PROJECT FINAL REPORT

Grant Agreement number: 243594

Project acronym: APIFRESH

Project title: Developing European standards for bee pollen and royal jelly: quality, safety and authenticity

Funding Scheme: FP7-SME-2008-2

Date of latest version of Annex I against which the assessment will be made:

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

Period covered: **from 01/07/2010 to 30/06/2013 (three years)**

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[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.

DECLARATION BY THE SCIENTIFIC REPRESENTATIVE OF THE PROJECT COORDINATOR

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):
  - **X** 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 Coordinator1: Tomás Rodríguez

Date: 06/08/2013

Signature of scientific representative of the Coordinator1:

[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.

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

Nowadays, there are no standards at European level for certain bee products like pollen and royal jelly. Few countries in Europe have some guidelines or regional standards for other products than honey. This means that it is possible to find products in the market under these labels without any quality and authenticity control. This might imply a **risk for both the consumer** and **the small and medium enterprises of the sector**, which not only have to compete with cheaper products produced in Eastern and South American countries but also compete with a product that sometimes is not even pollen or royal jelly.

The main idea of this project is to help European Beekeeping Sector[5] overcome their critical situation of uncertain sustainability, by developing a quality standard proposal for the two higher added-value apicultural products other than honey: pollen and royal jelly, and laying the foundations of a future European regulation.

The European Beekeeping Sector[6] is under the following **threats**:

- Bee population in Europe has been falling at an alarming rate in the last 3 years (30% less in Britain, 40% in Italy and France, the worst hit), with the corresponding effect on production shortages, which has fallen in the main European producers at a rate of 11.2% in the last three years[7].
- At the same time, honey imports in EU from Asia and South America (mainly China and Argentina) have raised at a rate of 20 per cent from 2001, due to cheaper prices of beekeeping products coming from these countries. Argentina and China have jointly displaced a 30% share of the European domestic market in the last 4 years. These imports can top €30M for all bee products.
- Lack of specific regulations with respect to beekeeping products has been proven to be a threat for beekeeping market and public health safety in the last years. Chinese honey and royal jelly were banned by the European and North American markets due to the presence of chloramphenicol and nitrofuranes residues, among other toxic residues[8], causing further social alarm and sales drops.

[5] Parliament urges the Commission to propose a financial aid mechanism should also be provided for beekeepers in difficulty, and ask that Member States bring forward "immediate support" for the beekeeping sector. European Parliament (2008).
[6] It should be noticed that pollen and royal jelly is produced by the same beekepers who manufacture honey, as secondary products. Therefore, threads for the sector can fatally affect our targeted products in the same way that enhancements on the target products can equally save it competitiveness.
[7] Not data available yet. National Associations of Beekeepers; personal communication.
[8] S. Bogdanov. 2005. "Contaminants of bee products". Apidologie 37 (2006) 1-18.

APIFRESH project will help Association of European Beekeepers by:

- Determining standardized methodologies in order to create European quality standards for both pollen and royal jelly. This methodology shall include analytical methods to determine sensory properties, bacterial load, water content, chemical composition (fat, proteins, carbohydrates, etc.) pesticides and heavy metals present.
- Identifying bio-active and other healthy-considered compounds present in pollen and royal jelly through techniques for measuring bio-active components, antioxidants, sterols, flavonoids, polyphenols, etc. in order to label these bee products as extra health properties container.
- Developing a precise and accurate methodology for the determination of pollen authenticity (both geographical and botanical) through PCR technique and the creation of a database with genetic information about different pollen types.
- Developing a cost effective Decision Support System to help pollen identification in order to reduce the time needed by the analysts once the standardization of pollen will boost the analyses of this product.

2. SUMMARY DESCRIPTION OF PROJECT CONTEXT AND OBJECTIVES

The main objective of the APIFRESH project is to help the European Beekeeping Sector overcome their critical situation of uncertain sustainability by providing the scientific and technological aids necessary to improve the quality of European pollen and royal jelly production and also by promoting the regulatory means that will allow European bee products compete under fair conditions against lower quality or adulterated products.

These core objectives will be realised by means of the following achievements:

- The development of a quality standard proposal aimed at protecting European pollen and royal jelly products against adulteration and contamination induced by environmental and bee-treatment toxic components.

