Strengthening STI Cooperation between the EU and Korea, Promoting Innovation and the Enhancement of Communication for Technology-related Policy Dialogue

KONNECT Joint Call on "Resources and Sustainability"

Please fill all sections of this document, add the researchers' CVs and upload it as one PDF file to the KONNECT Joint Call on "Resources and Sustainability" electronic submission system at: **https://www.pt-it.de/ptoutline/application/KONNECTJC1**

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The deadline for proposal submission is
Sunday, 15th Nov. 2015 (24:00 p.m. CET) / Monday, 16th Nov. 2015 (08:00 a.m. KST)

Please make sure that the number of pages prepared by you for each section corresponds to the maximum number indicated in brackets. Proposals exceeding the given limits will not be accepted.

Project title: Exploring the potential bioactive molecules from microalgae and understanding of their gene regulations

Project acronym: ALGACTIVE

Name/institution of project leader for Korea: Daegu Haany University,College of Oriental Medicine

Name/institution of project leader for Europe: Universite de Liege, Department of Life Sciences, Institute of Botany

Names/institutions of other project partners: Ege University, Faculty of Engineering, Department of Bioengineering

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1. General information

1.1. Short abstract of the project

Please describe briefly the rationale and overall aim of the project and its relevance regarding the aim of the Joint Call (max. 1/2 page).

The project is consisted of three partners form **Korea** (Daegu Haany University), **Belgium** (Universite de Liege) and **Turkey** (Ege University Department of Bioengineering). The project aims to evaluate the role of microalgal bioactive metabolites and their activity according to in vitro test results on cancer cell line experiments. The project aims to define new bioactive molecules and their role for potential promising therapeutics in terms of pharmaceuticals and nutraceuticals. Thus the project represent a brief journey of what has been done yet to date and what will be the added value if this project id rationalized.

Microalgae have been utilized for pharmaceutical, nutraceutical and cosmetic purposes since ancient times. The deep mystery in microalgal metabolism seems to hold the light for a broad understanding of scientific research. Here in this project the research team would like to collaborate for the screening of novel bioactive molecules from promising microalgae species which can rapidly cultivate in artificial cultivation system under controlled laboratory conditions. One of the essentials of this project looks like to be understanding the genomic perspective of microalgal metabolism in terms of biochemical composition and responses to environmental conditions.

With respect to this brief explanation the research team would like to investigate the interactions of genetic regulations of certain possible bioactive molecules isolated from microalgae and their responses to in vitro cell line experiments.

1.2. Main Objectives of the project

Please describe the overall aim and specific objectives in detail, state of the art, giving when possible quantitative data. Describe also the expected results of the project (max. 1/2 page).

The nature derived therapeutics are getting intense attention rather than chemical synthesis and synthetic ones. Today the expansion of natural bioactive molecule market is started to be dominated and generic drug and therapeutic understanding looks like to leave its place to a new horizon. Thus natural originated therapeutics under controlled production conditions are of importance. Besides the public attention on natural molecules are also gain advance and the demand on this bioactive molecules is also increasing dramatically. Another investment on natural products seems to be cosmeceuticals. Rather than colourful cosmetic applications, consumers demand lapses to natural products we can also name as cosmeceuticals. However conventional way to produce these molecules are wild collection of plant materials or macroalgae species or artificial cultivation of microalgae species. After a serial downstream processes the yield obtained is decreased due to sensitive techniques required for pharmaceutical or cosmeceutical purposes. Herein as an ultimate goal to understand the project team aims to;

- Explore the bioactive molecules from microalgae species and their potential application
- Extraction and purification of potential molecules from microalgae species
- Determination of the in vitro bioactivity of certain isolated molecules from microalgae species.
- Understanding the genetic expression of a certain bioactive molecule using genetic engineering techniques.

The expected results of the project can be listed as below:

- Extraction of bioactive molecules of microalgal metabolites
- Determination and classification of their molecular structure
- Expressing the bioactivity of isolated molecules
- Introduce a strategy for genetic expression of certain molecules in model

microalga systems.

1.3. The project description

Please explain the project (max. 2pages).

