PROJECT FINAL REPORT

Final Publishable Summary Report

Grant Agreement number: 604733

Project acronym: REPEAR

Project title: Development of a new sustainable, long-term solution, complying with IPM standards and the future EU Directive of sustainable use of pesticides, for the pear post-harvest sector.

Funding Scheme: FP7-SME-2013-2

Date of latest version of Annex I against which the assessment will be made: 2017-06-20

Final report: **1st** ☐ **2nd** X☐ **3rd** ☐ **4th** ☐

Period covered: **from** **01/07/2014** **to** **31/10/2017**

Name, title and organisation of the scientific representative of the project's coordinator[1]:

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Project website[2] address: http://www.repear.eu/

Declaration by the scientific representative of the project coordinator[1]

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

I, as scientific representative of the coordinator1 of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate):

  ☐ has fully achieved its objectives and technical goals for the period;

  ☒ has achieved most of its objectives and technical goals for the period with relatively minor deviations[3];

  • has failed to achieve critical objectives and/or is not at all on schedule[4].
- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator: Sixto Cabezon Largas

Date: 31/10/2017

Signature of scientific representative of the Coordinator:

[3] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

[4] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

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1. Executive Summary

Pears rank third among the most important tree fruits grown in the world and fourth among all fruits for which statistics are available. Pears are a highly perishable, seasonal product, they need to be picked up before maturation and should undergo through a postharvest treatment to be commercialised in optimal conditions along the year.

During the refrigerated storage process, there are several factors which may provoke pear loss – these include decay, bacteria and fungi. In developed countries, it is estimated that up to 25% of fruit production (516 Million tons in the case of pears) can be lost during the postharvest period. The main cause of pear deterioration is scalding. This physiological disorder is due to an oxidative process which induces browning of the pears surface. Although this disorder does not have a direct effect on the flavour or the firmness of the fruit, the resulting unpleasant brown appearance renders the product impossible to market.

Until recently, the control of superficial scald has been carried out with chemical synthetic antioxidants. These antioxidants were applied onto the fruit before they went into cold storage and they avoided the oxidation of certain compounds produced by the fruit as a response to the cold process conservation.

However, public concerns about food safety, and conservation of the environment, have triggered a change in EU legislation leading to the proposal of a new Directive on Sustainable Use of Pesticides due to be implemented by 2014 (Directive 2009/128/EC).

Thus, the pear postharvest sector is in urgent need of new sustainable and natural antioxidants, bactericides and fungicides as many of the most popular chemical treatments are about to be banned. RE-PEAR is an integrated Pest Management approach aiming to provide new, chemicals free, solutions for pear conservation by:

1) Elaboration of standardised Postharvest Management and Control Practices Guidelines aimed at minimising the risk of contamination of pears during the harvest and postharvest period.
2) The development of an anti-scalding and antimicrobial coating based on natural products for pear post-harvest treatment.
3) The design of a novel air filtration system to minimise the presence of fungal spores and bacteria in pear conservation chambers.

REPEAR solution has been developed by a Consortium of 9 selected partners from different European member states aiming to cover the whole supply chain:

Three SME Association (SME-AG) that disseminated and implemented the REPEAR technology among pear growers (Protected Designation of Origin Peras de Rincon de Soto, PRS, Spain; Federaçao Nacional dos Apicultores de Portugal, FNAP, Portugal; Association Européenne du Commerce de Fruits er Légumes de l`EU, EUCOFEL,EU).

Three Small and medium enterprises (SME) responsible of the industrial and commercial validation of the REPEAR technology (Soto del Ebro, Spain; Xeda International, France; HSL, Germany).

Three research organization involved in the technical development: Inspiralia, (Spain), designer of the REPEAR antioxidant and antimicrobial coating based on natural ingredients. IRTA (Spain), developing of PMCP guidelines and testing the efficiency of the REPEAR coating for the control

of pathogens and scald disorder along the postharvest chain. University of Malta, UoM (Malta) that was in charge of the development of REPEAR novel filtration system.

