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Antioxidant activity of natural resins and bioactive triterpenes in oil substrates

A.N. Assimopoulou, S.N. Zlatanos, V.P. Papageorgiou *

Organic Chemistry Laboratory, Department of Chemical Engineering, Aristotle University of Thessaloniki, 541 24 Thessaloniki, Greece

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Abstract

Natural resins that possess biological properties (*Pistacia lentiscus* var. Chia, *Commiphora myrrh*, *Boswellia serrata* and *Gum storax*) and the bioactive triterpenes (oleanolic acid and ursolic acid) were studied for their antioxidant activities. Lard, corn oil, olive oil and sunflower oil were used as oil substrates for the antioxidant assay.

Pistacia lentiscus resin showed significant antioxidant activity in each of the oil substrates examined; the best concentration of the resin presenting the highest activity depended on the substrate. The combination of *P. lentiscus* resin with citric acid presented a synergistic effect in both sunflower oil and corn oil. Essential oils of *C. myrrh* and *B. serrata* resins and the triterpenes, ursolic and oleanolic acid, presented satisfactory antioxidant activity in sunflower oil. In lard, *P. lentiscus* and *B. serrata* showed good antioxidant activity while, in virgin olive oil, *P. lentiscus* resin and its essential oil presented high antioxidant activity.

It can be concluded that *Pistacia lentiscus* resin and the essential oils of *P. lentiscus*, *C. myrrh* and *B. serrata* can be used in pharmaceutical and cosmetic preparations, and in functional foods, due to their antioxidant effects in oil substrates.

Keywords: *Pistacia lentiscus*; *Commiphora myrrh*; *Boswellia serrata*; Mastic gum; Antioxidant activity; Oven test

1. Introduction

Oils and fats are susceptible to oxidation. Traditionally, chemically synthesized compounds, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), are used as antioxidants in oil products. However, some of these compounds have been questioned for their safety (Bran, 1975; Whysner, Wang, Zang, Iatropoulos, & Williams, 1994). Therefore, the use of natural antioxidants is now becoming important.

In this research, natural resins and bioactive triterpenes are studied for their antioxidant effect on several oils and animal fats. Plants produce a variety of antioxidants against molecular damage from reactive species and thus certain natural products could play a preventive role due to their antioxidant properties. This research is a continuation of our investigations on exploiting bioactive natural products with prospects for use in pharmaceutical and cosmetic preparations as antioxidants.

All natural resins that were selected to be examined for their antioxidant activity have been reported to possess medicinal properties. In the present study, the natural resins *Pistacia lentiscus* var. Chia, *Commiphora myrrh*, *Boswellia serrata* and *Gum storax* were studied for their possible antioxidant activities. *Pistacia lentiscus* resin (known as mastic gum) has been reported to possess anticancer activity (Duke, 1983), antiulcer activity (gastric and duodenal) (Al-Said, Ageel, Parmar, & Tariq, 1986) and also haemostatic, immunostimulant and antimicrobial properties on *Salmonella* and *Staphylococcus* (Block, 1999; Duke, 1983). Also, *P. lentiscus*

* Corresponding author. Tel.: +30 32310 996242; fax: +30 32310 996252.
E-mail address: vaspap@eng.auth.gr (V.P. Papageorgiou).

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resin has been reported to have a fairly good antibacterial activity against *Helicobacter pylori* (Bona, Bono, Daghetta, & Marone, 2001; Huwez, 1999; Huwez, Thirwell, Cockayne, & Ala'Aldeen, 1998) and inhibits in vitro LUL oxidation (Andrikopoulos, Kaliora, Assinopoulos & Papageorgiou, 2004). The essential oil of *Pistacia lentiscus* resin has been reported to cure dyspepsia and peptic ulcer (Duke, 1983), and presents antimicrobial activity (Tassou & Nychas, 1995) and its use is wide-spread in cosmetics.

