

Parmeliaceae Lichens as Sources of Antioxidant Metabolites with Pharmacological Value

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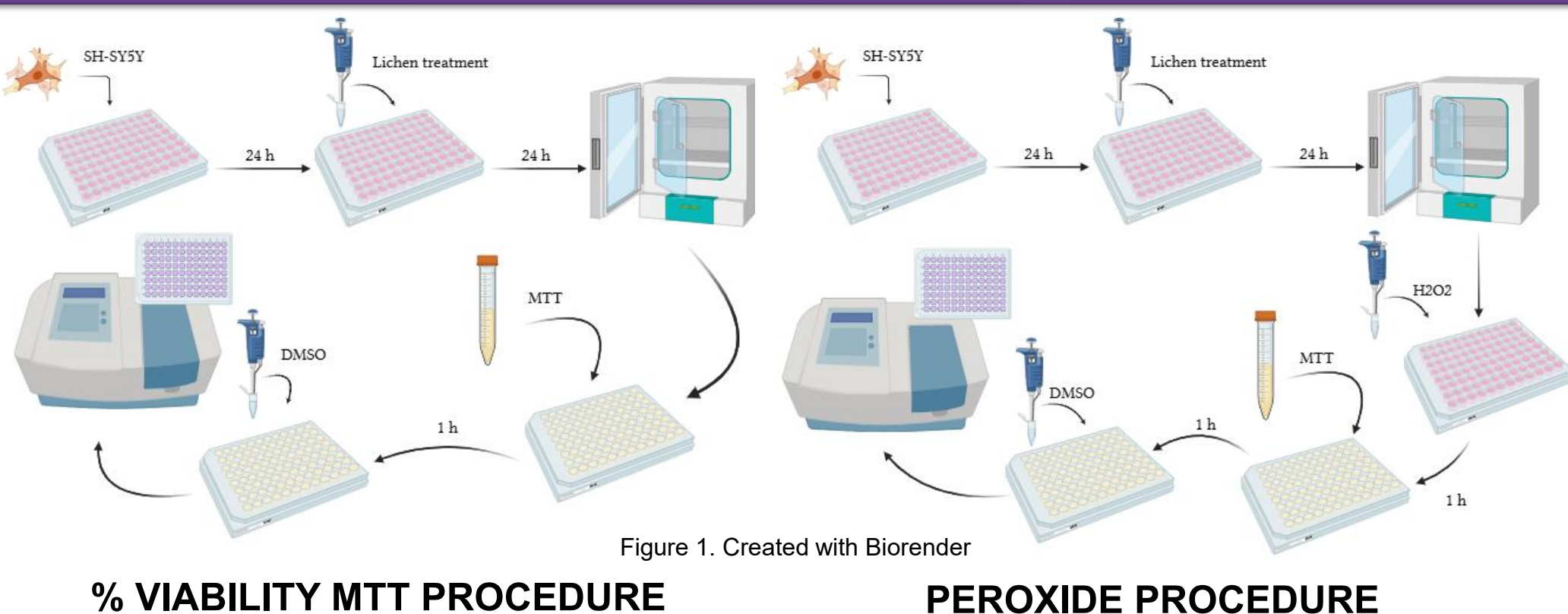
INTRODUCTION & AIM

Lichens are symbiotic organisms formed by a fungus and a photosynthetic partner (green alga or cyanobacterium), producing diverse secondary metabolites of ecological and pharmacological importance. Among them, the *Parmeliaceae* family is one of the largest and most chemically diverse groups, comprising over 2,800 species. Members of this family, particularly the genus *Parmotrema*, have been investigated for their antioxidant and therapeutic properties.