Microalgae as being one of the promising source in single cell protein market is also a promising volunteer with its biologically active molecules. For a long time ago humans started to consume microalgae for dietary purposes as well as a source for traditional medicine and cosmetics. The benefits and health promising characteristics of microalgae derive from the essential fatty acids, free amino acids, minerals, polysaccharides and other microalgal compounds. However the biologically active molecules of microalgae opened a new era in bioactive metabolites for pharmaceutical and cosmeceutical purposes.

The bioactive molecules from microalgae show antioxidant, antibacterial, antiviral, anticancer, skin regenerative, sunscreen, antihypertensive, neuroprotective and immunostimulatory effects which are favorable for pharmaceutical, nutraceutical and cosmetics industry. Also a new concept known as functional nutrition also broaden the acceptability and utilization of microalgae derived bioactive metabolites in new dietary formulations. The expansion of microalgal biotechnology and the number of research gained from the role of biologically active microalgal metabolites display the emergence of the microalgae farming for new therapeutic, nutritional and cosmetic formulations.

Increased attention towards microalgal biotechnology these days is because it involves products with high added value. Microalgae are reliable and sustainable feedstock sources for pharmaceuticals, food, cosmetics and feed industries. Considering the food sector along with agriculture and livestock sectors in our country, adaptation of valuable sources from microalgae into those aforementioned sectors can give birth to a new biotechnological investment area and/or make it possible to improve existing technologies.

Carotenoids which are found in higher plants like fruits and vegetables are also the photosynthetic products of microalgal metabolism. In order to sustain photosynthesis metabolism, besides auxiliary pigments which are synthesized in chloroplast, secondary pigments are also synthesized in lipid granules in cytoplasm when the cells are exposed to stress conditions. Under stress conditions several changes in cell morphology occur; the existing cell wall thickens and becomes more resistant to mechanical and chemical stress conditions. High amounts of secondary carotenoid (mainly astaxanthin and cantaxanthin) synthesis is induced in the cells under stress. Secondary carotenoids help protect the cells from DNA damage and can also be blended into the concept of functional nutrition for human and animals.

Microalgal processes are traditionally carried out in open systems. However, despite the fact that open systems are cost effective, the number of strains that can be cultured is limited because of the effects of atmosphere and environmental conditions and also the yield can be low. By providing controlled conditions, photobioreactors enable the growth of strains which are normally hard to culture. However scaling up becomes harder especially when the light path is regarded as a design criterion in order to maintain photosynthesis efficiency. Despite the fact that the production potential of commercial and value added products is high, development of microalgal biotechnology is hampered due to process related issues. This necessitates the design of a photobioreactor which provides easy installation and operation conditions while enabling scale up to commercial level. A photobioreactor design that will reduce mechanical and hydrodynamic stress on cells caused by the effects of pump, mechanical agitation and aeration, thus enabling the large scale production of sturdy microalgae cultures is one of the main points of this project.

The environmental stress conditions are regulsted via genetic control mechanism of microalgae. Thus the metabolism of microalgae is one of the essentials to be understand. Once the genetic background is defined the mass production of certain metabolite can be observed.

The natural sources are becoming a sustainable and reliable resource in order to develop new pharmaceuticals with its high potential of patentability criteria and formulation. With respect to this background knowledge; exploring new anticancer molecules is one of the emerging technologies. Thus the aim of the project is exploring microalgal bioactive metabolites and their genetic background.

1.4. Scientific excellence of the project and the project partners

Please explain what makes up the excellence of the proposal and the consortium, and its innovative aspect (max. 1page).

The innovation dimension is one of the flagships initiatives of the Europe and Korea. This project proposal is in compliance with the necessity to continuously innovate to preserve the competitiveness considering technology and economy. The project will provide scientific, strategic and economic benefits besides the knowhow. The knowledge exchange between each group will contribute to important partnerships and breakthroughs in different scientific domains. The consideration of the microalgal industry merging with the biomedical applications will increase the competitiveness of the generated products on a global market exchange and promote the health issues with regards to the project targets. The participation of the project partners, as well as the strong dissemination strategy will contribute to preserve present and create novel outcomes. A synergistic approach between each project group considering their expertise on the topic and combining these different aspects will have a beneficial impact in the quality of the scientific work and shorten the time between research and real life projections.

