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## BIA - Biopolymères, interactions assemblages

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# HCERES

High Council for the Evaluation of Research  
and Higher Education

Research units

HCERES report on interdisciplinary  
research unit:

Biopolymères Interactions Assemblages

BIA

Under the supervision of the following  
institutions and research bodies:

Institut National de la Recherche Agronomique - INRA

# HCERES

High Council for the Evaluation of Research  
and Higher Education

Research units

*In the name of HCERES,<sup>1</sup>*

Michel Cosnard, president

*In the name of the experts committee,<sup>2</sup>*

Martin Leser, chairman of the committee

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Under the decree No.2014-1365 dated 14 november 2014,

<sup>1</sup> The president of HCERES "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5)

<sup>2</sup> The evaluation reports "are signed by the chairman of the expert committee". (Article 11, paragraph 2)

## Evaluation report

This report is the sole result of evaluation by the expert committee, the composition of which is specified below.

The assessments contained herein are the expression of an independent and collegial reviewing by the committee.

**Unit name:** Biopolymères Interactions Assemblages

**Unit acronym:** BIA

**Label requested:** UR Inra

**Current number:** UR 1268

**Name of Director  
(2015-2016):** Mr Marc ANTON

**Name of Project Leader  
(2017-2021):** Mr Marc ANTON

## Expert committee members

**Chair:** Mr Martin LESER, Nestlé Research Center Lausanne, Switzerland

**Experts:**

- Ms Hélène FULCRAND, Inra, Montpellier (representative of CSS)
- Ms Karine GLINEL, Université catholique de Louvain, Belgium
- Ms Christiane HILGER, Luxembourg Institute of Health, Luxembourg
- Ms Gwyneth INGRAM, RDP, ENS, Lyon
- Ms Véronique SCHMITT, Centre de recherche Paul Pascal, Bordeaux

**Scientific delegates representing the HCERES:**

Mr Francois COQUET

Mr Jean-François HOCQUETTE

**Representative of supervising institutions and bodies:**

Ms Monique AXELOS, Inra

**Head of Doctoral School:**

Mr Philippe DELAVAUULT, Doctoral School VENAM "Végétal, Environnement, Nutrition, Agroalimentaire, Mer" Nantes - Angers - Le Mans

## 1 • Introduction

### History and geographical location of the unit

The Biopolymers Interactions Assemblies (BIA) unit is a unit of the Inra research Centre Angers-Nantes. It is almost 100% part of the CEPIA department (“Caractérisation et Elaboration des Produits Issus de l’Agriculture”). The BIA unit is organized in 8 teams having each a different scientific focus, and 1 team which is an instrumental platform having a transversal function by developing and deploying more sophisticated analytical methodologies, making them available to the scientific community. In 2013 a new team (E3-PRP: Polyphenols Reactivity Processes) was created. It is located at the Inra site the Rheu (Inra Rennes). The PRP team formalizes its relationship with the cider industry through close collaboration with the French Institute of Cider Products (“Institut Français des Productions Cidricoles” IFPC), which is reflected in its involvement in the UMT (“Unité Mixte de Technologie”) Novacidre. In December 2016 the team E6-FIP (Protein functions and interactions) will be closed.

The BIA laboratory was established on January 1<sup>st</sup> 2005 from the association of four research units of the Inra-CEPIA Division in Nantes. It is situated at 2 sites, in Nantes and Rennes. The BIA has now a staff of 126 permanent employees, i.e., 73 researchers (38 scientists, 35 engineers) and 53 technical and administrative personnel. In addition, the unit accommodates around 100 non-permanent employees such as PhD or master students, post-doc fellows, other fixed term contractual staff, project students etc.

Recently, (January 1<sup>st</sup> 2012) the BIA, together with the UMR (“Unité Mixte de Recherche”) GEPEA (“Génie des Procédés, Environnement, Agroalimentaire”: Université de Nantes, ONIRIS, École des Mines, CNRS) created the Joint Federation “Biopolymer Engineering for Matrices and Material Structuration” (i.e., “Structure Fédérative de Recherche (SFR) dans le domaine de l’ingénierie des biopolymères pour la structuration des matrices et des matériaux” (IBSM) n°4202) in order to propose more integrated research from the molecular scale to the finished product. The director of this SFR is Mr Marc ANTON assisted by the assistant director Mr Alain LE BAIL.

### Management team

The BIA director, Mr Marc ANTON is assisted by assistant directors, Mr Bernard CATHALA, Ms Claude GENOT and Mr Luc SAULNIER.

### HCERES nomenclature

Principal: “SVE Sciences du vivant et environnement”

Secondary: “ST5 Sciences pour l’ingénieur, ST2 Physique, SVE1\_LS1 Biologie moléculaire et structurale, biochimie”

### Scientific domains

The scientific activities of the BIA are organized around generating a better knowledge on complex bio-based materials, such as plant based objects, food or soft matter, through their characterization at scales going from the macroscopic to the molecular.

## Unit workforce

Unit workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	73 (70.2)	70 (67.2)
N3: Other permanent staff (technicians and administrative personnel)	53 (50.4)	52 (49.4)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers from Institutions (Postdoctoral students)	7	
N6: Other contractual staff (technicians and administrative personnel)	15	
N7: PhD students	25	
TOTAL N1 to N7	173 (167.6)	
Qualified research supervisors (HDR) or similar positions	24	

Unit record	From 01/01/2010 to 30/06/2015
PhD theses defended	53
Postdoctoral scientists having spent at least 12 months in the unit	20
Number of Research Supervisor Qualifications (HDR) obtained during the period	3

## 2 • Overall assessment of the interdisciplinary unit

### Introduction

The main scientific interests of the BIA research unit are based on understanding structure formation, especially as influenced by the interactions and functionality of biopolymers. The emphasis is put on the understanding of how biopolymers and their assemblies influence the structure and the properties of raw materials, transformed materials and bio-sourced matrices.

By focusing its research on the determination of the quality of both food and non-food agricultural products, and on the exploitation of raw materials or by-products, the BIA unit aims to address major societal issues, such as food transitions, green chemistry, or sustainable food systems. It is particularly focusing on issues like i) the control of the quality of crop plants to meet various requirements (food or otherwise) in the context of sustainable agriculture and climate change, ii) the development of functional foods and bio-based materials from the perspective of eco-design, and iii) improving the food "health" value taking into account the optimization of the risk-benefit balance.

The research projects are organized within eight research teams and one technological platform. This platform (E9-BIBS) has a transversal character, i.e. concentrates on the development of new analytical tools and methodologies in collaboration with the research teams. The specific scientific themes (areas) of the research teams are:

- E1-PVPP: Plant cell walls & their polysaccharides
- E2-ELIPS: Lipoprotein and protein-polysaccharide structures
- E3-PRP: Polyphenols Reactivity Processes
- E4-ISD: Interfaces and Dispersed Systems
- E5-ALL: Allergy to proteins
- E7-MC2: Materials processing and behaviour
- E8-NANO: Nanostructured Assemblies
- E9-BIBS: Biopolymers, structural biology platform

The research activities thus concern three general focus areas (axes): (i) Biopolymer assemblies in plant organs during their development, (ii) Assemblies and properties of food and bio-originated matrices, (iii) Structure formation, key factor in food for health. The uniqueness of the BIA unit lies on its multi- and interdisciplinary character. However, this is also creating a certain heterogeneity between the research groups, which is one of the main challenges that the BIA is facing. In the last period, the laboratory strengthened its solid position in (food) material science. The main changes and evolution since 2011 are (i) adapting the structure of the teams (incorporation of a new team: PRP Polyphenols Reactivity Processes; closing the team FIP Functions & Interactions of Proteins), (ii) nominating a new director (Mr Marc ANTON was replacing J. GUEGUEN), (iii) nominating some new team leaders, and (iv) creating the IBSM Federation. The number of permanent and non-permanent personnel stayed overall constant, at around 120 permanents and 80 non-permanent personnel. The same is true for the annual budget. It stayed at around 12 M Euro.

### Global assessment of the unit

The global research mission and the associated research themes and team focus areas are well chosen. The fact that the Interdisciplinarity is well built into the strategy makes the unit very effective in terms of scientific productivity. The unit's high quality output and scientific reputation are exemplified by its impressive number of 652 publications published in peer-reviewed journals between 2010 and 2015 (around 130 publications were issued per year). Most teams of the unit publish to a very similar rhythm and on average each scientist publishes 2 articles per year. In addition, 70% of the publications are in exceptional or excellent journals (based on Inra internal classification) such as for instance, *Journal of Experimental Botany* (IF=6,01), *Plant Cell* (IF=10,53), *Advanced Materials* (IF=15,58), *Allergy*: (IF=5,95). Most publications (158) are published in the WoS category "Food Science & Technology". However, the unit publishes also in other categories, such as Applied Chemistry, Biochemistry, Molecular Biology, Polymer Science, or Organic Chemistry, showing again the interdisciplinarity of the performed work.

The BIA unit is well integrated within the research community. This is obvious when considering the numerous strong partnerships and collaborations with other academic institutes and industrial partners. Looking at the publications of the BIA unit, around 80% of the publications are in collaboration with an outside partner. The majority are with national or regional partners.

The BIA unit has numerous relations with the socio-economic sector. A significant number of contracts are signed with industrial partners, the healthcare sector or with non-academic institutions or associations. In addition, the BIA unit is involved in events for the general public, such as open days or the science festival. These are events that help to increase the interaction of the unit with the non-academic world.

The organisational structure of the BIA unit is straightforward. The director is assisted by assistant directors Mr Bernard CATHALA, Ms Claude GENOT and Mr LUC SAULNIER (Management Board; "Conseil de Direction"), the Council of Team Leaders ("Conseil des Responsables d'Équipes"), the Unit Council ("Conseil d'Unité") and the Scientific Advisory Board ("Conseil Scientifique"). The support functions ("cellule logistique", PRI, "assistance technique"), and specific working and reflection groups also contribute to the organisation's activities. In 2013 an International Scientific Advisory Board was put into place, and in 2014 an "Observatoire des Conditions de Travail" was introduced.

Another important task of the unit is training through research. Between 2010 and 2015, 53 PhD theses were defended and 20 postdoctoral scientists spent at least 12 months in the unit. At the moment the unit hosts 20 CDDs, 30 students staying more than 6 months (M1, M2, Ing.) and 10 students staying for less than 6 months (BTS, Licence).

The strategy and the five-year plan of the BIA unit is driven by the keywords “Biobased Economy” and “Sustainability”. The main driver of future research activities is the aim of understanding the features of sustainable systems. A central part in this strategy is the assumption that more sustainable systems or products can be developed when the links between biopolymer properties and their construction and destruction is better understood. To achieve this aim, the acquisition of multiscale data is primordial in order to better capture the underlying scientific principles. The scientific priorities defined in this strategy are divided up into three bricks: (i) control and quality of structure formation in plants, ii) development of new safe and sustainable products, and iii) conception of new bio-sourced composite materials. Finally, senior scientist competences have not been fully replaced following retirement.

### Strengths and opportunities in the context

The main strengths and opportunities of the BIA are:

- good scientific understanding of biopolymers in their natural and product environment;
- excellent analytical tools available to better understand the architecture and chemistry of bio-sourced materials and their self-assembly;
- multidisciplinary approach in place (see objective of the different teams);
- modelling competence available to guide experimental work;
- connecting material science to process engineering approaches via the creation of the SFR IBSM.

### Weaknesses and threats in the context

The main weaknesses and threats of the BIA are:

- significant dependency on external partners in the area of sourcing of plant based materials;
- only few strong industrial partnerships available to develop further the results on non-food materials;
- significant competence loss due to retirement since 2010; this will continue over the next few years;
- communication between the members of the different teams could be still improved, both on the scientific and organisational level.

### Recommendations

The main recommendations of the expert committee are:

- to improve the success of the multidisciplinary approach in the BIA unit a significant investment in improving inter-team communication should be envisaged, especially at the level of technical discussions between the members of the different teams. This should facilitate inter team collaborations;
- to reinforce the strategy for replacement of key competences lost especially due to retirement. This should be discussed in alignment with the establishment of the new five-year plan;
- to still improve the international visibility and recognition of the BIA unit (i) by attracting more foreign researchers to come to Nantes, (ii) by playing an active role in more European network activities or (iii) by publishing more with international partners. Creating an increased international visibility needs to be accompanied by efforts to improve the environment within BIA for international visitors;
- to increase collaborations with GEPEA through the SFR in order to even better integrate processes. This means a higher involvement of BIA in terms of workforce;
- the unit, supported by its institution (Inra) aims at evolving towards a UMR (“Unité Mixte de Recherche”) together with Nantes University to increase its involvement in teaching and becoming more attractive to students. To reach this objective, the unit envisages the evolution of the SFR towards a UMR. However, the other unit composing the federative structure, GEPEA, does not share the same vision. Moreover, all the BIA teams are not concerned by the SFR project. The unit is therefore strongly recommended not to jeopardize its intern cohesiveness. Instead, the evolution towards an UMR status has to better mature and other scenari should be imagined.



### 3 • Detailed assessments

#### Assessment of scientific quality and outputs

The research done at the BIA unit is mainly dealing with the physico-chemical and biochemical properties of biopolymers, looking at their interactions and functionalities. Its high quality output and scientific reputation is shown in its impressive number of around 652 publications, published in around 210 journals between 2010 and 2015. This means around 130 publications per year. Half of the publications were led by unit members as first or last authors (between 45 and 55% for most teams, but 30% only for team 3 and 80% for team 8).

The publications are of very high quality (70% of the publications are published in journals classified as “exceptional” or “excellent” with excellent citation numbers, the h-index of the articles is 27 (time period 2010-2015)). This reflects also the highly original and relevant character of the BIA output. Most of publications are in collaboration between BIA teams, or with national or international collaborators showing the great collaborative spirit existing within the unit and its good recognition within the research community.

