Processing Factors (PF) for Pesticide Residues in Cold Pressed Lemon OIL

José-Antonio García. AILIMPO
Interprofessional Association representing the Spanish Lemon and Grapefruit industry officially recognized by:

- Spanish Ministry of Agriculture
- European Commission

Ailimpo is member of:

- freshfel
- EFEO
- World Citrus Organisation

Representing all the value chain

Production

Fresh

Processing
World Citrus Organisation

- **Discuss** common issues affecting citrus producing countries.
- **Exchange** information on production and market trends.
- **Foster** dialogue on policy issues of common concern.
- **Identify** and promote Research and Innovation projects specific to the citrus sector.
- **Liaise** with public and private stakeholders on citrus-related matters to highlight the importance of citrus producers and the need for a fair return.
- **Promote** the global consumption of citrus.
WCO Membership

WCO Associated Members

- ABCM
- Ailimpo
- AKiB
- Chilean Citrus Comité (Chile)
- Citrus Australia
- Citrus Growers’ Association (South Africa)

- Francoprint
- Gafan Colón
- Infocitrus
- Fruit Investments
- Protección de los Citricos del Peru (ProCitrus)
- Upfruy – Unión de Productores y Exportadores de Fruta del Uruguay (Upfruy)

- Wonderful Citrus
- Zalar

WCO Associated Members

- AgroFresh
- AM FRESH
- Apodi
- Classic Fruit Harvest
- Clane’s Orchard
- Leopold Logista

- FMC
- FructoExpo
- Klopheim
- San Miguel
- Taiti Citrus

World Citrus Organisation
Spanish lemon in the world 2021

- Spain
  - 2nd World producer
  - 1,375,000 tonnes
    - Fresh: 70-75%
    - Processing: 25-30%

World total: 6,615,000 tonnes

Fresh
- Spain
  - Fresh: 22% of world output
    - 960,000 tonnes
- Processing
  - Spain
    - Processing: 17% of world output
      - 415,000 tonnes

1st
2nd
Average CPLO Production in the world 2021

TOTAL CP LEMON OIL TONS: 10,340

Argentina: 58%
Spain: 14%
EE.UU: 8%
RSA: 6%
Mexico: 3%
Brazil: 3%
Italy: 3%
Others: 5%

CP LEMON OIL (TONS) Argentina 6,000 Spain 1,453 EE.UU 840 RSA 630 Mexico 350 Brazil 280 Italy 263 Others 525

Argentina
Spain
EE.UU
RSA
Mexico
Brazil
Italy
Others
INCREASING QUANTITIES SENT DIRECTLY FROM ORCHARD TO PROCESSING
Pre and Post Harvest Treatments According to Regulation

Concentrating legal pesticide residues in the very external peel of lemons.

In Pesticides presence terms, impact on the final product is very limited as quantity of CP Lemon Oil added in final product for consumers is quite small... *REAL DIMENSION OF THE ISSUE*...
Why do we use pesticides?

We have to comply with fresh trading standards and retailers quality (external appearance) requirements

We need to reduce production losses (in quantity and quality) caused by.... Pests and diseases
THE SPANISH APPROACH TO PESTICIDE RESIDUES ON CPLO

1. STRATEGY TO REDUCE THE USE OF PESTICIDES IN SPAIN:
   (1) MANDATORY PLAN APPROVED BY THE EUROPEAN UNION
   (2) INTERNAL EFFORTS FROM THE INDUSTRY ITSELF

2. PROCESSING FACTOR CALCULATION

3. AVOIDING POSTHARVEST RESIDUES PROCESSING FRUIT DIRECTLY FROM THE ORCHARDS
A European Green Deal
Striving to be the first climate-neutral continent

From Farm to Fork:
Our food, our health, our planet, our future
The European Green Deal

EU BIODIVERSITY STRATEGY
Bringing nature back into our lives

The use of pesticides in agriculture contributes to pollution of soil, water and air. The Commission will take actions to:
✔️ reduce by 50% the use and risk of chemical pesticides by 2030.
✔️ reduce by 50% the use of more hazardous pesticides by 2030.
Reducing the risk and use of pesticides

- **Legally binding targets** reducing the use and risk of chemical pesticides by 50% by the year 2030.

- **Environmentally friendly pest control** ensuring all farmers practice Integrated Pest Management in which chemical pesticides are used only as a last resort.