The consortium has been selected carefully to address the specific remit of biotechnologies for novel bioactive chemicals and to meet the objectives of the project and achieve highest complementarity of expertise. The Universities selected have the technical expertise, infrastructure and extensive previous experience in national and multinational projects. All partners have, in their possession, the prior knowledge and resources for early start. The researchers have consolidated experience, recognised at national and international level in the field of microalgal processes with a special emphasis on production, genetics, valuable chemicals and medical applications. With the scientific strength of each partner about the related sub titles of the project, like the microalgae genetics side (University of Liege), microalgae process side (university of Ege) and the microalgae active chemicals medical application side (University of Daegu Haany) will catalyse the future collaborations also.

The major aim of this project is exploring the potential bioactive molecules from microalgae and understanding of their gene regulations. Another goal of this project is to foster a scientific seed collaboration between a Korean and a European partner. The partners have already established contacts during previous meetings in Turkey. Ege University and Universite de Leige are world top class institute for Bioengineering and genetic research related to microalgal metabolism. Daegu Haany University (DHU) has actively investigated the bioactivity or therapeutics effects of natural sources as traditional herbal medicine and related industry, health and welfare for over 30 years. To our knowledge, there are no substantial collaborations ongoing as yet to jointly and systematically explore the Microalgae and Natural products as well as their evaluation for neutraceutical and pharmaceuticals. Out of the goals mentioned in the announcement, the current proposal relates to “Establishment of a collaboration” and in particular to the field “Health Research”. Therefore, the proposed project is intended to address two other goals: 1) To make the partners further acquainted with the respective capabilities of their counterparts, in order to elaborate detailed working plans for future joint applications for funding schemes that actually allow to ask for research funding. 2) To allow Early Stage researchers from both partner institutes to

actually become acquainted with the workflow in the respective partner institutes and prepare them for future grant applications that should allow them for longer stays in the respective host institution.

1.5. Project coordination and management

Please describe how the project will be coordinated, and what will be the tasks of each partners (max. 1 page).

The project is consisted of 3 different research teams who have agreed to generate a project according to their specific fields of expertise and the KONNECT criteria. The project partners are research teams from **Turkey** (Ege University Department of Bioengineering, Principal Project Leader), **Belgium** (Universite de Leige), and **Korea** (Daegu Haany University).

The project team has concluded a final aim with respect to their expertise and existing infrastructure because of the limited budget of KONNECT. With respect to these former introduction each partner will take an active role in the project. The detailed roles and tasks of each partners are listed as below.

- ✓ **Ege University Department of Bioengineering-TURKEY**

The team will be the principal project leader and coordinate other 2 teams' activities to pursue the project goals and stick to the planned time table. The team will be responsible from microalgae cultivation in laboratory conditions and extraction of certain molecules further to be tested according to their bioactivity.

- ✓ **Daegu Haany University- KOREA**

The team has a developed infrastructure in terms of in vitro cell line experiments and exploitation of potential molecules from plant species with bioactivity in order to be used as potential therapeutic applications. With the expertise of Korean Team, the researchers will conduct the experiments of potential molecules isolated from microalgae species.

- ✓ **Universite de Liege-BELGIUM**

The team in Belgium has expertise on microalgae genome studies and genetic engineering techniques. The active role of Belgium partner will be the drawing an outline for possible genetic modification of the microalgae species in order to increase the expression yields on terms of certain bioactive molecules. Because of the limited budget criteria of KONNECT, the Belgium team will transfer their knowledge and expertise on genetic modification techniques. However the study of Belgium team will highlight the possible future collaboration of related topic with a different point of view.

2. Work plan

Please describe the work plan according to the five aspects below (max. 1 page per aspect).

2.1. Research methodology

The project will last 24 months as it is referred at KONNECT rules and it is composed of 3 main Work Packages according to the expertise of the partners.

