Identification of Molecular Targets of the Oligomeric Nonprenylated Acylphloroglucinols from *Myrtus communis* and Their Implication as Anti-Inflammatory Compounds

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**ABSTRACT**

Myrtucommulone (MC) and semimyrtucommulone (S-MC) are unique oligomeric, nonprenylated acylphloroglucinols contained in the leaves of myrtle (*Myrtus communis*). Although extracts of myrtle have been traditionally used in folk medicine for the treatment of various disorders, studies addressing select cellular or molecular pharmacological properties of these extracts or specific ingredients thereof are rare. Here, we show for the first time that MC and S-MC potently suppress the biosynthesis of eicosanoids by direct inhibiting cyclooxygenase-1 and 5-lipoxygenase in vitro and in vivo at IC$_{50}$ values in the range of 1.8 to 29 µM. Moreover, we show that MC and S-MC prevent the mobilization of Ca$^{2+}$ in polymorphonuclear leukocytes, mediated by G protein signaling pathways at IC$_{50}$ values of 0.55 and 4.5 µM, respectively, and suppress the formation of reactive oxygen species and the release of elastase at comparable concentrations. The isobutyrophenone core of MC as well as S-MC was much less potent or even not active at all. In addition, MC or S-MC only partially inhibited peroxide formation or failed to block Ca$^{2+}$ mobilization and elastase release when polymorphonuclear leukocytes were challenged with ionomycin that circumvents G protein signaling for cell activation. We conclude that, in view of their ability to suppress typical proinflammatory cellular responses, the unique acylphloroglucinols MC and S-MC from myrtle may possess an anti-inflammatory potential, suggesting their therapeutic use for the treatment of diseases related to inflammation and allergy.

Myrtle (*Myrtus communis*, Myrtaceae) is a Mediterranean shrub used as a culinary spice and as a folk medicine, for example, in the treatment of diabetes mellitus and as an antiseptic agent. In fact, myrtle extracts have been traditionally used in folk medicine for the treatment of diseases related to oxidative stress, including inflammatory disorders. Myrtle contains a great variety of compounds like bitter substances, ethereal oil, and tannic substances (el-Sissi and el-Ansary, 1967). In addition to these rather ubiquitous ingredients that are present in many plants, myrtle contains unique oligomeric, nonprenylated acylphloroglucinols such as myrtucommulone (MC) and semimyrtucommulone (S-MC) (Appendino et al., 2002), which are considered to be responsible for the antioxidative (Rosa et al., 2003) and antibacterial (Appendino et al., 2002) activities of myrtle preparations.

Inflammation is a complex pathophysiological event, mediated and regulated by multiple cells that exert a number of select proinflammatory functions, including chemokine and...
cytokine liberation, release of bioactive mediators and pro-
teases, expression of adhesion molecules, and formation of high-
ly reactive molecules [e.g., reactive oxygen species (ROS) or
nitric oxide]. Activation of G protein-coupled receptors
(GPCRs), present on the surface of inflammatory cells, plays
an important role for elicitation of functional cellular re-
sponses (Johnson and Druey, 2002). Upon ligation by a spe-
cific agonist, GPCRs transduce the signal through different
signaling molecules to elevate the intracellular Ca\(^{2+}\) concen-
tration ([Ca\(^{2+}\)]\(_i\)), one key event for the subsequent recruit-
ment of effector enzymes such as 5-lipoxygenase (5-LO) or
cyclooxygenases (COXs) that produce leukotrienes (LTs) or
prostaglandins (PGs) and thromboxanes from arachidonic
acid (AA), respectively (Funk, 2001). Suppression of LT and
PG synthesis by interfering with the 5-LO and COX path-
ways represent an efficient pharmacological approach for the
treatment of inflammatory diseases (Funk, 2001). In addi-
tion, elevation of \([\text{Ca}^{2+}]\), causes release of proteases (e.g.,
leukocyte elastase or cathepsin G) and formation of ROS
(Krause et al., 1990; Parekh and Penner, 1997), both which
destroy invading particles but also damage cells and tissues
of the host.

