19th Euro Fed Lipid Congress and Expo
17–20 September 2023 Poznań · Poland

The effect of *Laurus nobilis* L. essential oil and different packaging systems on the photo-oxidative stability of Chemlal extra virgin olive oil

Aldjia Taoudiat[1], Giorgia Spigno[2], Djamel Djenane*[3]
[1]Ecole Nationale Superieure Agronomique, Dept. de Téchnologie Alimentaire et Nutrion Humaine, Algeria
[2]Università Cattolica del Sacro Cuore,Istituto di Enologia e Ingegneria Agro-Alimentare, Italia
[3]Université de Mouloud Mammeri, Dept.des Sciences Alimentaires, Algeria
djenane6@yahoo.es

Abstract
This study is undertaken to determine the effect of essential oil (EO) on the photo-oxidation of olive oil stored in different packaging for three months under fluorescent light (900 lux), the antioxidant capacity (DPPH, ORAC) and oxidative stability cried out. Olive oil with EO in brown glass packaging exhibited the highest amount of chlorophyll (2.6 to 0.79 mg/Kg) and carotenoid (1.55 to 0.63 mg/kg) values followed by those stored in brown PET and transparent glass and PET. The lowest total phenolic compound values were recorded in oil without EO from the transparent glass packaging (1036.72 to 84.74 mg GAE/Kg). The oil in brown PET and glass packaging had the highest antioxidant activities values. Olive oil enriched with EO is less photooxidized than olive oil without EO. Moreover, EO improved the stability oxidative of olive oil. This study shows that brown glass and PET can be the best commercial packaging for olive oil.

INTRODUCTION

Virgin olive oil (VVO) is one of the few vegetable oils consumed in its natural state without being subjected to any refining process. Even though VOO contains natural antioxidants (tocopherols and phenolic compounds), its high content in unsaturated fatty acids and the presence of chlorophylls make it high susceptible to oxidation and rancidity development. Fat oxidation is a very complex phenomena which can be promoted by many catalysing factors, including heat, light, oxygen and metals. It is then clear the role of packaging [1] in preventing oxidation and the potential protective effect given by the bio-enrichment of the VOO with natural antioxidants. Essential oils from aromatic plants generally possess high antioxidant capacity [2].

In this research, the potential protective effect of bio-enrichment of Algerian VOO with essential oil (EO) obtained from *Laurus nobilis* L. against light promoted oxidation was investigated, together with the role of different packaging materials: brown or transparent glass (BG, TG) and brown or transparent polyethylene terephthalate (BPET, TPET).

MATERIALS AND METHODS

L. *nobilis* EO was obtained from a biological material (certified by Ecocert SAS F33600, Florame-St Rémy of Provence, France). The EO was extracted by hydro distillation for 3 h using Clevenger- type apparatus.

VOO was obtained during 2014/2015 olive-oil year from Chemlal variety in Algeria. VOO samples (200 mL) were dispensed into 250 mL bottles of different materials (TPET, BPET, TG and BG) without and with EO enrichment (0.01 % v/v). The bottles were hermetically sealed and exposed horizontally to continuous fluorescent light intensity of 900 lux for 90 days at 25 °C, rotating the bottles every 24 h to minimize a possible abuse temperature and light intensity differences at the surface of samples. VOO samples were analyzed after 30, 60 and 90 days and compared to initial chemical profile (control).

VOO was characterized for free acidity, peroxide value (PV), K_{232} and K_{270} using the methods reported by the Regulations EEC/2568/91. Chlorophyll and carotenoids content was determined calorimetrically [3]. Total phenols content (TPC) was determined by the Folin's assay and expressed as equivalents of gallic acid (GAE). The antioxidant capacity was measured by DPPH assay and expressed as % inhibition.

RESULTS AND DISCUSSION

Acidity, expressed as % of oleic acid, was 61.89 ± 0.21 % in the control and slightly increased already after 30 days of illumination for all the samples to remain almost constant until the end of the trials. Final acidity was in the range of 62.96 – 64.18 %, with the highest value of 65.2 % found for VOO with OE in TG.

PV significantly increased in all the samples, in particular after 60 days. From the control value of 2.5 ± 0.21 mEq_{oxygen}/kg it achieved 13.0 for the samples VOO_EO in BPET and in BG and in VOO in BPET, 15.0 for VOO in BG, 17 in VOO in TG and 16.0 in all the other cases.