WORK PACKAGE 1: Production and extraction of potential molecules from selected microalgae species

The potential microalgae species which already exist in the microalgae culture collection of Ege University Department of Bioengineering (EGE-MACC) will be screened with their growth characteristics. Promising novel microalgae species will be cultivated under determined cultivation conditions. For this purpose the Generally Recognized as Safe (GRAS) categorized microalgae species will be chosen for cultivation. The omega-3 (fatty acids essential for human nutrition), pigments (carotenoids such as astaxanthin, lutein and phycocyannin) with high antioxidant properties concentration will be determined. The crude extracts will be prepared from

the dried biomass of selected model microalgae species.

- ***Methods:***

  -Selection of microalgae species with high biomass and potential bioactive accumulation properties: Microalgae species will be cultivated in illuminated (photosynthesis) specialized cultivation chambers (photobioreactors). The growth characteristics and growth kinetics of microalgae species will be determined according to daily sampling.

  -The biochemical composition of microalgae species will be determined according to colorimetric spectrophotometric methods and fingerprinting of microalgae species will be done via FTIR spectroscopy.

  -The potential bioactive molecules from microalgae species will be extracted with a combination of mechanical (bead milling or sonication) and solvent (hexan, methanol and ethanol) extraction techniques.

  -The antioxidant activity of the crude extracts will be determined via colorimetric assays (*e.g.* DPPH radical scavenging capability)

  -Total fatty acids and omega 3 fatty acids will be determined via Gas Chromotography (GC) methods that the Turkish Team has developed before.

- ***Expected Results:***

  -With this study, the potential new microalgae species can be investigated with their bioactive capabilities.

  -The growth characteristics of selected microalgae species and their responses to photobioreactor systems will be a clue for further scale up procedures.

  -Novel bioactive molecules can be isolated from the microalgae species as a potential molecule for pharmaceutical or cosmeceutical purposes.

WORK PACKAGE 2: Evaluation of their effects on cancer cell lines

The importance of anticancer molecules is gaining advance due to increasing rate of people with cancer occurrence. Thus new potential anticancer drug discovery systems are requited. With respect to this knowledge according to the aim of the project the team will do experiments related to anticancer activity of crude extracts of microalgae.

- ***Methods:***

- Activation of cancer cell lines prior to use.
- Determination of the concentration of crude extracts to determine anticancer activity.
- Selection of possible cancer cell line.
- Purification of bioactive molecule (if necessary).

- ***Expected Results:***

  -Finding the right concentration of crude extract with anticancer activity.

  -Determination of bioactive molecule and its natural source.

  - Determination of the activity of crude extracts on skin cell lines in order to understand the cosmeceutical roles.

WORK PACKAGE 3: Understanding the gene expression pathway of microalgae and metabolic regulations

The microalgae with eukaryotic cell morphology is a model specie in terms of eukaryotic model with their three separate genomes (nucleus, mitochondria and chloroplasts). Their genomic strength impose potential gene expression studies and over expression and mass production of a certain metabolite can be succeed via microalgal model systems. The response of microalgae to environmental changes are regulated with genes. Thus understanding the gene regulations and metabolic pathway is one of the essential tools for further microalgae studies.

Methods:

-Investigation of microalgal metabolism: Compering with existing literature knowledge

-Defining the stress physiology of selected microalgae systems (with respect to the results obtained from Turkish Team)

-Designing a data sheet for possible gene regulations of bioactive molecule extracted

from microalgae species

Expected Results:

-Definition of a future pathway for overexpression and bulk production of certain bioactive molecule

-Determination of stress physiology of selected microalgae species (carotenoid production)

-Understanding the photosynthetic activity and relation with microalgae growth with respect to model microalgae *Chlamydomonas reinhardtii*.

