

## Multi-omics Integration to Investigate the Infant Food Microbiome



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The aim of this PhD thesis research project is to implement innovatory sequencing methods, omics methods, for the microbial hazard detection and characterization, in order to provide scientific elements which could be used in the "next generation" microbiological risk assessment. In this way could become possible the prediction of pathogens behaviour in a complex food ecosystem, constructing applicable and accurate models that can benefit the community as a whole. This PhD is part of the European Project "SAFFI – Safe Food for Infants in the EU and China".

Integrazione Multi-omics per Investigare il Microbioma degli Alimenti per l'infanzia

Lo scopo di questo progetto di ricerca di tesi di dottorato è quello di implementare metodi di sequenziamento innovativi, cioè tecniche omics, per la rilevazione e caratterizzazione del rischio microbico. Questo fornirà elementi scientifici che potrebbero essere utilizzati nella valutazione del rischio microbiologico di "nuova generazione", un approccio che permetterà di predire il comportamento dei patogeni in un complesso ecosistema alimentare, costruendo modelli applicabili e accurati che possano avvantaggiare la comunità nel suo insieme. Questo dottorato fa parte del progetto europeo "SAFFI – Safe Food for Infants in the EU and China".

## State-of-the-Art

Foodborne disease is a significant public health issue that conduce to the global disease burden, causing illness and death after the ingestion of unsafe food. Immunocompromised individuals and children are particularly vulnerable, as for instance infants have a developmentally premature immune system and gastrointestinal tract, which raises the possibility of bacterial infection when exposed to contaminated food. Consequently, preventing microbial hazard is of great concern for health authorities, regulatory bodies, consumers and the food industry.

The food industry actually faces crucial and consecutive challenges, in an attempt to lessen the extent to which food products become contaminated with pathogenic or spoilage bacteria during primary processing. Indeed, microorganisms can enter and persist at several stages of the processing chain, with potential implications for quality and safety. For that reason, the ability to rapidly detect and understand the microbial prevalence is essential. Next-generation sequencing techniques, are demonstrating their effectiveness and accuracy in describing highly complex and heterogeneous microbial ecosystems in different sectors of food industry.



The implementation of holistic omics approach will lead to rapid control measures for each stage of the production line (Figure 1), as can set the light on the microbial interactions and the spatial heterogeneity responses that depend on the changing conditions inside the industrial environments that influence the formation of its microbiota. On the figure above can be observed the production line of infant formula, from which is clear this complexity. In other words, should be taken in consideration that the development of holistic omics approaches allows the comprehension of the dynamics of this heterogenic system, by tracing the sources of contamination, figuring out the population pools and their environments of favour together with their variable behaviour.

	Activity \ Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
	A1) Sample Plan															63										
	A2) Prevalence of																									
ĝ	Foodborne Pathogens	ŧ.																								
	A3) Microbial Behaviour				ð								1													
	A4) Data Interpretation and																									
	Predictive Models																									
	A5) Research and Writing																									
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he general objectives of this PhD thesis include the following activities, represented also in the Cantt diagram: I) Determination of the Samples, Collection and Analysis. A sample plan based on hazard identification and risk ranking, Determination of the Presence, Distribution and Prevalence of targeted Foodborne Profogens on Infant Food Models (four case studies). A combination califies when the resence, Distribution and Prevalence of targeted Foodborne Profogens on Infant Food Models (four case studies). A combination califies when the resence, Distribution and Prevalence of targeted Foodborne Profogens on Infant Food Models (four case studies). A combination califies when the resence of targetes and the targetes methods when genome support of the case studies of the target Determination of Microbial Behaviour. With the application of metatranscriptornics, the expression of genes will show the microbial behaviour in different cological inches and their responses under stress.

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