

PhD Program: “Food Science”

Research Project Title: Molecular and Microbial fingerprinting of buffalo and bovine colostrum: implications for food safety and dairy supply chain traceability.

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Settore Scientifico-Disciplinare di riferimento: 07/AGRI-09A LIVESTOCK SYSTEMS, ANIMAL BREEDING AND GENETICS

Research project objectives, methodologies, and interdisciplinary collaborations:

Today, molecular and microbial traceability represents a fundamental pillar for safeguarding agri-food excellence, specifically within the buffalo dairy chain. In this context, implementing advanced monitoring systems from the earliest production stages—starting with colostrum—is crucial to certify product authenticity and ensure the total absence of cross-contamination or adulteration with bovine milk and colostrum.

Beyond control functions, this research focuses on enhancing buffalo colostrum's value by utilizing it to formulate "novel foods," high-value-added dietary supplements, and cutting-edge nutraceuticals. The overall project objective is to develop an omic fingerprinting of buffalo colostrum. This tool is designed to guarantee food safety and promote colostrum as an elite nutraceutical resource for both human and animal health, aligning with modern safety standards and market demands for functional, high-quality ingredients in the global food industry.

Specific Objectives and Methodology

1. Development of optimized NGS bioinformatics pipelines to identify microbial species and strains in colostrum. 2. Identification of the "Core Microbiota" and specific biomarkers using Machine Learning models (e.g., Random Forest) to create the buffalo colostrum fingerprint. 3. Mapping the antibiotic resistome through microbial network analysis to assess health risks, aligning with One Health safety standards.

Interdisciplinary Collaborations

Given the project's multidisciplinary nature, collaborations involve Computer Science and Veterinary Medicine Departments—with research groups specializing in "OMIC" analysis—Protection Consortia (e.g., Mozzarella di Bufala Campana DOP), and Breeders' Associations. CREA ZA strengthens this network through active partnerships with IZS in the European EUPAHW project and the institutional presence of its researchers within Breeders' Associations' CTCs.

Innovation and/or originality of the project:

Moving beyond classical microbiology, the project adopts a data-driven approach based on shotgun metagenomics and multi-omic integration to define a holistic colostrum fingerprint. Technological innovation lies in custom bioinformatics pipelines and machine learning algorithms to discriminate between buffalo and bovine matrices. The study explores the buffalo colostrum "Dark Microbiome" and the resistome, aligning with the One Health approach. Finally, the project develops early molecular traceability, positioning colostrum as a premium matrix for novel foods and nutraceuticals in human and veterinary health.

Availability of funds:

This PhD project is fully funded by EU funds, specifically LIVECoVET (Livestock Innovation Environmental Future: Centre of Vocational Excellence) – ERASMUS-EDU-2024-PEX-COVE – ERASMUS Lump Sum Grants, in which CREA serves as a partner. The project's total budget is €3,944,041.40, with €224,058.00 allocated to CREA.

Availability of facilities: Both the University of Naples and CREA-ZA will provide a dedicated desk with a desktop computer workstation and access to the molecular biology laboratory.

Collaborations with International Institutions:

International collaborations are available with three institutions: a) EMBL-EBI (European Bioinformatics Institute) - Cambridge, UK; b) Center for Biological Sequence Analysis (CBS) at DTU - Denmark; and c) Wageningen University (Bioinformatics Group) - Netherlands.

Collaborations with External Organizations (outside of UNINA): Council for Agricultural Research and Economics (CREA) - Research Centre for Animal Production and Aquaculture, University of Rome Tor Vergata (Faculty of Veterinary Medicine), CINECA.