We and others have previously shown that the prenylated
acylphloroglucinol hyperforin from Hypericum perforatum
exerts anti-inflammatory properties in various cellular test
systems (Albert et al., 2002; Heilmann et al., 2003; Feist and
Werz, 2004). For myrtle and its nonprenylated acylphloro-
gluconols, information concerning anti-inflammatory proper-
ties is substantially still lacking. In the present study, we
examined the anti-inflammatory potential of the acylphloro-
gluconols MC and S-MC that share an isobutyrophenone core
(IBP-C) decorated with two (MC) and one (S-MC) syncarpic
acid moieties. We identified MC and to a lesser extent also
S-MC as direct inhibitors of 5-LO and COX-1, being able to
suppress the biosynthesis of PGs and LTs in vitro and in vivo.
In addition, these nonprenylated acylphloroglucinols inhibit
the release of elastase and the formation of ROS, apparently
by their ability to block receptor-coupled Ca\(^{2+}\) mobilization.

### Materials and Methods

**Materials.** MC and S-MC were isolated from myrtle leaves as
described previously (Appendino et al., 2002). The IBP-C was syn-
thesized from S-MC (G. Appendino, unpublished data). The com-
pounds were dissolved in dimethyl sulfoxide (DMSO) and kept in the
dark at \(-20°C\), and freezing/thawing cycles were kept to a minimum.

Materials used were Nycoprep (PAA Laboratories GmbH, Coelbe,
Germany); ionomycin, AA, MeO-Suc-Ala-Ala-Pro-Val-p-nitroanilide,
cytoschalin B, and fMLP, N-formyl-methylionyl-leucyl-phenylalanine
(fMLP) (Sigma-Aldrich, St. Louis, MO); 13(S)-hydroperoxy-9Z,11E-
octadecadienoic acid (Cayman Chemical, Ann Arbor, MI); FurA-2/AM
(Alexis Corporation, Läufelfingen, Switzerland); and 2',7'-dichlo-
rofluorescein diacetate (DCF-DA) (Invitrogen, Carlsbad, CA).

**Cells.** Human platelets and PMNLs were freshly isolated from
leukocyte concentrates obtained at St. Markus Hospital (Frankfurt,
Germany). In brief, venous blood was taken from healthy adult
donors and leukocyte concentrates were prepared by centrifugation
at 4000g/20 min/20°C. PMNLs were immediately isolated by dextran
sedimentation, centrifugation on Nycoprep cushions (PAA Laborato-
ries), and hypotonic lysis of erythrocytes as described previously
(Werz et al., 2002). PMNLs (7.5 \times 10^6 cells/ml; purity \(> 96-97\%\))
were finally resuspended in PBS containing 1 mg/ml glucose and 1
mM CaCl\(_2\) (PGC buffer) as indicated. Investigation of cell viability by
trypan blue exclusion using freshly isolated PMNLs indicated no
significant toxic effects of MC, S-MC, and IBP-C during preincuba-
tion periods up to 30 min.

For isolation of platelets, platelet-rich plasma, obtained from su-
pernants (800g, 10 min, rt) after centrifugation of leukocyte con-
centrates on Nycoprep cushions, was mixed with PBS, pH 5.9 (3.2,\n\text{v/v}) and centrifuged (2000g, 15 min, rt) and the pelleted platelets
were resuspended in PBS, pH 5.9/0.9% NaCl (1:1, \text{v/v}), washed by
centrifugation (2000g, 10 min, rt), and finally resuspended in PBS,
pH 5.9.

**Determination of 5- and 15-Lipoxygenase Products in
PMNLs.** To assay 5- and 15-LO product formation in intact cells,
7.5 \times 10^6 freshly isolated PMNLs were finally resuspended in 1 ml
of PGC buffer. After preincubation with the test compounds for 10 min
at 37°C, the reaction was started by the addition of 1 \mu M
20 \mu M AA. After 10 min at 37°C, the reaction was stopped with
1 ml of methanol and 30 \mu l of 1 N HCl, and 200 ng of prostaglandin
B\(_1\) and 500 \mu l of PBS were added. Formed AA metabolites
were extracted and analyzed by HPLC as described (Werz et al., 2002).

To determine product formation of purified 5-LO enzyme, 5-LO
protein (0.1 \mu g in 10 ml) was added to 990 \mu l of PBS containing 1 mM
EDTA and 1 mM ATP on ice and the indicated compounds were
added. After 5 to 10 min on ice, the samples were preincubated for
30 s at 37°C and CaCl\(_2\) and AA (2 mM and 10 \mu M, respectively) were
added to start the 5-LO reaction. After 10 min, the incubation was
terminated and 5-LO product formation was determined as de-
scribed for the intact cells.

