



Influence of ecological factors on the phytochemical composition and bioactivity of *Berberis tinctoria* Lesch. wild edible fruits

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ABSTRACT

Berberis tinctoria Lesch. is an endemic wild plant with significant medicinal value in traditional ethnomedicine. Although its chemical composition has not yet been studied, tribal communities in Nilgiri-Hills (NH) and Palani-Hills (PH) use it as food and to cure various ailments. The present study aims to analyze the influence of ecological factors on the accumulation of active compounds and antioxidants in *B. tinctoria* fruits. The anti-proliferative effect was also evaluated. Thus, two distinct geographic locations within the *B. tinctoria* cultivation area were selected. The contents of soil pH, organic carbon, nitrogen, phosphorus, potassium and primary and secondary active metabolites in the fruits were measured. Bioactive compounds were tentatively identified by liquid chromatography-mass spectrometry (LC-MS) analysis. Qualitative and quantitative phytochemical screening revealed that major primary and secondary metabolites were more abundant in fruits from the NH region, especially in terms of total phenols and alkaloids. The data acquired highlight that soil physicochemical properties have a highly positive correlation with secondary metabolites content and bioactivity. In particular, NH ethyl acetate (NH-EAF) extracts showed higher antioxidant and anti-inflammatory activity, as well as anti-bacterial activity against *Staphylococcus aureus* and *Enterococcus faecium*. Furthermore, NH-EAF extract showed cytotoxic effects with IC₅₀ equal to 102.85 µg/mL and 123.39 µg/mL towards Raw 264.7 and Caco-2 cell lines, respectively. The results of this study confirmed that the fruit variability of phytochemicals and biological activities is due to geographical variation and ecological factors.

1. Introduction

Bioactive compounds found in wild edible fruits particularly those rich in antioxidants, have caught the attention of scientists in recent years due to their potential benefits for human health. Epidemiological reports have shown that plant-derived bioactive compounds may prevent the onset and progression of various types of cancer and cardiovascular diseases (Samtiya et al., 2021; Cai et al., 2022). Up to 50% of the drugs used in cancer and other treatments are derived from natural products such as morphine, vincristine, atropine and artemisinin sourced solely from plant resources (Veeresham, 2012; Newman and Cragg, 2020). As a result, herbal medicinal products that contain a defined concentration of plant-derived bioactive compounds are an attractive strategy for controlling diseases, as they can be readily used as

dietary supplements with minimal toxic effects (Salehi et al., 2020). However, variations in bioactive metabolites within the same plant species from different geographical regions can pose challenges in selecting plants for therapeutic potential and developing herbal medicine (Ahmed et al., 2020). To address this, preliminary phytochemical screening of plants from different geographical locations is necessary to determine the concentration of key metabolites in specific plant parts, which can help to identify the quantitative variations of a particular bioactive compound during plant development under different environmental stress (Vilkickyte and Raudone, 2021). As a consequence, plants collected in different seasons exhibit distinct spatial-temporal variations, affecting their pharmacological activity (Vignesh et al., 2022a). Similarly, biotic stress can also induce variation in the secondary metabolites produced by plants inevitably imposing the development of herbal products (Sharma et al., 2022) (see Tables 8 and 9).

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