

PhD PROPOSAL FOR THE DOCTORAL SCHOOL

« Ecologie, Géosciences, Agronomie, ALimentation »

GENERAL INFORMATION

Thesis title: Fruit and vegetable waste reduction at consumer level through microbiological studies
Acronym: FOODREST
Disciplinary field 1: Food sciences
Disciplinary field 2: Ecology
Three keywords Food losses, Microbial ecology, Food spoilage
Research unit : LUBEM EA 3382
Name of the thesis director: Jérôme Mounier
Email address of the thesis director : jerome.mounier@univ-brest.fr
Name of the thesis co-supervisor 1 (if applicable): Adeline Picot
Email address of the thesis co-supervisor 1 (if applicable): adeline.picot@univ-brest.fr
Name of the thesis co-supervisor 2 (if applicable):
Email address of the thesis co-supervisor 2 (if applicable):
Thesis grant (funding origin and amount): ANR PRC, 207 k€
Contact(s) (mailing address and E-mail): Technopôle Brest Iroise 29280 Plouzané, lubem@univ-brest.fr
Recruitment process: Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website here . This information is needed for proposal publication. <input type="checkbox"/> Doctoral school contest <input checked="" type="checkbox"/> Interview <input type="checkbox"/> Other (indicate) :

All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name_Unit_Subject Acronym_EN.pdf

ED EGAAL

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SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

Socio-economic and scientific context

Households account for 53% of food waste in Europe, more than any other actors in the food chain. Fresh fruits and vegetables (F&V) are known to constitute the highest volumes of wasted food mainly associated with microbial contamination and spoilage. In this context, the ANR FOODREST project, involving both the LEGO and LUBEM teams of the UBO, aims at studying the stage of the food chain which represents the largest volumes of food waste: the consumer. Its goal is to help reduce the food waste of fresh fruit and vegetables (F&V) by selecting and adapting hygiene and conservation recommendations that are effective both microbiologically and in terms of changing current practices. The originality of this ANR project is based on the complementarity of a microbiological approach (studied by the LUBEM laboratory), to better understand spoilage processes according to storage locations and to explore the efficiency of hygiene recommendations, and a behavioral approach (studied by the LEGO laboratory), in order to capture household perceptions and practices in relation to the F&V spoilage. The project will allow, based on efficient communication tools, to provide proven conservation recommendations in terms of the efficiency of the message and how to convey it, in order to limit food waste. The work of the PhD student, hired in the frame of this ANR project, will be dedicated to the microbiological aspects of F&V waste.

Assumptions and questions

The PhD project aims to answer the following scientific questions, relative to the **microbiological aspects of F&V waste at consumer level**:

- What are the microorganisms associated to F&V spoilage in households?
- What is the link between consumer's practices, microorganisms associated to spoilage and their prevalence and actual F&V spoilage?
- What is the efficacy of cleaning and disinfection procedures on F&V storage compartments?
- Can we infer a set of efficient hygiene recommendation guidelines and acceptable by consumers?

The main steps of the thesis and scientific procedure & Methodological and technical approaches considered

The PhD project will be divided into 2 main tasks corresponding to the two main objectives of the PhD aiming to: i) **identify the microbiota associated to F&V storage facilities** as well as **the predominant microorganisms responsible for F&V spoilage**, et ii) propose a **set of efficient hygiene recommendations to limit F&V spoilage**, that are appropriate to consumer practices.

Task 1) Microbial ecology of household F&V storage facilities

The microbiota associated with F&V storage facilities will be studied by sampling the fridge drawer dedicated to F&V storage and the F&V bowl stored at room temperature at 50 households participating in our study. Their microbiota (bacteria and fungi) will be monitored using a culture-dependent and independent approach (metagenetic approach). Samples will be collected by swabbing the whole surface of the fridge drawer or F&V bowl during two seasons (in autumn and in summer). For each season, three time-points will be monitored, i.e. just before the storage compartment is being filled and 2 and 4 weeks later.

