

## Presentation of the funded projects in 2010 for the "Food and Food Industries" Programme

<b>ACRONYM and project title</b>	<b>Page</b>
<b>ORALISENS</b> – Oral sphere: salivary markers and food. A prospective study on children expressing oral disorders	3
<b>MAP'OPT</b> – Equilibrium gas composition in modified atmosphere packaging and food quality	5
<b>OENOPOLYS</b> – Polysaccharides of the lactic acid bacterium <i>Oenococcus oeni</i> : from structure and biosynthetic pathway determination to technological implementation	7
<b>FISH-PARASITES</b> – Fish parasites: hazard identification, impact, and researches to define an efficient strategy of prevention	9
<b>PHENOMENEP</b> – Phenotyping using Metabolomics for Nutritional Epidemiology	11
<b>POLIVD3</b> – Olive oil polyphenols, vitamin D and DHA synergistic effects on locomotor function	13
<b>SAFEFOODPACK DESIGN</b> – Computer-aided design of safe food plastic packaging	15
<b>WHEAFI</b> – Evaluation of anti-inflammatory properties of different sources of wheat grain dietary fibres	17
<b>MIRABEL</b> – Integrated framework for risk and cost/benefit analysis of food allergens	19
<b>PRESAGE</b> – Improving renutrition efficiency in elderly malnourished people for a better ageing	21

<b>SECURIVIANDE</b> – Strategies of prevention of colon carcinogenesis in production and processing of meats	23
<b>SURFING</b> – Starter SURFace against INFlammation of the Gut: Role of Lactobacillus delbrueckii and Propionibacterium freudenreichii surface proteins in the modulation of gut inflammation	25
<b>ECOBIOPRO</b> – Exploration of microbial ecosystems of fish and meat products: effects of bio-protective cultures	27

# “Food and Food Industries” programme

**YEAR 2010**

## Project title

**ORALISENS** – Oral sphere: salivary markers and food. A prospective study on children expressing oral disorders

## Abstract

In Human, the oral sphere is the first and main place where food sensory stimuli are released and perceived. The phenomena occurring during food breakdown and sensory perception are complex and in this system saliva plays a major role. In the last ten years, the increasing researches on human saliva revealed the extreme complexity of this biological fluid, in terms of protein and small molecules composition. As such, saliva may carry the biological signature of an individual. Related to food, the objective of ORALISENS is to evaluate whether this biological signature is established during early oral exposition to food and whether it reflects the future oral sensitivity of an individual to food (measured through food choices and habits). A mean to prove this concept is to follow children who had an oral by-pass during critical phases of food behaviour development, and to evaluate its consequence on saliva composition in relation to oral food sensitivity and food behaviour. This experimental paradigm is the core of ORALISENS. As such, ORALISENS is a fundamental project presented as a proof concept. In order to reach the main ORALISENS' objective, a multi-targeted global analysis of saliva will be conducted during one year on saliva of 20 children who had an early oral by-pass and who are currently suffering from an oral disorder. In parallel, food behaviour of these children will be studied. These children will be compared to a population of 20 children who do not suffer from oral disorder. Three academic partners are involved in the project. They represent different disciplines and expertise (Biochemistry, Consumer science, Statistics, Medecin, Pediatric studies). The multi-targeted global analysis of saliva will consist in metabolomic, proteomic (Seldi-TOF and 2D) and peptidomic (Maldi-TOF) analyses. Additionally, more specific analyses will be conducted: physico-chemical parameters and enzymes (lipids, ions, flow, protein amount, amino-acids, lipase, amylase, protease, antioxidant capacity ...). All analyses will be done on saliva collected before and after taste stimulation. In parallel, food habits and diet will be monitored. Ultimately, a joint data analysis will correlate all the data sets generated by ORALISENS in order to identify different saliva markers related to ORALISENS' proof concept. If successful, ORALISENS will

open new perspectives in the field of researches conducted on human saliva. In particular, it will permit to propose novel approaches to study human food behaviour and to propose predictive tools and correcting strategy related to food disorders or habits.