Conjugated dienes (K_{232} 2.23 ± 0.07 in the control) increased during storage without significant influence of neither bio-enrichment, nor packaging type (final values were in the range of 2.72 – 3.03). On the other hand, conjugated trienes (K_{270} 0.14 ± 0.002 in the control) increased as well without a significant influence of the packaging type, but with a protective effect of EO. Final values ranged from 0.19 to 0.20 for the VOO_EO samples, and from 0.25 to 0.35 for the others.

The control carotenoids content was 1.55 ± 0.02 mg/kg and decreased to 1 or below 1 already after 30 days. After 90 days, the highest contents were measured for brown packages, without a significant influence of EO addition. The chlorophyll content was initially 2.60 ± 0.07 mg/kg and it decreased more rapidly in transparent packaging. Addition of EO allowed for a higher retention only if combined with brown packaging. The initial TPC was 1036.72 ± 0.26 mg/kg and *Fig. 1* shows its decrease during the study, revealing a protective role of both brown packaging and EO addition. The latter was effective in delaying the phenolic degradation. The antioxidant capacity followed almost the same trend of total phenols suggesting a strong correlation of these two parameters.

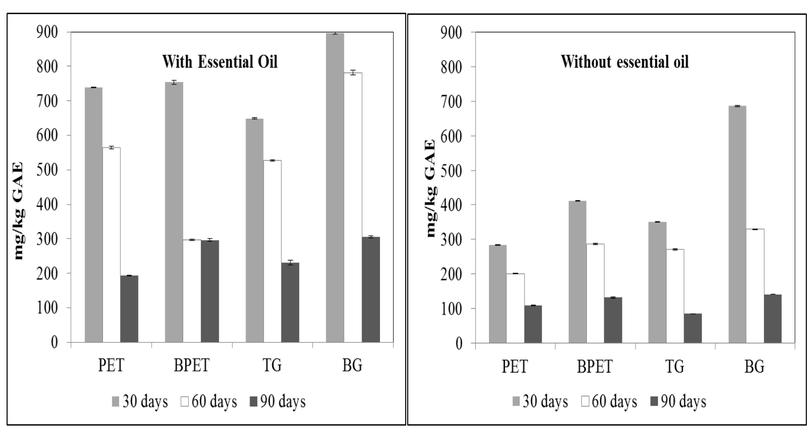

Fig. 1. Evolution of total phenols content (GAE) as a function of storage time under accelerated illumination conditions, for virgin olive oil samples with or without essential oil and stored in different packaging materials (B: brown, T: transparent, G: glass). Error bars indicate ± s.d. of mean values (n = 3).

CONCLUSIONS

Bio-enrichment of VOO with *Laurus nobilis* EO, combined with packaging in brown glass, allowed to maintain the highest amount of chlorophyll and carotenoids after 90 days of accelerated photo-oxidation, followed by enriched VOO in BPET, TG and TPET. The lowest total phenols content was recorded in VOO without EO packed in TG. EO enrichment and brown packaging allowed also for the retention of the highest antioxidant activity, but did not improve the considered oxidation indexes (PV, K_{232} and acidity) with exception of K_{270}.

REFERENCES

[1] Rizzo V., Torri L., Licciardello F., Piergiovanni L., Muratore G., 2014. "Quality Changes of Extra Virgin Olive Oil Packaged in Coloured Polyethylene Terephthalate Bottles Stored under Different Lighting Conditions". *Packaging Technology and Science*, Vol. 27, pp. 437–448.

[2] Sousa A., Casal S., Malheiro R., Lamas H., Bento A., Pereira JA., 2015. "Aromatized olive oils: Influence of flavouring in quality, composition, stability, antioxidants, and antiradical potential". *LW T - Food Science and Technology*, Vol. 60, pp. 22–28.

[3] Minguez-Mosquera MI., Rejano-Navarro L., Gandulrojas B., Sanchez Gomez AH., Garrido-Fernandez, J., 1991. "Color-pigment correlation in virgin olive oil". *Journal of the American Oil Chemists' Society*, Vol. 86, pp. 332-336.

Acknowledgement

We are grateful to the Istituto di Enologia e Ingegneria Agro-Alimentare, Università Cattolica del Sacro Cuore, for providing their facilities to carry out the present experiment. author is grateful to the laboratoire de Technologie Alimentaire de École Nationale Supérieure Agronomique for financial assistance .