- The development of the knowledge and technological aids necessary to enforce compliance with the proposed standard; including:

    - Determination of bee-product authenticity and origin identification that will enable proper labelling of the product. This aim is achieved by establishing a fair range for the different chemical, physical, microbiologic and sensory properties that characterizes European bee pollen and royal jelly through analytically validated methods.
    - Determination of the methodology to define the quality standard criteria. This methodology includes analytical methods to determine sensory properties (odour, taste, and visible contaminants), bacterial load, water content, chemical composition (fat, proteins, carbohydrates, etc.) and heavy metals present.
    - Determination of the health enhancing compounds present in bee products by identifying and quantifying in both pollen and royal jelly compounds like: flavonoids, polyphenols and other sterols; through techniques measuring bio-active components, antioxidants and antibacterial activity.
    - Setting-up a precise and accurate methodology for the determination of pollen authenticity (both geographical and botanical) through PCR technique and the creation of a database with genetic information about different pollen types.
    - Development of a timesaving, robust and low-cost decision support system for the identification of pollen vegetal species, relative proportions and geographical origin. This system is based on computer vision and machine learning techniques.

- The development of validated methodologies and best practice guidelines aimed at improving the quality of pollen and royal jelly products in all phases of

the production chain; including: harvesting, collecting, storage, transportation and presentation at the point of sale.

3. DESCRIPTION OF MAIN S & T RESULTS/FOREGROUNDS

In order to fill the existing gap over standards and regulations on bee products, this project was divided into three essential blocks (a) bee-product authenticity (through bee-pollen origin identification); (b) quality standard criteria (subdivided into physic chemical composition, microbiologic load and sensory properties) and (c) health enhancing compounds present in bee products.

The **scientific objectives** of APIFRESH are:

- To establish a fair range for the different chemical, physical, microbiologic and sensory properties that characterizes European bee pollen and Royal Jelly through analytical **validated methods**.
- To understand how PCR techniques (never used before in Melissopalynoloic analysis) and image analysis applied to optical data can be used to determine the botanical and geographical origin of bee pollen, and honey floral origin.
- To identify and quantify in both pollen and jelly health enhancing compounds like flavonoids, polyphenols and other sterols (not measurable by analytical methods used for quality determination) through techniques measuring bio-active components, antioxidants and antibacterial activity.

The **Technological objectives** of APIFRESH are:

- Determination and **development of validated methodologies in order to create European quality standards for both pollen and royal jelly**. This methodology shall include analytical methods to determine sensory properties (odour, taste, and visible contaminants), bacterial load, water content, chemical composition (fat, proteins, carbohydrates, etc.) pesticides and heavy metals present.
- **The identification of bio-active and other health enhancing compounds present in pollen and royal jelly** through techniques for measuring bio-active components, antioxidants, sterols, flavonoids, polyphenols, etc. in order to label these bee products as extra health properties container.
- **Developing a timesaving (50% time reduction), robust and low-cost decision support system for the identification of pollen vegetal species**, relative proportions and geographical origin, **by applying machine learning techniques on the optical data**. Also, **this tool will be suitable for determining floral origin.**
- **Setting-up a precise and accurate methodology for the determination of pollen authenticity** (both geographical and botanical**) through PCR technique**

and the creation of a database with genetic information about different pollen types.

Coming to the project end, we analyse the main project results against the project objectives in order to make a proper plan for the use of those results. The results obtained experimentally to meet the previously mentioned objectives have been organized in such a way that the consortium associations and SMEs can make use of them in a practical way. Thus, the following results have been produced from the Apifresh project:

- Two Proposals for a quality standard, one for bee pollen and the other one for royal jelly. These proposals include both physic-chemicals characteristics and the analytical techniques to determine those characteristics.
- Best practice guidelines for bee pollen and royal Jelly. These guidelines include harvesting, production and conservation of bee pollen and royal jelly.
- Manual of health enhancing compounds.
- DSS (decision support system) & PCR protocols for botanical and eventually geographical origin identification.

4. POTENTIAL IMPACT AND MAIN DISSEMINATION ACTIVITIES AND EXPLOITATION RESULTS

POTENTIAL IMPACTS

The main benefits the beekeepers will obtain from the APIFRESH project refer to the new standard being promoted. The standard is important because it will bring harmonisation to the currently existing beekeeping practices, it will determine the minimum acceptable quality levels, it will allow differentiating quality bee products from other cheaper alternatives and, in summary, it will protect the quality production of European beekeeping products against unfair competition from adulterated or contaminated substitutes from abroad.

In other words, the standard will guaranty when a customer purchases a European product that this product is compliant with the highest quality levels, it has not been adulterated and it is free from toxic compounds. The new standard will also make possible the inception of a new European branding, which will allow the reliable identification of the product origin for the consumer.

APIFRESH best practice guidelines are expected to improve the quality of European bee pollen and royal jelly products by introducing a specific methodology for the beekeepers and the participants in the retail chain on the correct collection, transportation, storage and presentation of the product at the sale point. These good practice guidelines are intended to be another competitive advantage over other foreign products not compliant with the mentioned methodology.