2. Summary description of project context and objectives

Pears are the fourth most important fruit in the world. They are a highly perishable seasonal fruit which needs to be treated with care and picked before it reaches maturity. Once harvested, they need to undergo through postharvest treatment and be stored in refrigerated chambers with a controlled atmosphere in order to assure that they can hit the commercial markets in optimal conditions.

During the refrigerated storage process, there are several factors which may cause pear losses, such as, dehydration, postharvest diseases and physiological disorders.

- Dehydration and too high respiratory rates, may be induce the loss of firmness and the decreasing of sensorial attributes and quality on a long term.
- Postharvest diseases are due to fungal pathogens such as *Penicillium expansum, Botrytis cinerea* and *Rhizopus stolonifer*.
- The physiological disorder, called superficial scald, occurs during cold storage and represents the main cause of pear deterioration. This lead to the development of diffuse brown areas on pear skin due to an oxidative process. This disorder does not have a direct effect on the flavour or on the firmness of the fruit, but the resulting unpleasant brown appearance renders the product impossible to market.

Until recently, superficial scald disorder was controlled using the chemical antioxidants Diphenylamine (DPA) and Ethoxyquin just before cold storage. These products were very effective to avoid the oxidation of certain compounds produced by the fruit in response to cold stress.

However, these conventional post-harvest treatments useful to extend pear shelf-life, are currently banned according to EU legislation regarding pesticides.

The REPEAR project offers an integrated solution to the problems appeared during the pear cold storage process and, at the same time, meets EU regulations.

REPEAR solution includes:

- **Development of Postharvest Management and Control Pesticides guidelines** aimed at minimising the risk of contamination of pears at harvest and during the postharvest phase, compliant with Directive 2009/128/EC

- **Cleaning the atmosphere of the pear warehouse cold room,** by the design, development and production of a novel air filtration system able to minimise the presence of fungal spores and bacteria.

- **Pear surface protection** through the development of an antioxidant and antimicrobial coating based on natural polymer to retard scald and prevent pathogens attack.

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REPEAR project looks for some scientific and technological objectives:

Scientific objectives:

1. Identify problems of the major pathologies affecting the Postharvest sector in order to implement any control measures. Elaboration of Postharvest Management and Control Practices (PMCP) as a first step and then its implementation in a pear warehouse will lead to a successful post-harvest practices training.
2. To increase the knowledge about of physicochemical, antioxidant and antifungal properties of propolis from different sources in order to enhance its purification and formulation.
3. Study of the physicochemical characteristics of the most common fungal spores in post-harvest treatment of pears.
4. Study of optimal material to use in the filter development.

Technological objectives:

5. Development of Postharvest Management and Control Practices Guidelines (PMCP) aimed at minimizing the risk of contamination of pears entering the postharvest phase and during the postharvest period. These guidelines will be compliant with Directive 2009/128/EC establishing a framework for Community action to achieve a sustainable use of pesticides.
6. Development of an anti-scald and fungicide coating based on propolis to be applied on pear surface as a postharvest treatment.
7. To design and develop a filter in order to absorb and neutralize fungal spores and bacteria present in the atmosphere of any pear warehouse cold room chambers.

Integrated objectives:

Integration and validation of RE-PEAR solution. Testing of all three components of RE-PEAR solution at Soto del Ebro pear conservation chambers. The combination of PMCP measures with the application of the propolis based coating and the novel air filtration system will extend pears

shelf life during postharvest conservation period from 6 months onwards, depending on variety and environmental conditions.

3. Description of main S & T results/foregrounds

During the REPEAR project the following results have been achieved:

1. Identification of the most important aspects for the PMCP guidelines. PMCP guide has been prepared during the first 12 months of the project. During the second period the PMCP guidelines have been implemented and the checklist developed by IRTA in SE warehouse.

2. Polyurethane foams, non-woven and melt-blown filters, as well as nanoparticles as anti-fungal treatments, have been selected for filter materials. They have been coated using the nanoparticles and tested using the most aggressive moulds which had been previously isolated from pear fruits or from their harvesting or storage environment.

3. Initial computational fluid dynamics (CFD) simulations were performed on an in-silico warehouse model having dimensions of a typical warehouse.