**Determination of 12-Lipoxygenase and Cyclooxygenase-1
Product Formation in Platelets.** Intact platelets (1 \times 10^8, resus-
pended in 1 ml of PGC buffer) were preincubated for 10 min with the test
compounds at room temperature, and 10 \mu M AA was added.
After 10 min at 37°C, incubations were stopped by the addition of 1
ml of methanol and 30 \mu l of 1 N HCl, and 200 ng of prostaglandin
B\(_1\) (internal standard) and 500 \mu l of PBS were added. After centri-
figation (10 min, 800g), the 12-LO product 12(S)-hydroperoxy-6,10-trans-8,14-cis-eicosatetraenoic acid and
12(S)-hydroperoxy-6,10-trans-8,11,14-cis-eicosatetraenoic acid.
Cysteinyl LTs (LTC\(_4\), D\(_4\), and E\(_4\)) were not detected, and oxidation products
of LTB\(_4\) were not determined.

**Determination of 12-Lipoxygenase and Cyclooxygenase-1
Product Formation in Platelets.** Intact platelets (1 \times 10^8, resus-
pended in 1 ml of PGC buffer) were preincubated for 10 min with the test
compounds at room temperature, and 10 \mu M AA was added.
After 10 min at 37°C, incubations were stopped by the addition of 1
ml of methanol and 30 \mu l of 1 N HCl, and 200 ng of prostaglandin
B\(_1\) (internal standard) and 500 \mu l of PBS were added. After centri-
figation (10 min, 800g), the 12-LO product 12(S)-hydroperoxy-6,8-cis-
10-trans-14-cis-eicosatetraenoic acid and the COX-1-derived AA
metabolite 12(S)-hydroxy-5,8,10-trans-heptadecatrienoic acid
(12-HHT) were extracted using C-18 solid phase extraction columns
and analyzed by HPLC as described (Albert et al., 2002).

For determination of COX-1 activity in cell homogenates, platelets
(1 \times 10^8) were resuspended in 1 ml of PBS (containing 1 mM
EDTA) and cooled on ice for 5 min. After sonication (3 5 s), the test
compounds were added (5–10 min at 4°C), the samples were pre-
cubated for 30 s at 37°C, and the incubation was started by the addition
of \([\text{Ca}^{2+}]\) and AA (2 mM and 10 \mu M final concentrations,
respectively). After 10 min at 37°C, the incubation was stopped with
1 ml of methanol and the formed 12(S)-hydroperoxy-5,8-cis-
10-trans-14-cis-eicosatetraenoic acid and 12-HHT were extracted
and analyzed as described for intact cells.

**Expression and Purification of 5-LO from Escherichia coli.**
Expression of 5-LO, performed in E. coli JM 109 cells transfected
with pTr3–5-LO, and purification of 5-LO by ATP affinity chromatog-
raphy (Sigma A2767) was performed as described previously (Fi-
scher et al., 2003). Partially purified 5-LO was immediately used for
in vitro activity assays.

**Determination of Cyclooxygenase-2 Product (6-Keto
PG\(_{1a}\)) Formation in Mono Mac 6 Cells.** Mono Mac 6 (MM6) cells
were grown with or without transforming growth factor \(\beta\) and cal-
citrol for 96 h as described previously (Brungs et al., 1995). Six
hours before harvest, LPS (100 ng/ml) was added. Cells were har-
vested, washed twice, resuspended in PGC buffer (5 \times 10^6 cells/ml),

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and incubated with AA (30 μM) for 15 min at 37°C. After centrifugation (300g, 5 min, 4°C), the amount of 6-keto PGF₁α, released was assessed by ELISA using a monoclonal antibody against 6-keto PGF₁α, as described elsewhere (Albert et al., 2002).

**Determination of Cellular Peroxide Formation.** Measurement of peroxides in PMNLs was conducted using the peroxide-sensitive fluorescence dye DCF-DA, which reacts with hydrogen peroxide but also with nitric oxide (Rao et al., 1992). Freshly isolated PMNLs (1 × 10⁶ in 1 ml of PGC buffer) were preincubated with test compounds or vehicle (DMSO, control) for 10 min at rt in the dark and then treated with DCF-DA (1 μg/ml) for 1 min at 37°C before the addition of the stimuli. The fluorescence emission at 530 nm was measured after excitation at 480 nm in a thermally controlled (37°C) fluorometer cuvette with continuous stirring in a spectrofluorometer (Amino-Bowman series 2; AMINCO-Bowman SPF, Silver Spring, MD). The mean fluorescence data measured 5 min after stimulus addition are expressed as arbitrary fluorescence units.