Most publications were issued by the 4 largest groups, i.e., E1-PVPP (98 publications), E4-ISD (124), E7-MC2 (111) and E9-BIBS (124). This means that each researcher publishes around 2 publications per year on average. In addition, 70% of the publications are in exceptional or excellent journals (see the internal Inra CREBI NORIA calculation). Most publications (158, i.e. 29%) are published in the WoS category “Food Science & Technology” followed by the categories “Applied Chemistry” (95/17%) and “Biochemistry Molecular Biology” (77/14%). The unit publishes also in other categories, such as “Polymer Science”, “Immunology” or “Organic Chemistry”, showing the interdisciplinary character of the performed work. Although the number of publications varies from group to group, the quality of the output is quite similar, i.e. on a high level. The most cited paper (79 citations) is the field of “New Pickering emulsions”.

The multidisciplinary of the unit can be easily shown by looking at the number of publications in which co-authors come from one or more different BIA teams. The E2-ELIPS, E9-BIBS and E5-ALL teams produce half or more of their publications with at least one other BIA team member as co-author. The teams E1-PVPP, E4-ISD, and E8-NANO are between 20 and 40%. As expected, the E9-BIBS platform is amongst the most interdisciplinary teams in the unit. However, also the smaller groups, such as the E2-ELIPS, E5-ALL, and E8-NANO are also very actively publishing with authors from other BIA teams.

The BIA unit develops strong partnerships and collaborations with other academic institutes and industrial partners. Looking at the publications of the BIA unit, 469 out of the 546 publications are realised in collaboration with an outside partner. Most of the partners are in France and 30 to 40% are international partners.

#### Short appreciation on this criterion

The scientific quality and originality of the output of the BIA unit are excellent, mainly thanks to its multidisciplinary character and also due to the high number and the high quality of the publications.

#### Assessment of the unit academic reputation and appeal

BIA researchers are involved in numerous highly important networks and strategic collaborations detailed below. They have the lead in, for instance, the “Fédération” IBSM (BIA-GEPEA), GDR Biomatpro or GDR Symbiose. Furthermore, they are involved in 81 academic contracts and they actively participate in networks, like the COST actions, e.g., the FA 1001 Food Structure Design or FA 1005 Info-gest or many more. Moreover, between 2010 and 2015, the BIA researchers were involved in 105 collaborations with national or international partners. In more details, 13 collaborations were with international partners, 36 with national partners, 28 projects with regional partners and 24 were direct contracts with industry.

The BIA unit is also organising scientific international events on a regular basis. In 2010, 2013 and 2015, the “Biopolymers” conference, in 2013 the “Cell Wall meeting” or in 2015 the “Annual European Rheology” conference were held in Nantes. The organisation of such events and more of this kind demonstrates that the BIA is well integrated within the research community in the region, in the whole country and on an international level. The fact that, among the 122 PhD students who were working in the unit, 74 of them were foreigners also shows that the unit is getting more and more attractive also for international students.

However, at the International level, the unit has to do more efforts in the future to attract especially more senior researchers, post-docs, sabbaticals, visiting professors) from foreign countries to reinforce the connection with the international scientific community.

#### Short appreciation on this criterion

The academic reputation and recognition of the unit is in general terms very good thanks to its involvement in many networks and due to the organisation of scientific international events. Although BIA hosts many students, its appeal can be still reinforced by attracting more students or scientists from abroad.

### Assessment of the unit interaction with the social, economic and cultural environment

The BIA unit shows great commitment to non-academic partners. It has numerous relations with the socio-economic sector. A significant number of contracts were made with the Industry: 24 out of 105 contracts are directly with Industrial partners. This has led to 17 patents with the generation of 6 licenses and 15 original prototypes. Moreover, 13 PhDs were executed in collaboration with socioeconomic partners. The BIA also participated in 13 strategic councils of private partners, e.g. the scientific advisory board of Kellogs or consultancies for France Export Cereals, Roquette, Tate & Lyle and others.

The unit works also closely together with non-academic institutions or associations that bring together research, teaching and Industry supporting a lasting and sustainable development of products and processes. Examples are Cap Aliment, the CA and CS IFPC, COS INBP, CS Improve and others.

Another important activity of the BIA unit is to disseminate the scientific culture and to link with the general public. In order to do this better, a responsible for the "médiation scientifique" was nominated to increase the contact with schools, to be more involved in events for the general public or in courses for teachers or for private companies (e.g. Nestlé, Barilla, Marie Surgelés, Danisco and others). Of course, open days or the science fair are also events that increase the interaction with the non-academic world.

The unit is participating to events for the general public on a regular basis. Examples are "open days", debates with the public etc. The BIA was actively involved in around 65 of such events in the last period.

#### Short appreciation on this criterion

The interaction of the BIA unit with the social, economic and cultural environment is excellent, mainly because a large part of the BIA collaborators is directly involved in bringing the science out into the "real world". This is mainly shown in the impressive number of contracts with Industrial partners, and the well-established connection with non-academic partners playing an active role in the development of a more sustainable Industry. The fact that the unit has nominated a responsible supporting these activities shows its dedication to play an active role in this field.

### Assessment of the unit organisation and life

The organisational structure of the BIA unit is straightforward. The director is assisted by 3 assistant directors (Management Board; "Conseil de Direction"), the Council of Team Leaders ("Conseil des Responsables d'Équipes"), the Unit Council ("Conseil d'Unité") and the Scientific Advisory Board ("Conseil Scientifique" which is composed of external experts). The support functions ("cellule logistique", PRI, "assistance technique") and specific working and reflection groups also contribute to the organisational activities. In 2013 an International Scientific Advisory Board was put into place, and in 2014 an "Observatoire des Conditions de Travail" was introduced.

Once a year, the General Assembly (Assemblée Générale) is organized bringing together the whole unit staff and students and presenting the achievements and strategic priorities set for the following year, and allowing all participants to ask questions.

The main structure within the BIA unit is the organisation of the teams, and how they are linked together from a science point of view. When looking at the objectives of each individual team and platform, it becomes clear that the scopes of the team are quite different, leading to a fairly 'heterogeneous' structure in terms of scientific focus and competence. Such a structure is the prerequisite for an innovative multidisciplinary organisation. But it has also its drawbacks, namely that it is not easy to bring the science areas of the different teams together in such a way that it becomes possible to define a coherent common research strategy. In order to accomplish this, the scientific communication between the different teams is crucial. Although scientific exchange between teams is taking place, it

became clear, during the discussion of the committee members with the employees, that scientific communication between the members of the different teams could be improved. This might be achieved by increasing the internal training effort and adapting it to the need of a multidisciplinary research unit.

#### Short appreciation on this criterion

The organisational structure of the unit is very good. However, it is also clear that the 'heterogeneity' of the unit due to the broad scientific scope of the different teams is not easy to manage. Communication between the different teams, and also between the technicians and the scientists, is crucial.

### Assessment of the unit involvement in training through research

The unit is hosting and training students at all levels (undergraduate, master, graduate). It is highly involved in the activities of the Doctoral School VENAM and in different other teaching initiatives, such as masters at the University of Nantes, Angers, Rennes and at different Engineering schools (ONIRIS, Agrocampus, AgroParisTech or others). Training is provided in the BIA core competence science areas, i.e., in Food science, plant biology, nutrition (allergy) and material science. There were 19 training workshops in the doctoral schools, and BIA was in charge of 3 of them, which is excellent.

Between 2010 and 2015, BIA was involved in 122 PhDs (including 74 foreigners). 81 of these PhD students were directly supervised by the unit, and 53 PhD theses were defended in the period 2010-2015. This is an impressive number when comparing with the size of the unit (126 permanent staff). BIA has 24 scientists holding a French "Accreditation" to direct research (HDR). In the same period the unit welcomed 31 post-docs and 160 masters and engineers. 20 postdoctoral scientists have spent at least 12 months in the unit. At the moment, the unit hosts 20 fixed term contractual staff, 30 students staying more than 6 months (M1, M2, engineer interns) and 10 students staying less than 6 months (BTS, Licence).

The mean duration of a thesis in the BIA unit is about 38 months, which is excellent regarding the constraints of Inra and the doctoral schools. The students to staff ratio is acceptable on average. The students have to follow the programme of the European Credit Training System (60 credits per year). Generally, all the rules of the doctoral school (thesis committees, etc) are well followed and PhD students publish quite well (they have between 1 and 6 publications with an average of 2 when they have finished their thesis).

Two BIA scientists are members of the Doctoral School (DS) Council and one BIA staff member coordinates the writing of the DS internal regulation. Every year the BIA is in charge of the organization of 3 thematic workshops within the frame of the DS. This shows that, BIA members are highly involved in the daily work and actions of the Doctoral School.

In conclusion, the excellent involvement in training through research of BIA is mainly reflected in the impressive number of students (Post-docs, PhDs, Master students) that went through the BIA during the last period. Moreover, the BIA hosts a significant and steadily increasing number (i.e. 95) of CDDs at different levels (from the technician to the engineer level). Last but not least, the BIA is co-founder of the master "Sciences de l'Aliment et Nutrition Humaine" (SANH) and a member of the office and actively involved in the council of ED VENAM. In conclusion, it clearly proved that it is able to provide an excellent level of training for graduate and master students.

#### Short appreciation on this criterion

The unit involvement in training through research is excellent.

### Assessment of the strategy and the five-year plan

The vision of the BIA unit concerning the plan for the next five years is very clear, well thought through and innovative. It is driven by the keywords "Biobased Economy" and "Sustainability". Part of the program is already aligned with this strategy. The five-year plan describes an integrated approach how to further develop and realize this vision in the future.

To implement this strategy, the themes and research axes will be developed towards the understanding, and creation, of sustainable systems. A central piece in this strategy is the assumption that more sustainable systems or products can be developed when the link between biopolymer properties and structure construction (e.g. occurring in organisation in planta, self-assembly, structure formation during formulation and processing etc.) and structure

destruction (e.g. Fractionation, transformation and degradation, *in vitro* digestion) is better understood. Thereby, the acquisition of experimental data on different length scales i.e., from the molecular to the macroscopic scale, is primordial in order to better capture the underlying scientific principles.

The scientific priorities are divided up into three bricks: (i) control and quality of structure formation in vegetables, ii) development of new safe and sustainable products, and iii) conception of new bio-sourced composite materials. This is an original and consistent strategy that will open up numerous new opportunities both for scientific research and application. The positioning of the existing teams seems to be straightforward. Only a few adaptations on the strategic level of a few teams have to be discussed and put into place.

In conclusion, the proposed five-year plan is well thought through, unique, and oriented towards proposing new solutions for solving the current socio-economical and health related issues of our society. It includes all existing teams and defines the stage how the teams of the unit can contribute together. It is expected that the realisation of this strategy will give the BIA more scientific and socio-economic recognition identifying new research opportunities that have the potential to become breakthrough innovations.

*Short appreciation on this criterion*

The proposed five-year plan of the BIA unit is excellent.

## 4 • Team-by-team analysis

**Team 1:** E1-PVPP Plant cell walls & their polysaccharides

**Name of team leader:** Mrs Fabienne GUILLON

### Team scientific domains

Plant cell wall biosynthesis, cell wall heterogeneity and modification, polysaccharide structure and assembly, linking the structure/composition of cell walls to their physico-chemical and mechanical properties.

### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	10 (9.5)	10 (9.5)
N3: Other permanent staff (technicians and administrative personnel)	7 (6.8)	7 (6.8)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)	1	
N6: Other contractual staff (technicians and administrative personnel)	3	
N7: PhD students	4	
TOTAL N1 to N7	25 (24.3)	
Qualified research supervisors (HDR) or similar positions	5	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	9
Postdoctoral scientists having spent at least 12 months in the unit	2
Number of Research Supervisor Qualifications (HDR) obtained during the period	

## • Detailed assessments

### Assessment of scientific quality and outputs

The research conducted by the PVPP group aims to generate knowledge about plant cell walls, their biosynthesis and modification over time, their physico-chemical and mechanical properties and how these characteristics are linked with processability and the quality of plant-derived products. The research of the team marries advanced imaging/chemical analysis with biomechanics and biological questions and is therefore highly interdisciplinary.

Over the last five years, the team has been a driver of highly significant methodology and tool development in collaboration with the BIBs platform, and has retained its position as an internationally recognised expert in the detailed analysis of cell wall structure and composition in complex plant tissues. Using novel advances in imaging and compositional analysis techniques developed over the period the team has concentrated on understanding polysaccharide fine structures, assembly mechanisms and the role of cell walls in functional/utilisation properties (texture of fleshy fruits, diet and nutrition, deconstruction and fractionation of plant biomass). The team has also identified glycosyltransferases involved in cell wall synthesis of wheat endosperm. The plants under investigations are mainly tomato and apple as model fleshy fruits, corn for lignocellulosic biomass, and wheat and *Brachypodium* for the cereal grain, although some collaborative work on *Arabidopsis* seeds has also been carried out.

The scientific production of the group is very good with 119 papers published (from 2010 to 2015) in international journals with a medium to high impact: for instance, Journal of Experimental Botany, Carbohydrate Polymers, Journal of Proteomics, etc. Team members are lead/corresponding authors of almost 50% of these articles in such journals, and 40% of articles published by the team are co-authored with other BIA teams, demonstrating the important transversal activity of this team within the frame of the research unit.

#### Short appreciation on this criterion

Scientific output of the team is very good and the research performed is based on the team's excellent advanced technology/methodology development.

### Assessment of the team academic reputation and appeal

The research activities of the PVPP group are carried out in the frame of numerous programs, including CEPIA incentivizing programs (ANS, AIC), inter-department programs, and programs at regional (5), national (13 ANR) and European (7) levels. Their involvement (or coordination) in both ANR and European programs are evidence of peer recognition of their expertise and research quality.