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and duration**

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**Reference**

ANR-10-ALIA-001

**Cluster label**

VITAGORA

**Project title****MAP'OPT – Equilibrium gas composition in modified atmosphere packaging and food quality****Abstract**

The objective of MAP'OPT project is to explain, quantify and model the effects of modified atmospheres according to packaging film type. Interactions between determining factors and their effects on the effectiveness of MAP will be evaluated. In parallel, methods will be assessed to characterise the effect of gas on food properties. The main factors that will be studied include the characteristics of films, gas composition, their diffusion properties, headspace volume and the weight of the food product. The nature of microorganisms and their respiratory metabolism (aerobic, anaerobic, microaerophilic) are also key factors in this project. Only non-respiring food products will be studied. Impact of gas composition in the headspace on spoilage mechanisms as oxidation will be evaluated. The input data of this project include the available and/or published data on the microbial behaviour under modified atmospheres and on the specific effects of each gas, already acquired knowledge on the gas diffusion through the film or between the headspace and the food product and the laws that govern the diffusion of gases. A general schematic diagramme of the model will be validated and the necessary data for defining the parameters of the models will be collected. The underlying assumptions of the model will be validated: laws of gas diffusion and models on the effects of gas on microbial growth curves. Based on new, acquired and existing data, we will construct models that can assess microbial behaviour according to film type and gas composition of the modified atmosphere. This project is expected to lead to a quantitative approach for optimising barriers properties of packaging films and modified atmospheres composition to ensure better food quality. According to the type of food product and knowledge of the microflora that limits its shelf life, this project aims to determine the parameters to be estimated to optimise the gas mixture and the choice of film. Based on the developed models, the volume of the food package can also be optimized. The Sym'Previous data intergration system will be completed in order to capitalize the new data which will be input in this project. A new database will be designed to modelise the knowledge on the gas diffusion through the film or between the headspace and the food product, and on the impact of gas on bacterial behaviour. Consequently, the Sym'Previous domain onthology will be complemented to take into account the new knowledge. This project gathers expertises in mass transfer, physical characteristics of food, in packaging, microbiology, biostatistics, quantitative modelling and Bayesian statistics and Bayesian networks. The projet has

to supply to the scientific community with criteria for the development of new packaging contributing to the safety of food and to the sustainable development.

**Partners**

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and duration**

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**Reference**

ANR-10-ALIA-002

**Cluster label**

VALORIAL - l'Aliment de demain

**Project title****OENOPOLYS – Polysaccharides of the lactic acid bacterium *Oenococcus oeni* : from structure and biosynthetic pathway determination to technological implementation****Abstract**

Apart from plant polysaccharides, microbial polysaccharides are receiving growing interest. Indeed, some display novel chemical structures associated with unique behavior in solution, which can be very interesting for the food industry. Lactic acid bacteria have the GRAS status and are used in traditional as well as in industrial food fermentations. Among them, *Oenococcus oeni* is of interest because it has a small, rapidly evolving genome and a specific ecological niche restricted to wine. Bacteria belonging to this species perform malolactic fermentation (MLF) in most wines in temperate regions, either spontaneously (indigenous grapes flora) or after addition of strains selected and produced industrially (commercial malolactic starters). The ability of malolactic starters to produce exopolysaccharides (EPS) is not so far a criterion used during selection. However, this property could be crucial, when considering the potential impact of these polysaccharides on the colloidal stability and organoleptic properties of wine. The EPS produced by *O. oeni* could also protect the bacteria during their industrial production, their storage or during their inoculation into the wine (providing resistance to acid shock, ethanol or phages). The tremendous diversity within the *O. oeni* species is currently assessed in the DivOeni (2008-2011) ANR project. As part of these studies, different strains of *O. oeni* with outstanding EPS production have been identified. The structure of these polymers, the genes dedicated to their production and export, the impact of EPS on wine quality and their biological role are still unknown. The current project aims to address these major issues and will bring together three academic partners who are key experts in the field in a collaborative effort, as well as an industrial partner, leader in the selection and production of enological starters. The project is expected to provide the following essential results: i; a comprehensive inventory of genes dedicated to the synthesis of EPS in the species *O. oeni* with particular attention to strains showing remarkable phenotypes, ii; the identification of the polysaccharides structures, iii; the respective role of each glycosyltransferase involved in the synthesis, iv; the interactions and physiological consequences of the presence of several polysaccharides biosynthetic pathways within a given *O. oeni* strain- which is frequent in the species- , v; the technological interest of the polysaccharides and of the producing-strains when they are used as additives during

winemaking (impact of the colloidal stability and palatability), and vi; ,more sustainable processes for starter production and storage enhancing the resistance of starters by stimulating the EPS formation may be developed. The latter result might have a strong impact on winemaking practices as it might reduce the cost of industrial malolactic starters and enable to generalize their use by winemakers, thus producing wines of better quality, under controlled conditions, and with a reduced electric or energetic consumption.

