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SHORT COMMUNICATION



Bioactive compounds and antioxidant capacity of *Chuquiraga jussieui* J.F.Gmel from the highlands of Ecuador

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ABSTRACT

Chuquiraga jussieui J.F.Gmel is grown between 3000 and 5000 meters above sea level throughout the Andean region of Ecuador and used by the indigenous populations of the Andes for medicinal purposes. Here, we determined the total phenolic, flavonoids, vitamin C and carotenoids content of the leaves and flowers of *Ch. jussieui* J.F.Gmel from different highlands of Ecuador as well as the capacity of a crude methanolic extract from the both parts of the plant to scavenge free radicals and protect red blood cell membranes from lipid oxidation. The leaves showed a high bioactive compound content in comparison to the flowers. The crude extract from the leaves proved to be more effective than the flowers in reducing iron and scavenging the DPPH, O₂⁻ and H₂O₂ radicals, as well as in protecting cellular membrane against lipid oxidation, demonstrating that *Ch. jussieui* J.F.Gmel represents an important source of bioactive compounds with relevant healthy properties.

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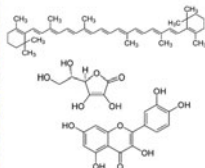
KEYWORDS

Chuquiraga jussieui J.F.Gmel; highlands of Ecuador; bioactive compounds; antioxidant capacity




Chuquiraga jussieui


Chemical composition of leaves and flowers



Antioxidant capacity of leaves and flowers methanolic extract

- ✓ Leaves proved to be more effective than the flowers in reducing iron and scavenging the DPPH, O₂⁻ and H₂O₂ radicals.
- ✓ Leaves proved to be more effective as in protecting cellular membrane against lipid oxidation.

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1. Introduction

Chuquiraga jussieui J.F.Gmel belongs to the *Asteraceae* family and *Barnadesioideae* subfamily. The genus *Chuquiraga* consists of 20 species distributed throughout the Andes from southwestern Colombia to central Chile and almost all of Patagonia, where the largest number of species is found. In Ecuador, only two species are present: *Chuquiraga arcuata* Harling and *Chuquiraga jussieui* J. Gmelin (Eddie 2000). *Ch. jussieui* J.F.Gmel can be found at altitudes ranging between 3000 and 5000 meters above sea level, that is, throughout the Andean region of Ecuador. The two species are found in the provinces of Azuay, Bolívar, Cañar, Carchi, Chimborazo, Cotopaxi, Imbabura, Loja, Napo, Pichincha and Tungurahua (de la Torre 2008), all located in the Andean region of Ecuador. *Ch. jussieui* J.F.Gmel is a well-known plant and is used by the indigenous populations of the Andes who use its leaves, stems and flowers for medicinal purposes. The infusion of its leaves, flowers and stems is used for the treatment of kidney and liver problems, due to its diuretic properties (de la Torre 2008). Some authors have reported the biological effects of other species of *Chuquiraga*, such as *Ch. spinosa* (Casado et al. 2011; Arroyo-Acevedo et al. 2017; 2018), while in the case of *Ch. jussieui* J.F.Gmel reports about its chemical composition and biological effects are still scarce. In this study, we aimed to investigate the principal bioactive compounds and antioxidant capacity of the leaves and flowers of *Ch. jussieui* J.F.Gmel from different highlands of Ecuador.

2. Results and discussion

The TPC, TFC and vitamin C content of the leaves and flowers of *Ch. jussieui* J.F.Gmel from different highlands of Ecuador (Antisana, Cotopaxi, Paschoa, Pichincha and Guaranda) are shown in Figure 15. The results indicate that the contents of the bioactive compounds studied (TPC, TFC and Vit C) differ significantly between both parts of the plants, as the leaves had a higher content ($P \leq 0.05$) than the flowers. A similar behavior was observed in total carotenoids content. Moreover, *Ch. jussieui* J.F.Gmel proved to be an important source of lutein, with the leaves as the principal source of this carotenoid. Our results are in agreement with those previously reported, which showed the bioactive compounds content to be higher in *Ch. jussieui* J.F.Gmel than in other medicinal plants from Ecuador (Rondón et al. 2015). The vitamin C and carotenoids content in plants have been associated with various external factors, such as climatic conditions (temperature and UV radiation). Ascorbate is a major metabolite in plants, with an important function as an antioxidant that protects plants against oxidative damage when associated with other antioxidants, such as carotenoids (Smirnoff 1996). The highlands of Ecuador are located at an altitude surpassing 3000 meters above sea level, with temperatures ranging between 6 °C and 8 °C during the day, dropping to as low as 0 °C at night (Hofstede et al. 2014). Therefore, we assume that the high vitamin C and carotenoids content in *Ch. jussieui* J.F.Gmel could be associated with the extreme environmental conditions to which the plants are exposed.

These adaptive responses of plants to the extreme conditions represent an opportunity to access natural sources with a high content of antioxidant compounds with important beneficial effects for health. Polyphenols, Vit C and carotenoids are known as excellent antioxidants and their positive effects on health have been well

documented (Del Rio et al. 2013; Granger and Eck 2018). To evaluate the biological properties of both methanolic extracts (from leaves and flowers) of *Ch. jussieui* J.F.Gmel, the total antioxidant capacity was studied to determine their free radical scavenging activities as well as their capacity to protect blood cells membrane against lipid oxidation. The crude methanolic extracts of leaves proved to have the highest antioxidant capacity ($P \leq 0.05$) due to their ability to reduce iron ($\text{Fe}^{3+} \rightarrow \text{Fe}^{2+}$), as well as to scavenge DPPH (Rondón et al. 2015), O_2^- and H_2O_2 radicals (Figure 2S). The methanolic extracts of leaves also had the highest capacity to protect red blood cells membrane against lipid peroxidation ($P \leq 0.05$), compared to flowers (Figure 2S). This could be because they have a higher content of bioactive compounds than the flowers.

3. Experimental procedures

The experimental procedures related to this article are available as [supplementary material](#).

4. Conclusion

In summary, the findings of this research reveal that *Ch. jussieui* J.F.Gmel represents an important source of bioactive compounds, such as polyphenols, carotenes and vitamin C and proved to be effective in scavenging free radicals as well as in protecting red blood cell membranes against lipid oxidation, where the leaves were noticeably more effective than the flowers. To the best of our knowledge, this study is the first research data related to the chemical composition and antioxidant capacity of *Ch. jussieui* J.F.Gmel. Further studies are necessary in order to identify the rest of the bioactive compounds that could be associated to the species' biological effects as well as the associated underlying mechanisms. Although this is a pilot study, our findings may serve as a basis for future studies in order to confirm this plant's potential in preventing oxidative damage and to justify its use as a source of bioactive compounds with relevant health benefits.

Disclosure statement

No potential conflict of interest was reported by the authors.

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