Species of *Parmotrema* are characterized by large foliose thalli with broad lobes, a naked marginal zone on the lower surface, and distinct reproductive structures such as perforate apothecia and thick-walled ascospores. This genus comprises around 300 species, mainly distributed in tropical and subtropical regions. Chemically, *Parmotrema* lichens produce a wide range of secondary metabolites—including depsides, depsidones, anthraquinones, xanthones, dibenzofurans (e.g., usnic acid), and pulvinic acid derivatives—synthesized through acetyl-polymalonyl, mevalonic, and shikimic acid pathways. Many of these compounds exhibit antimicrobial, antioxidant, and neuroprotective activities.

This study explores the antioxidant and neuroprotective potential of *Parmotrema* species using the SH-SY5Y cell line as a neuronal model to identify bioactive metabolites of pharmacological interest.

METHOD



Assessment of Antioxidant Capacity

ORAC (Oxygen Radical Absorbance Capacity)

Measures the ability of the sample to neutralise peroxy radicals.

The longer the fluorescence persists, the higher the antioxidant capacity.

FRAP (Ferric Reducing Antioxidant Power)

Evaluates the reducing power of antioxidants. The reduction of Fe^{3+} to Fe^{2+} produces a blue complex, indicating strong antioxidant activity.

DPPH (2,2-Diphenyl-1-picrylhydrazyl)

Determines the ability to donate electrons or hydrogen atoms.

The discolouration of the violet DPPH radical reflects the antioxidant effectiveness.

Folin–Ciocalteu Assay

Quantifies the total phenolic content of the sample.

Phenolic compounds reduce the Folin reagent, generating a blue chromophore whose intensity is proportional to phenolic concentration.

Plant Material

A total of three lichen samples were analysed: *Parmelia discordans* collected in Asturias (Spain), *Parmelia saxatilis* from Scotland, and *Xanthoparmelia tinctina* from Madrid (Spain).

Extract Preparation

The crude extracts were obtained by cold maceration in methanol for 24 hours. After extraction, the mixtures were filtered and the solvent was allowed to evaporate to dryness under controlled conditions.

