

Scheda di Programma

Per l'attivazione nell'ambito del Corso di Dottorato di ricerca in **SCIENZE VETERINARIE** del seguente Programma di ricerca, a valere sulle risorse di cui al DM n. 351/2022, relativamente alla seguente Misura:

M4C1- Inv. 3.4 "Didattica e competenze universitarie avanzate" → **Dottorati dedicati alle transizioni digitali e ambientali.**

M4C1- Inv. 4.1 "Estensione del numero di dottorati di ricerca e dottorati innovativi per la pubblica amministrazione e il patrimonio culturale". In particolare:

Dottorati PNRR

Dottorati per la Pubblica Amministrazione

(selezionare l'area/le aree CUN di riferimento del programma tra quelle di seguito indicate)

- Area 09 – Ingegneria industriale e dell'informazione
- Area 11 – Scienze storiche, filosofiche, pedagogiche e psicologiche
- Area 12 – Scienze giuridiche
- Area 13 – Scienze economiche e statistiche
- Area 14 – Scienze politiche e sociali

Dottorati per il patrimonio culturale

(selezionare l'area/le aree disciplinare/i e la tematica del programma tra quelle di seguito indicate)

- Area 01 – Scienze matematiche e informatiche **Tematica** – Informatica, patrimonio e beni culturali
- Area 02 – Scienze Fisiche **Tematica** – Fisica applicata al patrimonio culturale e ai beni culturali
- Area 03 – Scienze chimiche **Tematica** – Chimica, ambiente, patrimonio e beni culturali
- Area 04 Scienze della Terra **Tematica** – Georisorse minerarie per l'ambiente, il patrimonio e i beni culturali
- Area 05 Scienze Biologiche **Tematica** - Ecologia, patrimonio e beni culturali
- Area 08 – Ingegneria civile e Architettura **Tematiche** 1) Architettura, ambiente antropizzato, patrimonio e beni culturali 2) Architettura e paesaggio 3) storia dell'architettura; 4) Restauro; 5) Pianificazione e progettazione dell'ambiente antropizzato; 6) Design e progettazione tecnologica dell'architettura
- Area 10 Scienze dell'antichità, filologico-letterarie e storico -artistiche **Tematiche** 1) Archeologia; 2) Storia dell'arte; 3) Media, patrimonio e beni culturali
- Area 11 – Scienze storiche, filosofiche, pedagogiche, psicologiche **Tematiche** 1) Biblioteconomia; 2) Archivistica; 3) Storia del patrimonio e dei beni culturali 4) Paleografia; 5) Estetica; 6) Didattica dell'arte; 7) pedagogia dell'Arte
- Area 12 - Scienze giuridiche **Tematica** Diritto del patrimonio culturale
- Area 13 - Scienze Economiche e statistiche **Tematiche** 1) Economia della cultura e dell'arte 2) Economia e gestione delle imprese artistiche e culturali; 3) Statistica e Data Analytics per i beni culturali
- Area 14 Scienze Politiche e sociali **Tematiche** 1) Sociologia dei beni culturali 2) sociologia dell'ambiente e del territorio

Titolo del Programma di ricerca: Evaluation of the pharmacological effects of snail slime in the treatment of mastitis, as a new "green" approach



❖ Descrizione (MAX 5000 CARATTERI SPAZI ESCLUSI):

Recently, the market for snail slime and related products has experienced a significant increase. Currently the snail slime is of great interest from both a scientific and commercial point of view and in particular in the cosmetic and nutraceutical / pharmaceutical fields. Although the beneficial properties of snail slime have been known and exploited since ancient times in traditional medicine, only in a recent years, a scientific approach has been applied to the study of both the pharmacological properties and the chemical composition of this product, as well as to the study of improving techniques and breeding of heliciculture. As demonstrated by the number of scientific publications on pubmed (<https://pubmed.ncbi.nlm.nih.gov/?term=snail+; keyword Snail>) only since 2010 has this seen an exponential increase compared to the past years and shows a trend that growing until today. The present project, therefore, has as objectives articulated in different work packages (WP); in particular will be evaluated the study and improvement of heliciculture techniques that will be evaluated as an impact on the "quality" of the finished product, and therefore of the subsequent characterization of the pharmacological properties.

