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SHORT COMMUNICATION



## Composition and leishmanicidal activity of the essential oil of *Vernonia polyanthes* Less (Asteraceae)

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### ABSTRACT

The composition of the essential oil (EO) from leaves of *Vernonia polyanthes* and the evaluation of its leishmanicidal potential are reported here for the first time. The oil obtained by hydrodistillation was analysed by combination of GC and GC/MS. Thirty-five compounds were identified, representing 91.8% of the oil composition. The oil consists primarily of monoterpenes (37.1%), sesquiterpenes (26.3%) and oxygenated sesquiterpenes (23.9%), myrcene (34.3%), zerumbone (15.8%), bicyclogermacrene (8.9%),  $\alpha$ -humulene (4.8%) and germacrene D (4.3%) being the major constituents. Activity against *Leishmania infantum* was determined using the tetrazolium dye (MTT) colorimetric method. The oil, as well as zerumbone, one of its major constituents, showed significant leishmanicidal activity, with  $IC_{50}$  values of 19.4 and 9.0  $\mu\text{g/ml}$ , respectively. Cytotoxicity in macrophages cells was evaluated using the MTT colorimetric assay. The EO showed the  $CC_{50} < 10 \mu\text{g/ml}$  to macrophages cells.


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## 1. Introduction

*Leishmania infantum* is the causative agent of disseminated visceral leishmaniasis (VL), the most severe form of the disease. It is fatal if left untreated, characterised by irregular bouts of fever, weight loss, enlargement of the spleen, liver and anaemia (WHO 2015). It estimated 300,000 new cases, over 20,000 deaths, annually, and point to 310 million of people at risk of infection (WHO 2015). The current treatment leading to serious adverse effects and poor tolerance and increasing resistance of the parasites contributes for the ineffectiveness of the therapeutic regimens (Croft et al. 2006). For these reasons, the development of novel antileishmanial agents and new therapeutic strategies justifies major consideration. Plants may be alternative sources to look for new agents against leishmaniasis. Recently, several authors have evaluated the leishmanicidal activity of natural products. Lima et al. (2016) evaluated the leishmanicidal activity of *Calea uniflora* Less. Shyaula et al. (2016) showed the antileishmanial activity of the *Aconitum spicatum* (Bruhl) Stapf And Sosa et al. (2016) demonstrated that sesquiterpene lactones were active against against *Leishmania amazonensis* and *Leishmania braziliensis*. *Vernonia polyanthes* Less (Asteraceae) popularly known as 'assa-peixe' is a common plant of the Brazilian 'Cerrado'. In folk medicine, the herbal tea is used as anti-inflammatory, anthelmintic, febrifuge and for treatment of the pneumonia (Lorenzi & Matos 2008). Among other biological activities of *V. polyanthes*, the antileishmanial effects on *L. amazonensis* (Braga et al. 2007) stand out.

The lack of scientific knowledge on *V. polyanthes* encouraged us to investigate the composition of the essential oil and to evaluate its worth as a potential source of leishmanicidal agents against *L. infantum*.

## 2. Results and discussion

Thirty-five constituents were identified, representing 91.8% of the total composition. The oil consists predominantly of monoterpene hydrocarbons (37.1%), sesquiterpene hydrocarbons (26.3%) and oxygen containing sesquiterpenes (23.9%). Myrcene (34.3%), bicyclogermacrene (8.9%),  $\alpha$ -humulene (4.8%), germacrene D (4.3%) and zerumbone (15.8%) were found to be the major constituents. The composition of the EO of several species of *Vernonia* is characterised by high amounts of sesquiterpene hydrocarbons, as (*E*)-caryophyllene, bicyclogermacrene and  $\alpha$ -humulene, showed in *V. brasiliiana*, *V. remotiflora*, *V. chalybaea* and *V. scorpioides* (Maia et al. 2010). Our results are in agreement with these results since the oil of *V. polyanthes* has high levels of sesquiterpenes. However, the oil of this species is distinguished by the high content of zerumbone; sesquiterpenic ketone derived from the humulane nucleus was first recognised in the EO of *Zingiber zerumbet* (Balakrishnan et al. 1956). The biological evaluations showed strong antitumor activity (Zhang et al. 2012), antimalarial and activity against *L. donovani* (Singh et al. 2014). Our results on the evaluation of the leishmanicidal activity of the EO of *V. polyanthes* and zerumbone are shown in Table 1.

**Table 1.** Inhibitory concentrations at 50% ( $IC_{50}$ ) of *Vernonia polyanthes* essential oil and zerumbone on *Leishmania infantum* promastigotes.

	E.O. of <i>Vernonia</i>	Zerumbone	Miltefosine
$IC_{50}$ ( $\mu\text{g}\cdot\text{ml}^{-1}$ )	19.4 (16.3–23.0) <sup>a</sup>	9.0 (7.3–10.9) <sup>a</sup>	19.0 (16.3–26.6)

<sup>a</sup>Confidence interval at 95%.

Myrcene, the major compound of the oil, was previously reported as not active against *L. infantum* ( $IC_{50} = 164.0 \mu\text{g/ml}$ ) (Machado et al. 2012). The EO of *V. polyanthes* exhibited a significant activity against *L. infantum* promastigote forms, with  $IC_{50}$  value of  $19.4 \mu\text{g/ml}$ .  $IC_{50}$  value of zerumbone was estimated to be  $9.0 \mu\text{g/ml}$  (ca.  $41.2 \mu\text{M}$ ), being plausible to assign the most of the activity of the oil to this compound. This finding is consistent with the results recorded by Singh et al. (2014) that estimated the activity of zerumbone on *L. donovani* ( $IC_{50} < 1.6$  and  $IC_{90} = 4.69 \mu\text{g/ml}$ , approx.  $7.3 \mu\text{M}$  and  $21.5 \mu\text{M}$ ). Several compounds of this class, such as nerolidol,  $\alpha$ -bisabolol and polygodial, are associated to antileishmanial effects (Arruda et al. 2005; Morales-Yuste et al. 2010). So, the influence of others sesquiterpenic components present in the EO action of *V. polyanthes* against *L. infantum* cannot be excluded. The activity of the EO might depend of the minor oil components and/or on synergistic effects. Experiments revealed that the essential oil showed the  $CC_{50} < 10 \mu\text{g/ml}$  to macrophages cells.

### 3. Conclusions

As our knowledge, this is the first report on the composition of the EO of *V. polyanthes* (leaves) and on its leishmanicidal potential as well as of zerumbone, one of its major components. Results encourage further research to elucidate the kinetics and the mechanisms behind the effects of zerumbone on *L. infantum* amastigote forms.

### Conflicts of interest

The authors declare that they have no conflict of interest.

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