POTENTIAL ACTIVE PACKAGING FILMS TO PREVENT SUNFLOWER OIL OXIDATION

MRL. Perception of a need within a market

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MRL. Description of the need

1 INTRODUCTION

Sunflower oil is an unsaturated mixture of mainly oleic and linoleic acid fatty acids [1]. Their rapid oxidation can modify negatively the organoleptic properties of the product. Synthetic antioxidants, such as BHA, BHT and TBHQ* have been used as sunflower oil additives. However, substantial efforts have been focused on the replacement of these conventional additives for natural antioxidant compounds. Eugenol (E) is a natural phenolic compound with effective antimicrobial and antioxidant properties [2].

Figure 1. Eugenol molecule.

However, it is difficult to handle due to its limited water solubility and it is susceptible of losing functionality during its processing. These drawbacks could be minimised by encapsulating eugenol, and also could be incorporated into bioactive films to be used for food preservation [3].

MRL. Articulation of the need

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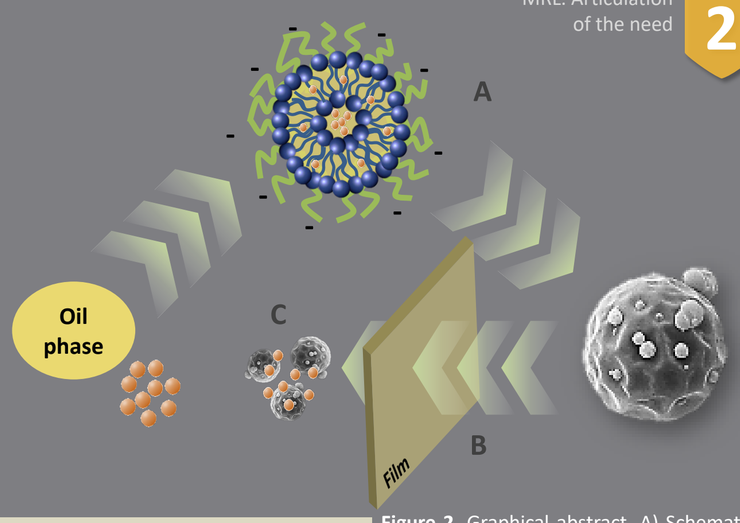


Figure 2. Graphical abstract. A) Schematic overview of possible interactions between eugenol and wall materials. B) Incorporation of spray-dryied powders into starch films. C) Active compound release.

Furthermore, there is an increasing interest on replacing the conventional commercial plastics used in food packaging (e.g. PE, PVC or PET**) with natural and biodegradable packaging materials, such as corn starch, which could also contain active compounds. These synthetic materials have some drawbacks, such as their relatively limited barrier properties as compared to glass and their impact on the environment [4].

AIM

The aim of this work was to evaluate the antioxidant power of starch bags containing encapsulated eugenol in lecithin and oleic acid (EOA-LE-S) on the protection of sunflower oil through the analysis of the evolution of peroxide index (PV). Moreover, the antioxidant effect of this package was compared with a commercial low-density polyethylene packaging (PE), starch film without E (S) and an open control (OC).

[1] Anushree et al. (2017). *Agron Sustain Dev*, 37(3), 18
[2] Chatterjee & Bhattacharjee (2013). *J Food Eng*, 117(4), 545-550
[3] Valencia-Sullca et al. (2016). *Polym Int*, 65(8), 979-987
[4] Kucuk & Caner (2005). *J Food Lipids*, 12(3), 222-231
[5] Galarza et al. (2017). *Food Hydrocolloid*, 65, 96-106

* Butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and tert-butyl hydroquinone (TBHQ)