In particular:

- WP1 has as its objective the study of heliciculture and snail slime extraction techniques. In fact, snail slime has a natural composition of active substances among the richest in nature, it contains allantoin, collagen, glycolic acid, lactic acid, anti-protease, vitamins and minerals. This makes it a unique basic ingredient that cannot be synthesized in the laboratory, furthermore the composition of the slime also depends on the techniques of heliciculture (feeding, extraction). In this WP snails of the genus *Helix Aspersa muller* will be used naturally bred in presence combined with medicinal plants of the Sicilian tradition (*Opuntia ficus indica*, *Silybum marianum*, *Malva trimestris* (L.) Salisb), studied and applied with a rigorous scientific method to face the growing attention towards a conscious use of natural medicine that replaces, when possible, chemistry, respecting the balance of the organism and nature. A cruelty free breeding and extraction technique will be used in which the slime will be collected manually and subjected only to a series of filtrations (e.g. 10 microns-1micron) to obtain the finished product stabilized for commercial use.

- WP2: The product thus obtained will be characterized in its chemical composition. The secretion of filtered snail slime from different batches will be qualitatively and quantitatively analyzed through standard analytical techniques such as IR \ UV vis spectrometry and HPLC \ MS analysis. In particular, the quantity of bioactive molecules present will be considered (allantoin, glycolic acid, gallic acid, ... etc, vitamins, mucopolysaccharides, etc ...)

WP3: from the results obtained in WP2 the secretions of snail slime with the best characteristics will be used for the study of their pharmacological properties and in particular in the treatment of mastitis. This will be evaluated through the topical application of these products in an in vivo mouse model of mastitis, induced by LPS (lipopolysaccharide) administration, in which the efficacy of the treatment and the mechanism of action (effect on immune response, cell differentiation) will be evaluated, inflammatory and oxidative process)

The techniques that will be used are immunohistochemistry for the expression of adhesion molecules; Western Blot analysis and Elisa kit for pro-inflammatory cytokine expression levels; RealTime-PCR analysis for the expression of the mRNA levels of proteins involved in inflammation and immune response; and finally the FACS analysis for immune cell subpopulations.

This project will be carried out in collaboration with the Snail Srls company (<https://www.innovahelix.it>) operating in the Sicilian territory. Snail Srls deals with sustainable green heliciculture with low environmental impact, Snail Srls also deals with research and enhancement of snail slime and its pharmaceutical preparations, respecting the balance of the ecosystem and the environment. In addition, the collaboration between Snail Srls and the University of Messina has produced important scientific results such as publications in important trade journals such as *Scientific Reports - Nature* (Titolo: Protective effect of snail secretion filtrate against ethanol-induced gastric ulcer in mice Autori: Gugliandolo E., Cordaro M., Fusco R., Peritore A.F., Siracusa R., Genovese T., D'Amico R., Impellizzeri D., Di Paola R., Cuzzocrea S., Crupi R. Anno: 2021 (febbraio) indirizzo: <https://doi.org/10.1038/s41598-021-83170-8>) e *Veterinary Sciences* (Titolo: The Protective Effect of Snail Secretion Filtrate in an Experimental Model of Excisional Wounds in Mice Autori: Gugliandolo E., Macri F., Fusco R., Siracusa R., D'Amico R., Cordaro M., Peritore A.F., Impellizzeri D., Genovese T., Cuzzocrea S., Di Paola R., Licata P., Crupi R. Anno: 2021 (agosto) Indirizzo: <https://doi.org/10.3390/vetsci8080167>). The locations where the training activities will take place are perfectly suited to the research activity concerning the doctorates that make up the project proposal. Computer stations are available to PhD students at the Department of Veterinary Sciences where there are several computers connected via cable or wireless network. At least one networked computer per laboratory is also available to PhD students at the affiliated centers. The doctoral student has an email address with large memory availability, access to IRIS for updating his publications, use of CIAM's computer science resources, access to the university canteen and to the hospitality services provided for by the agreements between the University and the ERSU. The locations where the training activities take place are perfectly suitable for the purpose.