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**Reference** ANR-10-ALIA-003

**Cluster label**

**Project title****FISH-PARASITES – Fish parasites: hazard identification, impact, and researches to define an efficient strategy of prevention****Abstract**

Protozoan and Metazoan parasites frequently infest edible fishes worldwide. Some of them are both fish pathogens and recognized agents of important zoonoses with high public health impact. In addition, uncertainty exists about the potential ability of other fish pathogens to infect humans. Meanwhile, parasitized fish can be found often enough in European fish stores. Furthermore, some parasites of fish are able to alter the organoleptic properties of fish products, having therefore a negative impact on fish industry. For these reasons, the present project is targeting fish parasites with impact on both health of consumers and quality of seafood. It proposes a reappraisal of fish-parasite related hazards by developing cost-effective innovative methods to detect eukaryotic pathogens in edible fish, associated with adapted training programs. It focuses mainly on both *Anisakidae* and *Diphyllobothriidae* larvae that cause two emerging helminthic diseases: anisakiasis and diphyllobothriasis, respectively. The growing consuming of marinated (or not) raw food, "exotic" or takeaway dishes and marked increase of out-of-home-food could favour the emergence of both typical anisakiasis and Anisakis-induced allergy. Interestingly, 43 % of restaurants and delicatessens did not freeze fish or did not use frozen fish for raw fish dishes. Likewise, the number of human cases of diphyllobothriasis due to the consumption of raw or undercooked freshwater fish from Alpine Lakes increased for the last years. This proposal targeted also the Apicomplexan protists of *Cryptosporidium* genus. In short, the pathogenic power to humans of fish-derived *Cryptosporidium* is unknown. We showed recently that *C. molnari* (from dorada and sea bass) was unable to infect SCID mice. We do not know, however, if other fish-derived *Cryptosporidium* species or strains are infectious to mammals. The diversity of *Cryptosporidium* genus could be important in sea- or freshwater teleosteans. We are able to detect, identify and describe new *Cryptosporidium* species on molecular and phenotypic bases as well as to explore their pathogenic power to mammals in a highly reproducible experimental model well mastered by BDEEP members. This project presents an integrative online approach in order to generate updated conceptions about edible-fish parasites, and innovative procedures to detect and identify them. Moreover, the present project (a) proposes a rationale screening activity of parasites harboured by edible fish as an added technological value integrated into an industrial structure or business establishment; (b) aims at integrating health safety,

nutritional quality, organoleptic quality, practical wisdom and reasonable costs; (c) proposes the combination of know-how of IFREMER specialists in quality of fish products, AFSSA specialists in microbiological health risk and protection of consumers, CEVPM specialists in RD and biotechnology of seafood products, skill of LASMEA and ARBOR Technology in conception and manufacturing of device for food industry; (d) parasitology specialists of three recognized centres: 'Biology & Diversity of Emerging Eukaryotic Pathogens' service of Lille Pasteur Institute (BDEEP, EA3609-Lille-2 University, formerly 'Ecology of Parasitism'), specialized in emerging parasitic Protists and protist-like organisms, Parasitology-Mycolology Central Lab of Cochin Hospital (Paris), specialized in Diphyllbothridae tapeworms and Parasitology laboratory of Public Health Sciences, DSSP, Sapienza Roma University (Rome) specialized in metazoan parasites of fish and marine mammals.

**Partners**

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 HALIOMER  
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**Reference**

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**Cluster label**

Aquimer (ex Filière halieutique - produits aquatiques)

**Abstract**

The purpose of dietary assessment is to estimate intake of foods, nutrients, bioactive compounds and food contaminants for exploration of associations with health outcomes and monitoring of population nutritional status. These data are still extremely difficult to obtain, especially at the individual level, due to the wide range of foods consumed and the high heterogeneity and variability of human dietary choices. Current methods based on questionnaires and a limited number of validated biomarkers of intake available are definitely not sufficient to assess dietary intakes with the accuracy and level of detail required for modern epidemiology. Evidence has mounting that much of the inconsistency of the results in nutritional epidemiology is largely due to poor dietary assessment. This project aims at developing a new innovative and integrative approach, based on mass spectrometry metabolomics, to characterize dietary intake and nutritional status of populations. Progress in high-throughput analytical technologies and in bioinformatics now allows the simultaneous analysis of hundred(s) of low molecular weight metabolites present in biofluids or tissues and constituting the metabolome, including all metabolites directly coming from the digestion and metabolism of food components. This part of the metabolome, called the Food metabolome, encompass a huge diversity of food components that are absorbed in the gut. Any given plant food contains a few hundreds of phytochemicals from different chemical families, which when ingested with the food, are absorbed to various extent and transformed in the body by intestinal and hepatic enzymes, as well as by the microbiota, into a number of metabolites, some of them being still unidentified. Our hypothesis is that the comparison of the phytochemical part of the metabolome of individuals consuming or not a specific plant food or a F&V -rich diet should lead to the discovery of new biomarkers of intake for these foods and diets. The proposal builds on some preliminary results obtained with the Agruvasc project (ANR ALIA 2007-2009), in which we clearly discriminated urine metabolomes of subjects consuming Citrus juices, both as part of a fully controlled diet or with their regular diet. Several phytochemical metabolites reflecting citrus intake could be identified. Some were expected but most of them had not been recognized before and would have never been anticipated as putative biomarkers using a traditional approach. PhenoMeNEp will be the first attempt worldwide to search biomarkers of food intake using metabolomics in a cohort study. Two subgroups of volunteers from the SU.VI.MAX2 cohort, with contrasted