2.2. Work plan (timetable / Gantt chart)

Year	2016		2017					2018
Quarter	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Work package 1 (TURKEY)								
Work package 2 (KOREA)								
Work Package 3 (BELGIUM)								
Course: Understanding algal genomics (Liege, BELGIUM)								
Annual Meeting and Workshop 1: The role of natural molecules on cancer treatment (Daegu, KOREA)								
Workshop 2 and Final Meeting: Microalgae with therapeutic applications (Izmir, TURKEY)								

2.3. Envisaged types of activities (including main milestones, deliverables and place in case of events)

Work Package 1: Production and extraction of potential molecules from selected microalgae species

Objectives:

- Cultivation and extraction of possible bioactive molecules from selected model microalgae species

Results:

- Determination of growth curves of microalgae species cultivated in photobioreactors
- Determination of biochemical composition of microalgae species
- Obtaining crude extracts with possible bioactivity on cell line experiments
- Organization of a workshop (Workshop 2) related to microalgae therapeutics and final meeting

Milestones:

- Susscessfully organized Workshop activity
- Scientific paper publication
- Presentation of results at a scientific event (congress etc.)
- Concluding the project with final meeting at the end of the year 2018

Work Package 2: Evaluation of their effects on cancer cell lines

Objectives: Determination of the bioactive molecules from crude microalgal extracts with anticancer activity.

Results:
-Selection of suitable cancer cell lines.
- Determination of anticancer activity of crude extracts
- If possible: purification of bioactive molecules
-Organization of workshop (Workshop 1) related to anticancer molecules from natural sources

Milestones:

- - Susscessfully organized Workshop activity
- Scientific paper publication
- Presentation of results at a scientific event (congress etc.)
- Education of students

Work Package 3: Understanding the gene expression pathway of microalgae and metabolic regulations

Objectives:

- Providing a technology and know-how base for genetic evaluation of microalgae

Results:

- Developing a strategy for gene manipulation techniques in microalgae
- Understanding the role of a certain gene on the synthesis of relevant bioactive molecule
- Adoption of possible and promising gene manipulation methodology for selected bioactive molecule production/overexpression
- Organization of a course related to microalgae genomics and gene technology

Milestones:

- Susscessfully organized course activity
- Developing a strategy map for microalgae gene manipulation
- Presentation of results at a scientific event (congress etc.)

2.4. Involvement of each partner

- ✓ **Ege University Departmenent of Bioengineering**

Ege University Department of Bioengineering will be responsible from the lab scale cultivation of selected microalgae species and crude extraction of possible bioactive metabolites. For this purpose the team will use their photobioreactors and downstream equipment which already exist in their infrastructure. The research team will also arrange a final meeting at the last quarter of the project in the year 2018. Successful microalgae cultivation and crude extraction will be the success criteria for TURKEY research team.

- ✓ **Daegu Haany University**

Daegue Haany Team will screen the crude extract which is done by Turkey research team. The Korean team will further purify the bioactive molecules and determine the overall bioactivity. The success criteria of Korean research team will be the determination of bioactive molecules from crude microalgal extracts. The team will use cell lines they already have in their cell line culture collection in terms of anticancer activity.

- ✓ **Universite de Liege**

The Belgium partner will be responsible from the knowledge transfer of microalgae species and their genome evaluation. With respect to this Belgium partner will be responsible from the briefings related to understanding the molecular and metabolic mechanism of a certain microalgae metabolite in terms of genetic control and regulations. The team will be responsible from the preparation of a data sheet containing the gen expression perspective in microalgae metabolism. The success criteria of the research team will be the understanding physiology and genetic regulation on cell basis of activity found molecules.

3. Financial plan

Please list your expenses.

- *The eligibility of all costs depends on the national/regional regulations applied by each Joint Call funding institution. Please refer to Part 2 of the Call tex for more information on national/regional regulations.*