The expertise of the PVPP group in the field of Plant cell walls is both nationally and internationally well recognized. Team members coordinated a regional ("Alfruit"), a national (ANR WHEAFI), and a European (ITN "WALLTRAC") project during the evaluation period, and participated as partners in numerous other national and international projects. The team organised the prestigious XIII International Cell Wall Meeting in 2013. It was also involved in the organisation of "Plant and Seaweed polysaccharides Symposium" in 2012.

Team members gave 12 conferences as invited speakers in national and international meetings.

The team participates in numerous national and international collaborations with academic institutes addressing scientific problems (French, British and Spanish laboratories), processing of agriculture products (National), methodological developments (laboratories in France (including the SOLEIL synchrotron, UK, Denmark, Finland and New Zealand).

They have been invited to participate in numerous PhD juries in France and abroad and are actively involved as experts reviewing both National and European project proposals.

#### Short appreciation on this criterion

The expertise and recognition of the group at the national and European levels is excellent as demonstrated by its central role in project coordination, meeting organisation, and its remarkable ability to attract funding and collaborations.

### Assessment of the unit interaction with the social, economic and cultural environment

During the evaluation period, the PVPP group has co-signed contracts with two industrial partners (ADISSEO and SOUFFLET (involving a CIFFRE studentship)). They have been involved in organising seminars and workshops with their industrial partners.

In line with their position as recognised experts in their field, team members sit on various national and regional committees, including committees emanating from French ministries. This includes participation as an expert in the “Committee of Validation of the Nutritional Progress Commitment Charters” for the ministries of Health, Agriculture, Economy and Finance, organisation of a thematic committee for GIS Green Biotechnology, and representation as an Inra delegate on a national steering committee for higher education and research.

The team has produced 5 publications in professional journals/ books, (Including “Cahiers de Nutrition et Diététique”) and given presentations to industrial partners. The team has also participated in scientific outreach/popularisation through contributions to open days and other events involving the general public.

#### Short appreciation on this criterion

The team has excellent interactions with the social economic and cultural environment. These include both industrial interactions (two contracts signed with industrial partners), and significant scientific outreach activities including involvement in organising open days.

### Assessment of the team involvement in training through research

Team members are involved in undergraduate teaching and in teaching in 5 different master courses on several different sites including AgroParisTech in Paris.

In addition to this significant investment in teaching, the team supervised 13 PhDs (including 9 defended) for 5 qualified research supervisors (HDR) and 4 post-docs over the evaluation period, along with an addition 9 PhD students in the frame of collaborations. Students who defended their thesis (n=9) have published between 1 and 5 papers as first author and at least 7 of them found a job.

Team members participated in several doctoral school committees and have organised training workshops both for the Doctoral School VENAM and as part of European projects. They have also participated as speakers in 2 training courses for researchers.

#### Short appreciation on this criterion

Team members clearly make significant efforts to be involved in teaching programs and are involved in training at both the undergraduate postgraduate and researcher level. This, combined with their direct and collaborative supervision of PhD students, means that their participation in training through research is excellent.

### Assessment of the strategy and the five-year plan

Over the next 5 years, the team proposes an ambitious project that aims to continue their acquisition of knowledge of plant cell wall biosynthesis, modification and physico-chemistry, and their relation to mechanical properties, quality and processing characteristics. The project clearly aims to reinforce the multidisciplinary nature of the team's activities.

Proposed research on the construction of the cell wall will be primarily focused on the structural profiling of cell wall polysaccharides taking into account their spatial and temporal variability, on the identification of actors involved in the biosynthesis and remodelling of cell walls, and on the study of relationships between polysaccharides chemical structures and their assemblies. The second priority will be given to the understanding of relationships between the cell wall architecture, tissue hydration and their combined effects on mechanical properties.

The approach proposed involves continuing tool development (specifically imaging techniques) and an increasing use of simplified synthetic cell wall substitute models (a transversal resource being developed in the unit). These approaches, although ambitious, build on the existing strengths of the team/unit and are both feasible and likely to produce exciting results.

The team also proposes to place more emphasis on two further approaches; mathematical/mechanical modelling of plant tissues, and the functional analysis of candidate cell wall modifying enzymes. Although these approaches are exciting, their feasibility remains questionable. In the first instance the team currently lacks modelling competence, and it is questionable whether, even in the event that a modeller was to be recruited, this would be enough to allow significant advances in what is an extremely complex, and increasingly competitive field. For the second question (gene function analysis), the team is entirely dependent upon collaborations with other sites for plant tissue generation, which may lead to questions of ownership, as well as difficulties in controlling the quality of plant materials used.

Finally, because several retirements are scheduled in the next five years, there is a real risk of skill losses and also a risk of too large diversity of research topics taken into account the existing staff. In particular, cell wall biosynthesis (as averse to modification) research may dilute the central theme of the group and there are no local facilities for plant growth to develop this research theme.

#### Short appreciation on this criterion

The five-year plan of the team is very good and is in line with the research developments achieved by the team over the past. It will contribute to improving the expertise and the interdisciplinary nature of the group in the field of plant cell wall polysaccharides, their distribution, and their physical properties.

### Conclusion

#### ▪ Strengths and opportunities:

The team are leaders at the national and European levels for their expertise in the structural characterisation, and physico-chemical properties of plant cell wall polysaccharides, as well as for their skills in multi- and hyperspectral imaging of plant cell walls.

The team has well-established collaborations, within BIA as well as nationally and internationally.

The team benefits from powerful analytical tools associated with a skilled staff of engineers and technicians.

The research of the team has the potential to produce results of significant interest to the industrial sector.

#### ▪ Weaknesses and threats:

The group is composed of senior scientists and several retirements are scheduled in the next five years. Without new recruitments, there is a real risk of skill losses.

A large diversity of research topics is undertaken compared to the size of the PVPP group.

Cell wall biosynthesis (as averse to modification) research may dilute the central theme of the group leading to marginalisation. There are no local facilities for plant growth, which constitutes a serious handicap in the development of this research theme.

#### ▪ Recommendations:

The team should take care not to loose focus. If the team is successful in recruiting a modeller, extreme care should be taken that he/she does not become isolated, and the rapid establishment of collaboration with other units involved in modelling plant tissues should be envisaged. The team should also weigh up the risks associated with reorienting their research towards gene function analysis. If this research direction is maintained, a clear strategy for managing the necessary collaborations should also be rapidly established. Given the high selection pressure in ANR and H2020 Calls, (ANR, H2020, etc), the team should also try to increase its industrial partnership (which is already excellent) to ensure a part of its budget with industrial research contracts.



**Team 2:** E2-ELIPS Lipoprotein and protein-polysaccharide structures

**Name of team leader:** Mr Didier MARION

### Team scientific domains

Structure, biogenesis and nutritional/industrial impact of plant cuticles; Industrial potential of plant cuticles ("cracking" and use as a source of novel synthons for industrial applications); Identification of the determinants of, and markers for endosperm textural traits in cereals.

### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	4 (4)	4 (4)
N3: Other permanent staff (technicians and administrative personnel)	2 (2)	2 (2)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)		
N6: Other contractual staff (technicians and administrative personnel)	2	
N7: PhD students	3	
TOTAL N1 to N7	11 (11)	
Qualified research supervisors (HDR) or similar positions	2	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	1
Postdoctoral scientists having spent at least 12 months in the unit	1
Number of Research Supervisor Qualifications (HDR) obtained during the period	1

## • Detailed assessments

### Assessment of scientific quality and outputs

The ELIPS team carries out high quality and original interdisciplinary research at the interface between plant science, chemistry and structural biology. This has led to the publication of 18 articles in refereed journals over the evaluation period, including 8 in which the team can be considered to be a primary driver (5 with members of the team as first author and 5 with members of the team as last authors). These include articles in very high quality journals with broad readerships including *Plant Cell*, *Green Chemistry* and *Plant Journal*, as well as highly respected but more specialised journals in the domain. This production clearly highlights a strategy prioritising quality over quantity in terms of publications.

The team can be considered to be a principal driver at the international level of fundamental research aimed at understanding cuticle biosynthesis and structure, and notably have identified the first cutin polymerase, GDSL1 (article in *Plant Cell* with an impact factor of 9,3). In addition, they are at the forefront of innovative research into both novel techniques for the analysis of cuticle structure (for example the use of mass spectrometry imaging, article in *Plant J.*) and the production and industrial potential of cuticle-derived molecules (article in *Green Chemistry*). Finally, the team has published a strong body of novel research addressing structural and compositional characteristics of the starch-protein matrix in the cereal endosperm, and the identification of the determinants of endosperm texture, with a strong emphasis on the roles of puroindolines.

The team overcomes potential problems related to its small size through a number of active collaborations at both the national and international level. In addition, the team actively collaborates with other teams within BIA, with more than half of its publications being co-authored by members of other teams.

#### *Short appreciation on this criterion*

The scientific quality and originality of this team's outputs, in terms of both scientific advances/impact (e.g. first to identify a cutin synthase) and in methodology development, is excellent, leading to a very good publication record over the period.

### Assessment of the team academic reputation and appeal

The team has an increasing national/international reputation, particularly regarding their activity related to cuticle biology, structure and usage. This translated recently into an invitation to organise the second international conference on Plant Apoplastic Diffusion BArriers (PADIBA 2015), which was held successfully in Nantes in 2015, but has not yet given rise to funded international projects.

Nonetheless, the group has hosted a visit from an international PhD student, and group members have been invited to give 3 talks in international conferences. A group member has spent several months in Germany as a visiting scientist, and group members have participated in the evaluation of international projects.

At the national level the group has participated in 4 projects, with one being co-ordinated by a group member. The group is clearly integrated in a very dynamic network of local, national and international collaborations that underpins much of its research.

#### *Short appreciation on this criterion*

Given the size of the team their academic reputation at the national and international level is excellent and is rapidly improving. This is particularly well illustrated by the group's recent involvement in organising an international conference, as well as their active exchanges with international collaborators. It will be important to consolidate recent advances by taking the lead in national and international consortia in order to help the team to emerge fully on the international stage.

### Assessment of the team interaction with the social, economic and cultural environment

The team has strong links with socio-economic partners. Team members sit on the scientific boards of the IFBM (French Institute of Beverages, Brewers and Malters) and the CTPS (Comité Technique Permanent de la Sélection) and the group belonging to the prospective cereal groups within Inra.

Group members have deposited two patents during the evaluation period, one European patent protecting the group's discovery of the first cutin polymerase identified in plants, and the other in collaboration with partners in the brewing industry.

The group participates as a partner in several collaborations (for example within the Granoflakes and Breedwheat projects) involving industrial partners (such as Limagrain, IFBM-Qualtech, Malteurs de France), and furthermore benefits from an important private industrial contract (BRIGHTMALT SOUFFLET) that is co-ordinated by the team and associated with one of the team's patents. The team has indeed authored two patents, one at the French level and one at the European level.

A member of the team was invited to join the scientific committee of the "Institut Mutualisé pour les Protéines végétales" (IMPROVE), demonstrating their status as experts in the field.

The project proposed by the team clearly aims to reinforce existing socio-economic links, as well as forging new associations.

#### Short appreciation on this criterion

The interactions of the team with the socioeconomic environment are excellent thanks to active and strong links with various industrial partners that have given rise both to a patent and to industrial research contracts.

### Assessment of the team involvement in training through research

The team currently hosts two PhD students for 2 qualified research supervisors (HDR) and has co-supervised a third during the evaluation period. Each student published between one and 3 scientific papers. One thesis was defended during the period and the student found a job after his thesis. Furthermore, a member of technical staff (AI) has initiated PhD studies. In addition, 7 master students have been hosted in the team and team members have participated in teaching at both the M1 and M2 level in two different master programmes. All PhD students (both completed and ongoing) have participated in laboratory publications indicating a high quality of supervision.

#### Short appreciation on this criterion

The team's involvement in training through research is excellent bearing in mind the small size of the team.

### Assessment of the strategy and the five-year plan

The team proposes a coherent five-year plan, focusing on three main areas centred on the plant cuticle. The first and second are continuations of work aimed at understanding the assembly of the cutin polymer and developing techniques for disassembling the plant cuticle to generate industrially valuable synthons. The third area is novel and involves understanding how the cutin polymer behaves in the gut and affects food digestibility. The team has clearly developed a strategy aimed at maximising both the originality and potential socio-economic impact of their research, whilst building on their existing strengths, expertise and collaborative networks. The project falls centrally within the global scientific project proposed by the unit.

The team has an excellent track record of maximising output with limited human resources through active collaborations, and this approach will clearly need to be maintained and expanded. However, as highlighted previously, and in the SWOT analysis, it will also be necessary to reinforce the team if this project is to be feasible, especially given the considerable and increasing international competition on this subject. This point is particularly relevant to proposed on-going studies into the function of the GDSL lipases, and the decision of the team to collaborate with some of their potential international competitors is to be applauded.

Although funding strategy for the second research area is partially secure, further thought/detail is needed regarding funding strategies for the first and third areas of research.

#### Short appreciation on this criterion

The strategy and five-year plan of the team is very good and fall directly within the priorities defined by BIA. Attention should be paid to ensuring new recruitment to the team, and to obtaining financial support permitting the recruitment of postdoctoral researchers who will provide some of the diverse skills required for the completion of this ambitious research programme.

## Conclusion

- **Strengths and opportunities:**

Dynamic and highly collaborative team which has gained increasing international recognition thanks to its innovative and highly original research programme. For the moment, this team is one of the leaders in its domain, and its local and national collaborative environment mean that it is very well placed to continue carrying out ground-breaking research

- **Weaknesses and threats:**

The small size of this team is clearly a weakness, and may make it difficult for the team to maintain its position as a leader in an increasingly competitive scientific environment.