**Determination of Leukocyte Elastase Release.** PMNLs (5 × 10⁶), resuspended in 1 ml of PGC buffer, were preincubated with the test compounds or vehicle (DMSO, control) for 10 min at rt in the dark. For stimulation with 1 μM fMLP, cells were preincubated with cytochalasin B (10 μM) for 5 min at 37°C and ionomycin was used as stimulus without pretreatment with cytochalasin B. The reaction was terminated after 10 min at 37°C by placing the samples on ice for 2 min. After centrifugation (1000g, 5 min, 4°C), the supernatants were incubated with MeO-Suc-Ala-Ala-Pre-Val-p-nitroanilide (200 μM) for 5 min at 37°C. The extent of p-nitrophenol released was measured at 405 nm.

**Measurement of Intracellular Ca²⁺ Levels.** PMNLs (1 × 10⁶/ml PGC buffer) were incubated with 2 μM Fura-2/AM for 30 min at 37°C, washed, resuspended in 1 ml of PGC buffer, and preincubated with the test compounds or vehicle (DMSO, control) for 10 min at rt in the dark. Cells were then transferred into a thermally controlled (37°C) fluorometer cuvette in a spectrofluorometer (Amino-Bowman series 2) with continuous stirring, and stimulants were added. The fluorescence emission at 510 nm was measured after excitation at 340 and 380 nm, respectively. Intracellular Ca²⁺ levels were calculated according to the method of Gryniewicz et al. (1985). F₀ (maximal fluorescence) was obtained by lysing the cells with 1% Triton X-100 and F₀ by chelating Ca²⁺ with 10 mM EDTA.

**Statistics.** The statistic program GraphPad PRISM 3.0 (GraphPad Software Inc., San Diego, CA) was used for statistical comparisons. Statistical evaluation of the data was performed using Student’s t test for unpaired observations. P < 0.05 was considered significant.

**Results**

**Effects of Myrtucommulone, Semimyrtucommulone, and the Isobutyrophenone Core on COX Activity.** Freshly isolated human platelets preincubated with MC, S-MC, IBP-C, or vehicle (DMSO) for 10 min were stimulated with 10 μM AA, and the formation of the COX-1-derived product 12-HHT was analyzed. MC suppressed 12-HHT formation with an IC₅₀ of 17 μM (Fig. 2A), whereas S-MC was somewhat less potent (IC₅₀ = 29 μM). Of interest, the IBP-C blocked COX-1 most efficiently (IC₅₀ = 5 μM). To determine whether the compounds exert their inhibitory effects by direct interference with the COX-1 enzyme, inhibition of 12-HHT formation was assessed in platelet homogenates. As can be seen from Fig. 2B, MC, S-MC, and IBP-C suppressed COX-1 activity in the cell-free assay with comparable potencies (IC₅₀ values are 6, 30, and 6.5 μM, respectively) as found for intact cell assays, implying that the compounds directly interfere with COX-1 activity. No inhibition of 12-LO product synthesis was observed (data not shown). To determine the effects of MC on the activity of COX-2, LPS-stimulated MM6 cells were used as selective source for COX-2 (Albert et al., 2002). In contrast to COX-1 from platelets, MC (up to 30 μM) failed to significantly block the activity of the inducible COX-2 in MM6 cells (data not shown).

**Effects of Myrtucommulone, Semimyrtucommulone, and the Isobutyrophenone Core on 5-LO Activity.** Inhibition of 5-LO activity was determined in freshly isolated human PMNLs or for isolated human recombinant 5-LO enzyme by assessment of the formation of the 5-LO-derived products LTB₄, its all-trans-isomers, and 5(S)-hydroxy(pero)xy-6-trans-8,11,14-cis-eicosatetraenoic acid. For investigation of the catalytic activity of the 5-LO product formation, MC, S-MC, IBP-C, or vehicle (DMSO) was added to PMNLs; after 10 min, cells were stimulated with 1 μM ionomycin plus 20 μM AA. As shown in Fig. 3A, 5-LO product synthesis was dose-dependently reduced by all compounds. MC was most efficient (IC₅₀ = 1.8 μM), whereas S-MC and the IBP-C showed equal potency (IC₅₀ ~ 10 μM). In contrast, the activity of the closely related (eosinophilic) 15-LO was not significantly affected by the compounds up to 30 μM (data not shown).

