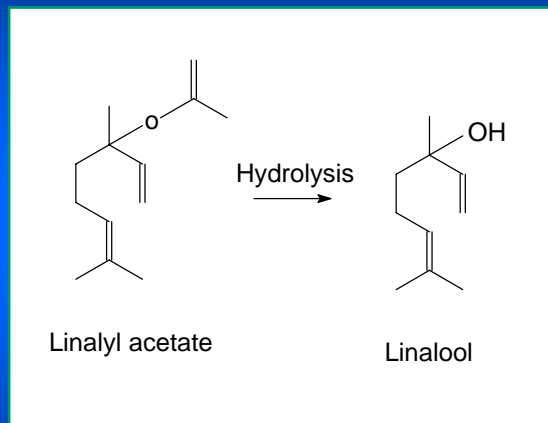
Essential oil components

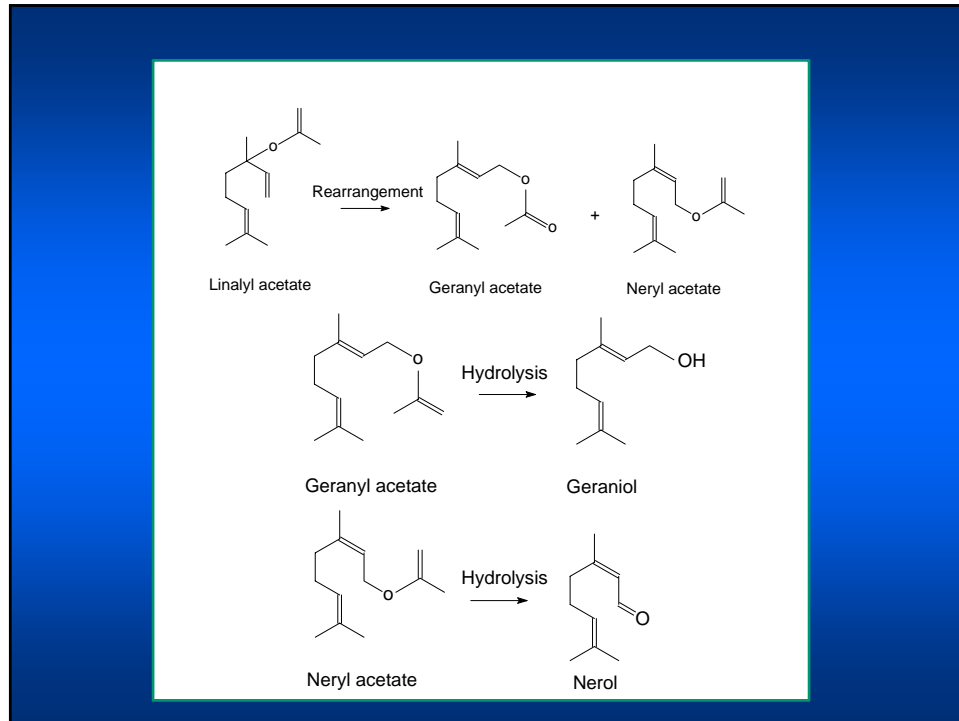
Group of components	Essential oil	Hydrosol
Esters	24.8	0.5
Hydrocarbons	17.4	0.0
Monoterpenes	8	0.0
Sesquiterpenes	9.4	0.0
Oxygenated components	56.2	92.0
Monoterpene alcohols	22	47
Oxygenated components + esters	81.1	92.5

Essential oil components

Components	Essential oil	Hydrosol
Linalool	14.9	22.5
Menthone	1.3	0.5
Menthofuran	9.9	-
Menthol	5.4	6.3
Terpin-4-ol	-	2.1
α - Terpineol	1.2	10.7
(E) Dihydrocarvone	0.4	0.8
Nerol	0.2	0.9
Pulegone	3.1	5.1
Carvone	3.9	15.5
Geraniol	-	4.0
Linalyl acetate	20.4	-
Menthyl acetate	2.5	0.2
Neryl acetate	0.4	0.1
Geranyl acetate	0.6	0.2

Chemical changes in the hydrosol





Conclusions

- Hydrosol was mainly composed of water from an external source, such as the inlet (64%), while the plant derived water has a minor contribution (36%).
- The physicochemical properties suggested that the hydrosol was essentially distilled water with low amounts of volatile components.
- The essential oil components dissolved in the *Mentha* sp hydrosol were different from those observed in the prime oil (devoid of hydrocarbons and esters (e.g. linalyl acetate)).
- Distillate water was composed mostly of oxygenated components (monoterpene alcohols).