- **Recommendations:**

The team needs urgent consolidation in the face of imminent retirements, and this should be a top priority both for the team and for the research unit. Further funding opportunities should be pursued, and possible sources of industrial funding should also be investigated in order to permit the proposed research project to be completed successfully over the next evaluation period.

**Team 3:** E3-PRP: Polyphenols Reactivity Processes

**Name of team leader:** Mr Sylvain GUYOT

### Team scientific domains

Polyphenols; enzymatic mediated oxidation, structural identification of resulting products, interactions with other constituents (polysaccharides, proteins/peptides) cider process.

### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	3 (3)	2 (2)
N3: Other permanent staff (technicians and administrative personnel)	6 (5.6)	6 (5.6)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)		
N6: Other contractual staff (technicians and administrative personnel)		
N7: PhD students	2	
TOTAL N1 to N7	11 (10.6)	
Qualified research supervisors (HDR) or similar positions	2	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	2
Postdoctoral scientists having spent at least 12 months in the unit	
Number of Research Supervisor Qualifications (HDR) obtained during the period	

## • Detailed assessments

### Assessment of scientific quality and outputs

The PRP group joined the BIA research unit (UR1268) in 2013 after the closing of its previous research unit (UR 117). The group remains located in the Inra Research Centre of Rennes and therefore stays geographically separate from the rest of BIA research unit.

Unlike the other teams of the BIA research unit, the research activity of PRP is anchored on a specific sector, the cider industry. Although the scientific questioning is mainly based on technological and product quality issues, the approach that the PRP group has developed to address them consists in getting fundamental knowledge on structures, reactivity and properties of polyphenols. Three main topics are developed: 1) profiling of phenolic composition in various species; 2) kinetics and mechanisms of phenolic oxidation and 3) process and product quality.

The scientific production of the group is qualitatively very good and quantitatively excellent considering the number of publishing staff (2-3) in the PRP group with 45 papers published (from 2010 to 2015) in international journals with a good impact in relation to their research area (engineering, technology, applied and analytical chemistry, food). All of these papers are authored by partnership members. One third only of these publications were with first or last authors of the team. These papers have been published in 22 journals (at least) which may reflect the effort of the team to be visible by a large scientific community. We can cite as examples publications in Journal of Mass Spectrometry (IF=2,7), in Rsc Advances (IF=3,84) and in Journal of Agricultural and Food Chemistry (IF=2,9). Only one article published by the team is co-authored with another BIA team, which testifies for their low interaction with the BIA research unit.

#### Short appreciation on this criterion

The scientific quality of the team is very good and the research activity is mainly dedicated to the cider sector through a close partnership with the French institute of cider products (IFPC).

### Assessment of the team academic reputation and appeal

The academic partnership is large and mainly established at local and national levels (UMR RIRHS, UMR GDEC, UMR PASTEUR, Lab. MSC, UMR Genial, UMR SQPOV, UMR SPO), but not in international networks. The team also lacks academic funding from ANR (The French Agency of Research). The collaborations aim at acquiring knowledge in disciplines out of the group's scope (genetic, histology) or acquiring skills and technologies not available in the group. The foreign students (Master, PhD and postdoctoral students) hosted in the laboratory give evidence of the reputation of the team in the field of polyphenol analysis. However, most of the collaborations seem to be developed in non-funded projects and the hosting to be borne by the PRP team.

The expertise of the PRP group in the field of polyphenols is internationally recognized as proven by their involvement in the International Congress On Polyphenols (as member of the Administrative board of Groupe Polyphenols and as member of the scientific committee of ICP 2010).

The team hosted several foreign PhD students and post-docs for stay of various lengths, for instance, one scientist from Norway and one from Poland for several months each.

Moreover, the group is co-author of numerous publications that are not directly in their topic research. This proves the recognized expertise of the group and their attractiveness at international level.

Members of the team were invited speakers in 5 international or national conferences.

#### Short appreciation on this criterion

The academic reputation and appeal of the PRP group is very good and its expertise on polyphenols analysis at the international level is well recognized and as proven by several stays of foreign students in the laboratory. However, the team lacks academic funding from ANR or EU to be integrated in a larger established network.

### Assessment of the team interaction with the social, economic and cultural environment

Over the last five years, the PRP team obtained different grants from mainly local (Region Pays de la Loire and Interg) and national public sources such as the "Ministère de l'Agriculture" (CASDAR). The PRP group had coordinated two of the granted programs. However, they failed to obtain ANR and European projects in the evaluated period.

The creation, by the PRP team and the French institute of cider products (IFPC), of the technology joint unit, UMT Cidre, in 2006, and then of the UMT Novacidre in 2011 are evidences of a strong partnership with the cider sector and therefore of a strong involvement of the team in the local economy. At least, 10 projects were funded by regional or national bodies thanks to this UMT.

Furthermore, the team is involved in the French Institute on cider Production as members of both the scientific committee and the administrative board.

Besides, the team members are involved in various scientific events organised at the local and national levels, as invited speakers. They generated a videoclip in 2011, within the frame of "la Fête de la Science de Rennes". These various activities testify for the interaction of the PRP group with the social and cultural environment.

#### *Short appreciation on this criterion*

The team conducts a very active partnership with the local cider industry (IFPC) and is strongly involved in scientific events open to the large public. Its interaction with the social and economic environment is excellent.

### Assessment of the team involvement in training through research

The team is involved in 3 different master programmes performed in Rennes, AgroCampus Ouest and Strasbourg universities, as well as in engineering school. The achievements of the team in these programmes consist in courses dedicated to specific topics related to the research performed in the group.

The team hosts several interns (masters, technicians, etc.), PhD students and post-docs, and European researchers (one from Norway and one from Poland from 2013 to 2014), which testifies for their involvement in academic training.

The only permanent researcher of the team who is qualified for research supervision (HDR) is very active. He has been or is responsible for 3 PhD students during the period. One of them defended his PhD with two publications and found a job.

The team contributes to disseminate their research activity through popular scientific events or seminars/workshops involving industrial partners.

#### *Short appreciation on this criterion*

Although the team members do not have professor position, their involvement in research training is excellent. They make efforts to be involved in teaching programs and they host a reasonable number of trainees, PhD's and postdocs despite the small size of the PRP group.

### Assessment of the strategy and the five-year plan

Over the next 5 years, the project of the PRP group is in line with the researches and expertise previously developed on issues concerning the polyphenols, in the plant materials and during their transformation. The programmes already started are mainly focused on the knowledge of the organoleptic quality and nutritional value of the products (ciders, apple juices) and develop a comprehensive approach on 1) the mechanism and kinetics of polyphenol oxidation, 2) the interaction of polyphenols with other (macro)molecules (proteins and polysaccharides) and 3) the impact of genetic and eco-physiological variability on polyphenols, polyphenol oxidase and oxygen availability.

The recent and future losses of human resources in the PRP team prompt to two priorities:

- the first, jointly developed with the French Institute on Cider Production (IFPC) within the frame of UMT Novacidre, aims to perpetuate the knowledge and expertise of the cider industry by collecting data, technical expertise and empirical knowledge in the form of a book of knowledge;

- the second priority is to develop internal collaborations with the other teams of the BIA research unit by offering their expertise on polyphenols, their oxidation and interaction with other biopolymers that must be necessarily at the heart of the BIA research issues. However, the desire to develop new collaborations with other BIA teams depends notably on the strengthening of the PRP group, which is currently limited to one scientist, with the recruitment of a young researcher.

Short appreciation on this criterion

The five-year plan of the team is good and in line with the research achieved by the team over the past years.

## Conclusion

### ▪ Strengths and opportunities:

The team performed research of very good quality that well serves the local cider industry. This close link with the cider sector, materialized in the creation of the UMT Novacidre, is a good way to get financial support from the local environment (Region and Interreg). Moreover, the research conducted by the team is perfectly in the scientific strategy and interdisciplinary programs of the department CEPIA, from which they receive financial support to several projects such as ANS PROXY, AIC COLOR.

The expertise on polyphenols analysis and the cider process is well recognised at the international level, which is mainly reflected by the number of foreign students and researchers hosted in the laboratory, mostly for short-term stays.

### ▪ Weaknesses and threats:

The size of the PRP group, and more specifically the number of researchers, is critical. The unique remaining researcher is the leader of the team and in charge of animation and operation of other collective structures in which the team is involved (UMT Novacidre, P2M2).

The remoteness of the PRP team from the Nantes research centre makes its integration in the BIA research unit difficult.

The interdisciplinarity character of the PRP team is the lowest in the BIA unit. Although, during the last period, the group has published a number of 39 articles, reasonable for its size, only one of these publications is done in collaboration with another BIA team.

### ▪ Recommendations:

The PRP group is encouraged to collaborate closely with other BIA teams in order to (i) increase their scientific workforce; (ii) build a common research strategy; and (iii) apply to /or be involved in European programs and thus extend its European links.

The research topics developed in E1-PVPP or E2-ELIPS could, for instance, take into account the role of the cell walls or cutin on the polyphenol extractability during the cider production process.



**Team 4:** E4-IDS Interfaces and Dispersed Systems

**Name of team leader:** Mr Marc ANTON (2010-2012) and Mr A. RIAUBLANC (2013-2015)

#### Team scientific domains

Formulating matrices for the protection of nutrients both during storage and under *in vitro* digestion conditions; Oxidation of encapsulated species before or during digestion; impact of multi-scale assembly formation on the dispersed systems' stability; Experimental and mathematical methods to characterize or predict the evolution of structures and species during digestion.

#### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	15 (12.5)	15 (12.5)
N3: Other permanent staff (technicians and administrative personnel)	5 (4.7)	6 (5.7)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)	1	
N6: Other contractual staff (technicians and administrative personnel)	4	
N7: PhD students	7	
TOTAL N1 to N7	32 (29.2)	
Qualified research supervisors (HDR) or similar positions	4	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	11
Postdoctoral scientists having spent at least 12 months in the unit	1
Number of Research Supervisor Qualifications (HDR) obtained during the period	1

## • Detailed assessments

### Assessment of scientific quality and outputs

The main goals of the Team ISD are mastering new ingredients, constructing optimized food matrices and understanding deconstruction phenomena, to ensure physical stability, to control oxidative phenomena, to maximize the release of nutrients (lipids, protein, fat-soluble vitamins) and to understand the fate of harmful compounds (oxidation products) during digestion.

The scientific quality and output is excellent and the proposed strategy is efficient to generate exciting results. The team has found its place, not only within the National but also within the International Research community. Moreover, it is dealing with both fundamental (soft matter science, analytical chemistry) and applied research aspects. Besides generating new know-how, the team has also showed its capacity to be at the forefront of developing new experimental tools (such as the “microfluidic digestion device”).

The team is very dynamic in the production of scientific knowledge as people have published 143 papers in national or international journals with a general scientific scope or in more applied journals dedicated to nutrition (9.5 publications per researcher on average). About 57% of these publications were done with a member of the team as first or last author. The team has published some articles in some journals with high impact factors such as Food Hydrocolloids (IF=4,35), Comprehensive Reviews in Food Science and Food safety (IF=6.48), Critical Reviews in Food Science and Nutrition (IF=6,27) or Green Chemistry (IF=7,08). This double target (basic and applied journals) shows how the team has managed to keep both an interdisciplinary but also a more specific expertise in the area of dispersed systems. The production of team ISD represents 23% of the unit's total publications, which is the highest (together with the BIBS platform) amount among all the teams.

People have been given an international visibility to their topics by contributing to conferences in an impressive way (about 50 oral communications in international conferences).

#### Short appreciation on this criterion

The team has an excellent scientific production publishing both in highly ranked scientific and more applied journals.

### Assessment of the team academic reputation and appeal

The team is highly involved in regional (as for example the project “Food for Tomorrow” as coordinator), national (in collaboration with Clermont-Ferrand, Rennes, Massy), and international projects (in collaboration with Norwich, La Plata, Yaoundé, Danemark, Cost INFOGEST and ITN Quench). Some collaborations with academic partners are long-term showing their excellent quality and interest. The team is involved in numerous collaborations through a great number of projects (3 ANR, 3 ANR-Carnot, 1 European, 1FUI, 1 Interreg, 5 Regional grants) playing an active or leading role in many of them (coordination of 2 ANR, 2 ANR-Carnot, 1 European project 3 Region projects). The team is also involved in European networks (Cost, ITN). The team has hosted a researcher from abroad for a few weeks.

The international visibility of the team is also assessed by invitations to international conferences (about 10 invited oral communications in international conferences over the last period).

#### Short appreciation on this criterion

The team has an excellent international visibility given their participation to European networks and to worldwide collaborations. The team is also very attractive to students. The academic reputation and appeal are excellent.

### Assessment of the team interaction with the social, economic and cultural environment

The team exhibits numerous collaborations with industrial partners from the food field (Soufflet, Roquette, Soredab, Cooperl, Solina, Grands moulins des Antilles, Pernod Ricard, Avril, Association Bretagne Biotechnologie Alimentaire) and provided a service for fee (NUTRICIA DANONE Prestation de service projet RA.MET), showing the relevance of their science that addresses social and economic concerns and demands. The involved researchers have also shown their willingness to diversify such demands and deal with them, essentially linked to food and nutrition and

evolving towards the development of new vegetal and animal proteins functionalities. The team is also initiating and developing small companies (project spirawline and innoprotéa).

A collaboration between the team and “le groupement des Producteurs de gelée royale” is an illustration of the relevance of structural studies toward application, as this collaboration lead to the demonstration of a link between structure and quality.

A very positive action was the elaboration of an interregional project, PROFIL, in which milk and egg-based product industries are involved. This project allowed the funding of 10 Theses, and the equivalent of 20 years of CDD Ingénieur. Within “the pôle Agronomique Ouest” 5 Theses are funded.

The team has submitted 5 patents, among them one is in collaboration with an industrial partner (Brevet Inra-Ingredia-Roquette).