To confirm a direct inhibition of 5-LO enzyme, human recombinant 5-LO was expressed in E. coli and partially purified and the effects of MC, S-MC, and IBP-C were determined. At a substrate concentration of 10 μM AA, MC and S-MC suppressed 5-LO product formation with an IC₅₀ of approximately 5 and 8 μM, respectively (Fig. 3B). The IBP-C was less potent, and the IC₅₀ value was determined at approximately 26 μM. Moreover, the potency of MC was assessed at various AA concentrations (3, 10, and 30 μM). The effectiveness of MC to suppress 5-LO activity was not impaired by elevating the substrate concentration. Instead, the potency slightly increased at higher amounts of AA (Fig. 3C). This suggests that AA does not compete with MC for binding at a common binding cleft of 5-LO but rather points to an uncompetitive mode of action.
and the IC$_{50}$ was >30 µM. In control experiments, ionomycin that circumvents G protein signaling was used to induce elevation of [Ca$^{2+}$]$_i$. Of interest, neither MC nor S-MC (up to 30 µM) could prevent the ionomycin-induced increases in [Ca$^{2+}$]$_i$, suggesting that the compounds attenuate Ca$^{2+}$ mobilization presumably by abrogating G protein signaling or by inhibiting Ca$^{2+}$ fluxes through interference with certain Ca$^{2+}$ channels.

**Effects of Myrtucommulone and Semimyrtucommulone on the Release of Leukocyte Elastase.** Upon agonist challenge, PMNLs are capable of releasing proteases (i.e., leukocyte elastase) from intracellular granules mediated by elevated levels of [Ca$^{2+}$]$_i$ (Khalfi et al., 1996). The release of elastase from freshly isolated PMNLs was assessed by determination of elastase-specific peptide cleavage in supernatants of stimulated cells. After preincubation (10 min) with MC, S-MC, IBP-C, or vehicle (DMSO), cells were challenged with 1 µM fMLP plus 10 µM cytochalasin B or with 1 µM ionomycin for 5 min, and elastase activity was analyzed. MC and S-MC, but not the IBP-C, concentration-dependently suppressed degranulation induced by fMLP with IC$_{50}$ values of 0.9 and 3.8 µM, respectively (Fig. 5). In contrast, when PMNLs were challenged with ionomycin, MC and S-MC (up to 10 µM each) did not impair elastase release (Fig. 5).

**Effects of Myrtucommulone and Semimyrtucommulone on the Formation of Reactive Oxygen Species.** Freshly isolated human PMNLs were used to determine the effects of the test compounds on agonist-induced ROS formation. After preincubation with MC, S-MC, IBP-C, or vehicle (DMSO) for 10 min, the amounts of peroxides released upon stimulation were determined by measuring the fluorescence of the peroxide-sensitive dye DCF-DA after oxidation. Peroxide formation evoked by stimulation with fMLP (1 µM) and S-MC (IC$_{50}$ = 0.24 µM) and S-MC (IC$_{50}$ = 1.9 µM) (Fig. 6). In contrast, the IBP-C up to 30 µM was hardly active. Of interest, peroxide production evoked by ionomycin that circumvents GPCR signaling was inhibited by MC with an IC$_{50}$ value of 0.8 µM. However, also at higher concentrations (90 µM) of MC, some peroxide formation still remained (approximately 25% of control) and S-MC failed to completely block the ionomycin-induced response (Fig. 6).

**Discussion**

Our results suggest an anti-inflammatory potential for myrtle. This suggestion is based on the observation that its acylphloroglucinol constituents MC and S-MC (0.12 and 0.14% dry weight, respectively) suppress various functional cellular leukocyte responses, including the biosynthesis of PGs and LTs, the release of leukocyte elastase, and the formation of peroxides that are of relevance for initiation and maintenance of inflammatory processes. With respect to the molecular mode of action, we show that MC and S-MC potentially inhibit the agonist-induced elevation of [Ca$^{2+}$]$_i$, a determinant in mediating cellular functional responses upon extracellular stimulation. To our knowledge, this is also the first study that identifies molecular targets (5-LO and COX-1/2) for MC and S-MC.