The identification of the predominant microorganisms responsible for F&V spoilage (collected by households during the study) will be performed using a culture-dependent approach.

Overall, the link between the microbiota determined by metagenetic approaches, the actual contamination of spoiled F&V and the abiotic factors will be studied. These analyses will provide information in terms of microbial diversity and prevalence of spoilage and hygiene indicator organisms, allowing to evaluate the overall hygienic and spoilage risk.

Task 2) Evaluation of efficacy of hygiene recommendations from the biological point of view

The efficacy of biocide and procedures recommended by ANSES or other agencies will be assessed. Two microbial consortia (spoilage moulds, yeasts and bacteria, and bacterial pathogens) respectively representative of those encountered in refrigerator drawers and storage bowls will be established based on the task 1 results. These

consortia will be used to artificially contaminate surfaces of cold or room-temperature storage facilities to challenge different cleaning and disinfection procedures. Bacterial pathogens will be included to evaluate the efficacy of the tested procedures in terms of food safety. Noteworthy, sodium hypochlorite, as the main recommended disinfectant, will be evaluated, as well as more acceptable alternatives in the consumer's eye, including vinegar, peracetic acid and sodium bicarbonate. Efficacy evaluation will be performed through classical microbiological detection and enumeration methods in order to determine the survival and growth of each targeted group at several time-points up to one month-storage period.

Scientific and technical skills required by the candidate

The candidate will be graduated from an engineering school or hold a master 2 degree, with a 6-month internship related to microbiology or microbial ecology. The candidate must have skills in molecular biology and microbiology. He/She must show ability to take initiative and work independently as well as in a team environment.

THESIS SUPERVISION¹

Unit name: LUBEM EA 3882	Team name: LUBEM site de Plouzané
Unit director name: Prof. Emmanuel Coton	Team director name: Prof. Jérôme Mounier
Mailing address of the unit director: emmanuel.coton@univ-brest.fr	Mailing address of the team director: jerome.mounier@univ-brest.fr
Thesis director Surname, first name: Mounier, Jérôme Position: Professor Obtained date of the HDR (Habilitation thesis to supervise research): 12/2012 Employer: UBO Doctoral school affiliation: ED EGAAL Rate of thesis supervision in the present project (%): 50% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 90% Number of current thesis supervisions/co-supervisions: 2	
Thesis co-supervisor 1 (if applicable) Surname, first name: Picot, Adeline Position: Associate Professor Habilitation thesis to supervise research <input type="checkbox"/> yes <input checked="" type="checkbox"/> no If yes, date diploma received: Employer: UBO	

¹ In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.

Doctoral school affiliation: ED EGAAL

Rate of thesis supervision in the present project (%): 50%

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 110

Number of current thesis supervisions/co-supervisions: 3

Thesis co-supervisor 2 (if applicable)

Surname, first name:

Position:

Habilitation thesis to supervise research yes no If yes, date diploma received:

Employer:

Doctoral school affiliation:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Private partner (if CIFRE funding, private funding,...)

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

International partner (if Cotutelle thesis)

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)

Please provide the following information for each PhD students supervised

Surname, first name: Franciosa Irene

Date of PhD beginning and PhD defence: 01/09/2017- 01/03/2021

Thesis supervision: Jérôme Mounier (50%)/Luca Cocolin (50%)

Professional status and location:: Post-doc, Université de Turin

Contract profile (post-doc, fixed-term, permanent):: CDD

List of publications from the thesis work:

1. Franciosa, I., Alessandria, V., Dolci, P., Rantsiou, K., & Cocolin, L. Sausage fermentation and starter cultures in the era of molecular biology methods. *Int J Food Microbiol.* 2018, 279, 26-32.
2. Franciosa, I., Coton, M., Ferrocino, I., Corvaglia, M. R., Poirier, E., Jany, J. L., ... & Mounier, J. Mycobiota dynamics and mycotoxin detection in PGI Salame Piemonte. *J Appl Microbiol.* In press.
3. Franciosa I., Ferrocino I., Giordano M., Mounier J., Rantsiou K., Cocolin C. Specific metagenomic asset drives the spontaneous fermentation of Italian sausages. *Food Res Int*, 110379, 20121.