#### Short appreciation on this criterion

The team is attached to real and practical life in an excellent way. It is concerned to apply its gained knowledge for solving also practical problems through fructuous and long-lasting collaborations with industrial partners. The interaction with the social economic and cultural environment is excellent.

### Assessment of the team involvement in training through research

As much as eleven PhD theses have been defended during the last period, 6 of them found a job. During their thesis, students are followed by experts in the field in a thesis committee. These experts are not directly involved in supervising the students but act as advisers. Reports of these committees create a link with doctoral schools. Each student has published between 1 and 7 papers. Moreover, 4 post-docs and 30 master students have been working in the team in the last period. The team is therefore very attractive for young scientists who benefit from a good training through research.

Even if researchers from the team are not involved in teaching at the M2 level, some of them were invited to participate in training schools.

#### Short appreciation on this criterion

The involvement of the team in training through research is excellent. The team shows an excellent involvement in the formation of PhD students. The team is very appealing for young scientists.

### Assessment of the strategy and the five-year plan

The team proposes a relevant and innovative plan for the next 5 years. The main objectives are linked to the development of a healthy sustainable diet taking into account technological and industrial constraints, limitations of natural resources, environmental aspects or energy consumption. Focus will be especially on:

- the utilisation of ingredients from alternative sources (e.g. proteins from vegetables) and improvement of their functionality;
- the reduction of additives (E-numbers);
- the consideration of the consumers' demands concerning the nutritional product quality (e.g. optimization of bioaccessibility of liposoluble nutrients);
- the absorption of the products resulting from the oxidation and their impact on metabolic diseases;
- the fate of nanoparticles during digestion and impact of their absorption.

The team definitely aims at making a link between nutrition and health. For that it defined two research axes: (i) elaboration of food matrices with the concern of sustainability and clean label and (ii) evaluation of the impact of these matrices on the digestion.

This project is ambitious but it corresponds to a reasonable continuity of the present activities. It is at the interface between various disciplines that meet the fields of expertise of the team member. The objectives are clearly defined. From a technical point of view, the project is feasible, as the needed equipment is available and well

adapted. As the project is in direct link with the evolution of the society, there is no doubt that the team will manage to get financial support from both public councils and industrial partners.

Short appreciation on this criterion

The proposed five-year plan is excellent since it is relevant not only from a scientific but also from an applied, socio-economic and environmental point of view.

## Conclusion

### ▪ Strengths and opportunities:

The team benefits from a strong workforce with diverse and complementary fields of expertise. Recently, a new researcher has been recruited who strengthens the team even more in the area of vegetal protein functionalities. The team is also well imbedded in networks to complement the required knowledge. Moreover, it has already secured a large part of funding, ensuring the financial feasibility of the project.

The team can rely on numerous experimental techniques available in the team or within the platform. The project is in a good relation with the societal evolution and demands. Also the project is in good alignment with the future strategy of the BIA unit and the Federative Structure so that the team should benefit from a close collaboration with GEPEA researchers.

### ▪ Weaknesses and threats

The project is very ambitious and diverse. Some prioritization work might be needed with time to guaranty the success of the project.

### ▪ Recommendations:

Depending on the success for funding, priorities may be re-defined. However, a large part of funding is already assured.

**Team 5:** E5-ALL Allergy to proteins

**Name of team leader:** Ms Sandra DENERY (2010-2014) / Ms Colette LARRE (2015-present)

#### Team scientific domains

Analysis of the allergenicity of food, in particular wheat and egg; study of allergen structure and biological mechanisms.

#### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	5 (4.9)	6 (5.9)
N3: Other permanent staff (technicians and administrative personnel)	5 (4.4)	4 (3.1)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)	1	
N6: Other contractual staff (technicians and administrative personnel)	1	
N7: PhD students		
TOTAL N1 to N7	12 (15.3)	
Qualified research supervisors (HDR) or similar positions	2	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	3
Postdoctoral scientists having spent at least 12 months in the unit	3
Number of Research Supervisor Qualifications (HDR) obtained during the period	1

### • Detailed assessments

#### Assessment of scientific quality and outputs

The team is organized into 2 axes: molecular structures and allergenicity, directed by S. DENERY, and study of immunological mechanisms of the allergic reaction and their modulation by diet, directed by M. BODINIER.

The research of the team can truly be considered interdisciplinary. The team has addressed several major questions over the evaluation period, including the effects of modifications introduced during food processing (article in "Allergy"), the effect of transgenesis on wheat allergenicity (article in "Journal of Proteomics"), interactions between food and respiratory allergies (article in Journal of Agricultural and Food Biochemistry), and the effects of prebiotics on tolerance during weaning (article in Journal of Agricultural and Food Chemistry). In addition, the group has developed novel Mass-Spectrometry based approaches to allergen quantification in multiple wheat varieties (article in "Proteomics"), and, in collaboration, has developed *in silico* approaches to the identification of allergen epitopes. In total, the group has published 32 articles in WOS references journals during the evaluation period, of which 15 have been led by the group (first or last authorship). Articles are of consistently high quality and are published in journals classified as very good to excellent in the domain, such as Proteomics (IF=3,8), Allergy (IF=6,0), Journal of Agricultural and Food Chemistry (IF=3,0). About half of these articles included collaborations inside BIA, mostly with the platform BIBS or with team PVPP.

#### Short appreciation on this criterion

The scientific quality and output of the team is excellent. The team publishes in specialized journals in the field of agriculture, food chemistry and proteomics and it also enhances its visibility by publishing in high impact biomedical journals.

### Assessment of the team academic reputation and appeal

ALL is member of at least four national and international networks (COST, STSM) and collaborates with wheat specialists in Italy, US and UK. One team member was appointed as a member of the experts' committee of ANSES on human nutrition. The WGPAT symposium (Working Group on Prolamins Analysis and Toxicity) was organized in 2014 in Nantes.

ALL is an active member of the COST ImpARAS, which provides opportunities for collaboration and project initiation. ALL is also a member of the international network of inflammation as well as of 2 other ITN networks Valkyria and NewWheat. These networks increase the visibility of the team at the European level.

Team members regularly attend national and international meetings for presentation of their scientific achievements, with a total of 107 oral and poster presentations. A number (around 23) of invited conferences were given, however the vast majority were in France, with only 3 outside France.

The group has built a strong network with several clinicians in 6 clinical centers in order to gain access to well defined patient sera. Another link has been established with researchers from Inserm.

The team was successful in applying for grants from ANR(n=2), Europe (n=1), FUI and the region, mostly as coordinator. Furthermore, the team has hosted a Marie Curie IEF, who has subsequently been recruited as a CR1, a strong testament to the quality of researchers attracted to the team.

Given the quality of the output of this group, and its implication in a European network and at least one other international initiative, it is perhaps surprising to note that international visibility appears relatively restricted. In particular invitations to international conferences are lacking.

#### Short appreciation on this criterion

The team clearly has a very good academic reputation, especially at the national level. It is aiming to increase visibility at the European level. More generally, an emphasis should be placed on emerging more at the international level.

### Assessment of the team interaction with the social, economic and cultural environment

The team has strong interactions with its socio-economic environment, as expected given the high potential for impact of its research on public health and health policy. The team filed one patent in 2013 (on a method for the detection of deaminated glutes) and declared one invention in 2015 (regarding an immunotherapeutic approach for treating gluten allergy sufferers) during the evaluation period. In addition, it has 2 funded industrial partnerships.

At the national level, the team is solicited for expert opinions by national bodies including ANSES, and a team member has been appointed to an expert committee of this organization.

The team has a strong clinical network. Team members are present at specific congresses of allergology to entertain the network and enhance visibility of their research. They are participating in education of clinicians by oral presentations and contributions in medical literature dedicated to this community. They participate in initiatives promoting communication with healthcare professionals and patients. ALL is also member of the network "réseau allergo-vigilance" in France.

The team is implicated in providing information to the public on allergy and gluten.

Short appreciation on this criterion

Interaction with the socio-economic environment is excellent as shown by its implication in national bodies, contributions to promote education of professionals and interaction with industrial partners.

### Assessment of the team involvement in training through research

Two team members have an HDR. During the evaluation period, 7 PhD students arrived in the team and 4 have already finished their thesis. Each student has published between 3 and 5 scientific papers. Three post-docs worked in ALL as well as 12 master 1 and 2 students. Two PhD students and 1 post-doc are currently in the team. Given the size of the team this represents a significant investment in training.

In addition to training research students, the team has also participated in the REAL 2 network (network on airborne and food allergies) and in the development of a new educational unit (master 1). Team members also teach in undergraduate and masters courses.

Short appreciation on this criterion

The implication of the team in teaching through research is excellent given the relatively small size of the team.

### Assessment of the strategy and the five-year plan

Human diet will change in the future as new protein sources are implemented. A major aim for the next contract is the elucidation of allergic mechanisms at the molecular and cellular levels, in order to predict the allergic potential of new food products and production techniques. Another focus is the prevention and treatment of allergy. A great number of projects are listed, but it is not clear what exactly will be done at BIA and what will be done in collaboration with other teams.

An immunologist is recruited for July 2016 in order to reinforce competences in immunology. 2 team members will retire in 2017 and 2019 and 2 others will move to another team. ALL will not be able to reach its aims without reinforcing competences in cell culture and animal experimentation.

The team has presented an extremely ambitious five-year plan which aims to build on, and extend, existing competences in order to both contribute to understanding of the molecular and cellular bases of allergies (with the ultimate aim of developing predictive tools for the evaluation of new proteins), and to develop novel strategies for treatment and prevention. The team clearly has the background and expertise necessary to develop research into any one of the themes presented. However, given the concerns raised in the team's own SWOT analysis regarding the ability to maintain existing competences, it seems potentially dangerous to make the considerable technical stretch that would be required to address all the fields detailed in the plan. In particular, the proposal that a team member should be trained in running clinical trials seems excessive, when such trials could potentially be run in the frame of existing collaborations.

This being said, the team has clearly planned ahead financially and has asked financial support (through two European ITNs) for two PhD students, Inra funding for some of the proposed experimental work, and a clinical contract for immunological studies in collaboration with a regional hospital. In addition, applications for several other financial aids permitting the recruitment of other contractual researchers have either been submitted or are being discussed. Finally, the team appears to have identified several potential regional industrial partners and hopes to benefit from further regional support for collaborations. The team has solicited international collaborations in the USA and Australia, whilst clearly working towards a consolidation of its position on the European stage.

The expected workload is not realistic, unless a lot is done in collaborations, which have not been detailed enough. Specific collaborations within BIA are not mentioned. Focusing on food processing, which represents a major competence within BIA, would allow the team to build on strengths that major competitors in the field are lacking. Linking allergenicity to food processing and to the analysis of emerging new protein sources in collaboration with other BIA teams and clinical partners could offer new opportunities in the frame of existing axes.

Short appreciation on this criterion

The strategy and 5-year plan is very good. It appears, however, to be too ambitious.

## Conclusion

### ▪ Strengths and opportunities:

The interdisciplinarity which is intrinsic to the team's structure constitutes a strength, its capacities in immunology will be reinforced by the recruitment of a new team member. The team has established strong local and national collaborations. The subject is very topical and of interest to the public and health care providers. Established active collaborations within BIA, in particular with the platform, constitute an opportunity for the team.

### ▪ Weaknesses and threats:

The international visibility is still low, but is being addressed through involvement in international networks and active collaborations. Financial support has been asked for two PhD students by two ITN networks, but solid financial support beyond 2016 is lacking. The team risks to lose some of its competences through the retirement of two members and the departure of two members to another team. There is a clear threat of spreading into too many research areas during the next few years.

### ▪ Recommendations:

The team should concentrate on consolidating its financial position before extending research into new domains. In particular attention should be paid to maintaining existing expertise within the team. The team should be careful not to spread themselves too thinly during the next evaluation period. International visibility has still to be improved, but this is on track as the team is implicated in several international collaborations and networks. Focussing more on food processing and vegetable protein allergenicity would increase the collaboration potential within the BIA unit and, thereby, would make the ALL team more relevant for the unit.



**Team 7:** E7-MC2 Materials processing and behaviour

**Name of team leader:** Mr G. DELLA VALLE

### Team scientific domains

Understanding of the supramolecular organisation of starch and derived products; impact of assembly on enzymatic hydrolysis during digestion; Mechanical behaviour of composite materials; Molecular mobility and glass transition; Visco-elasticity and density of matrices; Modelling.

### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	10 (10)	9 (9)
N3: Other permanent staff (technicians and administrative personnel)	5 (4.8)	4 (3.8)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)		
N6: Other contractual staff (technicians and administrative personnel)	1	
N7: PhD students	1	
TOTAL N1 to N7	17 (16.8)	
Qualified research supervisors (HDR) or similar positions	3	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	12
Postdoctoral scientists having spent at least 12 months in the unit	2
Number of Research Supervisor Qualifications (HDR) obtained during the period	

## • Detailed assessments

### Assessment of scientific quality and outputs

The team competences are structured around 3 axes: (i) multi-scale approach of catalysis in heterogeneous media; (ii) development of materials based on biopolymers with modular properties; and (iii) sustainable deconstruction of food formulations. Using high resolutions methods, the team has obtained very interesting results on

the mechanism of the enzymatic synthesis of polysaccharides. For example, these methods gave access to the depolymerisation process of starch during solubilisation in ionic liquids. They also allowed determination of the structural parameters (branch rate, size distribution...) of glycodendrimers synthesized in vitro using enzymatic tools. This knowledge has allowed the team to propose novel materials for the biomedical and food field. The properties have been modelled and their structural origin is elucidated. Modelling allows also predicting crack propagation and therefore proposing some clues to improve the mechanical behaviour of starch-clay nanoparticle composites. The team also focused on the understanding of the destructureation on fragile (breakfast cereals) or ductile (bread) alveolar materials.