5-LO and COX-1/2 are the key enzymes in the formation of proinflammatory LTs and PGs, respectively, which play pivotal roles in inflammation and allergy (Funk, 2001). Such
pathophysiological implications can be visualized by 5-LO or COX gene knock-out studies as well as by experimental and clinical application of 5-LO and/or COX inhibitors and receptor antagonists against the eicosanoids (Funk, 2001). Numerous potent and selective COX inhibitors are on the market and have been frequently used for intervention with pain, fever, and inflammatory disorders for many years (DeWitt, 1999; Celotti and Laufer, 2001). In contrast, no 5-LO inhibitor is presently available for clinical therapy, despite the strong need for such drugs with potent activity in intact cells and in a cell-free assay with similar potencies each. Hence, COX-1 inhibition is not a unique effect of the oligomeric nonprenylated acylphloroglucinols MC and S-MC but rather seems to be related to the acylphloroglucinol moiety present in all three structures. Nevertheless, COX-1 was markedly and concentration-dependently suppressed by the compounds investigated with comparable potencies to aspirin (Schorr, 1997) and therefore implies therapeutic potential for the treatment of COX-1-related disorders. Of interest, the inducible isoenzyme COX-2 from LPS-treated MM6 cells was not significantly inhibited by MC, which agrees with the fact that the acylphloroglucinol hyperforin from H. perforatum blocks COX-1 from platelets but not COX-2 from monocytes (Albert et al., 2002).

In addition, MC and S-MC also act as potent 5-LO inhibi-
tors, effective in intact cells as well as on the partially purified 5-LO with similar potencies. In contrast to COX-inhibition, the IBP-C was less potent for 5-LO and MC showed 6-fold superior effectiveness over S-MC in intact cells. Among 5-LO inhibitors that can be categorized into redox-active, iron-chelating, and nonredox-type inhibitors, most compounds act by reducing the iron in the active site, keeping it in the inactive ferrous state (Werz, 2002). In fact, different extracts from myrtle as well as MC and S-MC were shown to possess antioxidant activity in different experimental conditions (Rosa et al., 2003; Romani et al., 2004). In contrast to 5-LO inhibition, S-MC was much more powerful than MC in protecting oxidation of linoleic acid in vitro and lipid peroxidation in homogenates (Rosa et al., 2003), indicating that the efficacy of S-MC to scavenge hydroxyl and peroxyl radicals is superior over that of MC. Moreover, the antioxidant effects of MC were observed at much higher concentrations (IC_{50} values between 13.6 and 162 μM; Rosa et al., 2003) compared with those required to suppress 5-LO activity (IC_{50} = 1.8 to approximately 10 μM), indicating that mechanisms other than simply reducing or unspecific scavenging properties cause 5-LO inhibition. It should be noted that the closely related 12- and 15-LOs were not inhibited by MC or S-MC, again excluding unspecific uncoupling of LO redox cycles because of reducing properties of the compounds. On the other hand, variations of the AA concentration did not alter
respectively.

S-MC (1.9–4.5) was approximately 8-fold more potent compared with S-MC. Many effector enzymes such as phospholipases and protein kinases respond to and are regulated by an elevation of \([Ca^{2+}]\)i. Note that despite the different stimulation conditions (i.e., different fMLP concentration, inclusion of cytochalasin B) used to evoke ROS formation, elastase release, and \([Ca^{2+}]\)i mobilization, the IC50 values of MC (0.24–0.9 \(\mu\)M) or S-MC (1.9–4.5 \(\mu\)M) for all these responses are quite similar. We conclude that suppression of \([Ca^{2+}]\)i typically inhibit also the ionomycin effect in this respect, indicating that the compounds (in particular MC) may also directly interfere with peroxide-producing enzymes and/or pathways supported by the antioxidant properties observed by others (Rosa et al., 2003; Romani et al., 2004).

In summary, we have shown that the unique oligomeric, nonprenylated acylphloroglucinols MC and, to a lesser extent, S-MC compromise important cellular responses of inflammatory cells, suggesting a therapeutic potential for myrtle preparations in the treatment of inflammatory and allergic diseases. Further studies using methods to assess an anti-inflammatory action of myrtle and MC or S-MC in animals must remain to be conducted to allow the judgment of the potential for the treatment of inflammation in humans.

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References


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