Fruit and vegetable processing by-/co-products: Can they be used as functional feed ingredients in animal nutrition to produce novel value-added products?

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3rd International ISEKI Food Conference
ISEKI_Food 2014
Athens, May 21 – 23, 2014
Background

- **Food industry co-products and waste** is estimated at approximately 36 million tonnes per year in the EU countries in 2010; following an increasing trend

  Re-utilisation is a top priority
  Environmental, social and economic impact

- **Modern consumers are interested in**
  “clean”, “natural” and “eco/green” label food products

- **Fruit and vegetable industry co-products** promising sources
  Functional compounds
  Favourable technological or nutritional properties
<table>
<thead>
<tr>
<th>Production process</th>
<th>% of wastes and by-products</th>
</tr>
</thead>
<tbody>
<tr>
<td>White wine production</td>
<td>20-30</td>
</tr>
<tr>
<td>Red wine production</td>
<td>20-30</td>
</tr>
<tr>
<td>Fruit and vegetables juice production</td>
<td>30-50</td>
</tr>
<tr>
<td>Fruit and vegetables processing and preservation</td>
<td>5-30</td>
</tr>
<tr>
<td>Vegetable oil production</td>
<td>40-70</td>
</tr>
<tr>
<td>Corn starch production</td>
<td>41-43</td>
</tr>
<tr>
<td>Potato starch production</td>
<td>80</td>
</tr>
<tr>
<td>Wheat starch production</td>
<td>50</td>
</tr>
<tr>
<td>Sugar production from sugar beet</td>
<td>85</td>
</tr>
</tbody>
</table>

Food wastes and by-products distribution (Tn/yr)

Natural and clean label trend
Green and eco label trend
Current practices
Feed additives market potential

The global market value of feed additives

• $16.1 billion in 2010
• $27.6 billion in 2017

Estimated compound annual growth rate of 8.1% from 2010 to 2017 due to the expansion of meat and livestock production/consumption in the developing countries

(BCC Research Market Forecasting, 2012)
World market carotenoids (millions dollars)

(BCC Research Market Forecasting, 2012)
Objective

To present the recent developments in the field of utilisation of food industry co-products in livestock nutrition

- for improved product quality
- to consider the current limitations and
- to set the targets for future research work
Modes of action of feed additives in growing animals

(Wenk, 2011; www.engormix.com)
Food - feed - food system

Primary production

Food production

Residues 
(co-/by- products)

Main feed 
ingredients
(DDGS)

Functional feed 
ingredients
(Grape pomace)

Main and functional feed 
ingredients
(Citrus and olive pomace)

Livestock nutrition

Farm animal products

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# Examples

<table>
<thead>
<tr>
<th>Co-/by product</th>
<th>Animal</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choceberry pomace</td>
<td>Broilers</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Grape pomace</td>
<td>Broilers</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Dried tomato pomace</td>
<td>Broilers</td>
<td>Hypocholesterolemic</td>
</tr>
<tr>
<td>Hesperidin (citrus pulp)</td>
<td>Broilers</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>Broilers</td>
<td>Growth promotion, Antioxidant</td>
</tr>
<tr>
<td>Tomato pomace</td>
<td>Quails</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Tomato pomace</td>
<td>Layers</td>
<td>Egg yolk pigmentation</td>
</tr>
</tbody>
</table>
## Examples

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<tr>
<td>Grape pomace</td>
<td>Ewes &amp; Goats</td>
<td>Fatty acid composition (CLA content)</td>
</tr>
<tr>
<td>Olive pomace</td>
<td>Lambs</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Olive pomace</td>
<td>Rabbits</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Olive pomace</td>
<td>Pigs</td>
<td>Antioxidant Fatty acid composition</td>
</tr>
<tr>
<td>Grape extract</td>
<td>Pigs</td>
<td>Sensory (tenderness)</td>
</tr>
<tr>
<td>Cranberry pulp</td>
<td>Pigs</td>
<td>Antimicrobial</td>
</tr>
</tbody>
</table>
Considerations/ Limitations

• Available information regarding their application in animal nutrition derives only from experimental small scale trials.

• Seasonal and locally produced products affecting extensive application

• Variable chemical composition

• Complicated feed legislation

• Image of these products to the consumers in relation to recent food scandals
Factors affecting the commercial application of by-/co-products ingredients in animal nutrition

- **Animal**
  Presence of antinutritional factors influencing species, age, growth stage and quantity of the material used

- **Logistics**
  Efficient product quantity to support a supply chain and to be incorporated in various types of feed formulations (matrices)

- **Commercial**
  The value of the product should be attractive to the producer, all active members in the supply chain and the livestock producer who will be the end user of the product
Conclusions

• Fruit and vegetable co-products can be effectively used in farm animal nutrition for the production of animal food products with improved quality characteristics.

• Production of “natural” and “green” animal products is a promising area for the food industry. Embracement of the trend is still very slow.

• Modern biorefinery processes can satisfy the majority of constraints and lead to effective and sustainable utilisation of fruit and vegetable industry by-/- co- products in animal nutrition.
Needs for research

• Examination of other functions (antimicrobial, antiviral) of food industry co-products.

• Standarise composition of products irrespectively of botanical origin, storage conditions, processing to promote/ensure extensive application in farm animal nutrition.
The road ahead

Industry

Academia

Consumers

Government

Multidisciplinary research

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