

## **Note on Pharmacological Activities of *Calendula officinalis* L.**

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**Issued 04 January 2009**

*Calendula officinalis*, known as Pot Marigold or English Marigold, is a plant in the *Calendula* genus. *Calendula officinalis* is used for the treatment of skin disorders and pain, and as a bactericide, antiseptic and anti-inflammatory. The petals and pollen contain triterpenoid esters (an anti-inflammatory) and the carotenoids flavoxanthin and auroxanthin (antioxidants, and the source of the yellow-orange coloration). The leaves and stems contain other carotenoids, mostly lutein (80%) and zeaxanthin (5%), and beta-carotene. Plant extracts are also widely used by cosmetics, presumably due to presence of compounds such as saponins, resins and essential oils.

### **Phagocytosis**

Three polysaccharides isolated from an aqueous extract of Flos *Calendulae* enhanced phagocytosis in human granulocytes in vitro in the colloidal carbon clearance test<sup>1</sup>. Intraperitoneal injection of a

polysaccharide fraction isolated from an aqueous extract of the flowers to mice (10 mg/kg body weight) enhanced phagocytosis<sup>4</sup>. Intraperitoneal administration of an unsaponifiable fraction (0.5 ml) of a hydroalcoholic extract of the flowers weakly stimulated phagocytosis in mice inoculated with *Escherichia coli*. However, the hydroalcoholic extract was not active<sup>5</sup>.

### **Antimicrobial activity**

The essential oil of the flowers inhibited the growth in vitro of *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Candida albican*<sup>6</sup>. A flavonoid fraction isolated from the flowers inhibited the growth in vitro of *S. aureus*, *Sarcina lutea*, *E. coli*, *Klebsiella pneumoniae* and *Candida monosa*<sup>7</sup>. However, chloroform, ethanol, methanol or water extracts of the flowers did not inhibit bacterial growth in vitro<sup>8-10</sup>. Acetone, ethanol or water extracts inhibited the growth in vitro of the fungus *Neurospora crassa*<sup>11</sup>. Extracts of the flowers inhibited the growth in vitro of *Trichomonas vaginalis*<sup>12</sup>. Oxygenated terpenes appear to be responsible for the antimicrobial activity<sup>13</sup>.

### **Antiviral activity**

A tincture of the flowers suppressed the replication of herpes simplex, influenza A2 and influenza APR-8 viruses in vitro<sup>14</sup>. However, an aqueous extract of the flowers was not active<sup>14</sup>. A chloroform extract of the flowers inhibited the replication of HIV-1 in acutely infected lymphocytic MOLT-4 cells in vitro (IC<sub>50</sub> 0.4 mg/ml)<sup>15</sup>. A chloroform extract also inhibited HIV-1 reverse transcriptase activity in a dose-dependent manner (ED<sub>50</sub> 51.0 mg/ml). A 5% hot aqueous extract of the flowers (2 ml) inhibited the replication of encephalitis virus after intraperitoneal administration to mice<sup>16</sup>.

### **Anti-inflammaory activity**

Topical application of a 70% ethanol extract of the flowers to mice at a dose of 1.2 mg/ear

(corresponding to 4.16 mg crude drug) reduced croton oil-induced ear oedema by 20%<sup>17</sup>. External application of a carbon dioxide extract of the flowers (300 mg/cm<sup>2</sup>) suppressed croton oil-induced ear oedema in mice<sup>18</sup>. The triterpene fraction of an extract of the flowers had marked anti-inflammatory activity in mice (1 mg/ear) against ear oedema induced by 12-*O*-tetradecanoylphorbol-13-acetate<sup>19</sup>. Faradiol esters isolated from the flowers (240 mg/cm<sup>2</sup>) inhibited croton oil-induced ear oedema in mice<sup>20</sup>. Intra-gastric administration of an aqueous extract of the flowers (100 mg/kg body weight) inhibited carrageenan-induced footpad oedema in rats<sup>21</sup>. However, an 80% ethanol extract of the flowers was weakly active (11% inhibition) at a concentration of 100 mg/kg body weight administered orally 1 hour prior to induction of oedema<sup>22</sup>. Isorhamnetin glycosides isolated from the flowers inhibited rat lung lipoxygenase *in vitro*<sup>23</sup>.

### **Wound-healing activity**

External application of a hydroalcoholic extract accelerated the rate of contraction and epithelialization of excision wounds in rats<sup>24</sup>. A 3% freeze-dried aqueous extract of the flowers induced vascularization in the chick chorioallantoic membrane assay. Histological sections of the treated chorioallantoic membranes also indicated the presence of hyaluronan, a tissue glycosaminoglycan associated with neovascularization<sup>25</sup>.

### **Clinical pharmacology**

Although no randomized, controlled clinical trials have been performed, two case reports in the early medical literature support the traditional use of *Flos Calendulae*. The reports describe the use of a strong tincture of the flowers applied on compresses to reduce inflammation and suppuration, and to accelerate the healing of wounds<sup>26, 27</sup>.

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