FHM-1.1 M: Antibacterial phytochemicals against *Listeria monocytogenes*

Keywords:	*Listeria monocytogenes*, prenylated isoflavonoids, isothiocyanates, antimicrobial activity
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Project duration:	MSc – 5-6 months
Specialisation:	MBT B, MFT A/C, MFS A/C

Project description:
Synthetic additives are often used to control the growth of pathogens and spoilage bacteria in food. The growing trend of consumer demand for natural antibacterials has motivated researchers to find alternatives. Plants have long been used in traditional medicine to treat infections and the usage of natural antimicrobial to ensure food safety and extend product shelf life has been well studied. Among the vast chemical arsenal of secondary metabolites with antibacterial properties, prenylated isoflavonoids and isothiocyanates are receiving more attention due to their high activity against foodborne pathogens.
Listeria monocytogenes is a foodborne pathogen and the causative agent of listeriosis, one of the most severe foodborne diseases. It is a robust pathogen able to survive and grow in different food-related environments and thus a significant problem for food safety. Resistance and persistence of *L. monocytogenes* are essential aspects of its survival and major concerns to food industries and consumers. Therefore, alternatives to control the growth of this pathogen are needed.
In this project, we aim to elucidate the antimicrobial activity of selected prenylated isoflavonoids and isothiocyanates against *Listeria monocytogenes*. Furthermore, the effect of various conditions, such as temperature and pH, on the antimicrobial activity will be investigated. This will be determined by susceptibility tests conducted at different conditions especially relevant for food production and in food models.
Using a multidisciplinary approach, you will have the opportunity to characterize the antimicrobial effect of new compounds against *Listeria monocytogenes* and investigate their application in food and food-related environments.

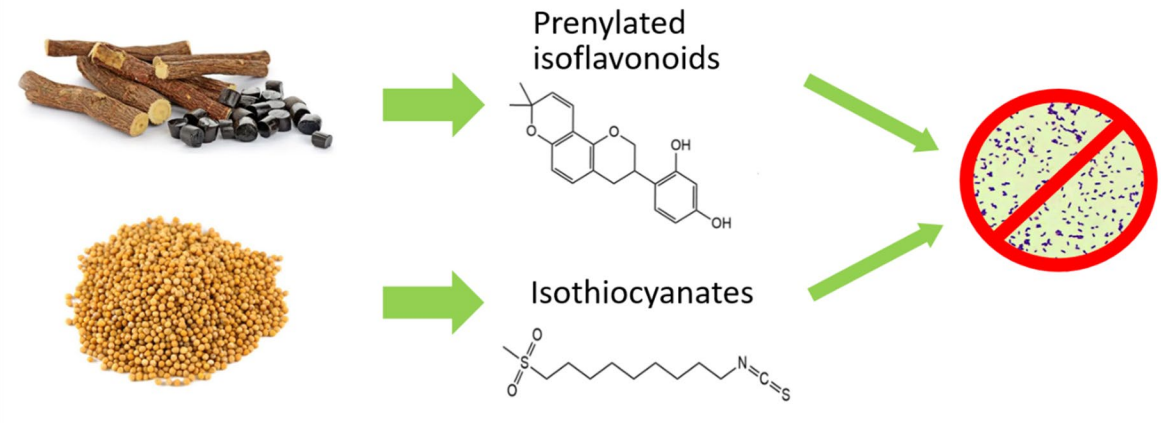


Figure 1: Classes of antibacterial phytochemicals tested against *Listeria monocytogenes*.

FHM-1.2 M: Hygiene in the household kitchen: Human and microbiological behaviour

Keywords:	Consumer handling, kitchen hygiene, cross contamination
Supervisors:	Heidy den Besten (heidy.denbesten@wur.nl) Wilma Hazeleger (wilma.hazeleger@wur.nl) Wieke van der Vossen (Voedingscentrum)
Project duration:	MSc – 5-6 months
Specialisation:	MBT B, MFT A/C, MFS A/C

Project description:
Food related illnesses are known as a serious health risk since many centuries. In the Netherlands it is estimated that in 2019 around 647,000 incidents and around 84 fatal cases occurred because of contaminated food with one of the 14 food-related pathogens [1].
Although the cause of foodborne incidents is not always known, experts agree that the domestic kitchen plays an important role in the contribution to the disease burden of foodborne infections [2]. What type of behaviour do consumers follow at home and which behaviour could increase the risk?
You will try to answer the question which strategies help in reducing the risk of infection in the domestic kitchen, with a focus on *Campylobacter* and poultry meat, because this is considered as the most important contributor to foodborne illnesses [1].
You will work in close collaboration with the Netherlands Nutrition Centre (Voedingscentrum). The aim of this organization is to inform consumers and to encourage them to handle food safely in order to prevent foodborne infections.

