Advanced methods for production of valuable compounds from aromatic and medicinal plants - liquefied gas and super heated water extraction

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**SUB-CRITICAL LIQUEFIED GAS EXTRACTION – KEY FIGURES**

- Focus on food grade solvent tetrafluoroethane (TFE)
- Developed in start-up companies Innosolv Ltd. (Bulgaria) and Comerg LLC (USA) by team of scientists
- Patented method for effective extraction process
- Vast investigations on optimal process, product properties and applications
- Suitable for aromatic and medicinal plants
- Industrial commercialization of method and equipment

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**PROCESS ADVANTAGES**

- Lipophilic, safe, odorless, food grade solvent used in pharmacy
- Solvent selectivity to aroma and active compounds in plants
- Low extraction pressure (up to 15 bar) and temperatures (0-40\(^\circ\) C) – high product quality
- Low extraction pressures – high product quality
- Cost effective process – low operational and capital costs

TFE rose extract    TFE lavender extract
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PRODUCT PROPERTIES

• Suitable raw materials – dried and fresh leaves, flowers, seeds, etc.

  • Extract appearance – oily liquids to solid masses, colored, with strong, typical smell of raw material

  • Chemical composition – similar to essential oils plus some non-volatile compounds, very close SC CO₂ select extracts

• Medium to strong antimicrobial and antioxidant properties

• Neglectable amount of solvent residue in product
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PRODUCT APPLICATIONS

- Substitutes of natural spices in food products and aroma preparations according European legislation – sausages, cheeses, ready meals, mayonnaise, chocolate, etc.

- Source of active ingredients for pharmaceutical, crop protection products, etc.

- Source of natural active ingredients for cosmetic products

- Perfumery
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PROCESS COMMERSIALIZATION

• Over 40 industrial, semi-industrial and laboratory scale equipment running worldwide.

  • US patented method

• Focus on industrial hemp extraction applications for active ingredients

• Attempts for medium scale industrial applications for rose, lavender, etc, extraction
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PRODUCT EXAMPLES

**Fresh rose petals extract:**
- Yield 0.15-0.25%
- Appearance – brown, thick liquid, aroma close to rose absolute
- Chemical composition:
  - Phenylethyl alcohol – 55-65%
  - β-Citronellol – 10-15%
  - Other...

PRODUCT EXAMPLES

**Hemp (CBD strain) extract:**
- Yield 2.0-3.5%
- Appearance – dark thick liquid, typical aroma of terpenes
- Chemical composition:
  - CBD – 30-50%
  - CBDA – 0.0-1.0%
  - THC – 3-5%
  - THCA – app. 0%
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SUPERHEATED WATER EXTRACTION

• Cheap, widespread, environmental, health and fire safe solvent - water.

• Working principle – increase pressure to increase solvent temperature and change water selectivity to non-polar compounds

• Perspectives – to extract non-polar molecules from biomass with water only

Typical extraction process parameters – temperatures up to 170°C, duration – 1-3 minutes

• Current development stage – laboratory scale, industrial application – expected soon

Dielectric constants:
Pure water (@170°C) = Aqueous-ethanolic solution, @67%w/w, 20°C)

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