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BBF - Biodiversité et biotechnologie fongiques

Rapport Hcéres

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Rapport d'évaluation d'une entité de recherche. BBF - Biodiversité et biotechnologie fongiques. 2017, Aix-Marseille université - AMU, Institut national de la recherche agronomique - INRA. hceres-02030395

HAL Id: hceres-02030395

<https://hal-hceres.archives-ouvertes.fr/hceres-02030395>

Submitted on 20 Feb 2019

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HCERES

High Council for the Evaluation of Research
and Higher Education

Department of Research Evaluation

report on research unit:

Biodiversité et Biotechnologie Fongiques
BBF

under the supervision of
the following institutions
and research bodies:

Aix-Marseille Université

Institut National de la Recherche Agronomique - INRA

Evaluation Campaign 2016-2017 (Group C)

HCERES

High Council for the Evaluation of Research
and Higher Education

Department of Research Evaluation

In the name of HCERES,¹

Michel Cosnard, president

In the name of the experts committee,²

Merja Penttilä, chairwoman of the committee

Under the decree N°2014-1365 dated 14 november 2014,

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

² 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: Biodiversité et Biotechnologie Fongiques

Unit acronym: BBF

Label requested: Unité Mixte de Recherche

Current number: UMR 1163

Name of Director (2016-2017): Mr Craig FAULDS

Name of Project Leader (2018-2022): Mr Craig FAULDS

Expert committee members

Chair: Ms Merja PENTTILÄ, VTT, Technical Research Centre of Finland, Finland

Experts: Mr Tristan BARBEYRON, CNRS, Roscoff (representative of the supporting personnel)

Ms Mirjam CZJEK, CNRS, Roscoff

Ms Fabienne GUILLON, INRA, Nantes (representative of the INRA CSS)

Mr Bernard OFFMANN, Université de Nantes (representative of the CNU)

Mr Philippe VANDENKOORNHUYSE, Université de Rennes 1

Scientific delegate representing the HCERES:

Mr Steven BALL

Representatives of supervising institutions and bodies:

Mr Pierre CHIAPPETTA, Aix-Marseille Université

Mr Michael O'DONOHUE, INRA, Département CEPIA

Mr Christophe NGUYEN-THE, INRA, Département MICA

Head of Doctoral School:

Mr Frédéric BARRAS, Doctoral School n° 62 "Sciences de la Vie et de la Santé"

1 • Introduction

History and geographical location of the unit

The Joint Research Unit n°1163 (JRU) of INRA and Aix-Marseille University (AMU) “Biodiversity and Biotechnology of Fungi” (Biodiversité et Biotechnologie Fongiques: BBF) was established in 1993 and is located in the polytech building on the luminy campus of the university. In 2014, it changed its name, which was previously “Biotechnology of Filamentous Fungi” (Biotechnologie des Champignons Filamenteux: BCF).

The BBF unit is attached to the INRA Departments CEPIA (Science and Process Engineering of Agricultural Products) and MICA (Microbiology of the Food Chain), and is administratively attached to the Inra Centre PACA, which is based in Avignon and Sofia Antipolis. Within AMU, the unit is mainly associated with the PR2I “Energies”, with interaction within the PR2I “Santé et Science de la vie” (Microbiology) and PR2I “Sciences et Technologies” (Biodiversity and Environment). BBF is part of the Cooperative Research Structure (FR) ECCOREV (Continental Ecosystems and Environmental Risks), as particularly applied to the mediterranean area, involving 35 laboratories from Marseille and the Provence-Alpes-Côte d’Azur Region (PACA).

The BBF unit is firmly anchored within the PACA Region also through teaching activities at AMU. This has been strengthened through collaborative projects with industries, competitive clusters and other units within AMU, together with the creation of a “Unit Under Contract (USC)” between INRA and AMU-CNRS (UMR 7257, Architecture et Fonction des Macromolécules Biologiques, AFMB).