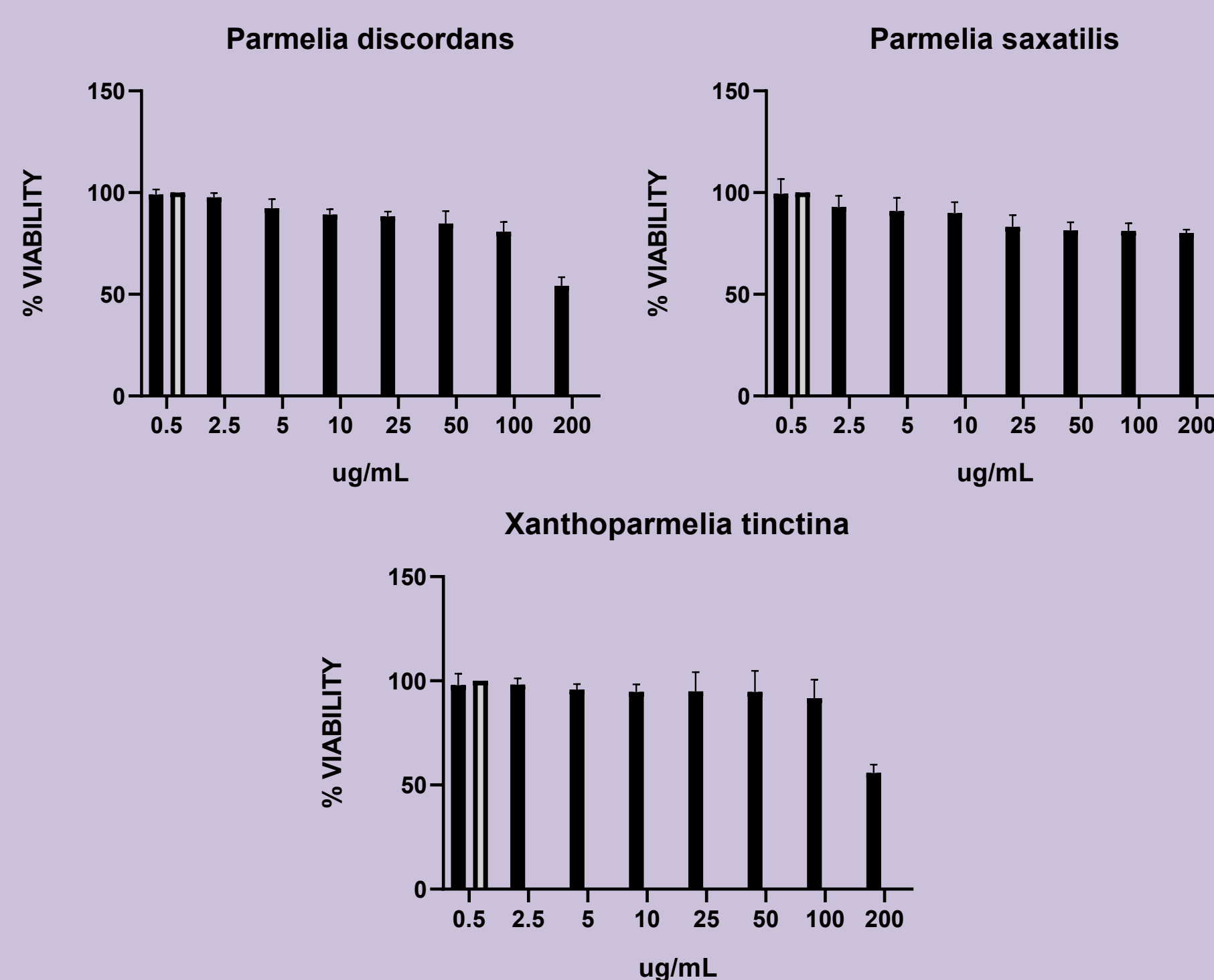
Cell Line

The SH-SY5Y human neuroblastoma cell line was used for the cellular assays. This line is widely employed as an *in vitro* model of neuronal function and oxidative stress due to its ability to differentiate into neuron-like cells. SH-SY5Y cells are particularly useful for studying neuroprotective and antioxidant effects, making them an appropriate model for evaluating the biological activity of the lichen extracts.