4. The filter prototype was produced and installed at the facilities of SE (together with the ventilation). The filter media (coating needle-punched) was pleated and assembled by HLS. This was then coated by UoM using antimicrobial nanoparticles. The filters were designed in such a way to abate by the pre-defined pressure drop parameters.

5. The antimicrobial efficiency of the developed prototype was then assessed in real conditions. The surface of the filters that were exposed to the air from the warehouse had some environmental contaminants. However, their levels were quite low indicating that even in the surface the antimicrobial efficacy of the nanoparticles were pronounced. Moreover, among the most common pathogens of pears, only one of them was detected.

6. Complete characterization of six types of propolis with different origins: Spain (Burgos North Spain, Valencia (Mediterranean area) Portugal, Italy, China and Brazil. Physicochemical properties, microbiological charge, analysis of bioactive compounds, antioxidant and fungicide properties has been evaluated. According to antioxidant ability, propolis from Spain and Portugal present the best performance. Due to supply terms, Burgos propolis will be employed in the preparation of post-harvest coatings.

7. Microencapsulation of propolis by solvent extraction method. Micro-capsules with an average diameter of 25 microns were prepared at laboratory scale.

8. Solvent extract was successfully used as a technique adapted for the nanoencapsulation. Particle size of the round shape nanoparticles obtained was measured by DLS, obtaining an average particle size of 200 nm, and achieving the new goal of REPEAR encapsulation.

9. Development of pear post-harvest coating based in food ingredients and natural antioxidants. More than 150 edible coating prototypes have been development. The main ingredients of the formulations were: polysaccharides to increase the barrier and reduce the respiration rate of the pear, lipids to increase the humidity barrier, vegetable oils to protect the α-farnesene from pear skin, emulsifiers to ensure a suitable stability between

hydrophilic and hydrophobic compounds, natural antioxidants such a blend of propolis and another natural antioxidants and fungicide additives.

10. Annually, optimization trials were carried out in Blanquilla, Conference, and 'Flor de Invierno' pears available in 2015-2016 and 2016-2017 pear harvest season. The optimization was achieved studying the performance of the oxygen and water vapour barrier properties on the fruits coated. Physiological, as respiration rate and ethylene emission, and quality as firmness and sugar content, parameters were determined. Most of the 150 edible coatings developed were tested and the best ones were selected for the tests during the pear summer season.

11. In 2016 pear crop season, different trials with Blanquilla and Conference were carried out to define how the optimized coatings are working inside the postharvest chain. Emphasis was given on 1- the effect of harvest date, 2- the effect of storage atmosphere and in complement 3- the effectiveness of new coating (last formulations) on superficial scald and quality of pears. Both trials showed the interests of the selected coating to control superficial scald and improve the overall quality of 'Conference' pears. The specific results obtained at the pilot scale on optimal harvest date gave valuable information on the way by which this new technology may be applied in packinghouse. Results obtained in this trial will be useful for further commercial and application of M135 in packinghouses. However, further information is still needed to confirm the typical behaviour found for fruit stored in CA. For the moment, our recommendation for the coated fruit is to store the fruit during short-term period in air (< 6 months) or in CA but with low levels of O2 (≤ to 1.5%). Some interesting results for scald control were observed by the application of new coatings in 'Blanquilla' and 'Conference' peas respectively. However, neither of them significantly improved the effectiveness observed by the application of the selected edible coating. Therefore, this selected coating was finally used for REPEAR commercial application.

12. The antimicrobial activity of several propolis extracts has been tested in vitro and in vivo on the main postharvest moulds and FBPs. Only limited antimicrobial control was obtained with all the propolis tested. Other antimicrobial compounds have to be added in the further formulations of coatings in order to achieve a better control on pears, from a microbiological point of view.
13. The efficacy of different raw ethanolic extract of propolis (EEP) as well as the first coating formulates have been tested in different fruit models to evaluate their impact on the fruit physiology, quality and physiological disorders incidence during storage. In addition, numerous tests carried out in vivo have allowed optimising the coating formulation for future or ongoing experiments. The effects of optimized coatings will be foreseen in the coming months.

