Innovations in postharvest treatments against weevils in rice (ELMIRA)

Summary

The project represents an important step towards reducing the risk of insects developing in postharvest rice, using a physical residue-free technology. The technology to be prepared is based on the industrial application of dielectric heating to eliminate insect infestations in cereals and/or other grains. Dielectric heating raises the temperature of insect larvae that develop within the grains more easily than that of the grain itself. This allows the elimination of pests without changing the properties of the cereals, with moderate energy consumption and potentially avoiding the presence of pesticides in the end product.

Objectives

a) Validate the breeding systems of the insects of interest (*Sitophilus oryzae*, *Oryzaephilus surinamensis* and *Tribolium confusum*) in order to obtain sufficient eggs, larvae and adults to allow the effectiveness of the treatments to be assessed.

b) Assessment of the degree of infestation in the products in order to define the treatment intensities required to guarantee product stability.

c) Carry out preliminary tests in which the insects are killed using microwaves and construct mathematical models to predict the effect of the microwaves on the survival of the three species of interest.

d) Perform insect removal tests on the radio frequency pilot prototype to determine effectiveness, including treatment penetration trials, and construction of mathematical models to predict the effect of microwaves on the survival of the three species of interest.

e) Physical, chemical and sensory assessment of the changes that radio frequency treatments may produce in rice.

f) Define the technical specifications and requirements that have to be met by the future RF team.

g) Disseminate the results and prepare proposals for the exploitation of the developed technology and products.

Description of the actions carried out in the project

- Adapting of the breeding systems of *Sitophilus oryzae* to other insect species of interest (*Oryzaephilus surinamensis* and *Tribolium confusum*) in order to obtain a sufficient number of eggs, larvae and adults to assess the effectiveness of the treatments.

- Carrying out insect destruction tests using microwaves (2450 MHz and 915 MHz) and radio frequency (27 MHz) at three power levels for each frequency in polished rice.

- Studies on eggs and two different levels of larval development of the insect.
- Studies on three values of cereal moisture.

- Carrying out tests for the destruction of insects by means of microwaves (2450 MHz and 915 MHz) and radio frequency (27 MHz) in rice with husk.

- Construction of mathematical models for predicting the effect of microwaves on the survival of the species of interest.

- Evaluation of the effect of dielectric heating on the cooking and sensory properties of treated polished rice.

Final results and practical recommendations

The methodology is available to provide samples of grains affected by insects in significant quantities. Energy densities around 150 J/g cause a moderate increase in grain temperature, with a reduction in live insects of approximately 50%. Densities in the range of 300 J/g eliminate 90% of insects (at any stage of their larval development), but the heat generated cannot be properly evacuated and causes excessive heating of the product.
Samples with higher humidity undergo greater heating (the differential in the dielectric coefficient between the grain and the insect is smaller), and this translates into greater changes in the cooking characteristics. The cooking time increases in the high humidity samples, probably because part of the applied energy causes starch gelatinisation. When the increase in temperature is not accompanied by greater availability of water, starch gelatinisation does not increase, and small fractures may appear, allowing water to penetrate more quickly when cooking the product.

Conclusions

Moderate intensity treatments (100-200 J/g) can halve the risk of insect development in rice. Higher energy densities improve effectiveness, but at the cost of worsening the cooking characteristics of rice. In low-humidity grains, changes in cooking are also minor, while the low humidity limits the risk of insect proliferation.
This solution would allow polished, packaged rice to be treated at the packaging line exit to reduce the risk of insects in egg or larval form developing inside the rice grains. This solution leaves no residue (does not use artificial or natural pesticides) and has very moderate energy expenditure.

Leader of the Operational Group

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Subject area(s) of application

☐	Agricultural production system
☐	Agricultural practice
☐	Agricultural equipment and machinery
☐	Livestock farming and animal welfare
☐	Vegetable production and horticulture
☐	Landscape / Territorial management
☐	Pest and disease control
☐	Fertilisation and nutrient management
☐	Soil management
☐	Genetic resources
☐	Forestry
☐	Water management
☐	Climate and Climate Change
☐	Energy management
☐	Waste and by-product management
☐	Biodiversity and environmental management
☒	Food quality/processing and nutrition
☒	Supply chain, marketing and consumption
☒	Competitiveness and agricultural and forestry diversification
☐	General

Geographical area(s) of application

PROVINCE(S)	REGION(S)
Tarragona	Baix Ebre

Dissemination of the project (publications, seminars, multimedia, etc.)

-Presentation at the ICFAE 2020 congress (International Conference on Food and Agricultural Engineering) by Jordi Saldo, entitled “How to get rid of pests in grains? Differential dielectric heating as a tool for insects' removal” (http://www.icfae.org/2020.html).

-Poster for the 8th Conference of Agri-food Cooperatives of Spain
http://cloud.fcac.coop/index.php/s/s3I1IiyLRRvKCCb

-http://www.cooperativesagraries.cat/ca/destaquem/571-finalitza-el-projecte-del-grup-operatiu-elmir.html

-https://www.linkedin.com/posts/cerpta-uab_despr%C3%A9s-de-dos-anys-de-feina-incloent-les-activity-6713014400585875456-A0UI

More information on the project

PROJECT DATES	TOTAL BUDGET
Start date (month-year): June 2018	Total budget: €65,000.00
Completion date (month-year): September 2020	DARP funding: €25,935.00
Current status: Executed	EU funding: €19,565.00
	Own funding: €19,500.00

With funding from:

Project funded through Operation 16.01.01 (Cooperation for Innovation) through the Catalan Rural Development Programme 2014–2020.

Order ARP/133/2017 of 21 June, approving the regulatory bases for grants for cooperation for innovation by promoting the creation of European Association for Innovation operational groups in the areas of agricultural productivity and sustainability and the execution of innovative pilot projects by those groups, and Resolution ARP/1868/2017, of 20 June, announcing the call for the grant.

Generalitat de Catalunya
Departament d'Agricultura, Ramaderia, Pesca i Alimentació

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