The classrooms and laboratories of the Administrative Headquarters (University of Messina) and of the affiliated offices are used. laboratory measurements and analyzes are modern and sophisticated and are part of the instrumental kit of the professors belonging to the Doctoral College.

Doctoral students have access to the Department Library, which has merged into the University Library Service (SBA), which is particularly equipped with up-to-date and specialist monographs and journals, which can also be consulted electronically. Books and encyclopedias relating to the SSDs of the courses are available; the same can be said for both the consortium offices and the external research bodies. Electronic subscriptions are available to major journals from publishing houses of major scientific publications (ACS, RSC, Wiley-VCH). There are online links to numerous databases (for example, the Cambridge Structure Database). During the PhD course, all the necessary information will be provided to improve the skills of using databases including Pubmed, Journal of Citation Reports and Isi Web of Knowledge, Macromedex.

The synergistic action with the company and the technology transfer will create not only the opportunity for a dynamic and innovative training course, but also the conditions for subsequently and targeted use of the skills acquired. In fact, this synergy opens up the interesting prospect of a future employment of the research doctor in research projects based on the know-how acquired in the company, for possible applications of the study also on other models of pathologies and their translation into clinical practice.

The doctoral training acquired with this synergistic path lays the foundations for a future employment of the doctoral student in the world of work also from a green perspective in terms of eco-sustainability. The research will expand the field of biochemical, pharmacological and environmental knowledge with the benefit of the training course of the research doctor who, in perspective, will be able to continue his path by using his degree of qualification, the skills acquired, on the productive fabric of the territory affected by the program. the ability to interact with different entities with a view to shared green planning and complementarity of expertise.

The project provides for collaboration and sharing of the results that will be disseminated through the standard channels of scientific information as evidence of the skills acquired by the trainee. The PhD student will be asked to improve communication skills through seminars in English, hospitality of foreign teachers and participation in international conferences. The research activity of the PhD student will be supervised by a senior tutor and, possibly, by a co-tutor. The training will be implemented in a Career Development Plan (acquisition of scientific and complementary skills; development of networking skills for interception of EU and national funding sources; acquisition of professional maturity and scientific independence). The doctoral student will be invited to personally draft the scientific papers in English resulting from his own experimental activity, stimulating him to use journals with I.F. and the publication process will follow with the tutor. He will be invited to take advantage of mobility in foreign research laboratories. The achievement of the PhD title will allow to acquire scientific authority and compete successfully for post-doc positions and international research projects. The proposal under study aims to use an integrated multidisciplinary approach with the company.

The PhD student will be followed daily by the company tutor during the working hours carried out at the host company. The PhD student will be enabled to carry out the work activities envisaged by the project, providing him with all the equipment and premises necessary for carrying out the activities. The project intends to promote the research of new therapeutic formulations whose application to be transferred to clinical practice as well as the study of their environmental sustainability.

❖ **PERIODO IN IMPRESA – CENTRI DI RICERCA – P.A.:**

Il Programma di ricerca sarà svolto in collaborazione con il seguente soggetto:

Ragione sociale: Snail Srls P. IVA 03485880839

Sede legale: Via Giovanni Zodda, 109- 98042 Pace del Mela (ME)

Rappresentante legale: Stefano Crupi

L'ente sopra citato ospiterà il dottorando beneficiario della borsa finanziata sulle risorse del DM 351/2022 per n. 6 mesi (**min 6 max 12**) nel corso del dottorato.

❖ **PERIODO ALL'ESTERO:**

Il Programma di ricerca prevede un periodo all'estero di n. 6 mesi (**min 6 max 18**) presso la seguente istituzione:

University of Roehampton

Si dichiara inoltre che il presente programma è conforme al principio "di non arrecare un danno significativo" (DHS) ai sensi dell'art. 17 del regolamento (UE) 2020/852 in coerenza con gli orientamenti tecnici predisposti dalla Commissione Europea (Comunicazione della Commissione Europea 2021/C58/01) e garantisce il rispetto dei principi orizzontali del PNRR (contributo all'obiettivo climatico e digitale c.d. tagging, il principio della parità di genere e l'obbligo di protezione e valorizzazione dei giovani).

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