Surname, first name: Quéro Laura

Date of PhD beginning and PhD defence: 01/12/2015- 21/12/2018

Thesis supervision: Jérôme Mounier

Professional status and location: Ingénieur Application, bioMérieux, Rennes

Contract profile (post-doc, fixed-term, permanent): CDI

List of publications from the thesis work:

1. Quéro L, Courault P, Cellière B, Lorber S, Jany JL, Puel O, Girard V, Vasseur V, Nodet P, Mounier J. Application of MALDI-TOF MS to species complex differentiation and strain typing of food related fungi: Case studies with *Aspergillus* section *Flavi* species and *Penicillium roqueforti* isolates. *Food Microbiol.* 2020. 86:103311.
2. Quéro L, Girard V, Pawtowski A, Tréguer S, Weill A, Arend S, Cellière B, Polsinelli S, Monnin V, van Belkum A, Vasseur V, Nodet P, Mounier J. Development and application of MALDI-TOF MS for identification of food spoilage fungi. *Food Microbiol.* 2019. 81:76-88.

Surname, first name: Nguyen Van Long, Nicolas

Date of PhD beginning and PhD defence: 01/10/2014- 11/10/2017

Thesis supervision: Jérôme Mounier

Professional status and location: Chef de projet, ADRIA Quimper

Contract profile (post-doc, fixed-term, permanent): CDI

List of publications from the thesis work:

1. Nguyen Van Long, N., Rigalma, K., Coroller, L., Dadure, R., Debaets, S., Mounier, J., Vasseur, V. Modelling the effect of water activity reduction by sodium chloride or glycerol on conidial germination and radial growth of filamentous fungi encountered in dairy foods. *Food Microbiol.* 2017. 68: 7-15.
2. Nguyen Van Long, N.N., Vasseur, V., Couvert, O., Coroller, L., Burlot, M., Rigalma, K., Mounier, J. Modeling the effect of modified atmospheres on conidial germination of fungi from dairy foods. 2017. *Frontiers in Microbiol.*, 8: art. no. 2109. 13.

3. Nguyen Van Long N, Vasseur V, Coroller L, Dantigny P, Le Panse S, Weill A, Mounier J, Rigalma K. Temperature, water activity and pH during conidia production affect the physiological state and germination time of *Penicillium* species. *Int J Food Microbiol.* 2017. 241: 151-160.

Surname, first name: Garnier, Lucille

Date of PhD beginning and PhD defence: 01/10/2014- 2/10/2017

Thesis supervision: Jérôme Mounier

Professional status and location: Coordinatrice pédagogique, Dax

Contract profile (post-doc, fixed-term, permanent): CDI

List of publications from the thesis work:

1. Garnier L, Salas ML, Pinon N, Wiernasz N, Pawtowski A, Coton E, Mounier J, Valence F. Technical note: High-throughput method for antifungal activity screening in a cheese-mimicking model. *J Dairy Sci.* 2018. pii: S0022-0302(18)30275-3.
2. Garnier, L., Valence, F., Mounier, J. Diversity and Control of Spoilage Fungi in Dairy Products: An Update. *Microorganisms.* 2017. 5: 42-52.
3. Garnier L, Valence F, Pawtowski A, Auhustsinava-Galerie L, Frotté N, Baroncelli R, Deniel F, Coton E, Mounier J. Diversity of spoilage fungi associated with various French dairy products. *Int J Food Microbiol.* 2017. 241: 191-197.
4. Coton, M., Lebreton, M., Leyva Salas, M., Garnier, L., Navarri, M., Pawtowski, A., Le Blay, G., Valence, F., Coton, E., Mounier, J. Biogenic amine and antibiotic resistance profiles determined for lactic acid bacteria and a propionibacterium prior to use as antifungal bioprotective cultures *Int Dairy J.* 2018. 1: 21-26.
5. Garnier L, Mounier J, Lê S, Pawtowski A, Pinon N, Camier B, Chatel M, Garric G, Thierry A, Coton E, Valence F. Development of antifungal ingredients for dairy products: From in vitro screening to pilot scale application. *Food Microbiol.* 2019.81:97-107.
6. Péter G, Mounier J, Garnier L, Soós D, Dlačny D. *Cutaneotrichosporon suis* sp. nov., a lipolytic yeast species from food and food-related environment. *Int J Syst Evol Microbiol.* 2019. 69:2367-2371.
7. Garnier, L., Penland, M., Thierry, A., Maillard, M. B., Jardin, J., Coton, M., ... & Mounier, J. (2020). Antifungal activity of fermented dairy ingredients: identification of antifungal compounds. . *Int J Food Microbiol*, 322, 108574.

Surname, first name: Offret, Clément

Date of PhD beginning and PhD defence:01/09/2013- 27/09/2016

Thesis supervision: Jérôme Mounier

Professional status and location: Post-doctorant, Université de Brest

Contract profile (post-doc, fixed-term, permanent): CDD

List of publications from the thesis work:

Offret C, Rochard V, Laguerre H, Mounier J, Huchette S, Brillet B, Le Chevalier P, Fleury Y. Protective Efficacy of a *Pseudoalteromonas* Strain in European Abalone, *Haliotis tuberculata*, Infected with *Vibrio harveyi* ORM4. *Probiotics Antimicrob Proteins.* 2018.

Offret C, Desriac F, Le Chevalier P, Mounier J, Jégou C, Fleury Y. Spotlight on Antimicrobial Metabolites from the Marine Bacteria *Pseudoalteromonas*: Chemodiversity and Ecological Significance. *Mar Drugs.* 2016. 14 . pii: E129.

Offret C., Jégou C., Mounier J., Fleury Y., Le Chevalier P. New insights into the haemo- and coelo-microbiota with antimicrobial activity from Echinodermata and Mollusca. *J Appl Microbiol.* 2019 : 1023-1037.

Surname, first name: Legrand, Fabienne

Date of PhD beginning and PhD defence: 1/05/2014 au 16/10 2017

Thesis supervision: Gaétan Le Floch

Professional status and location: ANSES, Paris

Contract profile (post-doc, fixed-term, permanent): CDI

List of publications from the thesis work:

1. Legrand, F., Chen, W., Cobo-Díaz, J. F., Picot, A. and Le Floch, G. Effects of agronomic practices and soil properties in soil fungistasis against *Fusarium graminearum*. *FEMS Microbial Ecology*. 95, fiz056.
2. Legrand, F., Picot, A., Cobo-Díaz, J.F., Carof M., Chen, W. and Le Floch, G. 2018 Effect of tillage and static abiotic soil properties on microbial diversity. *Applied Soil Ecology* 132 :135-145
3. Legrand, F., Picot, A., Cobo-Díaz, J. F., Delaunois, B., Cor, O., Barbier, G. and Le Floch, G. 2018 Development of qPCR assays to monitor the ability of *Gliocladium catenulatum* J1446 to reduce the cereal pathogen *Fusarium graminearum* inoculum in soils. *European Journal of Plant Pathology*, 152:285–295.
4. Legrand, F., Picot, A., Cobo-Díaz, J. F., Chen, W. and Le Floch, G. 2017 Challenges facing the biological control strategies for the management of *Fusarium* Head Blight of cereals caused by *F. graminearum*. *Biological Control* 113, 26–38.