The unit is structured as a mono-team, with projects led by the responsible INRA or AMU researchers. The unit consists currently of 10 permanent researchers/lecturers and 11 permanent technical staff, and 11 short-term contract personnel (6 post-docs, 3 PhD students, 2 technicians).

Management team

The unit is headed by C.-B. FAULDS, assisted by deputies M.-N. ROSSO and E. RECORD, and a financial assistant.

HCERES nomenclature

Main domain: SVE2 Biologie Cellulaire, Imagerie, Biologie Moléculaire, Biochimie, Génomique, Biologie Systémique, Développement, Biologie Structurale

Secondary domains: Microbiologie, Immunité SVE1 Agronomie, Biologie Végétale, Ecologie, Environnement, Evolution

Scientific domains

The mission statement of the BBF unit is: “to provide generic knowledge on the mechanisms by which diverse filamentous fungi break down and transform lignocellulosic biomass, to harness this knowledge and appropriate methodologies in order to enhance the potential of such fungi in today’s bio-economy”.

During the years 2011-2017 BBF has the following scientific focus themes:

- 1) biodiversity of lignocellulolytic fungi;
- 2) lignocellulolytic enzymes;
- 3) exploiting fungal systems;

For the next period, years 2018-2022, the strategic themes are the following:

- 1) fungal adaptations and responses to lignocellulosic biomass;
- 2) how do fungal systems degrade complex and recalcitrant polysaccharides?
- 3) how do fungi utilise and modify aromatic compounds?

Unit workforce

Unit workforce	Number on 30/06/2016	Number on 01/01/2018
N1: Permanent professors and similar positions	1	1
N2: Permanent researchers from Institutions and similar positions	7 (100%) 1 (90%) 1 (80%)	7 (100%) 1 (90%) 1 (80%)
N3: Other permanent staff (technicians and administrative personnel)	10	9
N4: Other researchers (Postdoctoral students, visitors, etc.)	10	
N5: Emeritus	1	
N6: Other contractual staff (technicians and administrative personnel)	3	
N7: PhD students	1	
TOTAL N1 to N7	35	
Qualified research supervisors (HDR) or similar positions	7	

Unit record	From 01/01/2011 to 30/06/2016
PhD theses defended	7
Postdoctoral scientists having spent at least 12 months in the unit	14
Number of Research Supervisor Qualifications (HDR) obtained during the period	1

2 • Assessment of the unit

Global assessment of the unit

Over the last 20 years, the BBF unit has developed a strong expertise in the discovery and exploitation of fungi and their enzymes for the biotransformation of lignocellulosic biomass. Fungi are major players in the decomposition of plant matter with a breadth of enzymes involved. This diversity of fungal strains and their enzymes represent an exceptional source of scientific and innovation potential in a number of domains. The BBF work is therefore in the core of global efforts to replace fossil resources with renewable ones in industrial production. Lignocellulose is the most abundant renewable resource but its use as a feedstock in biorefineries and bioeconomy still requires significant research and development efforts.

The research has been organized during years 2011-2016 into three complementary themes. Theme 1 is dedicated to understanding how the natural diversity of filamentous fungi can be exploited in the deconstruction of lignocellulosic biomass (e.g. wood, cereal straw), with two sub-themes: a) functional diversity within targeted lineages; and b) functional genomics and post-genomics. Theme 2 focuses on the study of lignocellulolytic enzymes, with 2 sub-themes: a) production and characterization of enzymes of biotechnological interest; and b) enzyme mechanisms and targeted engineering. Theme 3 focuses on the exploitation of fungal systems, with four sub-themes: a) plant biomass deconstruction; b) targeted approaches; c) implementing fungal and enzyme systems to valorize agro-industrial residues and d) enzyme utilization in pulp and paper applications.