- **Promoting low-risk alternatives with national targets** to increase non-chemical methods of pest control and sales of non-chemical plant protection products.

- **Accelerating approvals** of biological alternatives for farmers and other pesticide users.

- **Enabling the use of new technologies** such as precision farming, which contributes to further reducing the use of chemical pesticides.

- **Helping farmers access required advice and guidance** for more sustainable farming with less chemical pesticides.
Integrated Pest Management (IPM)

IPM is one of the tools for low-pesticide-input pest management including biological pest control and must be implemented by all professional users.
BOOSTING THE USE OF NATURAL PREDATORS: TAKING CARE OF BATS

Analysis of bat diet

BATS are a relevant actor in the fight against lemon tree pests in SPAIN

Phyllocnistis citrella

CONSERVATION STATUS ASSESSMENT OF THE LONG-FINGERED BAT (Myotis capaccinii) IN THE IBERIAN SOUTHEAST
(1) BIOSERECO PROJECT “Integrated management of biodiversity in agricultural environments to obtain ecosystem services.” To restore biodiversity to improve pest control and pollination

Installation of plant structures for:
- Habitats for natural enemies for biological pest control
- Reduce the use of pesticides

(2) BLOCKCHAIN PROJECT “LEMONTRACE”

Traceability to guarantee quality and safety

(3) SAFEOILS PROJECT

Promoting Good Agriculture Practices for a sustainable use of pesticides
Pesticides Processing Factors (PF´s) CPLO

- Situation >> Uncertainty and B2B Disputes
- The Way Forward
- PF calculation for 11 Pesticides
- Other Pesticides Regression Equation considering Log Pow
- Other Challenges
Situation >> Absence of harmonized PF creates Uncertainty and B2B Disputes

- European/Spanish CP Lemon Oil Producers must prove legal compliance of their products: *we can prove that raw material (fresh lemons) complies with Regulation*.... BUT... Clients demand for more.

- Grey / Black area around pesticide residues in B2B contract specifications >> Distortion of the market.

- In many cases the pesticide residues are not detectable in Fresh Lemons (<0,01 mg/kg) but due to concentration are unfortunately detected in the CPLO.

- Laboratory Analysis Level of Uncertainty (+- 50%)
Some PF for CPLO available worldwide ... but insufficient and not harmonised
THE LEMON FROM SPAIN® WAY FORWARD

- **A SENSITIVE TOPIC**: Better to be PROACTIVE rather than REACTIVE

- **PRIORITY**: eliminating uncertainty calculating a PF with ROBUST DATA

- **PRACTICAL APPROACH**: A Study
  - Following EU OFFICIAL GUIDELINES to be validated
  - Collaborating and informing other stakeholders within the industry: EFEO, IFEAT, EFFA... now here in the ICBC
  - Inviting the industry for a global commitment/solution
**PF COLD PRESSED LEMON OIL STUDY RESULTS FOR 11 ACTIVE SUBSTANCES**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Mean PF AILIMPO data</th>
<th>EU MRL (lemon RAC) mg/kg</th>
<th>MRL det lemon oil mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorpyrifos *</td>
<td>161</td>
<td>0,01</td>
<td>1,61</td>
</tr>
<tr>
<td>Chlorpyrifos-methyl *</td>
<td>58</td>
<td>0,01</td>
<td>0,58</td>
</tr>
<tr>
<td>2-Phenylphenol</td>
<td>71,4</td>
<td>10</td>
<td>714</td>
</tr>
<tr>
<td>Pyriproxyfen</td>
<td>121,7</td>
<td>0,6</td>
<td>7302</td>
</tr>
<tr>
<td>Pyrimethanil</td>
<td>56</td>
<td>8</td>
<td>448</td>
</tr>
<tr>
<td>Propiconazole *</td>
<td>58,4</td>
<td>5</td>
<td>292</td>
</tr>
<tr>
<td>Imazalil</td>
<td>2,6</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Prochloraz *</td>
<td>31,9</td>
<td>0,03</td>
<td>0,957</td>
</tr>
<tr>
<td>Thiabendazole</td>
<td>0,8</td>
<td>7</td>
<td>5,6</td>
</tr>
<tr>
<td>Hexythiazox</td>
<td>34</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>Metalaxyl/Metalaxyl-M</td>
<td>4,5</td>
<td>0,5</td>
<td>2,25</td>
</tr>
</tbody>
</table>

Lemon oil PF available from the AILIMPO study vary widely between active substances. It is therefore not considered feasible to derive a single or generic lemon oil PF for all pesticide active substances.