Surname, first name: Guillaume DUBRULLE

Date of PhD beginning and PhD defence: 01.10.2016 – 30.09.2019

Thesis supervision: Gaetan LE FLOCH

Professional status and location: ATER, Univ. Toulouse

Contract profile (post-doc, fixed-term, permanent): CDD

List of publications from the thesis work:

1. Dubrulle G, Picot A, Madec S, Corre E, Pawtowski A, Baroncelli R, Zivy M, Balliau T, Le Floch G, Pensec F. 2020. Deciphering the infectious process of *Colletotrichum lupini* in lupin through transcriptomic and proteomic analysis. *Microorganisms*, 8: 1621.
2. Dubrulle G., Pensec F., Picot A., Rigalma K., Pawtowski A., Nicolleau S., Harzic N., Nodet P., Baroncelli R., Le Floch G., 2020. Phylogenetic Diversity and Effect of Temperature on Pathogenicity of *Colletotrichum lupini*. *Plant Disease*, 104 (3)

Five main recent publications of the supervisors on thesis subject:

- Franciosa, I., Coton, M., Ferrocino, I., Corvaglia, M. R., Poirier, E., Jany, J. L., ... & Mounier, J. (2021). Mycobiota dynamics and mycotoxin detection in PGI Salame Piemonte. *J Appl Microbiol*. In press.
- Penland M., Mounier J., Pawtowski A., Tréguer S., Deutsch S.-M., Coton M. (2021). Use of metabarcoding and source tracking to identify desirable or spoilage autochthonous microorganism sources during black olive fermentations. *Food Res Int*, 144, 110344.
- Garnier L, Valence F, Pawtowski A, Auhustsinava-Galerie L, Frotté N, Baroncelli R, Deniel F, Coton E, Mounier J. Diversity of spoilage fungi associated with various French dairy products. *Int J Food Microbiol*. 2017. 241, 191-197.
- Quéro L, Girard V, Pawtowski A, Tréguer S, Weill A, Arend S, Cellière B, Polsinelli S, Monnin V, van Belkum A, Vasseur V, Nodet P, Mounier J. Development and application of MALDI-TOF MS for identification of food spoilage fungi. *Food Microbiol*. 2019. 81:76-88.
- Cobo-Díaz Jf, Baroncelli R, Le Floch G, Picot A. 2019. A novel metabarcoding approach to investigate the composition of *Fusarium* species in soil and plant samples. *FEMS Microbial Ecology*. 95, fiz084. doi : 10.1093/femsec/fiz084

Cobo-Díaz Jf, Baroncelli R, Le Floch G, **Picot A.** 2019. Combined metabarcoding and co-occurrence network analysis to profile the bacterial, fungal and *Fusarium* communities and their interactions in maize stalks. *Frontiers in Microbiology*. 10, 61. doi: 10.3389/fmicb.2019.00261.

Legrand F, Chen W, Cobo-Díaz Jf, **Picot A,** Le Floch G. 2019. Co-occurrence analysis reveal that biotic and abiotic factors influence soil fungistasis against *Fusarium graminearum*. *FEMS Microbial Ecology*. 95, fiz056. doi :10.1093/femsec/fiz056

Legrand F, **Picot A,** Cobo-Díaz Jf, Carof M, Chen W, Le Floch G. 2018 Effect of tillage and static abiotic soil properties on microbial diversity. *Applied Soil Ecology* 132 :135-145 doi : 10.1016/j.apsoil.2018.08.016

THESIS FUNDING

Origin(s) of the thesis funding: ANR

Gross monthly salary: 1770 euros

Thesis funding state : Acquired

Funding beginning date/Funding ending date: Oct 4th 2021, 3 years

Date: April 14th 2021

Name, signature of unit director: Emmanuel Coton



Name, signature of team director: Jérôme Mounier



Name, signature of thesis project director: Jérôme Mounier

