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Experimental Determination of the Influence of Color Type and Environmental Factors on the Concentration of Secondary Metabolites in the High Andean Plant Maca

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Abstract

Maca (*Lepidium meyenii* Walpers, also known as *Lepidium peruvianum* Chacón) grows best in the central Peruvian and Bolivian Andes between 3,800 and 4,500 m a.s.l. The persistent interest in this plant is based on its assumed fertility effects. These effects are reported to vary between maca colour types, and our preliminary study indicated that these types also might differ in potentially biologically active plant secondary metabolites. These include macaene, macamides, glucosinolates, campesterol and beta-sitosterol. The present study aimed at determining the influence of the factors colour type, soil type and planting history on the concentrations of the above mentioned compounds of maca hypocotyls in a controlled study. In the planting experiment, four colour types (yellow, red, violet and lead-coloured) were cultivated at two soils/locations (Ultisol/Alpacayán, Department of Pasco, Perú, and Vertisol/Patalá, Department of Junin, Peru) at 4,200 m.a.s.l. At each location two terrains were chosen (untouched or cultivated with maca in the 2–3 previous years). The harvested plant material (n=4 per colour type, location and terrain) was lyophilized, milled and analysed for the above mentioned metabolites, and data was subjected to analysis of variance considering all factors. The interactions were not significant. Color type had a significant influence on the concentration of macaene, macamides and the aromatic, indole and alkylthioalkyl glucosinolates, but not for the sterols and olefine glucosinolates. Across both locations and both terrains, lead maca (not analysed in the preliminary study) had the highest concentrations of glucosinolates, primarily due to higher contents of aromatic and indole glucosinolates. Violet maca exhibited the highest alkylthiolalkyl glucosinolate content, red maca showed the highest macaene and macamides content, while yellow maca was low in most metabolites, especially macaene and macamides. The glucosinolate content was higher in Patalá, and the macaene, macamides and beta-sitosterol content was higher in Alpacayán. The terrain had a significant effect on campesterol concentration only. The present results confirm the large importance of the colour and soil type and, to a lesser degree, of previous cultivation of the site on maca's metabolite composition thus explaining its variable effects on fertility reported.

Keywords: Beta-sitosterol, campesterol, glucosinolate, *Lepidium meyenii*, macamide, plant secondary compounds