Type of costs	Partner	2016	2017	2018	TOTAL
Research Materials	TURKEY	€3.000	€3.000	€3.000	€9.000
	KOREA	€4.000	€6.000	€4.000	€14.000
	BELGIUM	€1.000	€1.000	-	€2.000
Personnel costs	TURKEY	€3.000	€6.000	€3.000	€12.000
	KOREA	0	0	0	0
	BELGIUM	€3.000	€4.500	€3.000	€10.500
Travel	TURKEY	€3.300	€3.700	-	€7.000
	KOREA	€4.000	-	€4.000	€8.000
	BELGIUM	-	€3.300	€3.700	€7.000
Living expenses	TURKEY	€3.600	€3.750	-	€7.350
	KOREA	€4.000	-	€4.000	€8.000
	BELGIUM	-	€3.000	€3.500	€6.500
Organisation of Events	TURKEY	-	-	€4.650	€4.650
	KOREA	-	€4.000	-	€4.000
	BELGIUM	€4.000	-	-	€4.000
Eligible Indirect Costs	TURKEY	-	-	-	0
	KOREA	€2.000	€2.000	€2.000	€6.000
	BELGIUM	-	-	-	0
TOTAL					

4. Expected impact of project results

Please describe the expected impact of project results below (max. 1page).

The research project has diverse impacts in terms of scientific approaches and collaboration. The scientific background of the project is consisted of tools which are emerging and currently gaining advance. There is an accelerated attention to microalgal metabolites and microalgae genome exploring because microalgae seems to be future's sustainable resource for the production of value added chemicals in which bioactive molecules likely to have a big portion of share in this market. Thus as a start; exploring potential microalgal bioactive metabolites will open further gates in terms of drug formulation and patent pending. Thus the technology itself seems to be promising and innovative approach especially genetic engineering aspects of the project are considered.

With regards to the project partners, they have a wide spectrum of contacts at national and international levels. The project partners are fully committed to disseminating the outcomes of the project in upcoming scientific events they are involved in. They also intend to exploit involvements in policy making through their national responsibilities and through their different representations in scientific publications, professional bodies for disseminating the results of this project as well as for creating a platform for

the exploitation of results in order to elevate the impact of the results.

1. Scientific and economic benefits and applicability of the results
- The joint workshops and reciprocal visits will help to build a platform to launch Korea-Turkey-Belgium joint research.

2. Cancer is a global threat to public health.
- There is increasing need for novel drugs to fight cancer. In pharmaceutical industry, nonetheless, the pipeline of new antibiotics is almost dry because the search has become more challenging.
- A number of natural products have been used to treat cancer. Thus, natural products have the potential as novel sources of new drugs.

3. Application of the results
- Benefits for the cooperating countries (Korea, Turkey and Belgium) possibly be commercialised by patenting and licensing out.

5. Added values of multilateral cooperation

Please describe the added value of multilateral cooperation below (max. 1page).

The research teams from Turkey, Belgium and Korea has expertise on their specified scientific field and the connection line of this scientific background is the microalgae metabolism and pharmaceutical/cosmeceutical production. The expertise of each individual team is precious to develop a project at the times that the role of microalgal products on novel bioactive molecules gaining advance.

With the project development the research teams will have chances to exchange know-how, expertise and combine their research activities. This kind of scientific collaboration will also envision the graduate and undergraduate students of each team and encourage the young researchers to collaborate with the scope of a global vision. Because of the limited budget provided by KONNECT the researchers will use their existing infrastructure however the scientific background and intelligence transfer with an interdisciplinary vision will add value for further studies.

This project has active involvement and contributions of leading research groups with diverse expertise and knowhow in their respective fields with partners. Collaborations and strategic partnerships with relevant initiatives will be fostered and exploited for effective transfer of knowledge created through project activities as well as exchanging experiences formed through past and on-going projects. The project will endeavour to disseminate the experience obtained from the operation of the project, targeting at wide-spread awareness and application of microalgal processes blending with medical applications while providing a platform for contacts and liaison between academia and the industrial sector at national and international levels. An effective communication, dissemination, knowledge transfer strategy will be developed for strengthening participation of various contributors also.

6. Short CVs of main participating researchers

Please add a short CV of the main participating researchers involved in the proposal, including a list of the five most relevant publications of the last ten years (max. 1 page per researcher).