Commiphora myrrh (commonly known as myrrh) is extensively used as a sedative and in treating disorders of the oral cavity. It is used in cosmetics, in mouthrinses and for treatment of gingivitis (Tipton, Lyle, Babich, & Dabbous, 2003). Several studies report that myrrh acts against amenorrhoea, leucorrhoea and as an antiulcer agent (Duke, 1983). Gum storax (styrax), from the Liquidambar family, is used in the pharmaceutical industry for its antiseptic properties (Pastorova, Weeding, & Boon, 1998) and contains oleanolic acid derivatives. Finally, *Boswellia serrata* resin (commonly known as olibanum resin or frankincense) has been established to possess anticancer properties and help as a syphilis cure (Duke, 1983). It was used for treatment of inflammatory diseases in the traditional Ayurvedic medicine in India (Krohn, Rao, Raman, & Khalilullah, 2001), since its main component is boswellic acid, with established anti-inflammatory activity (Rios, Recio, Manez, & Giner, 2000). It is also used in pharmaceutical mouthwashes, since it helps in preventing dental caries (Duke, 1983). All these resins have been reported to have anti-inflammatory properties that seem to be related to antioxidant activity and they contain pentacyclic triterpenes, a class of bioactive natural products, probably responsible for the anti-inflammatory activity. Dammar resin, isolated from plants belonging to the family Dipterocarpaceae, contains dammarane type triterpenes.

Several bioactive triterpenes have also been examined for their possible antioxidant activities; all of them exert significant biological properties. Ursolic acid (3β-hydroxy-urs-12-en-28-oic acid; Fig. 1) and its isomer, oleanolic acid (3β-hydroxy-olea-12-en-28-oic acid; Fig. 1), which is a constituent of *Pistacia lentiscus* resin, are among the best known bioactive triterpenes. Both ursolic and oleanolic acid are effective in protecting against chemically induced liver injury in laboratory animals; they present anti-inflammatory and antihyperlipidemic properties, antitumor-promotion effects, are non toxic, have been used in cosmetic and health products and have also been proposed for skin cancer prevention (Liu, 1995; Rios et al., 2000). This study is a continuation of our efforts to evaluate natural products, for possible antioxidant activity, and that can be used in pharmaceutical and cosmetic formulations and food supplements.

2. Materials and methods

2.1. Chemicals

Lard was rendered from fresh pig fat, purchased from a local butcher's shop. Sunflower oil (Osolio) and corn oil (Corona) were purchased from a retail market. Virgin olive oil samples were kindly provided by an olive processing plant, located in the area of Chalkida (owner: A. Antoniou, Greece). Caffeic acid (Sigma Chemicals, Steinheim, Germany) was used as a reference antioxidant substance. Citric acid (Sigma) was used as metal chelator for sunflower and corn oils and for its possible synergistic action with natural resins.

Pistacia lentiscus var. Chia resin and essential oil of *P. lentiscus* resin (normal & liquid collection), were kindly donated by Mr. J. Perikos (Mastic Gum Growers' Association, Chios, Greece). Essential oil was distilled from resins collected in two ways: the traditional way, with incisions in the trees of *P. lentiscus* (normal collection) and the new way, with hormones, where resin is in the form of a liquid, and not tears (liquid collection).

Boswellia serrata and *Commiphora myrrh* resins were kindly donated by Dr. N. Argyriades (Vioryl S.A., Athens, Greece), while *Gum storax* and *Dammar* resin were purchased from Sigma and Fluka Chemika (Buchs, Switzerland), respectively. Essential oils of *C. myrrh* and *B. serrata* were purchased from Ath. Germanos Co. (Athens, Greece). The resin of *P. lentiscus* was sub-

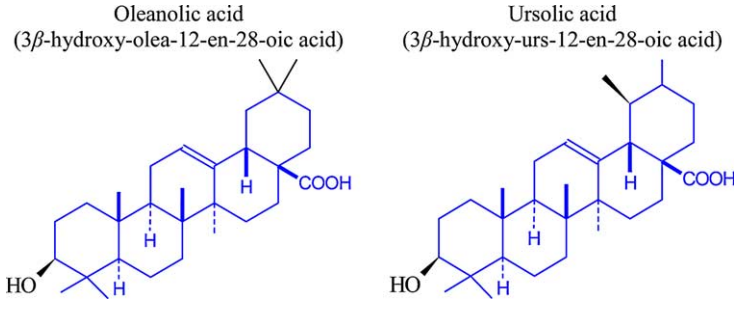

Fig. 1. Chemical structure of the triterpenes tested for their antioxidant activity.