level of fruit and vegetable (F&V) intake as assessed by questionnaires (1st vs 5th quintile of intake) will be selected. Plasma and urine metabolomes will be explored to identify biomarkers reflecting the consumption of F&V-rich diet or of 11 specific plant foods selected for their interest in chronic disease prevention. The metabolomic approach offers a considerable promise for dietary assessment; however progress is still hampered by several methodological problems, especially the difficulties met for annotating metabolites of phytochemicals. Primary objectives of the project will be to develop optimized MS-based analytical method and data mining workflow for the food metabolome, including a Food Metabolome database containing information on phytochemical metabolites. These developments are highly expected by the scientific community. They will make possible the full exploitation of the wealth of diet-relative information contained in the human metabolome. The project will rely on the complementary competencies from UREN (Unité de Recherche en Epidémiologie Nutritionnelle U 557 Inserm/ U 1125 Inra / CNAM /Université Paris 13) and UNH (Unité de Nutrition Humaine UMR 1019- INRA Clermont-Theix/Univ. Auvergne), regarding epidemiology, phytochemical metabolism and metabolomics.

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**ANR funding**

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**Starting date and duration**

January 2011 - 24 months

**Reference**

ANR-10-ALIA-007

**Cluster label**

**Project title****POLIVD3 – Olive oil polyphenols, vitamin D and DHA synergistic effects on locomotor function****Abstract**

All industrialised countries face a progressive increase in life expectancy, leading to a growing prevalence of chronic age-related conditions. This is why, alterations of the locomotor system (such as osteoporosis or sarcopenia) are now considered as major health and socio-economic problems world-wide. Because for such diseases the golden rule is prevention, health professionals strongly advocate implementing new strategies of proven clinical value to provide a wide array of treatments. Consequently, our project, which aims at developing new science-based dietary strategies to prevent bone and muscle loss (and to reduce fat mass), deals with issues high on the agenda of the current debate on quality of life, the first goal of prevention in the elderly population being to avoid or delay functional impairments resulting from such chronic conditions. To address this issue, pOLIVd3 is developing an innovative approach integrating the human complexity at the physiological (bone, muscle, adipose tissue), metabolic (low grade inflammation, oxidative stress, cell behavior) and nutritional levels (synergistic effects between fatty acids, lipophilic polyphenols, vitamin D), the main objective being to develop new science-based nutritional strategies to prevent dysfunction of the locomotor system. To achieve this goal, the proposal is built on a translational and integrated (from whole body to intracellular metabolisms) and interdisciplinary approach (physiology, cellular and molecular biology, chemistry, nutrition, food science, high throughput approaches (omics), consumers' survey). A growing body of evidence has contributed to stress the importance of nutritional preventive measures. Nevertheless, so far, our understanding of the influence of nutrition on bone and muscle health has mainly focused on calcium and proteins. In this light, the present proposal will provide new and salient conceptualisations because the working hypothesis is based on mechanisms leading to bone and muscle dysfunction, i.e. low grade inflammation and oxidative stress. Moreover, adipose tissue will be targeted, as well, because it shares same stem cells with both the skeleton and muscles and because its major input in inflammatory processes. In this light, pOLIVd3 will determine the effect of polyphenols from olive oil, endowed with such anti-oxidant and anti-inflammatory properties, and if addition of Vitamin D or specific fatty acids elicits synergistic effects. pOLIVd3 will also decipher the cellular and molecular mechanisms responsible for leading to health benefits. A series of studies will be performed in animals and in cell cultures (ex vivo), to select

the best combination and to understand the different regulatory pathways. Moreover, an investigation will be performed to assess if synergistic effects could also be induced on intestinal absorption. A clinical trial will then be set up to check if the results can be extrapolated to the human situation. Finally, a consumers' survey will allow studying the interest for such original foods. Such an approach should thus dramatically improve our understanding of nutritional prevention of chronic aged related conditions, thereby advancing our ability to progress towards nutritional needs for the elderly population. It consequently will be the basis for the food-processing industry, as well. Those goals will be achieved through a multidisciplinary approach, including nutritionists, clinicians, molecular and cellular biologists, physiologists, chemists. Finally, it is of major interest to notice that this innovative project gathers 1) scientists with long standing experience in the field of bone, muscle, adipose tissue or intestine and highly acknowledged expertise on polyphenols and fatty acids, 2) one the fourth Human Nutrition Research Centres in France, 3) the first Agro-Science Research Center in France and 4) the first Company in France for virgin and refined oils to consumers.

