Antioxidant activity of essential oils encapsulated in nanoemulsions

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Abstract
The encapsulation of essential oils using nano-emulsified systems has potential application in personal care products for antioxidant delivery systems. This work reports the formulation of oil-in-water nanoemulsions containing essential oils like lippia alba, rosemary and cypress in liquid paraffin. Paraffin and essential oils were characterized by their EACN (Equivalent Alkane Carbon Number) using the SAD (Surfactant-Affinity-Difference) generalized formulation concept. Nanoemulsions were prepared with a mixture of two nonionic surfactant calculated to adjust the proper SAD to produce the required phase transitions to use a low energy emulsification method. Nanoemulsions were characterized by droplet size, transmittance and stability. Antioxidant activity of pure essential oils and encapsulated in nanoemulsions and macroemulsion were studied by using the 2,2’-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging method. It was concluded that the antioxidant activity do not depend on the emulsion droplet size distribution.

Keywords: Nanoemulsions, nanometric delivery system, essential oil, antioxidant activity

Introduction

Free radicals
Factors:
- Environmental
- Biological
- Social

Oxidative stress
Pharm. vehicle
Skin

Pathologies
Prophylaxis

Antioxidants
Naturals and synthetic

Essential oils
Naturals antioxidants

SOW systems
- Microemulsion
- Liquid crystal
- Emulsion/Nanoemulsion

Experimental

a. Emulsification
a.1.- EACN
0 = \sigma + \ln(S) - k \cdot EACN + Q \cdot \Delta T \cdot I(A)

a.2.- Low energy emulsification
SAD = \alpha - EON + k \cdot AEN - \phi(A) + c \cdot (\Delta T)

b. Antioxidant activity: DPPH method

Results and discussion

Table 1. Calculated EACN of essentials oils
<table>
<thead>
<tr>
<th>Essential oil</th>
<th>EACN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lippia alba</td>
<td>6</td>
</tr>
<tr>
<td>Cypress</td>
<td>2.3–3.6</td>
</tr>
<tr>
<td>Rosemary</td>
<td>6</td>
</tr>
</tbody>
</table>

Droplet size of emulsions
- Nanoemulsions: 20-100 nm
- Macroemulsions: 500-1000 nm

Fig. 1 Introductory scheme

Fig. 2 DPPH and antioxidant (AH) reaction / Absorption bands

Fig. 3 Nano and macroemulsions obtained: (A) By dilution of liquid crystal (LC), and (B) by a high energy method.

Fig. 4 Antioxidant activity of essential oils encapsulated in nano and macroemulsions, using the DPPH method.

Conclusions
The antioxidant activity of essential oils has been object of investigation due to their potential as preservatives, cosmeceuticals or nutraceuticals in cosmetic or food industries. In this study, results suggest that encapsulation of essential oils in emulsions or nano-emulsions could greatly enhance essentials oil’s chemical stability during storage. The antioxidant activity of essential oils is independent of the droplet size of emulsions oil in water in the studied time interval (6 weeks). In addition, the essential oils studied (encapsulated), have a similar antioxidant activity (slightly higher in the lippia alba). The advantage of encapsulated essential oils in the nanoemulsions morphology is because these systems have high kinetic stability.

References