The team is very dynamic in the production of scientific publications, as the team has published 130 papers in national or international journals (around 13 per researcher), in journals dedicated to cereals or in high quality journals for the understanding of composites properties. About 55% of these publications were written with a member of team as first or last author. Some papers were published in journals with good impact factors such as Analytical and bioanalytical chemistry (IF=3,7), soft matter (IF=4,4), carbohydrate Polymers (IF=4,3), etc. The production of the team represents around 20% of the publications produced by the BIA unit.

#### Short appreciation on this criterion

The scientific quality and output of the team is excellent. The results are very original allowing the team to be one of the 3 most publishing teams in the unit.

#### Assessment of the team academic reputation and appeal

People have orally communicated their results in international conference for high visibility (about 43 presentations, 10 invited presentations). The fact that team members have been invited to many oral presentations at international conferences shows their good reputation within the international community.

The team is very much involved in the collaboration with GEPEA and in the animation of the Federation (SFR).

The team was involved in 4 regional projects (LimponNan, Pan&Sens, NANOFONC, POLE AGR), 6 ANR (SRMS2, ASPIRE, GLYCOBALLS, IRMAS, ALIMASSENS, BRAISE and ITE-IFMAS) or international (DREAM) networks.

The team was coordinator of the IRMAS ANR "Dispositif médical implantable résorbable à mémoire de forme en Amidon" with a BIA budget of 102 825 €. Partners of this ANR were the Université Paris 13, the Centre Hospitalier Intercommunal de Toulon and Inra Transfert.

The team is also quite successful in attracting researchers from abroad (1 professor from Venezuela, 8 PhDs from Thailand, The Netherlands, US, Colombia, Spain, Algeria and 5 master students from Algeria, Egypt and Tunisia). Also one member of the team has worked abroad for 8 months (Cambodia).

#### Short appreciation on this criterion

The team is well established at the national and international level. The academic reputation and appeal is excellent.

#### Assessment of the team interaction with the social, economic and cultural environment

The team had 10 industrial partnerships during the period (Novozymes, Lesafre, Cargill, Servier, BioFournil, Roquette). The team managed to apply the knowledge from their fundamental research to diverse industrial projects: interactions between milk proteins, vegetable proteins and starch, link between bread structure and its deconstruction in mouth, paste rheology and link with the final product, amyliced galenic formulations for control release, optimisation of yeast... All these projects are of strong relevance for society. Moreover, they totalise a financial contribution to BIA of more than 456 k€.

The team also plays an important part in the dissemination of knowledge towards the society through manifestations in media.

The team recently contributed to a breakthrough innovation with the development of a biocompatible starch material for implants for the biomedical field. This invention is entitled "Starch-based stents for use in the treatment of duct obstructions" (European Patent application EP14153877 (02/04/2014), PCT Request: PCT/EP2015/052236, 02/04/2015).

Short appreciation on this criterion

The MC2 team is very active in promoting its scientific research results into applications via its numerous collaborations with industrial partners. Its results are valuable and applicable in different Industries (food and non-food). Its interaction with the social and economic environment is outstanding since its research results open up new opportunities of solving practical problems that are relevant for society.

### Assessment of the team involvement in training through research

Team Members are involved in academic teaching (>50 h /year) at the Doctoral School in Nantes, at the Masters Biovigpa, SANH, Production et Technologie Végétale, Génie des Procédés et Bioprocédés, and in École Centrale, Cnam, ESA, ENSMIC, Oniris. Besides, they are also involved in Professional training initiatives (Cnam FODAGRO, formation FFF - summer school), industries in France and abroad (AIB-Kansas, JIB-Tokyo, Bread bakers Chicago, Unicamp Sao Paulo)...(>100h).

During the previous period, 12 PhD theses have been defended. Each student has published on average 3,5 papers each. All of them except one found a job after their PhD. In addition, a special effort was made attracting young students from high school. Moreover, the team has produced Design of electronic knowledge books (AsCoPain, rhéologie) and created a Simulation software that is now available for teaching purposes.

Short appreciation on this criterion

The team is heavily involved in training activities and transfer of knowledge at different levels (from students to professionals) in France and abroad. The involvement of the team in training through research is excellent.

### Assessment of the strategy and the five-year plan

The main project of the MC2 team in the area of starch interaction and assembly properties will further be developed within 3 different research axes:

I) Heterogeneous catalysis at various length scales: The team aims at investigating in more details the mechanisms of enzymatic hydrolysis, focussing, for instance, on the localization of the enzyme during the whole process by studying the accessibility of the enzyme and its diffusion properties. A complete 3D characterisation of the reaction kinetics is planned. Despite the highly competitive field, the team is following an original approach;

II) elaboration of functional materials with adjustable properties based on biopolymers: New properties are targeted using bipolymers assembly and the development of new processes. Modelling will be a useful tool to support this activity. A complete characterisation of interfacial and bulk structures will be conducted to better understand the new properties obtained;

III) elaboration of sustainable food: As a continuation of the work on fragmentation during chewing, materials will be optimised both in terms of mechanical and nutritional properties.

Modelling will remain an important part of the project and will be developed further simultaneously.

The project appears to be mature and well defined but very ambitious if the three axes are developed simultaneously. The more complex and risky part of the project seems to be the modelling of the heterogeneous catalysis due to the complexity of the materials and mechanisms. However, recent recruitments should provide the necessary human resources.

Short appreciation on this criterion

Although the project seems to be very ambitious, it is of high relevance to the science of biopolymer based materials. The strategy and five year-plan are of excellent quality.

## Conclusion

- **Strengths and opportunities:**

The team can rely on a well-established and recognized basis of knowledge and expertise inside the team. Moreover, it has strong collaborations in place, such as the Federative Structure IBSM. The team has access to highly performing imaging techniques. The future project is mature and well defined. It is also in good agreement with the demands coming from the society. Also it is in good agreement with the future strategy of the BIA unit.

- **Weaknesses and threats:**

Not all funding is secured yet.

- **Recommendations:**

The project may require to be adapted if the requested funding is not fully obtained.

**Team 8:** E8-NANO: Nanostructured Assemblies

**Name of team leader:** Mr Bernard CATHALA

### Team scientific domains

Nanostructured assemblies based on renewable materials; bio-based materials; self association.

### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	7 (6.8)	7 (6.8)
N3: Other permanent staff (technicians and administrative personnel)	3 (2.8)	3 (2.8)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)	2	
N6: Other contractual staff (technicians and administrative personnel)	3	
N7: PhD students	3	
TOTAL N1 to N7	18 (17.6)	
Qualified research supervisors (HDR) or similar positions	2	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	5
Postdoctoral scientists having spent at least 12 months in the unit	6
Number of Research Supervisor Qualifications (HDR) obtained during the period	

## • Detailed assessments

### Assessment of scientific quality and outputs

The NANO group, created in 2008, conducts an innovative research combining bio-based materials and nanotechnologies to design new functional materials. Three main topics are developed: 1) biomimetic assemblies; 2) nano- and micro-structured particles and 3) nanostructured surfaces. The research is based on both fine control of the

structure of elementary building blocks (molecules, biopolymers and nanoparticles) and knowledge of the physical chemistry of these objects (including their self-association properties).

Over the last years, the team made efforts to establish collaborations with academic partners at the regional and national level. These collaborations allowed them to get access to raw materials, specific characterization techniques and microdevices to develop new systems based on bio-based materials, notably cellulose derivatives.

The scientific production of the group is excellent with 52 papers published (from 2010 to 2015) in international peer-reviewed journals with a very good impact (for example, several papers in *Biomacromolecules* with an IF of 5,7, 1 paper in *Advanced Materials* (IF = 17.5) and 1 paper in *Lab on Chip* (IF = 6.1)). Most of these papers (about 80%) are mainly authored by the group members as first or last author which testifies for their leadership in the research performed. In addition, 37% of the articles published by the team are co-authored with another BIA team, which proves their collaborative activity within the frame of the research unit.

#### Short appreciation on this criterion

The scientific activity of the team is excellent and the research performed is innovative.

#### Assessment of the team academic reputation and appeal

The team is involved in the coordination of the national "Groupe de Recherche" Symbiose that aims to foster the action of different French research groups working on bio-based materials. It is also a member of the IFMAS Institute, which groups academic partners and companies working on bio-based materials, and of the Laboratory of Excellence (Labex) SERENADE which is part of the French program "Investissements d'avenir". This proves the recognized expertise of the group at the national level. However, the group suffers from a lack of international recognition as illustrated by its non-involvement in European projects and its limited participation to international conferences with a large audience.

The expertise of the NANO group in the field of bio-based materials is also nationally recognized as proven by its central role in the coordination of project MATIERES which involves both academic and industrial partners.

Over the last five years, the NANO team obtained different grants from national public sources such as the ANR agency (two grants including one coordinated by the team), "Investissements d'avenir" and the Region Pays de la Loire. However, they failed to obtain European projects.

#### Short appreciation on this criterion

The academic reputation and appeal of the group is in general very good. The involvement of the team in several local and national programs, notably as coordinator, testifies for its leadership in the field of bio-based materials. It lacks, however, some visibility at the international level.

#### Assessment of the team interaction with the social, economic and cultural environment

The successful patenting strategy conducted by the team, notably regarding the Pickering emulsion topic, testifies for the originality of the performed applied research. The NANO team has indeed deposited 6 patents over the last 5 years which testifies for the quality of their applied research. In addition, some of these patents have been already licensed by 2 SMEs, which proves the effort of the team to promote their applied research. The fact that some patents published by the team have been licensed by industrial partners proves the quality of the performed research but also the continuous efforts done by the team to transfer its results to industry.

In addition, the team contributes to disseminate its research activity through participation in popular scientific events or seminars involving industrial parties.

#### Short appreciation on this criterion

The team conducts an excellent activity to promote its applied research and to reinforce its interaction with industrial parties notably by developing a very active patenting strategy and participating to research programmes involving both academic and industrial partners. The research topics developed by the team clearly support the drive to promote the use of bio-based materials for the production of high added value materials.

### Assessment of the team involvement in training through research

The team performs a very good training activity since it is involved in 3 different master programmes performed in Pays de la Loire Universities and the Technological University of Compiègne. The achievements of the team in these programmes consist in courses dedicated to specific topics related to the research performed in the group.

The team hosts several interns (master year 1 and 2, technician year 2, etc.) per year, which testifies for its involvement in academic training.

The team hosted 10 PhD students and 8 of them have already defended their PhD with a mean of 2,9 articles per student. Except 2, all of them found a job.

It can be noticed that only two permanent researchers of the team are qualified for research supervision (HDR).

#### *Short appreciation on this criterion*

Although the team members do not benefit from professorship position, they make strong efforts to be involved in teaching programs performed in the surrounding universities. In addition, the group hosts a reasonable number of trainees, PhD's and postdocs per year. The commitment of the team in training activities through research is very good.

### Assessment of the strategy and the five-year plan

Over the next 5 years, the team plans to continue the development of nano-assemblies based on bio-based materials. They aim to improve the control of the structure and the functionality of the assemblies by varying the nature, the morphology and the structure of the elementary building blocks. The research will be developed along three different directions which are directly related to the current research of the group: i) development of new biopolymer-based systems to better understand the structure and the degradability of biopolymer assemblies; ii) development of new building blocks to create nano-assemblies; iii) fabrication of functional nano-assemblies based on these new biopolymer building blocks.

The five-year project of the team is consistent with the scientific activity performed over the last few years, in the sense that it aims to develop new functional materials from processes recently developed in the group but also from new bio-based building blocks varying in their structure and nature. This research will be developed in close collaboration with other teams of BIA (PVPP, ISD, BIBS, MC2, etc.) and external groups. However, some approaches described in the five-year project strongly depend on the contribution of external partners (notably regarding the production, extraction and modification of raw materials, the structural analysis of assemblies, etc.). Therefore, the team should consolidate its collaborations with other partners, notably through funded projects.

#### *Short appreciation on this criterion*

The five-year plan of the team is very good and in line with the research developments achieved by the team over the last few years. It will contribute to improve the expertise and the interdisciplinary of the group in the field of the fabrication and the analysis of functional biopolymer assemblies.

### Conclusion

#### ▪ Strengths and opportunities:

The team performed a research of excellent quality as evidenced by its scientific production. Its expertise in biopolymer assembly is very well recognized at the national level, as testified by their coordinating role in national programmes dedicated to bio-based materials. In addition, local and national partnerships are well established and reinforce the capabilities of the team to develop and analyse new systems based on various bio-based materials.

The team benefits from numerous contacts with industrial partners notably through their strong patenting strategy, which should be helpful to develop new collaborative projects.

- **Weaknesses and threats:**

The strong patenting strategy of the group is not yet supported by formal collaborations with industrial partners. However, strong efforts are made to reinforce the partnership with industrial parties.

The team lacks international visibility. Indeed, it is not involved in international programs and does not benefit from European funding.

Some analytical and technical capabilities of the team depend on other labs. The research performed by the team also depends on external collaborations to get raw materials. This could be a limitation for the future development of the team.

- **Recommendations:**

The papers produced by the group have been published in a limited number of journals, which may limit the width of its audience. The team should increase its attractiveness notably by expanding its network of collaborations beyond the national level. It should also promote its research activity through the participation to international events. The team should also continue its effort to be involved in European projects, notably to attract young foreign researchers. It should take the advantage of its expertise on bio-based materials and its contacts with SMEs to apply to "green European programs".

The young permanent researchers of the team are encouraged to obtain their "HDR" to facilitate the supervision of PhD students and to increase the attractiveness of the group.

The functionalities targeted through the fabrication of nano-assemblies based on new building blocks should be better defined in order to clarify to which application fields the research will be oriented within the next few years. This approach should help the team to better identify the potential calls of interest, the potential partners to set-up projects and the required experimental conditions to develop the projects.

The project of the team for the next five years requests additional expertise in the chemical modification of biopolymers and in physical analysis of macromolecular assemblies. This should be secured by setting up sturdy collaborations with other groups or possibly by the recruitment of new experts.