**Partners**

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**ANR funding**

872 k€

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March 2011 - 36 months

**Reference**

ANR-10-ALIA-008

**Cluster label**

Pôle Européen d'Innovation Fruits et Légumes (PEIFL)

**Abstract**

The primary aim of the research program is to develop a general framework to tailor the design of barrier and safe food packaging systems. As the project will reuse a significant amount of data and methods from basic research and previous EU research programs, it is complementary of the EU effort more specifically directed upstream towards chemical companies and regulatory authorities. The paradigm is however changed: i) by integrating the safety of packaging materials as a component of food engineering (i.e. safe by design instead of controlled as safe) and ii) by making it possible to integrate efficiently the risk of the migration of packaging constituents into food within international food safety standards (e.g. recent ISO 22000-2200x standards). In particular, the project will seek methods and tools that facilitate the cooperation between stakeholders (downstream and upstream) and generate auditable requirements. Generated results and methods will be integrated into an open-source client-server platform, so-called SafeFoodPack Design, including: i) safe design methodologies (Failure Mode Effects and Critical Analysis), ii) simulations tools to optimize barrier properties and minimize the risk of migration of packaging constituent during specific conditions of use (product shelf-life, temperature of storage, hot filling, oven heating...), iii) databases (formulation rulebases, physico-chemical data) and iv) traceability management tools. As the platform will rely exclusively on open standards, it will make it possible to integrate it seamlessly within existing tools used in industries and laboratories, and to share common data formats between stakeholders. In particular, the whole approach will contribute to integrate more efficiently cost (mass reduction), environmental constraints (e.g. use of recycled materials, bio-sourced or biodegradable alternative materials), process constraints (hot filling, aseptic treatments...). By its construction, the project, supported by the National thematic network PROPACFOOD, is representative of the whole French food packaging sector including the leading professional associations of both Food and Packaging Industries, the national reference laboratories supporting the industry or acting as enforcement laboratory and the leading research laboratories in France on the topic. Rapid and efficient dissemination will be managed by creating a pool of companies (external to the project) that will profit along the project of the proposed framework and training sessions. In return, an efficient feedback from end-users is expected as well a significant impact on upstream stakeholders (Chemical Industry, EU regulatory and

surveillance authorities). Customer associations will be invited to participate to our debates.

**Partners**

GENIAL / INRA  
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SCL33  
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**ANR funding**

790 k€

**Starting date  
and duration**

January 2011 - 36 months

**Reference**

ANR-10-ALIA-009

**Cluster label**

VITAGORA

**Project title****WHEAFI – Evaluation of anti-inflammatory properties of different sources of wheat grain dietary fibres****Abstract**

Cardiovascular diseases, diabetes and obesity are major health problems in Western Europe and Northern America. The general nutritional recommendation is a lowering of lipids intake and an increase in the consumption of complex carbohydrates, with a promotion of food exhibiting a low Glycemic Index and a high dietary fibre content. Today the dietary fibre intake fails to meet the recommendations and in most cases the trend for population is to eat less fibre not more. The cereals products, one of the pillars of a healthy diet, clearly might help to increase dietary fibre intake in French population. The WHEAFI project aims at developing cereal food enriched with fibre selected for their nutritional properties. The objective of this project is to determine the ability of fibre enrichment to reduce chronic inflammatory processes in overweight population. These results could be extrapolated to the reduction of chronic nutrition diseases (as diabetes and CVD) in general population. Systemic inflammation is increasingly recognized as an important mediator of coronary artery disease, chronic degenerative diseases such as diabetes and Alzheimer dementia and other chronic diseases such as metabolic syndrome and obesity. Epidemiological studies have shown the reduction of coronary heart disease, of oxidant stress and of inflammation by intake of dietary fibre, cereal fibre (wheat bran) and whole grain. Unexpectedly, there are some contradictory results between studies that have evaluated the short and long term effects of wheat bran and whole grains on human health. However depending on their specific chemical structure, physico-chemical property (solubility/viscosity) and fermentation ability, cereal dietary fibre may have considerable different extent of effects. The main hypothesis of this project is that prebiotic effect of specific wheat dietary fibres (endosperm, aleurone), modulation of colic microflora and formation of SCFA (butyrate) contribute to the reduction of inflammatory process. A clinical study with food enriched in different wheat dietary fibres is proposed to explore the potential favourable effects as observed epidemiologically, and to understand the anti-inflammatory effect and long-term reduction of chronic diseases. In addition, new assay methods will be developed to assay AX and grain tissues. These assays will help to select wheat dietary fibres for their nutritional effects. This project gathers academic and industrial partners in order to bring new insights in the domain of nutrition and to help the development of cereal products with an improved nutritional quality.

