

# Green technology to boost production of natural extracts

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## What is green engineering?

Green engineering is the design, commercialization, and use of processes and products, which are feasible and economical while minimizing:

- generation of pollution at the source
- risk to human health and the environment.

Green engineering embraces the concept that decisions to protect human health and the environment can have the greatest impact and cost effectiveness when applied early to the design and development phase of a process or product.



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Pharmacological effects of herbal oils and oily extracts on the human is unique due to their ability to help organism to use unopened own resources.

Design and study of preparations from herbal oily extracts are one of perspective directions of activity of St-Petersburg Institute of Pharmacy.



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## Factors playing important role in efficacy of extraction

- Difference in concentration
- Size of particles
- Temperature
- Time of extraction
- Hystology of plant material
- Viscosity of extragent
- Hydrodynamic conditions



## Main techniques for oily extract preparation

- - maceration at 50-70 °C
  - - percolation
  - extraction by organic solvents
  - extraction by carbon dioxide
  - extraction by freon
- } used seldom

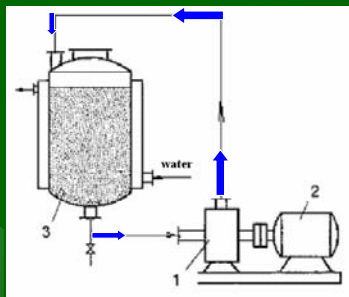


## Drawbacks of maceration

- long extraction time
- heating of system and possible degradation of biological active compounds
- bad hydrodynamic condition for extraction
- low masse exchange and yield
- selective extraction of unpolar compounds
- low coefficient of raw plant material utilization



## Rotary-pulsation extraction



Complex method for the intensification of raw plant material extraction include processing in the so-called rotary-pulsation extractor (RPE) was developed\*

\*Shikov A.N. 2006. Developing a model for mathematical description of the fractional composition and interphase contact surface for raw plant material extraction in a rotary-pulsation apparatus. Pharmaceutical Chemistry Journal 40(7): 385-388

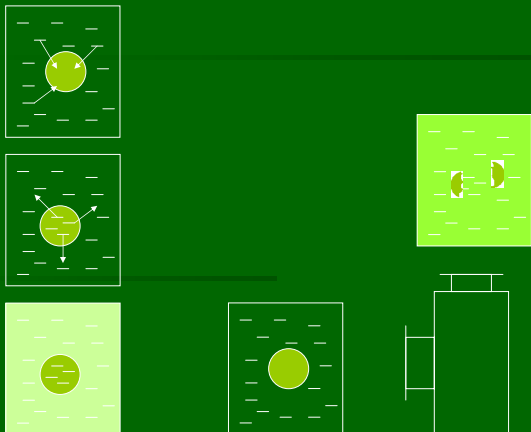


Processes in the working zone of RPE involve a combination of various hydrodynamic phenomena, including:

- high-gradient flow in the gap between rotor and stator,
- intensive turbulization,
- pump effects,
- complicated velocity fields,
- vortex formation,
- cavitation and pulsation due to variations of the by-pass flow cross section.



## Difference between maceration and RPE



## Mathematical description of extraction in RPE

$$\varphi_{i0}(x, u) = \frac{x^3}{2\sigma^4} \exp\left(-\frac{x^2}{2\sigma^2}\right)$$

Differential function for particle distribution (initial size  $u$ )

$$P = P_{i0}(x, u) = 1 - \left(1 + \frac{x^2}{2\sigma^2}\right) \exp\left(-\frac{x^2}{2\sigma^2}\right)$$

Integral function for particle distribution (initial size  $u$ )

$$S_i = \frac{6M\varphi_i(x, u)}{\rho x}$$

Function for calculation of interphase contact

\*Shikov A.N. 2006. Pharmaceutical Chemistry Journal 40(7): 385-388



## Technological benefits of RPE:

- Ensure much better product quality
- Provide for increased coefficients of raw material usage
- Make possible the use of various extragents including plant oils



We successfully used RPE to obtain the oil extracts of different herbal materials as

- *Matricaria recutita* L. flowers,
- *Leonurus cardiaca* L. herb,
- *Pinus sibirica* Du Tour seeds,
- Herbal mixtures



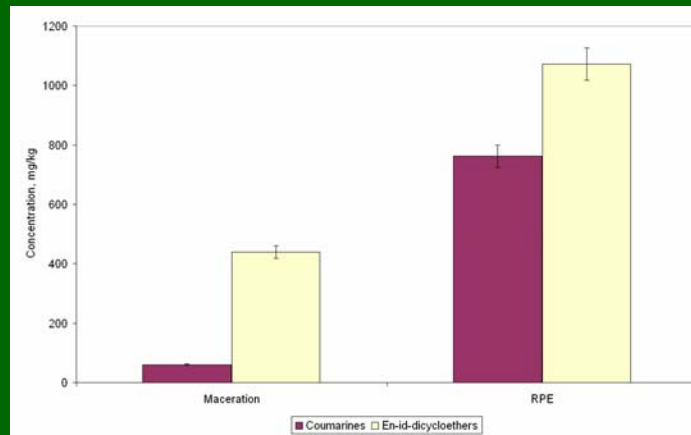
### *Matricaria recutita* L.