Activities:
- Perform literature research about survival and cross-contamination routes in the domestic kitchen;
- Perform experiments in the laboratory that simulate main transmission routes to determine survival and transmission in households;
- Use the experimental output in quantitative microbial risk assessment to estimate and compare the impact of transmission routes on public risks.

1. Lagerweij, G.R., et al., Disease burden of food-related pathogens in the Netherlands, 2019. RIVM report, 2020. 2020-0117: 50 pages.
2. Kusumaningrum, H.D. 2003. Behaviour and cross-contamination of pathogenic bacteria in household kitchens - relevance to exposure assessment. https://edepot.wur.nl/121440

FHM-1.3 M: Is there a microbiological selection bias in our enrichment-based detection method?

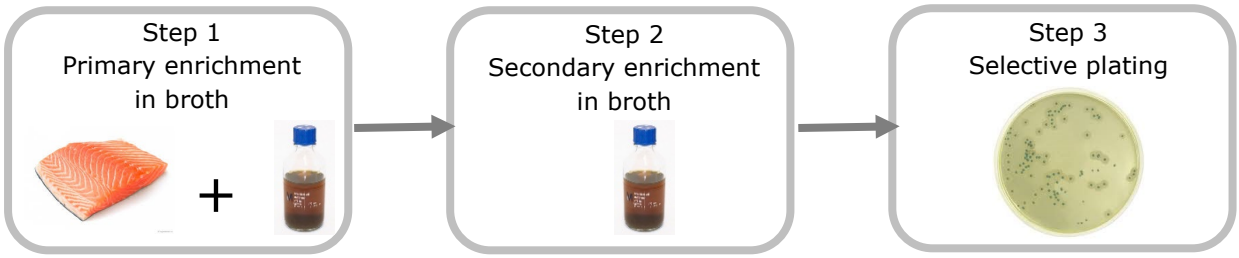
Keywords:	foodborne pathogens, enrichment, competition
Supervisors:	Heidy den Besten (heidy.denbesten@wur.nl) Wilma Hazeleger (wilma.hazeleger@wur.nl) External supervisors from RIVM
Project duration:	MSc – 5-6 months, start-up lab work early September
Specialisation:	MBT B, MFT A/C, MFS A/C

National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

Project description:
Sampling of food for pathogenic contaminants is routinely done by industries and governmental partners using enrichment-based methods. These sampling methods make use of different sequential steps to isolate the pathogen from the food (figure below illustrates the detection procedure of *L. monocytogenes*). The used enrichment media include antibiotics to suppress the growth of the non-target microorganisms to selectively enrich only the target pathogen allowing detection. The use of culturing steps with selective agents in the enrichment-based detection method might favour detection of specific subtypes of pathogens. This may result in a selection bias in pathogen detection from food, hence inadequate estimation of their presence in foods and food processing environment. This project has a focus on *Campylobacter* and *Listeria monocytogenes* because both pathogen detection procedures are based on selective enrichments.
In this project you will apply the enrichment-based method to detect the target pathogens from food, and also determine the microbiota during the different steps of the detection procedure to answer the following questions:

- Is food contaminated with one pathogenic strain, or multiple strains from one or more pathogenic species?
- Does the enrichment-based method select for specific subtypes of pathogenic strains?

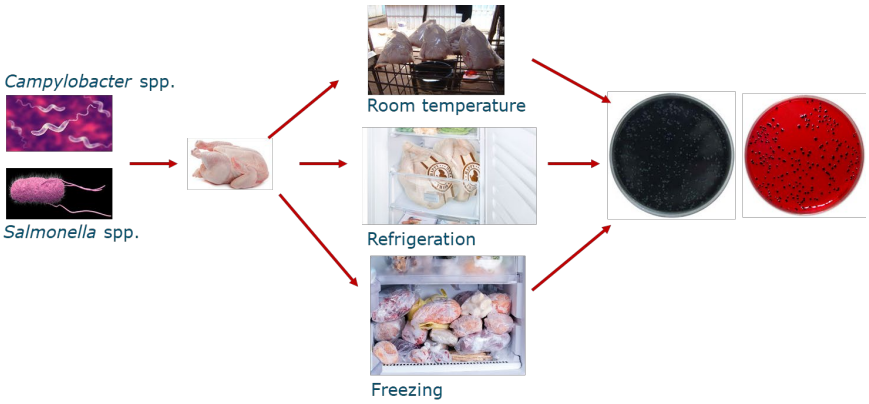
In this project you will use the conventional enrichment-based procedure (see figure) to detect the target pathogen from food. In parallel, you will also analyse the samples using molecular detection methods (metagenomics) to determine the microbiota from the food and during the sequential detection steps.
The metagenomics analysis will give insight in the composition of the microbiota, including the pathogens, in the food. Examination during the different steps of the detection procedure will allow to evaluate whether there is a selection bias towards specific pathogenic subtypes. These metagenomic analyses will be done in collaboration with the RIVM - National Institute for Public Health and the Environment-, and you will dedicate part of your time working in this institute.