14. Eleven GRAS substances at different doses were tested in vitro against *P. expansum*, *B. cinerea* and *R. stolonifer* as target moulds, by including the substance in the growth medium and measuring radial growth. Six of them, reduce mould growth and were selected for in vivo studies. Sodium and potassium metabisulphite had the most promising effects and were selected to be added into several edible coating prototypes. Four of them reduced the incidence of one or more of the diseases. Then, they were selected to be tested against L. monocytogenes and Salmonella but no antibacterial effect was found. Besides, the antimicrobial efficacy of 24 essential oils was tested in vitro against fungal

and foodborne pathogens using different methodologies (mouth-to-mouth and direct contact). Those showing the best results were assayed against *P. expansum, B. cinerea* and *R. stolonifer* on pears. Four selected essential oils at 0.3% showed promising results when tested alone and were subsequently added into the two best coatings form the physiological and quality determinations. Results demonstrated that combinations reduced the incidence of *R. stolonifer* in a range of 26-79% and 35 to 85% the incidence caused by *B. cinerea*. No effect was observed against *P. expansum*.

15. The test of the REPEAR integral solution was done under real commercial conditions in SE warehouse in 2016 and 2017 pear harvest season. In 2016, 90 tons of pears (Blanquilla, Conference and Abate Fetel) harvested according to REPEAR guidelines were treated with five optimized edible coatings by drenching and stored under controlled atmosphere conditions. The storage chamber was equipped with a full-scale version of the novel air filter developed in the project. In 2017, 150 tons of pears were treated with M135 edible coating that showed the best results concerning the antiscalding effect in pilot scale tests.

4. Potential impact and main dissemination activities and exploitation results

POTENTIAL IMPACT

The project is going to provide SME-AGs and SME´s opportunities to strengthen their current market position, increasing shares in their respective markets, and entering in new markets. They also increase their competitiveness:

- RE-PEAR project aims at *providing European pear growers* with an integrated solution based in IPM practices combined with the use of a new natural antioxidant and antimicrobial formulation and a novel filtration system for pear warehouses that will allow them to be compliant with the upcoming legislation based on Directive 2009/128/EC, increasing their productivity and reducing yield losses. Our project will have an impact for both pear SME growers and SMEs Associations providing an overall benefit for Europe in terms of pesticides reduction, increase in productivity and employment maintenance.
- RE-PEAR integral solution includes the development of a natural antioxidant and antimicrobial formulation based on food grade ingredients that will help pear growers to limit quality and yield losses along the fruit conservation period in cold chamber.
- The developed coating will allow to SME XEDA International partner increase their product portfolio with a novel solution for pear post-harvest. Besides, this novel coating could be employed for other fruits such as apples. This fruit present also scalding issues although in less extension than pears.
- The novel filtration system will allow HS LUFTFILTERBAU partner to introduce in novel markets. Besides, this solution could be adapted to another fruit storage chambers.

DISSEMINATION ACTIVITIES

Relevant dissemination action where REPEAR has been present are shown next:

1. **WEB SITE:** The REPEAR project website (www.repear.eu) has been developed by Dissemination Manager, and is being keeping updated during the whole life of the project. This website has allowed partners from the Consortium, European Commission, or external companies or agents to know what the project is about and promote it.

   The website has covered two sides:
   - A public site that can be accessed by anyone with public general information about the project. The link to this page needs to be easily reachable and accessible from common web search engines.
   - A private area within the website only accessible by the members of the consortium that makes possible the collaborative work.

   The “public area” has different pages with project information:
   - General description of the project concept, need, etc.
   - Detailed information of the main objectives of the project.

- Possibility to download public dissemination material.
- Information about the partners of the project, contact information, R&D performers and SMEs involved.

The “private area” is placed in the same site as the public website but login name and password are required to access that content. A user account is given to every member of the consortium in order to facilitate the access to the private area of the website.

Once a user logs into the website, he/she can access any time to important information for project development, such as:

- Contracts: Last version of DOW, GA and CA.
- Meeting information: Minutes and presentation.
- Technical information: technical deliverables and reports.
- Other: videos, images or any type of file.

SMEs can also access to this section to get these files and check the status of the project.