**Platform:** E9-BIBS: Biopolymers, structural biology platform

**Name of platform leader:** Ms H. ROGNIAUX

### Platform scientific domains

Analytical methods: microscopy, mass spectrometry, nuclear magnetic resonance (NMR) and pheno/chemotyping; bioinformatics. Multi-scale analyses to chemically and structurally characterize complex biopolymer systems.

### Workforce

Team workforce ("Full Time Employee" (FTE) between brackets)	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions		
N2: Permanent researchers from Institutions and similar positions	13 (13)	13 (13)
N3: Other permanent staff (technicians and administrative personnel)	3 (2.8)	2 (1.8)
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers (Emeritus Research Director, Postdoctoral scientists, visitors, etc.)		
N6: Other contractual staff (technicians and administrative personnel)	4	
N7: PhD students		
TOTAL N1 to N7	20 (19.8)	
Qualified research supervisors (HDR) or similar positions	1	

Team record	From 01/01/2010 to 30/06/2015
PhD theses defended	3
Postdoctoral scientists having spent at least 12 months in the unit	2
Number of Research Supervisor Qualifications (HDR) obtained during the period	

## • Detailed assessments

BIBS is recognized as a strategic Inra-platform and has obtained ISO9001 certification in 2009 and the IBISA label. Its strength lies in the combination of different methodologies and there is no equivalent in Europe.

The platform is well equipped technically and has a strong workforce including 1 researcher, 12 engineers (one with the HDR) and 3 technicians. Three PhD students have defended their thesis in the BIA unit (including one member of BIBS who worked in collaboration with PVPP) with a large part of the results obtained thanks to the platform.

BIBS is developing and optimizing cutting edge methods and technology and it has strong interactions with industrial and academic stakeholders. About 100 analytical requests are treated every year by the team whose half comes from external requests. The team is indeed open to other scientists as about 40-50% of its projects are done with collaborators external to BIA. BIBS interacts closely with the economic environment as it performs characterization for industrial partners. It has also filed a patent in 2011, with a European extension (PCT/FR2011/051989. 2011). BIBS is an original and very useful platform that combines method developments with high-quality characterization of biopolymers for BIA and for external collaborators. The team provides a high visibility for Inra in the field of the characterization of complex systems of bio-based materials.

The BIBS team is notably involved as a collaborative partner through other BIA teams or as a main partner in European, national and local projects. It collaborates with more than 50 academic labs and more than 20 private companies. Therefore, the expertise of the platform is nationally and internationally recognized. BIBS is a major team driving the interdisciplinarity in BIA: the collaborations on different aspects of research and the involvement of team members in other BIA teams contribute to this dynamic.

Together with Team PVPP, BIBS is involved in a Regional project (AI-FRUIT), 2 ANR (FUNLOCK and HI-SOLIDS) and 2 European projects (FRUITGRADING and FIBEBIOTICS). BIBS is coordinator, with PVPP, of the Regional AI-FRUIT public-private project ("Approches intégratives du déterminisme structural, génétique et écophysologique de la qualité des fruits") with the following partners: UMR Genhort Angers, UPSP Grappe Angers, Lampa ENSAM Angers, LAUM Univ du Maine Angers, UR TERE Equipe IRM Food plf PRISM Cemagref Rennes, EA 3858 LASQUO Univ Angers, PSP ONIRIS Nantes, UMR 6087 LPEC Univ Angers; Associé : EA 921 SONAS Univ Angers. The funding for the platform is about 246 k€. The total funding received by BIA for the projects in which BIBS is involved amounts to 764 k€.

BIBS is also concerned with the dissemination of knowledge inside BIA, towards the general public (organisation of "Open days" at the BIBS platform, Organisation of practical workshops for undergraduate students and PhD students, training of a few interns and Master students every year). Team members are very active at congresses and workshops and have a good national visibility.

Besides the service activity, BIBS carries out its own research to develop innovative analytical approaches; this research is developed by one post-doc and 3 PhD students in collaboration with other teams. BIBS benefits from a significant number of technicians and engineers who are experts in the characterization of complex biopolymer systems; this staff obviously contributes to the dynamic development of the platform. The PhenoChem and Bioinformatics divisions of BIBS contribute to the original approach developed by the platform; they reinforce the attractiveness of the platform at the national and international level. The development of the platform is not only based on the acquisition of new equipment, but also on the development of new expertise, new methodologies that fully meet BIA needs. The acquisition of innovative techniques for the characterization of complex systems contributes to the attractiveness of the platform; this leads the team to be involved in various projects with academic or industrial partners.

The team has obtained significant results in the structural characterization of glycans. It has also elaborated innovative porosimetry characterisation methods by NMR and has proposed new interpretations of peptide mass spectra. The scientific production of the group is very good with 142 papers published (from 2010 to 2015) in international journals with a good impact (+ 1 book chapter). As a platform, the team has a lot of interactions with the other BIA teams (50% of the publications are with one or more co-authors from a different team). Collaborations with teams E1-PVPP, E4-ISD and E5-ALL are the most productive in terms of scientific output. However, because the team acts as a technical support for the research projects developed by other teams, most of these papers are not mainly authored by the team members. This reflects however the collaborative and service role of the platform.

The team members have been invited in 5 PhD defence juries (Univ. Angers, Univ. Nantes, Univ. Tours, Univ. Bourgogne and ENSIACET). The team members are actively present in congresses and workshops with 24 oral abstracts and 47 posters presented during the evaluation period. In addition, 33 invited conferences were given by team members. With a few exceptions, these conferences were essentially organized at the local or national level. This dissemination activity gives a good national visibility to the team. However, its international visibility remains limited. BIBS is very successful in attracting public money through grants from ANR (NOMAC as coordinator and MAGIC as

Partner) and the region (5 projects during the period). BIBS is also a partner of 1 European project (LEGATO) and 1 "Investissement d'avenir" (PHENOME).

In summary, the scientific quality and outputs of team are excellent and its academic reputation and appeal is very good. By its certification and numerous collaborations with industrial partners as well by its teaching efforts, BIBS has strong interactions with its environment. The interactions of BIBS with the social, economic and cultural environment are therefore excellent

The multimodality and complementarity is maintained by a pluriannual investment plan. A scientific committee composed of external members to BIA examines every year the activity and the future strategy of the platform. The originality of the platform organization resides in the fact that people are assigned to three main tasks: performing experiments, developing methodologies and carrying out research in the team they are originating from. This close contact between the platform and the other teams of BIA allows BIBS to develop analytical tools very useful for the BIA community. A significant effort is done to improve the methodologies used to characterize complex systems. The team has therefore developed a unique expertise in the field of the characterization of complex systems based on biopolymers. BIBS organised international training courses of 2-3 days for around 25 PhD students within the frame of the European WALLTRAC project "Spectrométrie de masse pour la caractérisation structurale des polysaccharide". It has also co-organized a school for 55 Inra Researchers on Proteomics, and it is also involved in the organisation of national conferences. The BIBS team hosts several interns every year which testifies for its will of involvement in academic training. A member of BIBS chairs the Development council of the Bioinformatics Master of the University of Nantes, showing the interest of this member in the formation of young scientists.

In summary, the organisation of BIBS is excellent and its involvement in training through research is very good.

Over the next 5 years, BIBS aims at improving the results delivered to the BIA scientists by improving analytical methods. Along this line, new equipment will replace older machines and 2 new acquisitions are foreseen: a Scanning Electronic Microscop working under environmental conditions and a micro-NMR. These future acquisitions are fully in agreement with the research strategy developed in BIA. Also BIBS will keep on developing methodologies. A new major effort will be dedicated to the integration of the enormous data that are generated from the different analyses, in a software dedicated to the exploitation and valorisation of results. BIBS aims to develop a generic method to exploit the data obtained through a multi-scale approach; this future methodology is of great interest for the BIA unit considering the large variability and complexity of the systems investigated. BIBS has the will to integrate, using its transversal group of bioinformatics, these multi-scale data by putting together results obtained by the 4 "laboratories" composing the platform team (microscopies, RMN, mass spectrometry, PhenoChem), and the transversal group (bioinformatics). However, the format of these data are so diverse that the way this can be done remains unclear. Several persons will leave the team within the next years and efforts have to be made to recruit new experts to keep the level of competences. The strategy and five-year plan of the team are excellent and in agreement with the general BIA project.

## Conclusion

- **Strengths and opportunities:**

The development of innovative techniques with a multidisciplinary methodology, including bioinformatics is a strength of BIBS.

The involvement of the BIBS staff in some other BIA teams creates a high coherence between the platform and other BIA teams. The platform obtains high scientific outputs through this collaborative strategy.

Such a platform with this high level of equipment is unique at Inra. The equipment obtained by BIBS contribute to reinforce its national visibility and its involvement in a few European projects. Also the team built a large academic and industrial partnership.

The BIBS platform strongly benefits to other BIA teams; it is therefore of utmost importance regarding the general scientific activity of BIA.

Quality management is a strong asset for the platform.

The platform management is good.

Some financial supports have been already obtained to secure the acquisition of new equipments.

- **Weaknesses and threats:**

The Platform is located in 2 different buildings with few exchanges between team members.

The staff competences are specific. The staff members are not really multi-skilled which limits the development of the platform.

Obtaining funding to support the maintenance of the equipments may be a hard job. The team may encounter difficulties to maintain high-level financial resources for equipment and staff.

- **Recommendations:**

Active participation in more international congresses is encouraged to enhance international visibility and network.

Application to European Research infrastructure projects should be considered by the team to reinforce its international network and visibility.

Other sources of funding (collaborations with industrial partners for instance) should be obtained to support the maintenance of equipments.

Development of partnership with other national or European platforms should be considered to increase the expertise and the visibility of the team.

The multi-competency of the staff should be reinforced through internal/external trainings.

## 5 • Conduct of the visit

### Visit dates

**Start:** Monday January 11<sup>th</sup> 2016 at 8.00 am

**End:** Tuesday January 12<sup>th</sup> 2016 at 5.00 pm

**Visit site:** Inra Nantes

**Institution:** Unité Biopolymères, Interactions, Assemblages

**Address:** rue de la Géraudière, 44316 Nantes cedex 03

### Program of the visit:

#### January 11<sup>th</sup> 2016

08.00 am	Welcome (closed-door) Visiting committee with the HCERES Scientific advisor
08.15 am	HCERES representative: the role and procedures of HCERES
08.30 am-09.30 am	Director of the unit (presentation + discussion): presentation of the unit and of its past activities
09.30 am-10.10 am	Director of the unit (presentation + discussion): presentation of the project of the unit
	Presentations of the teams (past activities and projects)
10.30 am-11.30 am	Team 1 "PVPP" (talk + discussion)
11.30 am-12.10 pm	Team 2 "ELIPS" (talk + discussion)
12.10 pm-12.50 pm	Team 3 "PRP" (talk + discussion)
02.00 pm-03.00 pm	Team 4 "ISD" (talk + discussion)
03.00 pm-03.50 pm	Team 5 "ALL" (talk + discussion)
03.50 pm-04.40 pm	Team 7 "MC2" (talk + discussion)
05.00 pm-05.50 pm	Team 8 "NANO" (talk + discussion)
05.50 pm-06.40 pm	Team 9 "BIBS" (talk + discussion)
06.40 pm-07.30 pm	SFR-IBSM (talk + discussion)
07.30 pm	Debriefing of the expert committee

#### January 12<sup>th</sup> 2016

08.30 am-08.30 am	Discussions with staff scientists including engineers
08.30 am-09.00 am	Discussions with technicians and administrative
09.00 am-09.30 am	Discussions with students and post-docs
09.30 am	Meeting with the director of the local doctoral school
10.30 am	Discussion with the representatives of the managing bodies
11.00 am	Discussion with the team leaders
11.30 am	Discussion with the head of the unit
01.00 pm	Private meeting of the visiting committee (in presence of the HCERES scientific advisor)
05.00 pm	End of the visit

## 6 • Supervising bodies' general comments



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Références :

S2PUR170011963 – Biopolymères  
Interactions Assemblages – 075361v

Nantes, le 11 mai 2016

**Observations de portée générale du rapport HCERES de l'Unité BIA**  
(S2PUR170011963 – Biopolymères Interactions Assemblages – 075361v)

**BIA Unit**

**Page 6 line 31 (and same theme in the report): “communication inter-team ...”**

We would like to underline that communication between teams already exists, particularly during the construction of collaborative projects, as they are often built and conducted by a core of 2-3 BIA teams sharing scientific questions and ideas. Furthermore, we have built different transversal groups (mathematical modelisation of complex systems, H2020 think tank, ...) and we ensure many global scientific seminars (about one event monthly), which facilitate that inter-team overall cohesion. Finally, and concerning specifically communication between technicians, our observatory on working conditions group (OCT) has decided to propose the organization of BIA technical days in view to better exchange on common and specific technics.

**Page 9, line 43 (and same theme in the report): “heterogenous structure in terms of scientific focus and competence ...”**

BIA Unit is well recognised on the knowledge of multi-scale structures built by biopolymers through interactions to deliver functionalities. From this specificity, BIA unit shares some generic models and integrative approaches to represent complexity of real systems. After that, the different scientific teams take possession of these knowledge and approaches to apply them on specific and more focused outputs. Furthermore, researchers of BIA Unit share generic scientific questions around biopolymer interactions, dynamics of assemblies deconstruction, oxidation/anti-oxidation cycles, structure-function relationships, ..., resulting on a consolidation of Unit cohesion.

**Page 6, line 33 (and same theme in the report): “replacement of key competencies ...”**

We have built a strategic note concerning our politic and priorities for replacement of key competencies. The strategy consists:

(1) **in maintaining our competencies** to a high level of excellence on key themes for the Unity and inside its scientific framework and the announced objectives. These priorities concern: reactivity and physico-chemical properties of polyphenols (PRP Team), enzymic deconstruction of proteic and lipidic plant polymers (ELIPS Team), and modelisation of the mechanical behavior of highly hydrated plant (PVPP Team).