FHM-1.4 M: Survival and growth of *Campylobacter* and *Salmonella* on raw chicken meat under different storage conditions typical of developing countries

Keywords:	Food borne pathogens, aerotolerant *Campylobacter* growth kinetics, open air meat storage, cold temperature storage, low income countries
Supervisors:	James Noah Ssemanda(james.ssemanda@wur.nl) Wilma Hazeleger (wilma.hazeleger@wur.nl) Heidy den Besten (heidy.denbesten@wur.nl)
Project duration:	MSc – 5-6 months
Specialisation:	MBT B, MFT A/C, MFS A/C

Project description:
Worldwide, there is a reported gradual and steady increase in the production and consumption of chicken meat while at the same time there is a substantial attributed health and economic burden of foodborne illnesses. Among the top ranked hazards reported to cause this disease burden are *Campylobacter* spp. and *Salmonella* spp., two pathogens commonly associated with poultry meat. To investigate the associated microbial risk, quantitative microbial risk assessment (QMRA) is gaining more attention as an effective tool. However, QMRA studies are in most cases hindered by paucity of data especially on the survival and growth of pathogens on or in the food product and as a consequence several assumptions have to be made, resulting to pronounced uncertain estimates. For *Campylobacter* spp. these studies usually do not include models to cater for the survival and growth of the microorganism during storage. The rationale for this approach is based on the premise that *Campylobacter* spp. does not grow on food or outside the gut of host animal due to oxidative stress and low temperature storage of foods. Conversely, some strains of *Campylobacter* spp. have been reported to be aerotolerant and can grow on meat provided favorable conditions of pH, temperature and oxygen consuming microorganisms. While in developed countries growth of *Campylobacter* spp. may not be an issue because meat is always displayed or stored under freezing and refrigeration conditions, in developing countries, these storage infrastructures are not always available. Moreover in some of these low income countries like Burkina Faso (Ouagadougou) and Ethiopia (Dire Dawa), outside temperatures can range between 30-40°C, which are also within growth range of *Campylobacter* spp. In this study, we will screen for aerotolerant strains of *Campylobacter* spp. and different of strains *Salmonella* ssp., inoculate them on chicken meat and investigate their survival and growth under storage conditions typical of developing countries (aerobic and microaerobic conditions and temperatures between -20 to 0°C , 0 to 10°C above 30°C). Finally we will fit the obtained data to obtain growth and survival models.

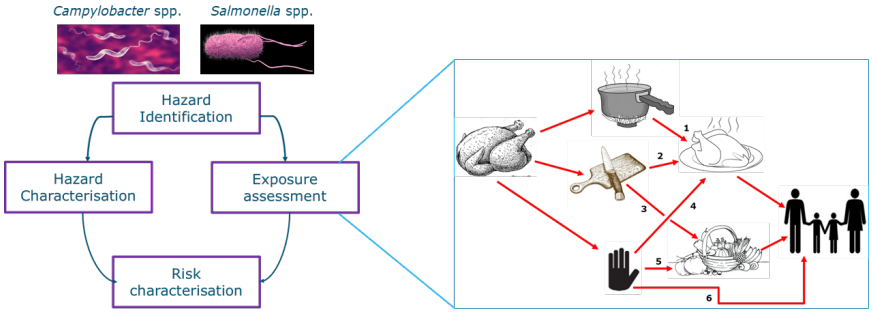


FHM-1.5 M: Quantitative microbial risk assessment of *Salmonella* and *Campylobacter* during consumer preparation of chicken meat

Keywords:	consumer behavior, microbial exposure routes, Monte Carlo simulations, probability of illness, incidence of salmonellosis
Supervisors:	James Noah Ssemanda(james.ssemanda@wur.nl) Heidy den Besten (heidy.denbesten@wur.nl) Marcel Zwietering (marcel.zwietering@wur.nl)
Project duration:	MSc – 5-6 months
Specialisation:	MBT B, MFT A/C, MFS A/C

Project description:
Foodborne illnesses pose a significant threat to public health and social economic development. In 2015, the World Health Organization reported that globally about 600 million foodborne illnesses and 420,000 deaths were caused by 31 foodborne pathogens in 2010. *Salmonella* spp. and *Campylobacter* spp. as foodborne pathogens were ranked among the top hazards causing this burden. Investigations into *Salmonella* spp. and *Campylobacter* spp. transmission to humans indicate that chicken meat is one of the major food vehicles. While chicken meat is cooked and hence expected to kill associated vegetative microbial hazards, the inconsistencies in the knowledge and behavior of food handlers have meant that there is under cooking, contamination of ready to eat food (salads) and kitchen utensils, and direct spread through touching the mouth. Information campaign has been suggested as one of the key interventions, however, for effective communication there is need for risk based food safety directions. In this study, a quantitative microbial risk assessment (QMRA) model will be developed to quantify the risk attributed to *Salmonella* spp. and *Campylobacter* spp. at consumer level during preparing chicken and other foods in the kitchen.