2. **TRAINING ACTIVITIES**: Two training sessions have been given by SMEs in order to explain the procedures described in PCMP Guidelines, the manufacturing processes and industrial application of both edible coating and the antimicrobial filter.

   The first one was an open day visit for the pear grower of the DOP Rincon de Soto have been organized by SMEs in Soto del Ebro warehouse. The event had the aim to show the REPEAR integrated solution and it has been set up in concomitance with chamber opening in May 2017. Visitors could appreciate the effect of the edible coatings application on pears harvest according with the PMCP guidelines and treat during the industrial DEMO test in August 2016. Moreover, pear growers could monitor the cold chamber equipped with the novel antimicrobial filter.

   The second one consisted of a dissemination and training session for the Postharvest Management and Control Practices Guideline (PMCP). The event was held by SMEs in Rincon de Soto for pear producers and technicians or managers from packinghouses. The session was done by IRTA technicians and a Spanish version of a dissemination leaflet was given to all assistants. Finally, the technical session was evaluated by attendant using a questionnaire.

3. **REPEAR VIDEO CLIP:** one promotional video clip has been produced to show the problem of the pear postharvest sector, the REPEAR technology as an effective solution to the problem, the benefits for the end-users and the role of the partners in the Consortium. Video clip has been uploaded at www.youtube.com in the following link: https://www.youtube.com/watch?v=1u13G9cbcAk&t=22s. Furthermore, the video has been uploaded to the main social networks sites such as Facebook, Twitter and LinkedIn.

4. **INTERNET PRESENCE**: Partners’ websites, social and professional networks have been considered for the dissemination activities.

At the beginning of the REPEAR project, an article has been release on line in the postharvest specialized web page: http://www.poscosecha.com/es/noticias/en-busca-de-una-solucion-natural-para-alargar-la-conservacion-de-la-pera/_id:79824/

5. **SCIENTIFIC CONFERENCES AND CONGRESSES:** The scientific communications presented during the project lifetime are the following:
- D.Sardella, R. Gatt, V. Valdramidis (2017). Physiological effects and mode of action of ZnO nanoparticles against postharvest fungal isolates (poster). APS annual meeting (San Antonio, TX, USA).
- D. Sardella, R. Gatt, S. Decelis, V. Valdramidis (2017). Optimizing protocols to assess the efficacy of ZnO nanoparticles as antifungal agents (oral presentation). IV International Symposium on Postharvest Pathology (Skukuza, South Africa).
- A. Muscat, D. Sardella, S. Marin, S. Decelis, V. Valdramidis (2017). Characterization of fungal contaminants affecting preservation properties of Pirus communis var. bambinella (poster). Q-Safe International Conference (Ermoupoli, Greece).
- D. Sardella, R. Gatt, V. Valdramidis (2017). Quantitative assessment of the efficacy of ZnO nanoparticles against P. expansum (oral presentation). Q-Safe International Conference (Ermoupoli, Greece).
- D. Sardella, R. Gatt, S. Decelis, V. Valdramidis (2016). Quantitative assessment of the efficacy of ZnO nanoparticles against selected fruit fungal contaminants (poster). American Phytopathologycal Society Annual Meeting (Tampa, FL, USA)
- V. Valdramidis, T. Triganza, D. Sardella, R. Gatt, S. Decelis (2016). Assessing the antifungal efficacy of filters coated with ZnO nanoparticles (oral presentation). ICFM Workshop (Freising, Germany).
- C. Ghidelli, M. Herrero, S. Cabezón, J. Giné-Bordonaba, C. Larrigaudière (2016). REPEAR: Desarrollo de una nueva solución natural y sostenible para el tratamiento post-cosecha de pera (poster). IX Iberian Postharvest Symposium (Lisboa, Portugal).
- Usall, J. ; Larrigaudière, C. ; Torres, R. ; Gine, J. ; Abadias, M. ; Teixidó, N. ; Echeverría, G. ; Gatt, R.; Valdramidis, V.; Ghidelli, C.; Herrero, M.; Cabezon, S. (2017). New sustainable and long term solution for the pear postharvest sector (poster). IV International Symposium on Postharvest Pathology. (Skukuza, South Africa).
- Jordi Giné-Bordonaba, Dolors Ubach, Christian Ghidelli and Christian Larrigaudière (2017). Combining edible coatings and low oxygen storage conditions to improve the storage potential of 'Conference' pears (poster). XII International Controlled and Modified Atmosphere Research Conference (Warsaw, Poland).