Principal Project Leader (Turkish Partner)
Name : Murat Elibol
Date of Birth and Passport: 17/05/1965-REPUBLIC OF TURKEY-P-TUR-S 01401834
Address: Ege Universitesi Department of Bioengineering EBILTEM Hall 35040 Bornova/ Izmir-TURKEY
Tel. No.: + 90 232 343 4400/ Ext.139
Fax No: + 90 232 388 4955
Mobile Phone No.: +90 533 779 3366
E-mail Adress: murat.elibol@ege.edu.tr; elibol.murat@gmail.com
Academic Qualification:
•1982-1986 B.Sc. Chemical Engineering, Firat University, Elazig, Turkey
•1986-1989 M.Sc.Chemical Engineering, Firat University, Elazig, Turkey
•1991-1995 PhD Chemical and Biochemical Engineering, University of Manchester Institute of Science and Technology (UMIST), Manchester, UK
Brief Career History:
•1987-1991 Research and Teaching Assistant in Chem. Eng. Dept., Elazig, Turkey
•1992-1995 Research and Teaching Assistant in Dept. of Chem. Eng., UMIST, UK
•1995-2005 Lecturer-Researcher in Chem. Eng. Dept., Elazig, Turkey.
•April 2002-October 2002 Visiting Researcher, Chemical&Biochemical Eng. Dept., University of Maryland, Baltimore County (UMBC), Maryland, USA
•2005-…… Lecturer-Researcher&Vice Head, Bioeng. Dept., Ege University, Izmir,Turkey.
•2006-2009 Part-time Instructor, Yaşar University
•2009-….. Part-time Instructor, Izmir University
•2010 Invited Lecturer, Kumamoto University, Japan
•2010-…..External examiner, University of Putra, Faculty of Biotechnology, Malaysia
Field(s) of Specialization:
Biochemical engineering, fermentation, enzymology, antibiotic production, oxygen transport, immobilized systems, solid-state fermentation, bioreactors, microalgal bioprocess
Current Research Areas/Topics
-Lipase production by freely suspended and immobilised Rhizopus arrhizus
-Production of chitin, chitosan and derivatives from crustacean shell waste
-Microbial lipase production from olive pomace and olive mill waste
-Small-scale MAb production and purification
-Optimization of omega-3-fatty acid production by heterotrophic microalgae
-Production of microbial bioflavour from agrowaste materials
-Biohydrogen production by microalgae in photobioreactor systems
-Valorisation of olive mill waste
-Cultivation of Shewanella onedidensis MR-1 for production of hydrogen using a Bio-Electro Combined System
-Alkaline protease production by Teredinobacter turnirae using different operational modes.
-Optimization of recombinant-humanized anti tumor necrosis factor-alpha MAb production process
Korean Partner:

NAME : Young Woo, Kim. Ph.D.
AFFILIATION
College of Oriental Medicine, Daegu Haany University, Yugok-dong, Gyeong San 712-715, Korea Tel: 00-82-10-9047-4140. Email: ywkim@dhu.ac.kr; drywkim@gmail.com

EDUCATION
Aug.2010 Ph.D. in Pharmacology (concentration: Molecular Pharmacology) Seoul National University, Seoul, Korea
Feb. 2002 Graduated with Oriental Medical Doctor College of Oriental Medicine, Daegu Haany University, Daegu, Korea

EXPERIENCE
April. 2011-Present Assistant Professor, Daegu Haany University

RESEARCH INTERESTS
Part I. Herbal medicine
- Biotransformation of herbs for pharmaceuticals and nutraceuticals
- Bioengineering and bioprocess of herbs for cosmetics
Part II. Cell biology and immunology
- Cell interaction between hepatocyte and hepatic stellate cell during the metabolic syndrome
- Angiogenesis signaling pathway in hepatocellular carcinoma
- NLRP3 inflammasome as a danger signal in the autoimmune disease
- Targeted therapy for melanoma and skin-aging