The asset of the unit is a strain collection established in 2006 and enlarged since then, dedicated to the preservation of saprotrophic filamentous fungi: the “Centre International de Ressources Microbiennes-Champignons Filamenteux (CIRM-CF)”, labelled “Biological Resource Centre” (BRC), maintained under an ISO 9001 certification. An excellent complementing addition to the BBF activities is the bioinformatics resources of the FOLY database, which has now been incorporated within the grouping of “Auxillary Activities” into the CAZy database run by the AFMB-Glycogenomics team (<http://www.cazy.org>) on the luminy campus. In addition, the unit has a high-throughput robotics infrastructure, which is set-up for cultivation and screening of filamentous fungal systems in particular. Together these activities form an excellent base to exploit fungal biodiversity for biorefinery applications. In a relatively short time the unit has been able to take advantage of fungal genome sequencing (done in collaboration in global networks), and used this data for enzyme expression and characterisation.

The scientific output as peer-reviewed articles has doubled from the previous period (years 2006-2010), being now about 110 originating from the current period (2011-2016), most of them rated as exceptional or excellent quality. The number of peer-reviewed publications per scientist has thus increased to a very good level. Even though many of the high quality publications in particular on genomics are not led by the unit researchers, the unit has positioned itself very well at national and international level.

The previous evaluation report recommended that the unit should focus more on scientific questions than just technology development. The progress in this respect has been very good. The unit has been able to exploit its fungal expertise in genome analysis and identified novel enzymes that will help the unit to address original scientific questions in the continuation. The unit has now laid out a vision and strategy for the next period (years 2018-2022) as a common effort between the unit members, led by the unit director. This resulted in three themes with specific goals. This is seen as an excellent mean to guide the activities of the unit away from dispersed broad-range individual projects towards bigger scientifically up-to-date entities. The three strategic themes are: 1) fungal adaptations and responses to lignocellulosic biomass; 2) how do fungal systems degrade complex and recalcitrant polysaccharides? and 3) how do fungi utilise and modify aromatic compounds? These are logical continuations from the present activities and the foundations established, and form important aspects of biotechnology for biorefineries. In particular, the third theme has the potential to provide still novel discoveries and unique application possibilities, but requires extensive efforts.

The previous evaluation report also recommended that the unit’s researchers should take more responsibility in leading and management of national and international projects. BBF has now coordinated 2 ANR projects and has been a work package leader of an EC FP7 project. Members of the unit are coordinating or are partners in AMIDEX (PIA) projects. The unit has also carried out industrial projects “service contracts” (e.g. CIRM-CF contract).

The strength of the BBF unit is the good balance of researchers and post-docs, which promotes high scientific quality of the work. The unit has a good collaborative spirit and the personnel are inspired by the future possibilities. The unit can take advantage of the sizable fungal culture collection, with a unique feature of having a large number of Basidiomycete fungi. Previous research has resulted in a number of yet unexplored enzyme activities (including lignin

active enzymes), which form an excellent basis for further research. Linking the unit's activities with bioinformatics and the CAZy database is a good strategic step. Academic and industrial networks are extensive, and can be utilised to gain a solid position at the cutting edge of this field, both in terms of fundamental and applied research. The unit has been able to establish functional and stable collaborations with expertise areas needed for the unit to succeed.

The field is very competitive with many groups working on lignocellulose-active enzymes. The critical mass of the unit is rather small to carry out a broad range of activities. The unit should consider which cutting-edge fundamental and applied aspects it wants to focus on. INRA and AMU both see high level of science as a prerequisite for breakthrough innovations. The BBF unit has now a unique possibility to valorise the data on fungal genomes and novel enzymes for lignocellulose refining. It should take care that it can implement its vision as laid out in the three themes for the period 2018-2022. It should continue sharpening the common focus areas for the whole unit, and ensure that the researchers target their expertise and contributions towards the theme goals. Since BBF is a small and specialised unit, it should ensure that it has all necessary strategic expert collaborations in place to support its success now that it is transforming itself to a higher scientific level.