General objective
Quantify the risk of *Salmonella* spp. and *Campylobacter* spp. due to preparing chicken meat and identify the most import exposure routes.

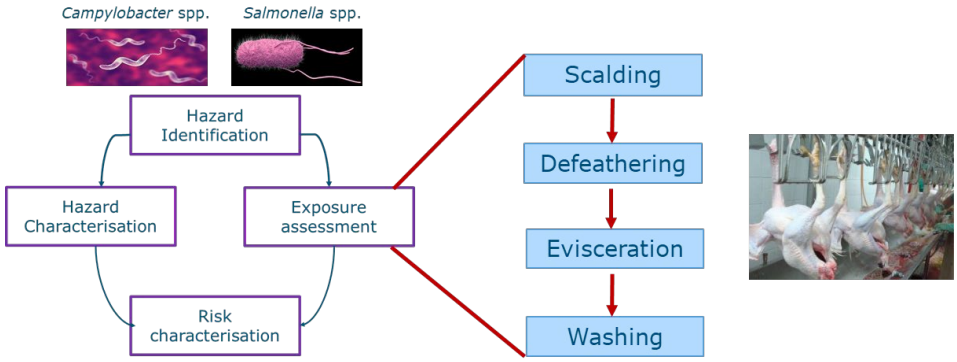


Specific objectives
1. Develop a QMRA model in @risk software (Palisade, Ithaca, NY) to quantify the risk of *Salmonella* spp. and *Campylobacter* spp. at consumer level in general and also for different exposure routes.
2. Literature search on the Model inputs:
    - Prevalence and concentration of *Salmonella* spp. and *Campylobacter* spp. at consumer level of the poultry supply chain
    - Consumer kitchen practices: hand washing, use of cutting board, touching of mouth,
    - Chicken cooking methods, temperature and time
    - Microbial transfer rates between chicken meat and cutting board, ready to eat food and hands

FHM-1.6 M : Quantifying the microbial risk associated with chicken slaughter processes

Keywords:	QMRA, *Salmonella* spp., *Campylobacter* spp., probability of illness, Monte Carlo simulations
Supervisors:	James Noah Ssemanda(james.ssemanda@wur.nl) Heidy den Besten (heidy.denbesten@wur.nl) Marcel Zwietering (marcel.zwietering@wur.nl)
Project duration:	MSc – 5-6 months
Specialisation:	MBT B, MFT A/C, MFS A/C

Project description:
Worldwide, a gradual and steady increase in the production and consumption of chicken meat has been reported in tandem with a substantial attributed health and economic burden of foodborne illnesses. Among the top ranked hazards reported to cause this disease burden are *Campylobacter* spp. and *Salmonella* spp., two pathogens commonly associated with poultry meat. These two pathogens originate from the farm environment, feeds, water and other animals and colonize the intestinal gut of the chickens. Once one chicken is infected, the infection can spread on the farm to other birds in the flock within one week. From farms to slaughter houses, contaminated and infected chickens can introduce pathogens into slaughter houses and possibly lead to contamination and cross contamination and survival in the slaughter environment which may result to contaminated carcasses. With all these challenges, it is evident that it is almost impossible to supply *Campylobacter* spp. and *Salmonella* spp. free chickens from farms to slaughter houses. Consequently, the operations at slaughter houses will remain very key in controlling the spread of these pathogens to chicken consumers. To investigate the associated microbial risk, quantitative microbial risk assessment (QMRAs) is gaining more attention as an effective tool to assess potential risks associated with foodborne pathogens. In this study we will use published and grey data on *Salmonella* spp. and *Campylobacter* spp. to conduct a QMRA study for chicken slaughter processes.



General objective
Estimate the risk of *Campylobacter* spp. and *Salmonella* spp. from chicken slaughter process.

Specific objectives
1. Conduct a systematic literature review on the effect of consecutive slaughter processes (scalding, defeaturing, evisceration, washing, chilling and freezing) on the concentration and prevalence of *Salmonella* spp. and *Campylobacter* spp.;
2. Develop a QMRA model and perform Monte Carlo Simulations to determine the probability of illnesses from chicken slaughter processes.