

Ribosome-Inactivating Proteins in *Sambucus ebulus*: A Mini Review

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SUMMARY. Ribosome-inactivating proteins (RIPs) are a family of enzymatic proteins that depurinate ribosomal RNA, leading to the inhibition of protein synthesis. *Sambucus ebulus* L. (dwarf elder), a perennial herb of the Adoxaceae family found in Europe and Western Asia, is a known source of diverse biologically active RIPs. These proteins, including ebulin isoforms, have shown significant cytotoxic, antiviral, and anticancer activities. This mini-review delineates the structure, mode of action, and biomedical applications of RIPs isolated from *S. ebulus* and emphasizes their biosafety and therapeutic values. The short review also discusses recent challenges in the utilization of these molecules and future directions for controlling their activity in clinical and agri-biotechnology.

RESUMEN. Las proteínas inactivadoras de ribosomas (RIP) son una familia de proteínas enzimáticas que despurinan el ARN ribosómico, lo que induce la inhibición de la síntesis proteica. *Sambucus ebulus* L. (saúco enano), una hierba perenne de la familia Adoxaceae presente en Europa y Asia occidental, es una fuente conocida de diversas RIP biológicamente activas. Estas proteínas, incluidas las isoformas de ebulina, han mostrado importantes actividades citotóxicas, antivirales y anticancerígenas. Esta minirrevisión describe la estructura, el mecanismo de acción y las aplicaciones biomédicas de las RIP aisladas de *S. ebulus* y destaca su bioseguridad y sus valores terapéuticos. La breve reseña también analiza los desafíos recientes en el uso de estas moléculas y las futuras direcciones para controlar su actividad en la clínica y la agrobiotecnología.

KEYWORDS: biotechnology, cytotoxicity, ebulin, ribosome-inactivating proteins, *Sambucus ebulus*, therapeutic potential.

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