ANTIOXIDANT ACTIVITY OF SODIUM ALGINATE FILMS WITH PLANT EXTRACTS OBTAINED BY ULTRASOUND-ASSISTED EXTRACTION FOR MEAT PRESERVATION

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I. INTRODUCTION

Meat is susceptible to chemical deterioration processes which limit the shelf-life of the product. Deterioration processes cause several undesired changes in the product such as appearance, colour, flavour, texture, reduction of its nutritional value, and formation of compounds harmful to health (1, 2). The use of sustainable polymers with the incorporation of antioxidants and agents may be an alternative approach to minimize these problems and may increase the shelf-life of meats. This study aimed to evaluate the antioxidant activity of laurel (*Laurus nobilis)* and olive (*Olea europaea*) leaves extracts when incorporated in sodium alginate-based active films and their behaviour in different food simulants.

II. MATERIALS AND METHODS

Olive and laurel leaves were harvested, washed, and dried at 25ºC under air circulation until constant weight. Dried leaves were milled in a 1 mm sieve. Twenty grams of dried milled leaves in 100 mL of 70:30 (v/v) ethanol:water solution was sealed in an Erlenmeyer flask and placed into an ultrasound bath with 3 L of water at 25ºC ±5ºC for 1 h. Samples were centrifuged at 5000 × *g* for 10 min. After centrifugation, the solvent was removed in a rotary evaporator at 38 ºC, under vacuum, and the samples were freeze-dried. The films were obtained by mixing 1% (w/v) of sodium alginate (SA) and 0.5 % (w/v) of glycerol in distilled water under agitation overnight. The lyophilised extracts were dissolved in distilled water, stirred for 1 h, filtered under vacuum, and added to the film-forming solutions in the following concentrations: laurel leaves extract (LLE) at 1 and 2%, olive leaves extract (OLE) at 1 and 2%, and a mixture of LLE 0.5% + OLE 0.5%, and LLE 1% + OLE 1%. All solutions were stirred for 1 h, homogenised with an Ultra-Turrax at 10000 rpm for 2 minutes and degassed under vacuum. The film-forming solutions were cast in polystyrene petri plates, dried at 35 ºC (air circulation) for 24 h, and conditioned in desiccators containing a saturated solution of $Mg(NO_3)_2.6H_2O$ at 53% of relative humidity and 20 ºC before analysis. Migration assay was determined by different simulants at 40 °C: water, 10% ethanol, and 95% ethanol. Square samples of 1 cm^2 of each treatment were mixed with 1.67 mL of the simulant, achieving an area-to-volume ratio of 6 $dm^2.L^{-1}$. Antioxidant capacity was measured by Trolox equivalent antioxidant capacity (TEAC) for extracts and films after 1, 3, 6, 9, and 15 days. All the analyses were performed in triplicate.

III. RESULTS AND DISCUSSION

Regarding the antioxidant activity of the extracts dissolved in water at 1 mg/mL, higher TEAC (mM Trolox equivalent) levels were obtained for LLE - 2.04 ±0.21, and lower levels for OLE - 0.74 ±0.02. The mixture of 50% of LLE and 50% exhibited 1.12 ±0.06. For Butylated Hydroxytoluene (BHT), an antioxidant compound, used as a preservative in foods, 1.52 ±0.17 was obtained at the same concentration (in 100% ethanol). These values were lower than those obtained for LLE extract, which indicates an optimum antioxidant capacity of this extract at these concentrations. The antioxidant activity of the diffused compounds is shown in Figure 1. For the same sample-simulant, the antioxidant activity remained stable

over 15 days, with no significant differences (p ≥0.05) being observed over time in practically all the samples, except for SA + LLE1% (E95%), SA + OLE 1% (E95%), SA + LLE 0.5% + OLE 0.5% (Water and E95%) and SA + LLE 1% + OLE 1% (E95%).

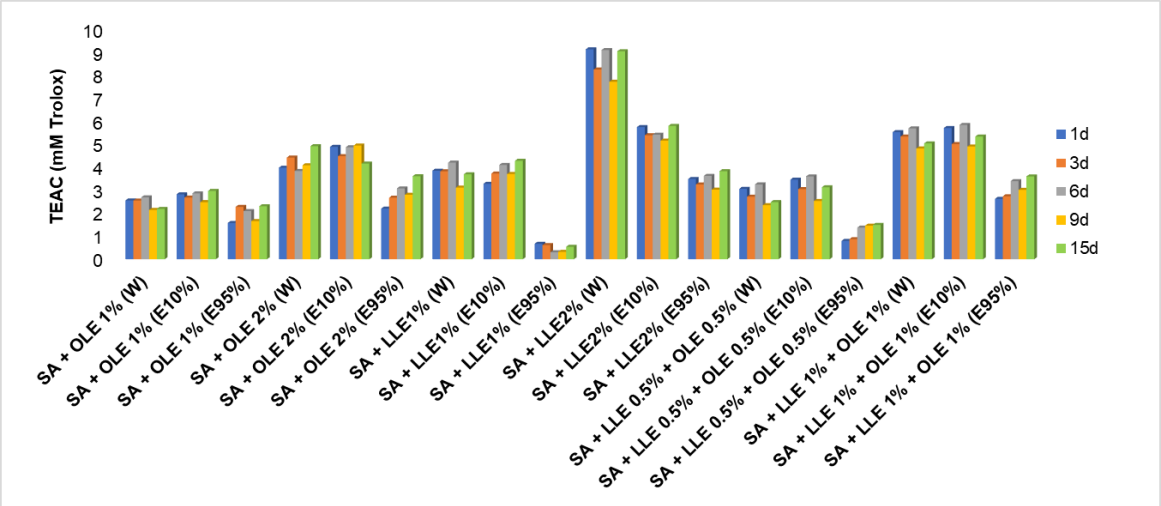

Figure 1 – Antioxidant activity of simulant media expressed in Trolox equivalent (TEAC). Legend: SA – sodium alginate; OLE – olive leaves extract; LLE – laurel leaves extract; W –water simulant; E10% - ethanol 10% simulant; E95% - ethanol 95% simulant.

The maximum rate of antioxidant activity released was 9.11, which was observed for SA + LLE 2% film in water simulant, 5.83 for SA + LLE 1% + OLE 1% in ethanol 10% simulant, and 3.82 for SA + LLE 2% in ethanol 95% simulant. For films with LLE, better results were obtained in water simulant, W > E10% > E95% mainly for LLE 2% where significant differences (p <0.001) were observed compared to the other simulants. For films with OLE, better results were obtained in ethanol 10% simulant, E10% > W > E95%, although no differences between averages were observed with the use of water and 10% ethanol at 1 and 2% OLE concentration. For films with LLE + OLE, better results were also obtained for E10% simulant, E10% > W > E95%, with no significant differences between E10% and W.

IV. CONCLUSION

The food simulant of 10% ethanol is mainly used for products made of fruits, vegetables, eggs, meat, and fish. In this case, better results were achieved for SA + LLE 2% and SA + LLE 1% + OLE 1%. The results demonstrate the possibility of using plant extracts to improve antioxidant capacity. In addition, the use of olive leaves allows the valorisation of a by-product.

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