Oil extract of *Matricaria recutita* flowers



### Extraction of *Matricaria recutita* flowers by maceration and RPE



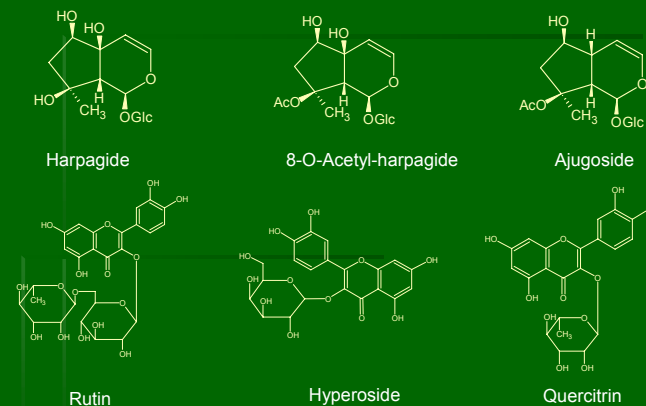
### *Leonurus cardiaca* L.

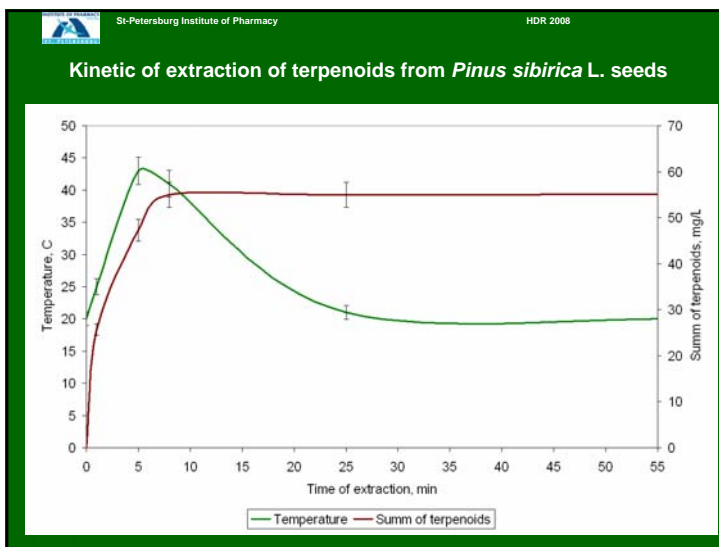
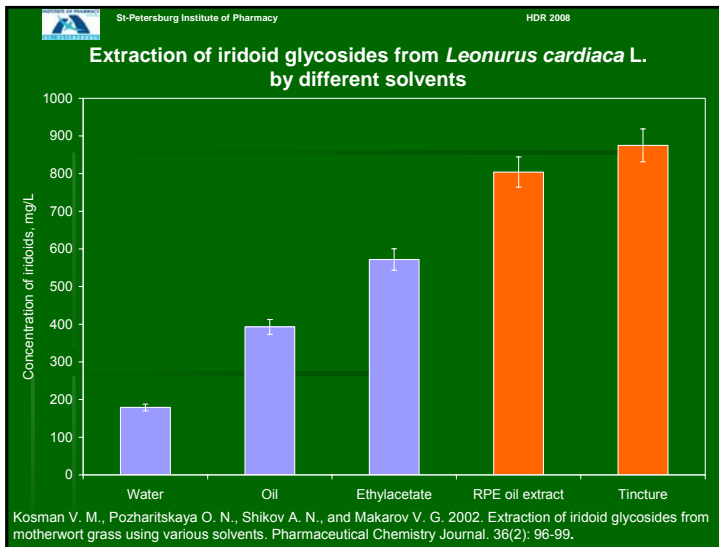


Oil extract of *Leonurus cardiaca* herbs



### Main active compound of *L. cardiaca* oil extract





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- ### Benefits of developed technology
- Significant decreasing of time of extraction
  - It is possible to obtain concentrated oil extracts
  - It is possible to extract lipophylic active compounds both middle polarity compounds
  - Temperature of extraction is moderated under 45 °C
- ### Why it is green?
- Absence of toxic organic solvents
  - Raw plant material may be extracted without preliminary grinding
  - Low dusting
  - Waste may be used in agriculture as fertilizer



## New phytopreparations on the base of oil herbal extracts

- Gastroromazol (*Matricaria recutita* L. flowers)
- Iridol (*Leonurus cardiaca* L. herb)
- Kedrol (*Pinus sibirica* Du Tour seeds)
- Fitusol (extract of mixture of herbs)



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