**Partners**

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**ANR funding**

630 k€

**Starting date  
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January 2011 - 36 months

**Reference**

ANR-10-ALIA-010

**Cluster label**

Céréales Vallée, VITAGORA

**Project title****MIRABEL – Integrated framework for risk and cost/benefit analysis of food allergens****Abstract**

Allergenic foods represent a significant health risk for persons who have an allergy to specific food. However, this risk remains poorly characterised. Knowledge is often missing on the different risk components such as the presence of allergens in food, food consumption behaviours of allergic sufferers and thresholds of reaction. Usual risk assessment approaches cannot be easily implemented to assess the risk from sporadic contamination and that concerns only a small part of the population. As a consequence, there is a lack of risk-based guidance and operational tools of those involved in allergen risk management, who are the food industries, the allergic individuals and the food regulators. To upgrade knowledge, methodological and operational tools in food allergy, MIRABEL project involves various scientific fields such as chemical analysis, dietary survey, medical research, socio-economics, applied mathematics and statistics to exposure and risk assessments. In this way, MIRABEL project, which enters in the field of fundamental research, aims to set an integrated and operational framework for the allergic risk analysis, in order to improve quality of life of allergic sufferers. Each component of the risk will be investigated in order to accurately characterize the risk of food allergy and to test different risk management options. To complete existing but sparse information, field surveys will be conducted in order to acquire accurate data on allergic consumers' behaviours relating to allergen-containing products and their thresholds of reaction, and to allergen presence in food consumed by allergic sufferers. In parallel, methodological developments in Bayesian statistics and probabilistic modelling will be realized to be able to combine the acquired data in an integrated risk quantification model. A cost-benefits analysis for the stakeholders (food industry, allergic individuals and regulators) will also be conducted to anticipate impacts of new policies. The project will be focused on the peanut, which can be adventitiously present in various foodstuffs such as chocolate, cereals or biscuits. This allergen is associated with the highest prevalence of food allergy and is one of the food allergens that lead to the most severe adverse effects.

**Partners**

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**ANR funding** 599 k€

**Starting date and duration** January 2011 - 42 months

**Reference** ANR-10-ALIA-012

**Cluster label**

**Project title****PRESAGE – Improving renutrition efficiency in elderly malnourished people for a better ageing****Abstract**

Aging is a physiological mechanism that induces a progressive loss of functional capacities of several tissues. In aged people, this is highlighted by an increase in frailty and a decrease in physical and cognitive performances. Consequently, aging exposes to loss of autonomy and major consequences (notably malnutrition), which results in heavy treatments, blunting of quality of life, important costs, and hospitalisation. In this context, malnutrition is a major factor of loss of autonomy. Physical function depends on strong and coordinate interactions between several physiological mechanisms and systems, i.e. nervous, skeletal and muscular systems. Both aging and malnutrition have pejorative issues on functional abilities by inducing negative alteration of these systems. To date, there is no significant difference in the management of malnutrition between elderly and younger people. Additionally, nutritional strategy or dietary complement specifically dedicated to aged malnourished people are not available. Nutritional products for malnourished aged patients are needed since the capacity of elderly persons to respond successfully to renutrition is less than in younger persons. In addition, their nutritional requirements are different. Clinicians need new approaches for a more efficient dietary management of malnutrition in elderly patients. The aim of the PRESAGE project is to study the efficiency of a specific oral complement for improving functional abilities of undernourished elderly people and more globally to prevent the loss of autonomy. The program is based on 5 inter-dependent tasks. Products under study will contain a mix of nutrients with action on muscle mass and function, on bone metabolism and function and on inflammation and cognition. We anticipate a synergistic action of these compounds to improve functional activity of malnourished aged patients. This concept is new since it puts together different nutrients with for each very well-known beneficial effect during malnutrition and ageing. According to this formulation, the project will be organized to answer several questions. The aim of the first part (task 1) is to evaluate the absorption rate and the availability of the product in malnourished aged patients. In a second task (task 2), the product will be given to nursing home residents with the aim to evaluate its effect on nutritional status, cognition, functional capacities and autonomy. To go further in the mechanisms, we also plan to refeed aged malnourished rats with either the complete formula or with each of the compounds separately and to evaluate their metabolic and functional effects on several tissues such as skeletal muscle,