(*) Authorised substances when the study was made
FOR OTHER PESTICIDES
A PRACTICAL APPROACH BASED ON OCTANOL/WATER PARTITION COEFFICIENT (Log Pow)

Theoretical lemon oil processing factors can be calculated using the regression equation from the AILIMPO processing data study:

\[ y = 40.66x - 81.04 \]

where X = Log Pow.

Based on the data from AILIMPO study it is concluded:

>> For substances with a log Pow of 3 or greater, log Pow is a useful indicator of the expected concentration of pesticide residue in lemon oil using the regression equation.

>> For water soluble substances with a log Pow <3, the concentration of residue in lemon oil is generally small and cannot accurately be predicted via log Pow. >> If no experimental data are available, a generic PF of 2 may be used.

### Table: Log Pow vs Mean PF AILIMPO

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<tr>
<th>Substance</th>
<th>Log Pow</th>
<th>Mean PF AILIMPO</th>
</tr>
</thead>
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<tr>
<td>Chloryprifos</td>
<td>4.7</td>
<td>161</td>
</tr>
<tr>
<td>Chloryprifos-methyl</td>
<td>4</td>
<td>58</td>
</tr>
<tr>
<td>2-Phenylphenol</td>
<td>3.2</td>
<td>71.4</td>
</tr>
<tr>
<td>Pyriproxyfen</td>
<td>5.37</td>
<td>121.7</td>
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<tr>
<td>Pyrimethanil</td>
<td>2.84</td>
<td>56</td>
</tr>
<tr>
<td>Propiconazole</td>
<td>3.72</td>
<td>58.4</td>
</tr>
<tr>
<td>Imazalil</td>
<td>2.56</td>
<td>2.6</td>
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<td>Prochloraz</td>
<td>3.5</td>
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<td>2.39</td>
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<td>2.7</td>
<td>34</td>
</tr>
<tr>
<td>Metalaxyl /Metalaxyl-M</td>
<td>1.71</td>
<td>4.5</td>
</tr>
<tr>
<td>Linear regression equation</td>
<td>( y = 40.66x - 81.04 )</td>
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</tr>
<tr>
<td>Correlation coefficient ( r^2 )</td>
<td>0.75</td>
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</tr>
<tr>
<td>Significance / F-value</td>
<td>0.0006</td>
<td></td>
</tr>
</tbody>
</table>
CPLO PF CALCULATED BY AILIMPO: OFFICIAL VALIDATION

- SPANISH GOVERNMENT: MINISTRY OF HEALTH
  
  https://www.aesan.gob.es/AECOSAN/docs/documentos/seguridad_alimentaria/gestion_riesgos/aceite_limon.pdf

- EUROPEAN COMMISION
  
It clarifies 2 points that are of particular importance to the entire value chain:

- If the raw material complies with the corresponding MRLs, then all processed intermediate products derived from it and subsequently incorporated into a final product/foodstuff are equally to be considered compliant.

- Processing factors are applicable to all plant protection products (both approved and non-approved as per the EU Pesticides Database).
FUTURE CHALLENGES (1)>> **Global Harmonization**
Harmonization is a must: Official level and/or Industry agreement

FUTURE CHALLENGES (2)>> **defining appropriate transitional periods**
A more practical and realistic transition period following the delayed applicability for processed and longer shelf-life commodities is called for

FUTURE CHALLENGES (3)>> **Laboratory analysis Level of uncertainty (± 50%)**
CONCLUSIONS & HIGHLIGHTS

- Spain as a KEY LEMON PLAYER worldwide.
- Pesticides in CPLO is a sensitive topic >> Harmonization needed
- SPAIN decided to be PROACTIVE rather than REACTIVE
- FRESH Market is the driver of Lemon production in Spain
- Use of Pesticides is essential to keep the business model... AND ....
CONCLUSIONS & HIGHLIGHTS

- EUROPE’s OFFICIAL NEW STRATEGIES promote a reduction of use of pesticides
- The SPANISH industry is committed with this goal
- A robust Study calculates PF for 11 active substances
- For other substances PF can be fixed according to Log Pow
- Finally, remember that impact on the final product is very limited as quantity of CP Lemon Oil added in final product for consumers is quite small... *REAL DIMENSION OF THE ISSUE...*