AgriMax Biorefinery
Valorization of crop and food processing by-products through an integrated cascade process

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This project has received funding from the Bio Based Industries Joint Undertaking (JU) under grant agreement No 837863. The JU receives support from the European Union’s Horizon 2020 research and innovation programme and the Bio Based Industries Consortium.
SSICA, Experimental Station for the Food Preserving Industry, is a Research Institute, established in Parma in 1922. SSICA activities focus on applied research regarding the production chain in the agro-food sector and food processing industry.

SSICA has about 100 employees in 2 locations, Parma and Angri (SA).

The Packaging department focuses its activity on the hygienic-sanitary control, as well as on the correct functioning of the containers and of the materials involved, in relation with their construction characteristics and operating conditions for use.

The Packaging department is actively involved in research projects related to the development of new sustainable packaging and biobased materials for the food sector.
One third of all food produced globally is wasted every year 1.3 billion tons of food\(^1\)

Within the European Union approximately 90 million tons of food are wasted\(^2\) and about 700 million tons\(^3\) of agricultural wastes are generated annually.

These wastes can be reused in other production processes and are potential sources of bioactive compounds.

\(^3\)A. Pawelczyk. 2015. EU policy and legislation on recycling of organic wastes to agriculture. ISAH. 1. 64-71.
AgriMax General Information

Type of action: Innovation Action - Demonstration

Start date: 01 October 2016

End date: 30 September 2021

BBI JU contribution: € 12,484,461.46

The Consortium

✓ 11 RTDs

✓ 18 SME and Large industry

✓ 3 partners are BIC members and 8 associated BIC members to maximise the output alignment to the BBI programme

covering the whole supply and value chain
Project goals

➔ To demonstrate the **technical and economic feasibility** of combined flexible biorefinery processes for valorising crops & food processing derived wastes

➔ To maximise the economic and environmental **sustainability** of the EU agricultural and food sectors in while providing new **bio compounds** to the chemical, bioplastic, **food, packaging and agriculture sectors**.

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 720719.
The two pilot plants were built (one in Italy and one in Spain) on a cooperative basis to prove the viability of the proposed approach.

- **Flexible and integrated**
- **Designed to maximise shared equipment**
Italian Biorefinery
Canneto sull’Oglio (MN) - ITALY
Tomato by-products

- Cutin
- Lycopene
- Compost and hydrocompost

Cereals by-products

- Ferulic acid
- Fibers
Tomato (peels & seeds) waste

- **Cutin extraction**: a new coating, from natural source, for metal food packaging industry
- **Lycopene extraction**: antioxidant, food ingredient for the food industry
- **Biogas production**: exploitation of the residual biomasses from the cutin and the lycopene extraction, for a sustainable production of energy
Cutin is:

- A component of the cuticle of the tomato peels
- **Natural polymer of polyester type**
- Mainly composed (70-80%) of **10,16 dihydroxyhexadecanoic acid**

Cutin is extracted from tomato by-products:

- Avoiding organic solvent
- Exploiting few simple steps
- Using commercial available equipment

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Project Development

- **Formulation** of the **new bio-lacquer** at **pilot scale**

- **Industrial application** on aluminium, tin free steel and tinplate

- Evaluation of the **chemical and mechanical properties** and **food contact compliance** with the Italian and European legislation

- **Industrial production** of 3 pieces cans and open top ends

- **Filling** of the cans with tomato, tuna and legumes for **shelf life** evaluation
Evaluation of the bio-lacquer applied on metal sheets

- Food contact compliance

Overall and specific migration tests referring to the National (Ministerial Decree 21st March 1973 and further amendments, Ministerial Decree 18/2/84 and Ministerial Decree 26th April 1993) and European (Regulation (EU) n.10/2011 and further amendments and Regulation (UE) n. 2018/213 - 12nd February 2018) Legislation

- Chemical and mechanical properties

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>WACO porosity</td>
<td>NaCl 1% solution (electrochemical analysis)</td>
<td>&lt; 10 mA/dm²</td>
</tr>
<tr>
<td>Dry adhesion</td>
<td>UNI 8574/6</td>
<td>Good</td>
</tr>
<tr>
<td>Thermal resistance</td>
<td>Water and vapour 121°C 1h (UNI 8574-1:1984)</td>
<td>Good</td>
</tr>
<tr>
<td>Corrosion resistance</td>
<td>Citric solution pH 4 and cysteine solution pH 6</td>
<td>Low-medium acidic products</td>
</tr>
<tr>
<td></td>
<td>EIS (Electrochemical Impedance Spectroscopy)</td>
<td></td>
</tr>
</tbody>
</table>
Some data about production

✓ The biorefinery can process 500 kg/h of tomato by-products

✓ n. 10 trials carried out on the biorefinery to optimize the cutin extraction process

  ✓ 90 kg of cutin produced for the industrial bio-lacquer production
    ✓ 90 kg of bio-lacquer produced

✓ n. 6000 tinplate cans of ½ kg size produced on industrial line

✓ n. 500 tinplate cans of 80 g size produced on industrial line

  ✓ n. 500 cans filled with tomato passata
    ✓ n. 200 cans filled with legumes
    ✓ n. 170 cans filled with tuna

By courtesy of Salchi Metalcoat
Lycopene is:

- a molecule present in red fruits and vegetables of which tomatoes are the major contributor
- a natural antioxidant
- a carotenoid

Project development and results

- Extraction of lycopene from the tomato peels discarded by the cutin extraction process (additional valorization of tomato by-products)

- Set up of the extraction method at laboratory scale - n.12 trials on 2 L Naviglio® Extractor

- Scale up of the extraction protocol to pilot scale - n.12 trials on 40 L Naviglio® Extractor

- Application as food colorant
Tomato (cull fruit & plant) waste

- **Compost**: Solid fertiliser for the farming industry
- **Hydrocompost**: liquid fertiliser for the farming industry
Cereals (wheat bran) waste

- Biopolymers (mycelium materials) for farming / packaging industry
- Extraction of ferulic acid, phenolic compounds and fibres
- Proteins plus ferulic acid extract as ingredient for functional food
Conclusions

The biorefinery can successfully process all the feedstocks tested
All the products obtained were applied in their specific sector

Cutin
✓ Successfully extracted from tomato peels at the biorefinery
✓ Production of the bio-lacquer at pilot scale and its application on industrial line
✓ Industrial production of tinplate cans and filling with food products on industrial line
✓ The migration tests verified the compliance to food contact
✓ The bio-lacquer is suitable for packing medium and low acidic food products (e.g. tomato, legumes, tuna)

Lycopene
✓ Identification of the extraction protocol at laboratory scale
✓ Scale up of the protocol at pilot scale → further research needed
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Thank you for the attention

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