bone and brain (tasks 3 and 4). The project will enable scientists from public and private structures involved to work together on an ambitious programme aimed at observing and experimenting the potential interest of a new nutritional concept for elderly malnourished people. Therefore, the results of this study will be communicated and transferred to the industrial and scientific communities by oral communication, articles and organisation of meetings (task 5). Finally, these data would be of industrial interest to market a product with this new formulation.

**Partners** Pôle Gériatrie  
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Private company

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**ANR funding** 900 k€

**Starting date and duration** March 2011 - 36 months

**Reference** ANR-10-ALIA-013

**Cluster label**

**Project title****SECURIVIANDE – Strategies of prevention of colon carcinogenesis in production and processing of meats****Abstract**

Colorectal cancer is the first cause of death in non-smokers: each day one hundred new cases are detected in France and 45 of them will die within few years. Red meat and processed meat intake is clearly a risk factor for colorectal cancer, according to meta-analyses of epidemiological studies. The increase in risk is not very high (+25-30%) but WCRF-2007 panel recommendations are strong: "Limit red meat intake (300 g/week at a population level), and avoid processed meat intake". These key recommendations to improve public health could lead to a drastic reduction of meat intake, and could have dramatic economical consequences be dramatic on the processed meat pork industry and on the bovine market. The research of preventive strategies is thus important to reduce colorectal cancer risk without eliminating any food from our plates. Two strategies can be considered: (i) industrial processes could be modified to produce healthier meat and processed meat, and (ii) consumers could adhere to specific recommendations (e.g., eating a specific protective food in the same meal as processed meat). The first suggestion would lead to production of processed meat without cancer risk, by changing food processing: the goal of this project is thus to define processing, and packaging that would improve food safety and decrease colorectal cancer risk. The central hypothesis is that heme iron in meat would increase lipoperoxidation, nitrosation and cytotoxicity of the intestinal content. Resulting aldehydes and N-nitrosated compounds would select tumor cells and promote tumor growth. The present project will thus test additives and processes to make beef and pork meat products that limit fat peroxidation, N-nitrosation, and cytotoxicity in the colon lumen. Most effective modifications will be identified in animal and cellular models, and these modifications will be validated in human volunteers. In addition, the research of molecular mechanisms should lead to new molecular biomarkers that we will use to translate results from rodents to Humans. Furthermore, the project aims to validate the acceptance of these new meat products by consumers, testing their sensory (organoleptic) properties. The project is structured in six steps: (i) beef and pork meat processing to obtain 28 beef meat products and 16 pork meat products. These products will be given to rodents to test (ii) the impact on peroxidation, cytotoxicity, nitrosylation and iron status in the colon. Following this step, six meat processes will be chosen, according to their effect on the above cited biomarkers. These six processed meats will be tested in rodents to see (iii) their

effect on colorectal carcinogenesis, and (iv) their cellular and molecular mechanisms of effect. (v) Relevance of these processes will be tested in "real life" industrial workshop. Eventually, three processes will be chosen to be tested in human volunteers (vi) to check their effect on fecal peroxidation and cytotoxicity and on consumer acceptance. This scientific project is thus part of the effort of food industry to improve continuously the safety of food products, and specifically to adapt to the recently identified cancer risk associated with meat consumption.

**Partners** UMR1089  
NovaLeads  
UMR1324  
CRNH  
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**Reference** ANR-10-ALIA-014

**Cluster label** VITAGORA, Cancer-Bio-Santé, AGRIMIP INNOVATION

**Project title****SURFING – Starter SURFace against INFlammation of the Gut: Role of Lactobacillus delbrueckii and Propionibacterium freudenreichii surface proteins in the modulation of gut inflammation****Abstract**