Selected Publications
1. Lee JH, Jang EJ, Seo HL, Ku SK, Lee JR, Shin SS, Park SD, Kim SC, Kim YW*. Sauchinone attenuates liver fibrosis and hepatic stellate cell activation through TGF-β/Smad signaling pathway. Chemico biological interactions, 2015;224C:58-67. (*Corresponding author)
2. Zhao ZL , Park SM, Guan LX, Wu YY, Lee JR, Kim SC, Kim YW*. Isoliquiritigenin attenuates oxidative hepatic damage induced by carbon tetrachloride with or without buthionine sulfoximine. Chemico biological interactions. 2015;225:13. (*Corresponding author)
3. Park SM, Ki SH, Han NR, Cho IJ, Ku SK, Kim SC, Zhao RJ, Kim YW*. Tacrine, an Oral Acetylcholinesterase Inhibitor, Induced Hepatic Oxidative Damage, Which Was Blocked by Liquiritigenin through GSK3-beta Inhibition. Biological Pharmaceutical Bulletin. 2015;38:184. (*Corresponding author)
4. Lee JH, Jung JY, Jang EJ, Jegal KH, Moon SY, Ku SK, Kang SH, Cho IJ, Park SJ, Lee JR, Zhao RJ, Kim SC, Kim YW*. Combination of honokiol and magnolol inhibits hepatic steatosis through AMPK-SREBP-1 c pathway. Experimental biology and medicine. 2015;in press. (*Corresponding author)
5. Hwangbo M, Jung JY, Ki SH, Park SM, Jegal KH, Cho IJ, Lee JH, Kang SH, Park SD, Ku SK, Kim SC, Zhao RJ, Jee SY, Kim YW*. U-Bang-Haequi Tang: A Herbal Prescription that Prevents Acute Inflammation through Inhibition of NF-κB-Mediated Inducible Nitric Oxide Synthase. 2014;2014:542825. (*Corresponding author)

Belgium Partner
NAME : Remacle, Claire Ph.D.
AFFILIATION
Laboratory of Genetics
of Microorganisms , Institute
of Botany B22, University of Liège ,
Liège B-4000 , Belgium
CONTACT
+32-4-3663812
C.Remacle@ulg.ac.be

BACKGROUND and RSEARCH INTEREST
Claire Remacle earned her Master's degree in Botany in 1989. She then began work on a doctoral dissertation concerning the mode of transmission of the mitochondrial genome of the green microalgae Chlamydomonas reinhardtii in the laboratory of Microorganism genetics at ULg, under the supervision of Fr. René-Fernand Matagne. Once she had obtained her doctoral degree, Claire Remacle obtained a grant from EMBO to study at the

Institute of Molecular Plant Biology in Strasbourg, where she studied the potato. Returning to Belgium in 1996, Remacle rejoined the Microorganism genetics laboratory, and was named FNRS research associate. In 2003 she became an instructor. Now head of the laboratory, she supervises research on mitochondria in microalgae. Like mitochondria are key components for energy production and accumulation of biomass and molecules that could be used as alternatives to fossil fuels such as triacylglycerides or hydrogen, she also conducts research on the discovery and analyses of enzymes controlling energetic processes, metabolism and photoproduction of biohydrogen.

SELECTED PUBLICATIONS

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I. PERSONAL INFORMATION

First name, family name: ***Danny GEELEN***
Address: Vlaamsekaai 12
9000, Gent
Belgium
Email: danny.geelen@ugent.be
Affiliation Faculty Bioscience Engineering
Department Plant Production
Ghent University, Coupure links 653, 9000 Ghent, Belgium

II. EDUCATION

1995 Doctoral degree in Biological Sciences. (First Class honours)
Ghent University, Belgium; Faculty of Science
Doctoral thesis: “Early symbiotic steps of the nitrogen fixing bacterium *Azorhizobium caulinodans* ORS571.”.

III. CURRENT POSITION AND ACTIVITIES

Professor at **Ghent University**, Faculty of Bioengineering and Bioscience, Department of Plant Production, Coupure Links 653, 9000 Gent. Head of research unit “In vitro Biotechnology and Horticulture”.

Lecturing and contributions to the following courses:
Dutch courses: Sturen van groeiprocessen bij planten in vitro en in vivo; Praktijkstudies plantenbiotechnologie;
English courses: Plant hormone regulation and tissue culture; Plant Biotechnology; Plant Molecular Biology. Molecular microbiology and epigenetics;

7. Confirmation letter

This confirmation letter is necessary only in case of additional partners that need to secure their own funding.