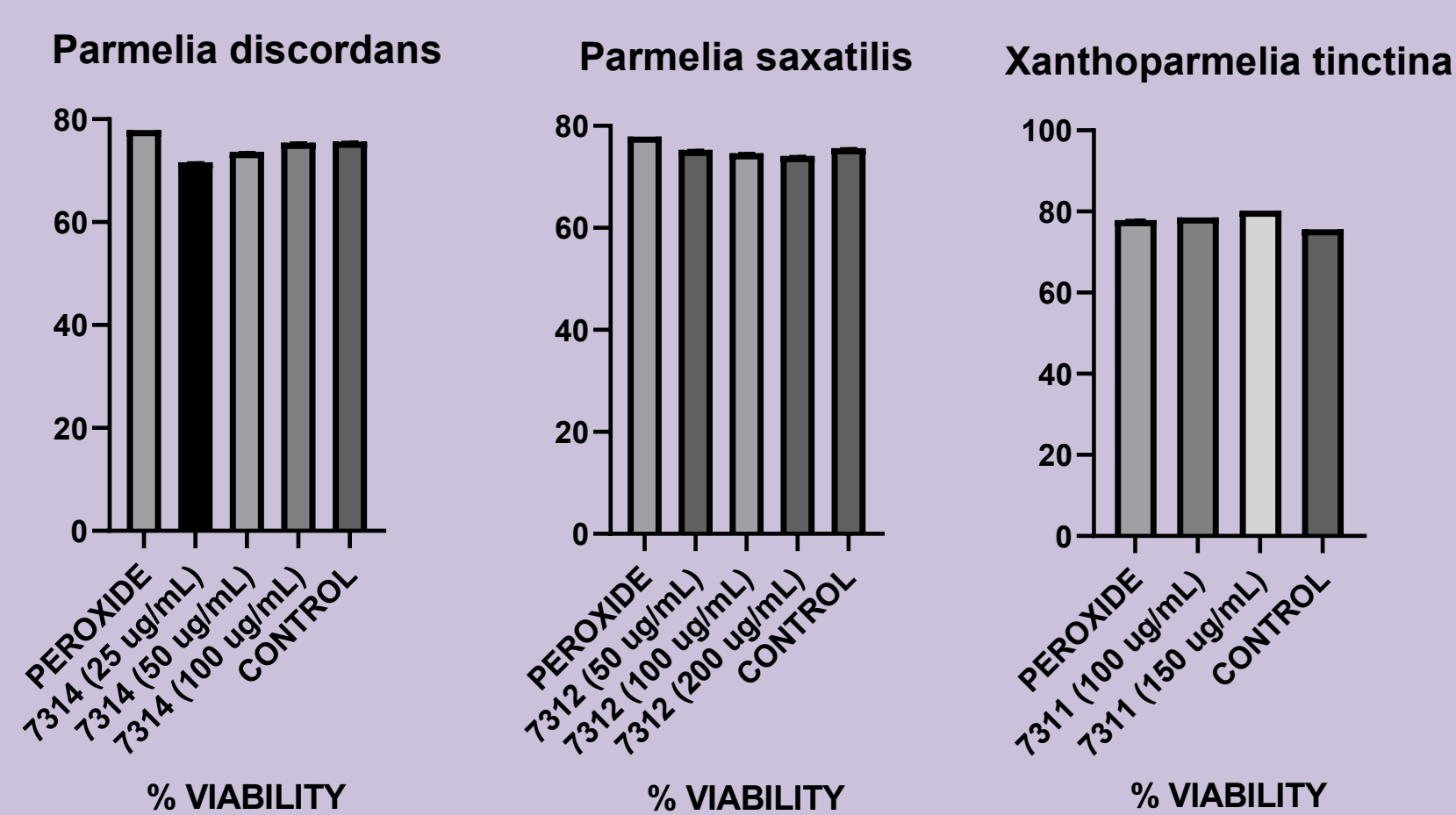
RESULTS & DISCUSSION

	ORAC ($\mu\text{mol TE}/\text{mg}$)	FRAP (Eq Fe^{2+} $\mu\text{mol}/\text{g}$)	DPPH (IC_{50} $\mu\text{g}/\text{mL}$)	Folin-Ciocalteu ($\mu\text{g AG}/\text{mg}$)
<i>P. discordans</i>	24,94	$0,953 \pm 0,15$	1013,14	$106,49 \pm 0,013$
<i>P. saxatilis</i>	19,03	$1,029 \pm 0,13$	814,42	$97,86 \pm 0,01$
<i>X. tinctina</i>	18,74	$2,295 \pm 0,11$	642,93	$20,13 \pm 0,002$

MTT ASSAY



PEROXIDE ASSAY



CONCLUSION

The methanolic extracts of *Parmelia discordans*, *Parmelia saxatilis*, and *Xanthoparmelia tinctina* exhibited remarkable antioxidant and neuroprotective activities. *P. discordans* showed the highest overall antioxidant capacity and phenolic content, while *X. tinctina* displayed strong reducing power. These results highlight Parmeliaceae lichens as promising sources of bioactive metabolites with potential pharmacological value.

FUTURE WORK / REFERENCES

Future research will aim to isolate and characterize the specific metabolites responsible for the observed antioxidant and neuroprotective activities. Further studies will also explore the underlying molecular mechanisms involved in neuronal protection and oxidative stress modulation. In addition, *in vivo* experiments will be conducted to confirm the pharmacological potential of *Parmotrema* extracts and their applicability in neurodegenerative disease models.