Inflammatory bowel diseases (IBD) constitute a main health concern in industrialized countries. Their incidence is currently about 1% of the population in these countries. In addition to some genetic predisposition, they are linked to lifestyle and diet. They are caused by a dysregulation of the immune system leading to disequilibrium between protection towards pathogens and tolerance towards gut commensal bacteria. Intestinal inflammation, key factor in IBD, can be partly treated by consumption of bacterial strains selected for their immunomodulatory and anti-inflammatory properties. In this context, the effect of some bacteria commercialized in this aim, mainly belonging to the genus *Bifidobacterium* or *Lactobacillus*, was thoroughly studied. *Propionibacterium freudenreichii* (*Pf*) and *Lactobacillus delbrueckii* (*Ld*) are two bacterial species massively used as starters in fermented dairy products. Despite this massive use, the anti-inflammatory potential of these two species is surprisingly rarely studied. *Pf* is massively ingested via the consumption of Swiss type cheeses and of a growing number of other cheeses in which this starter is more and more used to improve organoleptic properties. *Ld* is very abundant in various fermented dairy products. The subspecies *lactis* is more and more used in Swiss type cheeses because of its acidifying abilities. As an example, one gram of Emmental cheese contains 10<sup>8</sup> to 10<sup>9</sup> cells of *Pf* and 10<sup>3</sup> to 10<sup>9</sup> cells of *Ld*, which are potentially immunomodulatory. The *Ld* subspecies *bulgaricus* is also highly consumed in various fermented milks, including yogurt. In the SURFING project, we will focus on the immunomodulatory properties of these two dairy starters. Indeed, cheeses and fermented milks already on the market contain high amounts of *Pf* and *Ld*. These two bacteria can thus help in treating IBD, via specific surface components showing variable anti-inflammatory properties which are crucial and should be characterized. Our preliminary results revealed anti-inflammatory properties which are highly strain-dependent in both *Pf* and *Ld*. One selected strain of each species was tested in an experimental model of colitis in mice and revealed a promising protective effect. The aims of the SURFING project are: 1- Show that the ingestion of *Pf* or of *Ld* can have an anti-inflammatory impact in the context of IBD. 2- Identify the surface proteins responsible for the two species immunomodulatory properties

3- Elucidate the molecular mechanisms of the immune response triggered *in vitro* and *in vivo* in epithelial cells  
4- Confirm the presence of the key surface immunomodulatory proteins in real conditions during starter preparation and dairy products making using these *Pf* and *Ld* starters.

**Partners**

INRA STLO  
INRA MICALIS  
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**ANR funding**

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and duration**

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**Reference**

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**Cluster label**

VALORIAL - l'Aliment de demain, Nutrition Santé Longévité

**Project title****ECOBIOPRO – Exploration of microbial ecosystems of fish and meat products: effects of bio-protective cultures****Abstract**

Meat and seafood products are highly perishable foodstuffs, the preservation of which is crucial. Indeed, a bad preservation of these products may lead to important hygienic and safety risks as well as considerable economic loss, a situation that is particularly true for novel products. The utilisation of protective cultures in order to limit these risks is proposed since several years but is still not in common use, partially because a lack of knowledge of microbial ecosystems of these products. The partners of the French network FLOREPRO decided to share their know-how and scientific knowledge on one hand, and their various expertise about food on the other hand, in order to increase the knowledge of meat and seafood products and on the impact of protective cultures on these ecosystems and on the quality of the products. Our aim is thus to provide a sound scientific based information on the benefit that the utilisation of protective cultures may represent in the production of meat/fish foodstuffs. The project is divided into three tasks: - an as exhaustive as possible characterisation of the ecosystem of height selected products (meat and seafood) by the up to date most performing method, 16S rDNA pyrosequencing of the bacterial DNA present on these products, at the time of production and after the use by date. This task also encompasses the selection of putative spoiler micro-organisms from those products; - set up and sharing of model matrices and sensory analysis in order to reproduce spoilage and to prove the spoiling properties of the strains selected from the first task; - evaluation of the impact of already available protective cultures on spoilage, sensorial quality, and global ecosystem of the products we propose to study. The partners of this project are academics, agro institutes and one SME which was a pioneer in the commercialisation of protective cultures. Other industries, SMEs with no financial support, joined the project to furnish the foodstuffs to be analysed. Know-how, expertise and missions of the partners are complementary and about meat/fish products. The foodstuffs we selected are representative of a large panel of origins (beef, veal, poultry, fish, shellfish) and processes (ground, diced cubes, fillets, peeled) and concern novel products for which knowledge about their ecosystem and sanitary quality is scarce.

<b>Partners</b>	<p>INRA  INRA-Microbiologie  ONIRIS  IFREMER  ADIV  IFIP  ADRIA Normandie  AÉRIAL  HALIOMER  Biocéane  SOFRANOR  Siebert Volailles  Geo/Madrangle  Charal  Viviers Marins</p>
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<b>Reference</b>	ANR-10-ALIA-018
<b>Cluster label</b>	VALORIAL - l'Aliment de demain, INNOVIANDES (ex. Viandes et produits carnés), Aquimer (ex Filière halieutique - produits aquatiques)