A case study on *Asparagus officinalis*

- *Asparagus officinalis* the source of the young shoots know as asparagus
- New Jersey ranks 4th nationally in asparagus production
- Rutgers University has an active asparagus breeding program. Several well know hybrids has been released (Jersey Giant, Jersey Knight, Jersey Supreme, and Jersey King)
- Early work at Rutgers showed that asparagus could be a rich source of unique saponins which appeared promising against colon cancer in vitro studies



Picture from <http://aesop.rutgers.edu/~asparagus/research/asparagus.html>

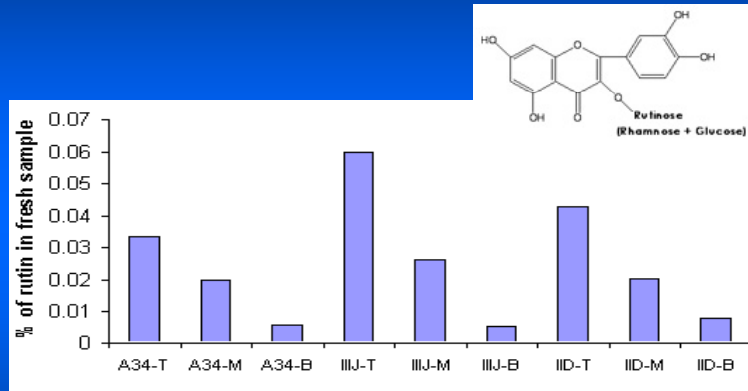
Quantification of Protodioscin and Rutin asparagus shoot

- The objectives of this study were:
- to determine the amount of active principles in different sections of the asparagus shoot
- To find new uses for the lower portion of the shoot that is discarded during processing



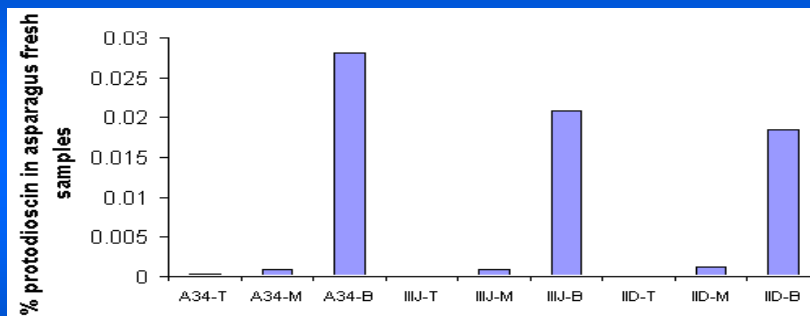
Picture from <http://aesop.rutgers.edu/~asparagus/research/asparagus.html>

Flavonoids in asparagus



Rutin (HPLC) in three asparagus breeding lines, A34, IIIJ, IID (T=top, M=mid., B=bottom)

Protodioscin, the main saponin in asparagus



Protodioscin in three asparagus breeding lines, A34, IIIJ, IID (T=top, M=mid., B=bottom).

Protodioscin, the major saponin in asparagus has attracted intense attention

- Protodioscin has been reported to possess the following bioactivities:
- cytotoxicity against several human cancer cell lines,
- Reduction in bone loss
- Improved sexual desire

Conclusions

- The distribution of rutin and protodioscin within the shoots was found to vary by location, with the tissue closest to the rhizome found to be a rich source of protodioscin,
- while the upper youngest shoot tissue contained the highest amount of rutin at levels of 0.03-0.06% tissue fresh weight.
- The lower portions of the asparagus shoots that are discarded during grading and processing can be considered a promising source of a new value-added nutraceutical product.