APIFRESH will also contribute to provide scientific support to the long awaited claim of the beekeeping sector for the healthy compounds present in pollen and royal jelly. This scientific backup is necessary to overcome the currently existing barriers preventing the commercialisation of pollen and royal jelly as health enhancing products in certain European countries.

Finally, APIFRESH will develop a fast and inexpensive technical methodology to rapidly detect non-compliance with regulations and quality standards. A methodology that is widely accessible, affordable and easy to implement. This availability, affordability and time reduction, contributed by the new techniques, are seen as a necessary element for the successful implementation of the APIFRESH quality standard.

DISSEMINATION ACTIVITIES

Dissemination activities were led by the Exploitation Manager Mr. Angel Martinez, assisted by all the members of the Consortium and, in particular, with the special aid of the Project Coordinator Mr. Tomas Rodriguez. The Consortium played an active role in the dissemination of the knowledge and the technology transfer of the results of the project to the members of the Consortium, the members of the Associations participating in the project, the beekeeping community, the scientific community, public bodies, decision makers, standardization committees; as well as any other organization or individual potentially interested in the project.

Since the aim of the APIFRESH project is to promote the adoption of an open standard, the project has placed great emphasis on the actions aimed at the widest possible dissemination of the results of the project. For that purpose we used both traditional as well as novel dissemination means; including workshops, attendance to conferences, web presence, press releases, etc.

The Dissemination plan has been implemented following a list of specific actions, described below:

- Web Presence:
    - The Project Website. APIFRESH has a specific project website, where information, documentation and news about the project have been updated regularly.
    - Wikipedia Page. One of the dissemination actions executed in the project was the preparation and publication of a Wikipedia page describing the contents of the APIFRESH project.
    - Other Web Sites. A summary description of the APIFRESH project has been included in the web portal of the project participants. In addition, references to the APIFRESH web site have been included in some of the most relevant websites of the beekeeping sector.
- Conferences, Seminars and Trade Fairs:

    Attendance to important events such as conferences, trade fairs and seminars was an excellent opportunity to disseminate the results of the project, keep updated on the state of the art, remain aware of the needs of the beekeeping sector and contact potential partners and interested organizations.

    Two types of events have been considered here: scientific events and professional events. There was no fixed schedule for scientific events, they were selected on demand; depending on the subject and the progress of the different technical task of the project. In the case of professional events, attendance followed strictly value for money rules. In that sense we have tried to maximize impact while minimizing the costs. One approach was to take advantage of the normal activities

done by the partners of the consortium in fairs and conferences to disseminate the results of the project with minimum costs. Another approach was involving national and regional governments to attend these events.

Extensive dissemination work has been performed during the three years project duration (01/07/2010-30/06/2013), as part of the normal activities of the consortium members, especially associations, however we also expect to present Apifresh in future events in order to ensure the maximum diffusion of the results among the beekeeping sector.

- Publications and Other Dissemination Materials:
  - Project Leaflet. We have created a Project Brochure describing, in a friendly way, which are the objectives of the project, the expected results and the benefits for the beekeepers of the technologies, guidelines and information compiled in the project.
  - Poster. We created a poster describing the objectives and expected results of the project. The Poster has been used at fairs, conferences, workshops and poster sessions to explain to interested partners the benefits of the APIFRESH project.
  - Media Releases. We issued a press release as soon as any new outstanding result was achieved in the project. We also took advantage of opportunities to promote the results of the project in local, regional and national press.
  - Scientific Publications: We have published scientific publications in journals, conferences and periodic science newsletters. In particular, we submitted for publication three scientific papers in International journals / conferences in the course of the project.

- Clustering and Standardisation.
  - Clustering: Clustering activities have been undertaken throughout the project lifetime but with the aim of making them effective also after the project completion. The project approached the most relevant organizations in the beekeeping sector. In particular we got in contact with APIMONDIA (http://www.apimondia.com/en) and APITHERAPY (http://www.apitherapy.com). At European Level APIFRESH has contacted the Food Cluster Initiative that was launched in 2007 with the ambition of involving different EU funded research projects within an exchange of knowledge and experiences,
  - Contribution to Standards. Main certification bodies have been contacted at a national level by the different partners

- Workshops and Training:

- Workshops. Each partner has been involved in a continuous process of technology transfer and absorption throughout the development phase. This has been achieved through the close collaboration of the RTD performers technicians and managers with the participating organizations to ensure complete assimilation of projects results. Technology transfer has been reinforced during the later stages of the project, and the completed results were finally absorbed by the partners through a program of training events. Given the nature of the beekeeping sector, beekeepers are very busy most of the year and we found that face to face dissemination in the national or local fairs were probably the best opportunity to approach them and present them the objectives and results of the project. Some of APIFRESH workshops have also been carried out at scientific events, however, the main focus was on commercial fairs. On the other hand, we also prepared our own workshops in coincidence with the project meetings. Important personalities from the beekeeping sector were invited to the workshops, including reputed researchers from other organisations, presidents of beekeeping associations, etc.
- Training and Technology Transfer. Training in both senses from RTD to SME-AG and from SME-AG to their members were planned and performed in a successful way.