6. **PUBLICATIONS IN PEER-REVIEWED JOURNALS:**
- D. Sardella, V.P. Valdramidis, R. Gatt (2017). Physiological effects and mode of action of ZnO nanoparticles against postharvest fungal contaminants. Food Research International (accepted).
- D. Sardella, V.P. Valdramidis, R. Gatt (2017). Assessing the efficacy of Zinc Oxide nanoparticles against Penicillium expansum by automated turbidimetric analysis. Mycology (accepted).
- S. Decelis, D. Sardella, T. Triganza, J.P. Brincat, R. Gatt, V. Valdramidis (2017). Assessing the antifungal efficiency of filters coated with zinc oxide nanoparticles. R. Soc. open sci. 4: 161032.

- J.P. Brincat, D. Sardella, A. Muscat, S. Decelis, J. Grima, V. Valdramidis, R. Gatt (2016). A review of the state-of-the art in air filtration technologies as may be applied to cold storage warehouses. Trend Food Sci. and Tech. 50: 175- 185
- D. Sardella, A. Muscat, J.P. Brincat, R. Gatt, S. Decelis, V. Valdramidis (2016). A comprehensive review of the pear fungal diseases. Int. Jour. of Fruit Sci.

7. PARTICIPATION IN TRADE-FAIRS AND EVENTS

Dissemination and commercialisation of RE-PEAR's integral solution to potential end users will be granted by participating in European/International trade fairs and exhibitions for fruits, agricultural and plant protection products.

EUCOFEL: FRUIT ATTRACTION 2014, 2015, 2016 and 2017. International Trade Show for the Fruit and Vegetables Industry, Madrid, Spain.

FRUIT LOGISTICA 2015, 2016, 2017 the fresh produce trade show, Berlin, Germany.

FRESKON 2016. International Trade Show for the Fruit and Vegetables, Thessaloniki, Greece.

MEDFEL 2016. The international fruit and vegetable business gathering. Perpignan, France.

PRS: FRUIT ATTRACTION 2014, 2015, 2016, 2017 the International Trade Show for the Fruit and Vegetables Industry, Madrid, Spain.

MEDFEL 2016. The international fruit and vegetable business gathering. Perpignan, France.

8. WORKSHOPS AND SEMINARS

Workshops and seminars have been organised by SME-AGs for potential users within the pear growers, plant protection products manufacturers/marketers and postharvest equipment manufacturers. The following sessions have been carried out along the project lifetime:

IRTA: New alternatives and tendencies to control superficial scald in apple and pear. Technical session on post-harvesting, Lleida, Spain, 13/05/2015.

FNAP and INSPIRALIA: REPEAR – Propolis based edible coating development as a pear postharvest treatments. XVIII National Bee-keeping Forum, Vila Pouca do Aguiar, 09/09/2017.

PRS and SE: An open day visit for the pear grower of the DOP Rincon de Soto have been organized by PRS and SE in Soto del Ebro warehouse. The event had the aim to show the REPEAR integrated solution and it has been set up in concomitance with chamber opening in May 2017. Visitors could appreciate the effect of the edible coatings application on pears harvest according with the PMCP guidelines and treat during the industrial DEMO test in August 2016. Moreover, pear growers could monitor the cold chamber equipped with the novel antimicrobial filter.

9. **DISSEMINATION MATERIAL**: All members of the consortium have participated in preparing some dissemination material to be distributed in the events they attend. For external dissemination:

- Logos: Three RE-PEAR logos should be used for all kinds of publications, templates and dissemination materials, as well as for the website.
- Press release: A general text was agreed in the Consortium in English, and members have translate them to the different languages (Italian, French, Spanish, and Portuguese) and delivered to their natural communication channels to announce the nature of the project and the objective it pursues. Press Releases have been sent to specialized reviews and newspapers during the project execution to announce the main technological developments.
- Brochures and Leaflets describing RE-PEAR project, its objectives and expected results have been designed and printed in English and Spanish version as dissemination tool by partners involved in the project at conferences, workshops, seminars, etc. Moreover, SME-AGs shall disseminate these brochures amongst their associates.
- REPEAR Roll-ups will be used to catch the attention of end users at public events. REPEAR roll up designed and printed by the Consortium. Roll ups have been exhibit in international fair as Fruit Logistica (Germany) and Fruit Attraction (Spain).

