Spent coffee ground as second-generation feedstuff for dairy cattle

dsanmartin@azti.es
Spent coffee ground as second-generation feedstuff for dairy cattle

Introduction Objective Material & methods Results & discussion Conclusions
COFFEE SECTOR

Coffee consumption figures

• Coffee World production → **9.5 million tons**

• EU countries were the most important worldwide consumers → **2.52 million tons**

• Spain involves the 8 % of EU coffee consumption → **0.21 million tons**

Processing and consuming coffee leads to **substantial amounts of wastes**

- From 1 kg of coffee is generated around 2 kg of **Spent Coffee Ground**
Spent coffee ground as second-generation feedstuff for dairy cattle

Introduction

Managing of wet SCG in the European landfills → high carbon footprint

→ 650 million kg CO₂ eq./year (0.26 CO₂ eq./kg)

An alternative solution for large wet SCG volumes currently sent to landfills.
Spent coffee ground as second-generation feedstuff for dairy cattle

Introduction

Livestock is projected to increase up to by 70% by 2050

Many of the ingredients in the diets of EU livestock are sourced from imported raw materials: soybeans, etc.

A risk to social, economic and environmental progress in Europe due to the increasing scarcity of global resources

Inclusion of biowaste in animal feed → benefits for animal feed sector

1. Availability of environmentally friendly ingredient sources
2. Decrease of dependence on foreign sources

Livestock sector

Objective Material & methods Results & discussion Conclusions
Spent coffee ground as second-generation feedstuff for dairy cattle

Introduction  **Objective** Material & methods Results & discussion Conclusions

To **develop, test and demonstrate** an **innovative, viable and sustainable** solution which increases **significantly the coffee by-products recovery at EU level** through their **up-grading as animal feed ingredients**, satisfying the increasing demand of alternative raw materials for animal feed.
Spent coffee ground as second-generation feedstuff for dairy cattle

STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

1) A multi-product logistic collection system for wet SCG from HORECA

→ Used oil; Coffee capsules & wet-SCG
Spent coffee ground as second-generation feedstuff for dairy cattle

STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

2) A decapsulation of coffee capsules
Spent coffee ground as second-generation feedstuff for dairy cattle

Objective

Material & methods

Introduction

3) A flash drying process for wet SCG stabilization
Spent coffee ground as second-generation feedstuff for dairy cattle

STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

4) A feed efficiency analysis of SCG ingredients in dairy cattle

Introduction Objective Material & methods Results & discussion Conclusions

5% of SCG inclusion
Introduction

Objective

Material & methods

Results & discussion

Conclusions

Spent coffee ground as second-generation feedstuff for dairy cattle

Geographic area for the case study

North of Spain

- 3rd coffee consumer in EU → 210 thousand tons
- 7th in dairy cattle activity → 7.1 million tons of milk

Proposed solution replicable to any EU region, since the coffee consumption and dairy cattle are widely distributed across EU.
Spent coffee ground as second-generation feedstuff for dairy cattle

DEMONSTRATION TRIAL

- At semi-industrial scale
  - Collecting and processing about 3 tons of wet SCG
  - Producing 1.5 tons of SCG ingredient & 30 tons of experimental diet
  - Testing them in 150 heads of dairy cattle for about half a month

- This scale has allowed us to reach a Transfer readiness level (TRL) of 7

To evaluate the technical and economic viability of industrial-scale implementation

To reduce considerably the techno-economic and environmental risks

To facilitate the replicability of the proposed solution across EU
Spent coffee ground as second-generation feedstuff for dairy cattle

1) LOGISTICS

3 tons of wet SCG; 100 kg of CC & 3 tons of used oil were simultaneously collected from HORECA in different containers
→ 10 generation points
→ 1 week

Technical feasibility of multi-product collection system for centralizing wet SCG produced by HORECA sector in a processing plant was demonstrated
2) DECAPSULATION

100 kg of CC were decapsulated

1) Coffee capsules were **crushed to extract wet SCG**

2) Crushed material was placed in a **vibrating screen sieve (3 mm)** to recover the organic part and leaving above plastic and aluminium

3) Plastic and aluminium were separated according to the **Eddy current** where metal elements were attracted by a magnetic system

3g inorganic material / capsule

9g organic material / capsule

(Plastic: 23.44%; Aluminium: 1.38%; SCG 75.18%)
3) DRYING

3 tons of wet SCG was dried with Flash drying to produce 1.5 tons of SCG ingredient.

This technology is more energy efficient than traditional technologies.

- Product is broken in the drying chamber and the surface area of particles increases significantly.
- Instantaneous drying → required energy decreases considerably.

It is appropriate for temperature-sensitive products to maintain nutritional value and safely (food security).
Spent coffee ground as second-generation feedstuff for dairy cattle

4) FEED PRODUCTION

30 tons of dairy cattle feed was produced

→ 5% of SCG ingredient

<table>
<thead>
<tr>
<th>Raw materials</th>
<th>% Inclusion</th>
<th>Protein</th>
<th>Forage Units-milks (UFI)</th>
<th>Starch</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>14.92</td>
<td>11.6</td>
<td>1.09</td>
<td>60.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Durum wheat</td>
<td>4.48</td>
<td>16.5</td>
<td>1.17</td>
<td>63.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Corn</td>
<td>37.90</td>
<td>9.4</td>
<td>1.22</td>
<td>74.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Rapeseed cake</td>
<td>13.35</td>
<td>38</td>
<td>0.96</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>Soy cake</td>
<td>18.43</td>
<td>47</td>
<td>1.20</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>0</strong></td>
<td><strong>100</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

Composition of experimental diet for dairy cattle with 5% of spent coffee grounds
5) FEED EFFICIENCY

Experimental diets were tested in 150 heads of dairy cattle for about half a month.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>5 % of inclusion</th>
<th>EEM¹</th>
<th>p-valor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production (L/day)</strong></td>
<td>31.4</td>
<td>31.8</td>
<td>0.61</td>
<td>0.0715</td>
</tr>
<tr>
<td><strong>Crude protein (g/kg)</strong></td>
<td>33.5ᵃ</td>
<td>32.9ᵇ</td>
<td>0.37</td>
<td>0.0018</td>
</tr>
<tr>
<td><strong>Crude fat (g/kg)</strong></td>
<td>39.3</td>
<td>40.0</td>
<td>0.93</td>
<td>0.1345</td>
</tr>
</tbody>
</table>

Average daily production and milk quality in dairy cattle with 5 % of spent coffee grounds

No animals’ behaviour alteration

Slight *increase or maintenance of milk production*

Slight *increase or maintenance of fat content in milk*
Spent coffee ground as second-generation feedstuff for dairy cattle

Introduction

Objective

Material & methods

Results & discussion

Conclusions

• SCG ingredient stands as a potential alternative for replacing current ingredients (such as soy meal) in dairy cattle:
  ✓ Availability in Europe → 2.52 millions tons of wet SCG
  ✓ Nutritional characteristics
  ✓ Results obtained in the feed efficiency trials with animals

• This will contribute to increase the sustainability and competitiveness of coffee producing and consuming sector
  ✓ By reducing wet SCG quantities landfilled
  ✓ Through their up-grading as animal feed ingredients

• This will contribute to increase the sustainability and competitiveness of feed sector
  ✓ By reducing the dependence on current raw materials market
  ✓ By satisfying the highly increasing demand of new raw materials for animal feed
Spent coffee ground as second-generation feedstuff for dairy cattle

Thank you!

Any question?