** Polyethylene (PE), polyvinylchoride (PVC) and polyethylenetetraphthalate (PET)

MRL. An initial offering

3 MATERIALS AND METHODS

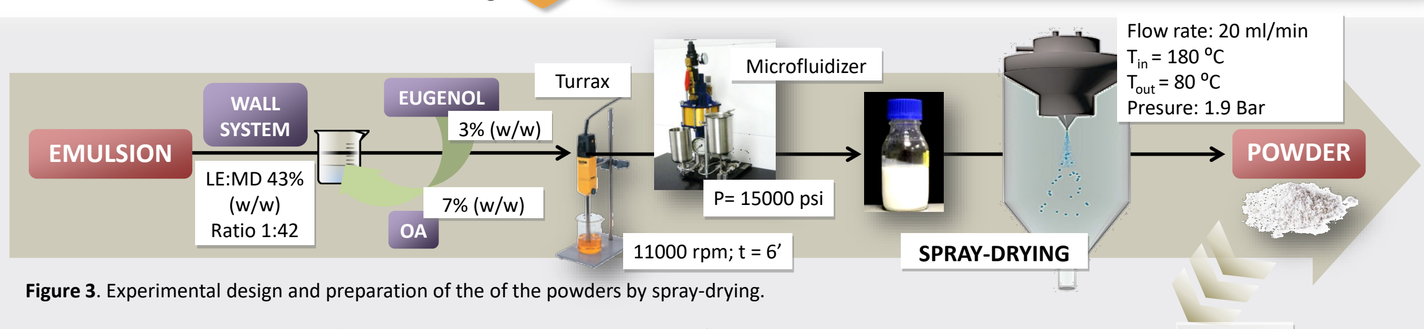


Figure 3. Experimental design and preparation of the of the powders by spray-drying.

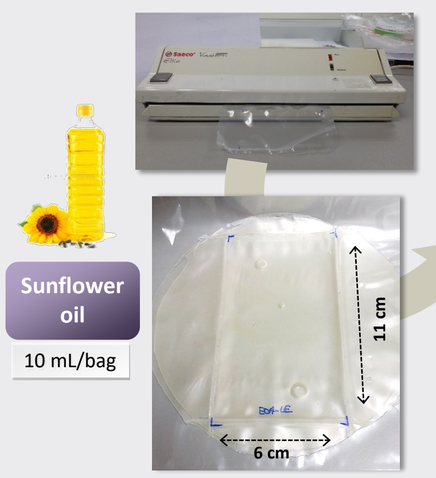


Figure 5. Experimental design and preparation of sunflower bags.

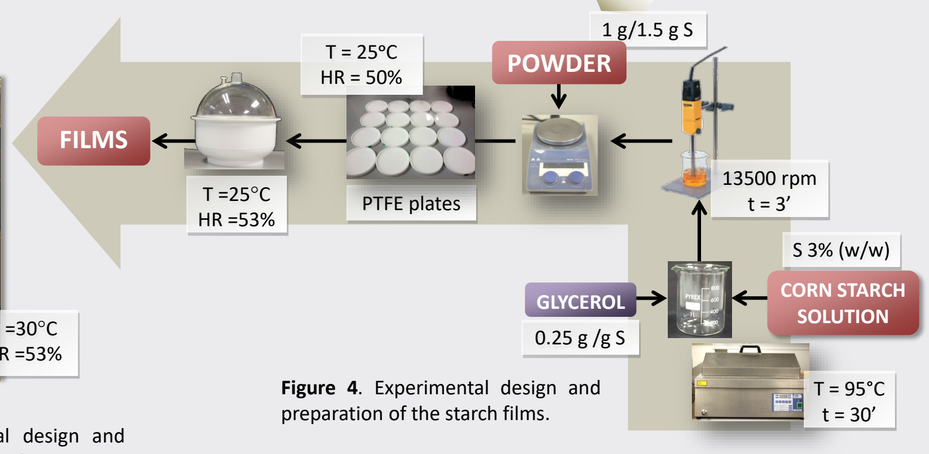


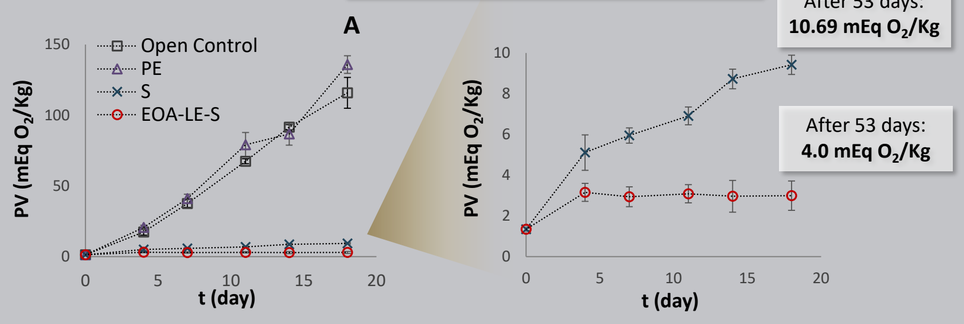
Figure 4. Experimental design and preparation of the starch films.