(2) **in preserving key technical skills:** at short term we need a mass spectrometry engineer and a technician on microscopy (BIBS Team) ; competencies on immunochemical methods (engineer) and cellular culture (technician) : ALL team ; and a technician on biochemistry of biomolecules : ELIPS Team.

On a longer term, engineers around vibrational spectroscopy (PVPP team) and knowledge integration (PRP team) and technicians around extraction of proteins (ISD team), and physico-chemistry of biomolecules (PVPP Team), are needed.

(3) **in integrating new competences around sustainability:** we have to develop knowledge around deconstruction of lignocellulosic biomass, to rise in power on coupling methods for macromolecular assessments, to intensify the development of chemotyping, to develop lipidoreactomic methods, and come to bear with the thematic of recently recruited scientifics around allergy and composite materials.

**Page 9, line 1 (and same them in the report): “international level ...”**

We have developed a plan to enhance our international attractiveness. In this way, one of the Unit's priorities for the next five year is to increase the number of international projects including European projects.

For this purpose we have set up an international partnership policy including:

- the creation of strategic alliances with leading international research units (WUR, IRF Norwich, ETH Zurich, VTT Research, TU Berlin, ...) by sending our young researchers (via outgoing AgreenSkills Sklodowska Curie Fellowships and Marie or other devices). This will help us to get strategic skills for the Unit and establish long-term collaborations to integrate networks.

- the participation and coordination at H2020 projects: nomination of aH2020 correspondent, creation of a working group to identify issues and identification of future bearers to accompany them. The goal is to understand H2020 programs and potentials. As an example we have recently obtained an European project as partner (Greenproteins) on the H2020-BBI call.

- the simplification of international exchanges by welcoming foreign top scientists (AgreenSkills tools, Marie Sklodowska Curie, Connect Talents, RFI Food 4.2, ...).

- the organization in Nantes of the most important congresses of our areas of excellence (eg. Cell Wall Meeting in 2013), while ramp up our biennial Congress Biopolymers International Conference. The increase since 2010 in the number of events that we organize annually is an encouraging sign.



## E1-PVPP Team

**Page 15: “The team also proposes to place more emphasis on two further approaches; mathematical/mechanical modelling of plant tissues, and the functional analysis of candidate cell wall modifying enzymes.”**

The PVPP team agrees with the two remarks:

- **mathematical/mechanical modelling of plant tissue** is very challenging and with the departure of Adelin Barbacci, who was in charge of this topic in our group, we have no experts in the team. Adelin Barbacci demonstrated that it was possible to progress in this field even being the only one with this expertise in the group. To do so, he established links with well-known labs in this field and was able to take advantage of all our knowledge on plant cell walls. Marc Lahaye was also very involved in the development of his network and the links established can easily be reactivated.

In case of non-recruitment, unfortunately, we will have to give up the mathematical modeling aspect. However, we will continue to investigate the relationships between mechanical properties of plant tissues (or cell layers) and plant cell wall polymer assemblies. This will be done in collaboration with other BIA teams and collaborators from other labs. Furthermore one technician who has developed in past competence in measurement of rheological properties of gels agrees to be trained on the measurement of viscoelastic properties of plant tissues.

- **concerning the cell wall biosynthesis topic**, this research was initiated ten years ago first by recruiting a postdoc (PE Sado 2005-2008) then a scientist (AL Chateigner-Boutin 2010). We are aware that it is a very competitive topic. We have already identified several good candidate genes and mutants and/or transformants have already been identified/generated with the help of our long-standing collaborators (INRA-IJPB, INRA-GDEC and Rothamsted Research). A PhD student co-supervised by members of PVPP and of INRA-IJPB has managed to identify *Brachypodium* mutants for a gene involved in cell wall synthesis (Ho-Yue-Kuang et al., 2016). We have obtained a Marie Curie fellowship (2016-2018) to analyse several of these candidate genes potentially involved in the synthesis of mannan. Therefore we will continue with this research at least for the two coming years.

In the meantime, with the arrival of Mathilde Francin-Allami in the team in 2011, the gene function topic has been extended to genes encoding cell wall modifying enzymes. We agree that this research is closer to the team central theme (as opposed to cell wall biosynthesis).

In the future we will put the focus on genes/protein candidates involved in cell wall remodeling. We have already identified several proteins of interest that we intend to characterize. PVPP has experience in the characterization of cell wall hydrolytic enzyme specificity and has the capacity to produce oligosaccharides with well-defined structure which could be very helpful to annotate correctly the enzyme function. These proteins could be also applied to isolated tissues, layers or cell walls to look for their influence on cell wall properties

We would like to emphasize that we are not totally dependent upon collaborators for our gene function research. First, in BIA, we have well-equipped C1 facilities to produce recombinant proteins in bacteria, yeast and in tobacco plants and cell culture (BY2), with a growth cabinet for plants. We also have a room dedicated to grow wild-type plants.

Within our Centre INRA Angers-Nantes, in Angers (50 minutes away from BIA), we have access to facilities to grow wild-type and transformed plants. Currently we have transformants of wheat and wild-type *Brachypodium* growing in the glass-houses and we follow our plants ourselves with the help of the people working in the glass-house.

**Page 15: “A large diversity of research topic is undertaken compared to the size of the PVPP group.”**

We agree that we are dealing with different plant objects that could be seen as dispersal. However, this strategy has proven to be efficient for getting at various sources of funding and the basic science remains the same on the biochemistry and physicochemistry of polysaccharides in these different plant objects. Nevertheless, with the expected decrease in human potential in the coming years, we decided to focus on projects dealing on relationships between cell wall polymers assemblies and cell walls properties taking into account the structural diversity of the polysaccharides and the role of enzymes. This refocusing can give cohesion on the whole team.

## **E2-ELIPS Team**

We entirely share the conclusions of the evaluation comity. We especially appreciated all the comments and encouragements that will obviously boost our constant efforts, performed over several years, to reach the highest scientific level at the interface of basic and applied sciences. We are convinced that such a strategic positioning ensures efficient interactions with both academic and industrial partners and, to a significant degree, secures our financial supports in the short and medium terms. However, we are obviously aware that our scientific ambitiousness can stumble on the modest size of our team. Our demand for the recruitment of a young scientist is actually considered as a top priority by the research unit. Meanwhile, we are reinforcing collaborations within the research unit and with external partners at both the national and international levels to attract non-permanent engineers and young scientific personnel (e.g. doc and post-docs).

## **E3-PRP Team**

**Page 23: “Increase their scientific workforce”**

We agree with this comment. The size of the scientific staff of the PRP group is critical (1 DR and 1 IR). The recruitment of a young researcher for a permanent position (CR2) in the PRP team is identified as a priority in the global recruitment plan of BIA Unit.

**Page 23: “Increase collaboration with other BIA teams”**

PRP is a new team of BIA (since January 2013). Collaborations already exist with E1-PVPP (OPTIPRESS Project and with E5-ALL (ProtAlsafe Project). Moreover, official involvement of E1-PVPP and E2-ELIPS scientific leaders is planned in the next UMT Novacidre Project (2017-2021).

**Page 23: “Apply to /or be involved in European programs and thus extend its European links”**

Application to EU or ANR calls as coordinator or WP leader can be highly time-consuming with very low rate of success. Therefore, taking into account the very small size of the scientific staff, PRP strategy is more orientated toward regional, interregional or technological (Casdar, Qualiment) sources of financial supports. However, we will be highly favourable to contribute European programs if relevant opportunities appear in the coming years.

## **E4-ISD Team**

No particular comment

## **E5-ALL Team**

**A great number of projects are listed, but it is not clear what exactly will be done at BIA and what will be done in collaboration with other teams**

The projects corresponding to axe 1 will be mainly done at BIA.

In the case of axe 2, the project dealing with the mechanism of food allergy will be mainly done at BIA.

Among the other cited projects, those concerning “the atopic march” and “the contribution of the enteric nervous system dysfunction” will be done in collaborations with A. Magnan’s team (INSERM U1087 de l’institut du thorax, Nantes) and Mr. Neunlist’s team (INSERM U913 of IMAD, Nantes) respectively. The therapeutic project is only done in collaboration. The project concerning the perinatal period is being assembled, it will be done in collaboration and only if funding is obtained.

**In particular, the proposal that a team member should be trained in running clinical trials seems excessive, when such trials could potentially be run in the frame of existing collaborations.**

The post doctoral stay of M. Bodinier was a real opportunity to initiate collaboration with S. Prescott who is very well known in allergy and prevention, she is following clinical trials and for M. Bodinier it is an opportunity to be trained to this type of job and to become an informed partner for future clinical studies. Concerning the participation of M. Bodinier in the clinical trial funded by PHRC, it is estimated to 20% ETP per year for the next three years. Some preclinical trials related to this project are intended, they will be part of MB’s activities in BIA and will be done depending on fundings.

**There is a clear threat of spreading into too many research areas during the next few years.**

We need to maintain a large research area for answering national or private calls. However in this context, we always try to focus on the heart of our activities. However, it is clear that our future research areas will depend on calls’ success.

**In particular attention should be paid to maintaining existing expertise within the team**

We have been asking for new permanent positions for several years, we do not have the hand over the allocation of these positions. Furthermore, when we present a project we pay attention to the amount of work and in most cases we ask for funding for qualified contractual researchers.

## **E7-MC2-Team**

No particular comment. The project will be adapted according to obtained fundings.

## **E8-NANO Team**

We globally agree with the recommendations of HCERES committee. Some specific answers are listed below:

Page 39: **“The team should increase its attractiveness notably by expanding its network of collaborations beyond the national level. It should also promote its research activity through the participation to international events. The team should also continue its effort to be involved in European projects, notably to attract young foreign researchers. It should take the advantage of its expertise on bio-based materials and its contacts with SMEs to apply to “green European programs”.”**

The team is conscious of the lack of industrial partnership and has already started to develop projects to face this drawback. This strategy will be enhanced in coming years.

For industrial partnership:

one project has started in collaboration with a French SME early 2016 for microfluidic development for a two years collaboration involving a post-doc, another one for valorization of a new patent filed by the team in 2015. It will allow promoting new industrial partnership. We have also applied to an ANR project with an industrial partner.

For International visibility:

we will be involved in TAPPI nano conference as theme leader (International nanocellulose conference) and will organize the next “international conference biobased materials and composites” (ICBMC) in Nantes in 2017 (150 participants expected). We have also started a collaboration with Aalto University (Finland), we shall welcome a post-doc in June 2016. We will try to develop and implement new European collaborations to promote our participation to European networks and projects.

**Page 39: “The young permanent researchers of the team are encouraged to obtain their “HDR” to facilitate the supervision of PhD students and to increase the attractiveness of the group.”**

One researcher has already defended a HDR in March 2016.

**Page 39: “The functionalities targeted through the fabrication of nano-assemblies based on new building blocks should be better defined in order to clarify to which application fields the research will be oriented within the next few years. This approach should help the team to better identify the potential calls of interest, the potential partners to set-up projects and the required experimental conditions to develop the projects.”**

We have made a focus on the elaboration of new building blocks that we develop (nanoparticles source and shape, hemicellulose coating, chemical modification). Developing knowledge in this field allows a large panel of functionalities. We agree with the committee, applications depend on collaborations with partners. To strengthen this aspect we develop our partnership activity applying to projects. The team has applied to 5 national research agency (ANR) projects. Four have been selected for the second step (including 2 as coordinators).

**Page 39: “The project of the team for the next five years requests additional expertise in the chemical modification of biopolymers and in physical analysis of macromolecular assemblies. This should be secured by setting up sturdy collaborations with other groups or possibly by the recruitment of new experts.”**

We agree that additional expertise would be welcome for the team development.

## **E9-BIBS Team**

**Page 42: “BIBS aims to develop a generic method to exploit the data obtained through a multi-scale approach. (...)The format of these data are so diverse that the way this can be done remains unclear.”**

Since the time when documents have been produced for the HCERES evaluation, the project “Intégration des données multi-modales et multi-échelles” has considerably progressed and we have now a better view of the different steps, methods, and possible bottlenecks regarding the integration of the heterogeneous data that the BIBS platform is producing.

**Page 42: “Reinforce multi-competency of the staff”**

With the project “Intégration des données multi-modales et multi-échelles” that the BIBS platform is currently building, significant interactions are taking place between the engineers of the different analytical facilities of the BIBS platform and with the bioinformatics group. These interactions contribute

to develop the multi-competency of the staff, which will be further reinforced by an internal training that we have planned in 2016.

**Page 43: “Other sources of funding (ex. industrial partners) should be obtained to support maintenance of the equipments.”**

We note the recommendation to find other sources of funding to maintain the equipment, especially through the development of collaborations with industrial partners. In fact, these collaborations will become reinforced in a close future in the frame of two projects that strongly involve BIBS and several industrial partners: the project “Intégration des données multi-modales et multi-échelles” (partners of the cereal industry), and the project FoodL@b (under review, with several partners of the AAI sector). In addition, the platform is working with the “Commission Valorisation” of the Biogenouest network, in order to improve the marketing of our service towards industrial partners and reinforce bipartite contracts with industrial partners (better definition of the service, organization of business meetings during certain events, etc.)

**Page 43: “International visibility, partnerships with other national or European platforms, application to European Research Infrastructures projects.”**

At the national level, BIBS already interacts with other platforms, either through the Phenome project or within specialized networks and societies (Biogenouest, MassProt'INRA, SF5M, SFEAP, RμI, Remanan, CIMEN federation ...). We note the recommendation to better interact at the European scale, or to apply specifically to European Research Infrastructure calls, in order to increase the visibility of the team.

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