EXPLOITATION OF RESULTS

By explicit agreement of the members of the Consortium, all Apifresh results will be made available free of charge to the public. However, this fact does not imply IPR and exploitation issues must be ignored.

The first step is to protect the results of the project. In Apifresh we have five main results:

1. The Apifresh Standard proposal.
2. The Good Practice Guidelines.
3. The Manual of Nutritive Compounds.
4. The Decision Support System.
5. In addition the project has produced a huge amount of technical data which is also valuable and must be protected.

Given the fact that the members of the Consortium do not expect to get direct commercial benefit from the results of the project, at least not in the first stage, patenting is not considered the best approach, and we have decided to protect the five Apifresh results described above by making them public. Publishing the results of the project will have two benefits: first we comply with our compromise to make the results of the project public domain and second we ensure our results are protected so that we can avoid other third parties trying to patent these same results. This is very important because if the results are not published or patented, anybody may claim the property of our results.

Taking into account this limitation, Apifresh exploitation strategies will be focused in five main actions:

1. Dissemination of the standard among beekeeping stakeholders: Basically refers to the actions required to promote and complete the process of achieving and implementing the Apifresh standard
2. Promotion of the use of good practices among the beekeepers: This action has been started already and is of immediate benefit for the beekeepers. The good practice guidelines will be distributed basically through the associations members of the Consortium and more specifically through the European Beekeepers Association (EPBA). The Good Practice Guidelines is already available for download at the project web site. The guidelines will also be available shortly at the websites of the associations.
3. Promotion of the healthy properties of bee products with the consumers and other actors involved in the beekeeping business: The Manual of Healthy Compounds produced in the project is presented as an important scientific publication confirming the claimed healthy properties of bee pollen and royal jelly. We foresee this manual will be used by a wide range of stakeholders participating in the beekeeping business including: the beekeeping organizations, individual beekeepers, health authorities, consumer organizations, packagers, retailers, etc. These organizations may use the manual to promote their products and differentiate them against competing food products or even against lower quality bee products from the competence.
4. Use of the project results for further research: An important research effort has been done since the beginning of the project. In that sense the number of scientific results is huge. The most obvious results deserving further research are the computer vision algorithms. Even if these algorithms already achieve a high degree of accuracy, nevertheless still further improvement is possible. It would also be desirable to extend / complete the database with more images and pollen types. Inspiralia and Balparmak are already compromised with the investigation of the merits of the developed software in new applications (being the most immediate honey). Other research institutions will surely join as soon as the software is made available to the public. The PCR techniques developed in the project can also be subject to further research; in particular with the aim to reduce the rate of rejected samples. This objective will allow increasing the number of pollen types identified and reducing the costs of these tests. UCM is the partner interested in this additional research. Finally, the huge amount of data resulting from the chemical analysis performed will be made available to the scientific community to conduct further research on healthy properties, contamination, adulteration, etc. One of the most interesting topics to be improved would be to optimize the number and costs of the tests required to enforce the standard in order to lower the costs of the tests, reduce the time required and limit the quantity of the samples. Tubitak and Marchamalo will be the leaders in these on-going research efforts.

5. Indirect use of the project results; mainly the software: By indirect use of the results we mean activities that will allow certain organizations get commercial profit from the project results without violating the IPR or distribution license terms of the results. These actions refer basically to the Decision Support System software (DSS). In the software community this added value may come from two sides: added services around the software (i.e. packaging and distribution, training, technical support) or by improving the software itself. Both possibilities are foreseen in our approach. For that purpose we will provide the software in the form of a library distributed under the LGPL license.

5. ADDRESS OF PROJECT PUBLIC WEBSITE AND RELEVANT CONTACT DETAILS

CONSORTIUM MEMBERS

EUROPEAN PROFESSIONAL BEEKEEPERS ASOCIATION

http://www.epba.info/default.htm

ORSZAGOS MAGYAR MEHESZETI EGYESULET

1094 Budapest, Viola u. 50

Hungary

http://www.omme.hu/portal/

FEDERACAO NACIONAL DOS APICULTORES DE PORTUGAL

Av. do Colégio Militar, Lote 1786

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CENTRO TECNOLÓGICO NACIONAL DE LA CONSERVA Y LA ALIMENTACIÓN

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http://www.ctnc.es/

CAMPOMIEL

La Rioja, Spain

http://www.campomiel.com/

BALPARMAK

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http://www.balparmak.com.tr/

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