BAGS	
S	Pure starch film
EOA-LE-S	OA:LE:MD Microencapsulated eugenol film
PE	Commercial low density polyethylene packaging
OC	Open Control

RESULTS AND DISCUSSION

Peroxide Index (PV) [5]

$$PV(mEq_{O_2}) = \frac{c_t \cdot (V_t - V_B) \cdot 1000 \cdot CF_t}{m_{oil}}$$



Dienes (λ=232): Primary degradation products

$$K_{\lambda(g/100mL)} = \frac{E_\lambda}{c} \cdot s$$

Trienes (λ=268): Secondary products

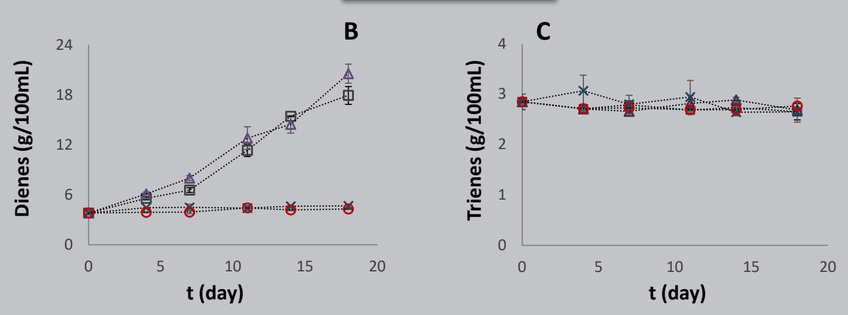


Figure 6. Peroxide index (PV) (mEq O_2/Kg) (A); conjugated dienes (B) and conjugated trienes (C) (in g/100g) of sunflower oil.

The results showed a continuous increase in PV with the increase of storage period for all controls (S, PE and OC) reaching values of 9.4, 135.8 and 115.8 mEq O_2/Kg respectively, at 18 days of storage.

The lowest PV was registered for samples packaged in S and EOA-LE-S bags, due to the low oxygen permeability of this films. In samples packaged with EOA-LE-S films, PV was kept at an average of 4 mEq O_2/kg during 53 days, below the peroxide limit established by the Codex Alimentarius for refined oils, thus indicating the effectiveness in preventing sunflower oil oxidation in accelerated storage conditions.

MRL. Run a campaign with stakeholders

4 POTENTIAL APPLICATION

INCORPORATION OF THE ANTIOXIDANT FILM INTO MULTILAYER PACKAGING MATERIALS AGAINST VEGETABLE OILS OXIDATION

2. Emergent biodegradable materials, as the one developed here, usually present poor mechanical properties.

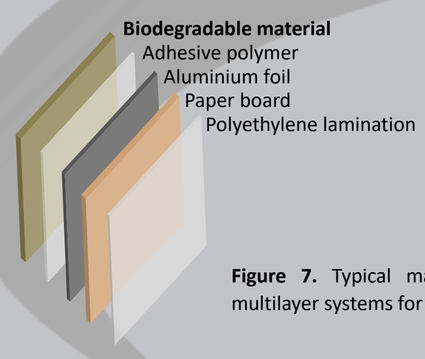


Figure 7. Typical materials used in multilayer systems for food packaging.

1. Conventional packaging materials for food preservation are very commonly composed of multilayers.

3. The incorporation of these active biodegradable materials into conventional multilayer packaging will solve their mechanical drawback and, at the same time, will provide natural compounds with functional properties to enhance food quality.

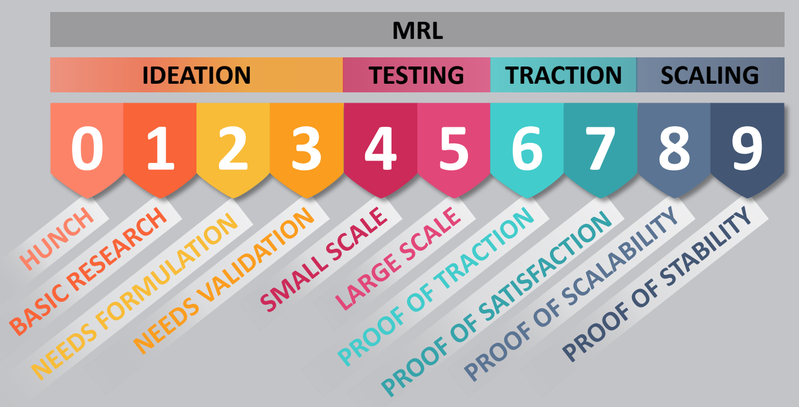


Figure 8. Schematic overview of Market Readiness Levels (MRL). Source: CloudWATCH2. Website: http://www.cloudwatchhub.eu

CONCLUSIONS

The use of active starch films incorporating encapsulated eugenol seems to be an effective package to prevent sunflower oil oxidation and could be used for individual doses of oil which have a market demand. Further research is needed to test the active packaging material in real conditions.

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