Any dissemination material, project publications and project website have include the following mention: The research leading to these results has received funding from the European Union's Seventh Framework Programme managed by REA – Research Executive Agency http://ec.europa.eu/research/rea (FP7/2007_2013) under Grant Agreement N. 604733.

EXPLOITATION OF RESULTS

Consortium has identified the potential market for the REPEAR solution including an analysis of the postharvest needs form the sector, validation of target market, and the geographical scope. An estimation of the REPEAR edible coating and antimicrobial air filter sell prices has been presented. Moreover, the Consortium will be able to adjust the sales forecast and market penetration based on competitor’s comparison.

The 3 SME AGs PRS, FNAP and EUCOFEL are entitled to exploit the Foreground by using, manufacturing and selling products within its business. For this purpose, the owning Beneficiary(s) grants to each of the other Beneficiaries Access Rights to the Foreground for exploitation on a royalty free, (5 year), non-exclusive basis limited to “Use” in respect of its business. The businesses and “Uses” for which Access Rights are granted under this Clause are as follows:

The SME AGs that can exploit these results and have joint ownership can prepare a patent to protect them. These SME AGs are: PRS, FNAP and EUCOFEL, who are the jointly owners of all the rights relating to the 3 Project results and will have the initial right to patent the Foreground. Access Rights to Foreground if needed for use of a Party's own Foreground including for third-Party research shall be granted on Fair and Reasonable conditions. Access Rights for internal research activities shall be granted on a royalty-free basis.

SME will benefit from royalty-free non-exclusive rights to manufacture and sell the REPEAR technology.

The SME-AGs will be able to offer non-exclusive licenses to third Parties if the broad deployment is endangered by the limitations of the partner SME supply chain plus their extended sublicenses.

The RTD Performer(s), namely IRTA, UoM and INSP will not commercially exploit the developments from the Project, but will be granted access rights to use and disseminate through research, consultancy and any other academic and scholarly activities (with non-commercial) purposes regarding the intellectual property and Knowledge generated from the project. In all cases, the dissemination and use of the generated Knowledge must be compatible with the protection of intellectual property rights.

The Parties agree to negotiate in good faith any additional Access Rights to Foreground as might be asked for by any Party, upon adequate financial conditions to be agreed

Management of IPRs will be performed following the IAPED methodology: Identify–Assess–Protect–Exploit-Disseminate. All exploitable results will be identified, assessed and protected first, and only then their dissemination take place.

General guidelines on the implementation of IPR protection will be:

- The first level of protection will be through patent. This is the highest form of protection but is costly to maintain and may take some time to obtain.
- Utility model and trade marking will also be evaluated for minor or less important parts of the system.

The most reasonable REPEAR IPR protection methods are:

- IPR result 1: Ownership
- IPR result 2: Trade Mark regist5ration and Sanitary registration
- IPR result 3: Utility model

PMCP guidelines will be accessible for use, but its contents cannot be copied or altered in any way, being a property of REPEAR SME Associations

GENDER ISSUES/ ETHICAL ISSUES

Regarding gender aspects, the best consideration is to put aside the gender and value people for what they are capable of. We did not force or avoid the participation of women or men, and it turned out that 43% of the personnel involved in the project are women.

During the REPEAR project, women will perform key roles in the research and project management within the core of the Association and RTD performers. Mrs. Ridao-Bouloumié (EUCOFEL) will act as Dissemination manager and most of IRTA researchers involved in the project are women being fully responsible of the pathological and sensorial analysis tasks.

Additionally, the consortium is ensured no discrimination against researchers in any way based on age, ethnic, national or social origin, religion or belief, sexual orientation, language, disability, political opinion or social or economic condition.

5. Address of project public website and relevant contact details

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