



Spent coffee ground as second-generation feedstuff for dairy cattle

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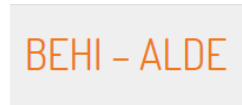




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COFFEE SECTOR



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 Ground



coffee is



around 2



spent Coffee

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COFFEE SECTOR

Managing of wet SCG in the European landfills → hi_ footprint



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

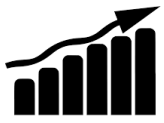
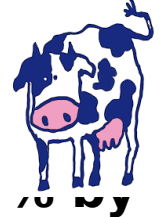


An **alternative solution** for large wet SCG volumes currently sent



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LIVESTOCK SECTOR



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



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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

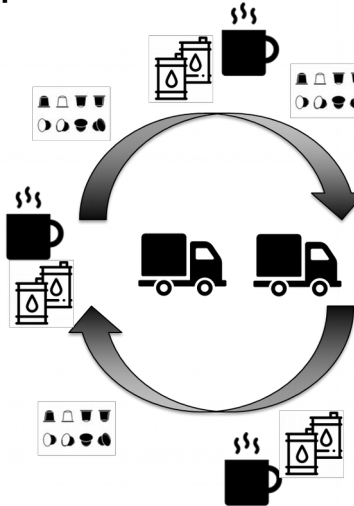


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STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

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

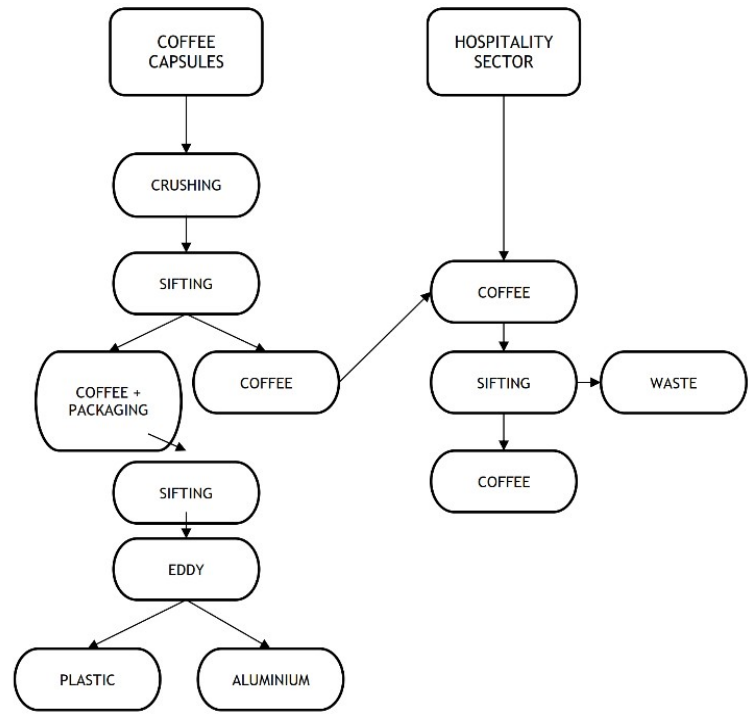
→ Used oil; Coffee capsules & wet-SCG



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STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

2)A decapsulation of coffee capsules



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STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

3) A flash drying process for wet SCG stabilization



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STAGES IN WHICH RECOVERY PROCESS IS DIVIDED

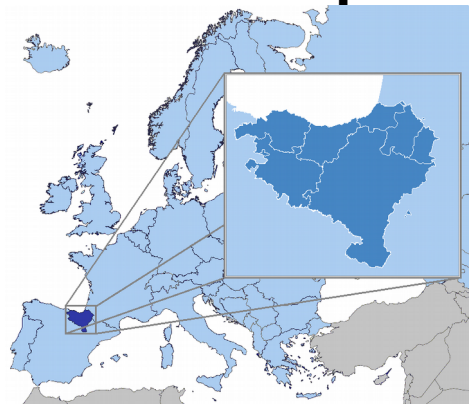
4) A feed efficiency analysis of SCG ingredients in dairy cattle



5 % of SCG inclusion

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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


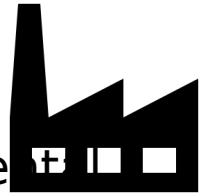



Proposed solution **replicable to any EU region**, since the coffee consumption and dairy cattle are widely distributed

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DEMONSTRATION TRIAL

- At semi-industrial scale**

- Collecting and processing about 3 tons of waste 
- 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

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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



Wet SCG & CC



Used oil



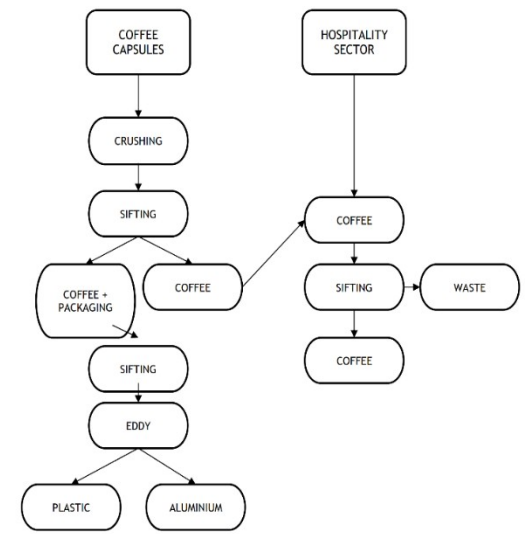
Technical feasibility of multi-product collection system for centralizing wet SCG produced by HORECA sector in a processing plant was demonstrated

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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%)

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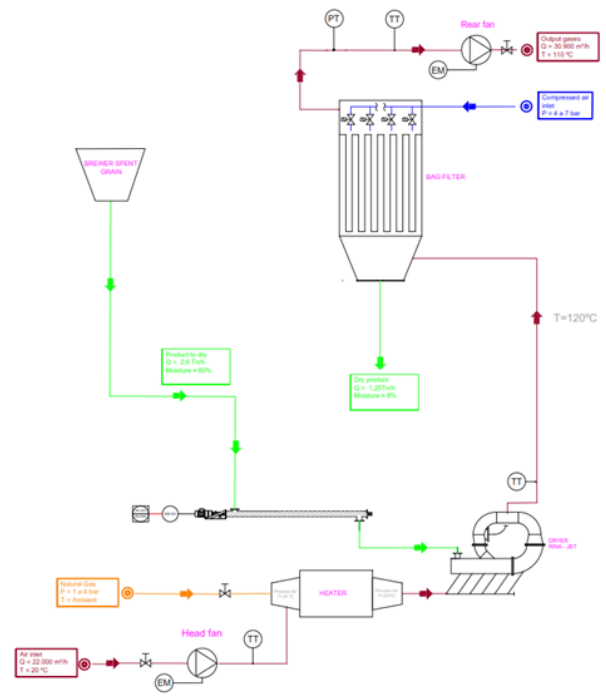
3) DRYING

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



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4) FEED PRODUCTION

30 tons of dairy cattle feed was produced



→ 5 % of SCG ingredient

Raw materials	% Inclusion	Protein	Forage Units-milks (UFI)	Starch	Fat
Barley	14.92	11.6	1.09	60.2	2.1
Durum wheat	4.48	16.5	1.17	63.3	2.1
Corn	37.90	9.4	1.22	74.2	4.3
Rapeseed cake	13.35	38	0.96	0	2.6
Soy cake	18.43	47	1.20	0	1.9
Oil	1.54	0	2.73	0	100
SCG	5.00	13.4	0.16	0	13.55
Vit-min	4.38	0	0.00	0	0

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

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5) FEED EFFICIENCY

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

	Control	5 % of inclusion	EEM ¹	p-valor
Production (L/day)	31.4	31.8	0.61	0.0715
Crude protein (g/kg)	33.5 ^a	32.9 ^b	0.37	0.0018
Crude fat (g/kg)	39.3	40.0	0.93	0.1345

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**

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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

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