Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
agritech National Research Center for Technology in Agriculture

VALORIZATION OF BY-PRODUCTS THROUGH THE DEVELOPMENT OF ACTIVE FILMS

Borriello A (University of Naples Federico II), *Marotta A* (University of Naples Federico II), *Romano R* (University of Naples Federico II), *Cavella S* (University of Naples Federico II), *Leto L* (University of Parma), *Di Fazio A* (University of Parma), *Cirlini M* (University of Parma), *Chiancone B* (University of Parma), *Torrieri E* (University of Naples Federico II), *Ambrogi V* (University of Naples Federico II)

Department of Agricultural Sciences, University of Naples Federico II, Piazza Carlo di Borbone, 80055, Portici, Italy
Department of Chemical, Materials, and Industrial Production Engineering, University of Naples Federico II, P.le Tecchio, 80125, Naples, Italy
Department of Food and Drug, University of Parma, Viale Parco Area delle Scienze 27/A, 43124 Parma, Italy

E-mail:
elena.torrieri@unina.it
ambrogi@unina.it
benedetta.chiancone@unipr.it

SPOKE, WP & TASK

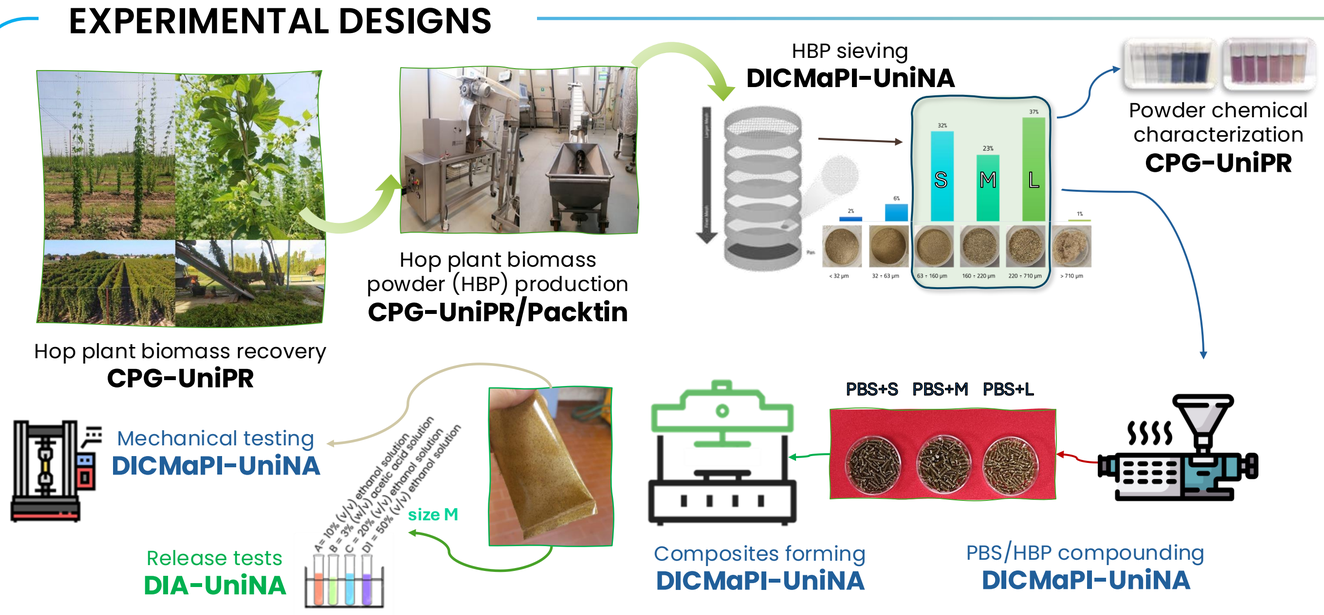
Spoke 8, WP 8.1 Task 8.1.3
Valorization of the waste to obtain biomaterials
Elena Torrieri, Angela Borriello - Department of Agricultural Sciences, University of Naples Federico II (DIA-UniNA)
Veronica Ambrogi, Angela Marotta - Department of Chemical, Materials, and Industrial Production Engineering, University of Naples Federico II (DICMaPi-UniNA)

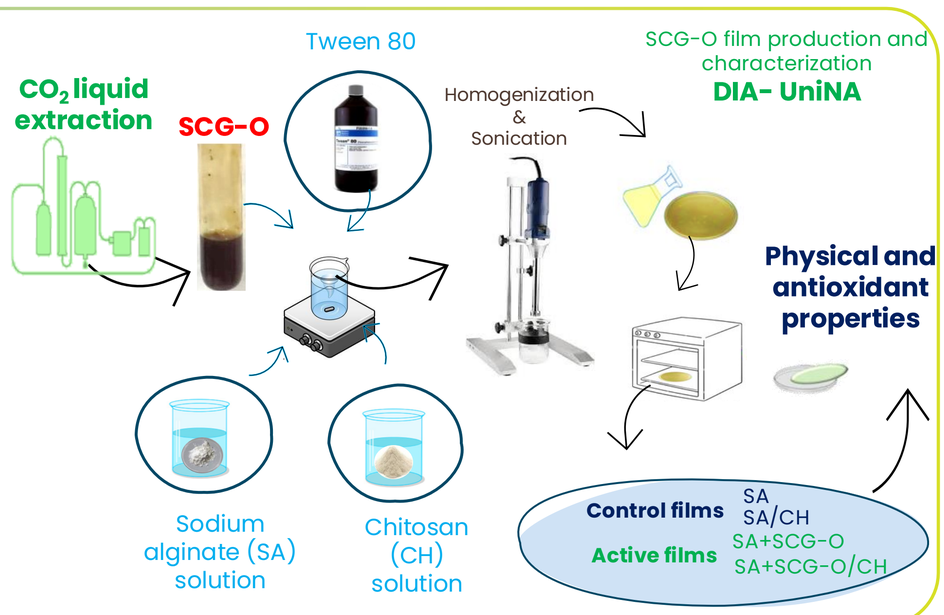
Spoke 8, WP 8.3 Task 8.3.2
Valorization and biological regeneration of wastes as resources - organic fertilizers - or amendments to improve carbon storage and soil quality
Benedetta Chiancone, Martina Cirlini, Leandra Leto, Andrea Di Fazio - Department of Food and Drug, University of Parma (CPG-UniPR)

BACKGROUND & AIM

Agri-food by-products have gained significant attention as a promise resource for the production of biodegradable packaging. Spent coffee ground (SCG) is an abundant residue from coffee beverage preparation and the oily extract derived from SCG (SCG-O) is an excellent source of antioxidant compounds (ACs) (Romano et al., 2023). Hop by-product powder (HBP), which is rich in fiber and ACs, is obtained by low temperature drying and then grinding the plant biomass remaining after cone harvesting. The work objective was to develop two active films based on biopolymers and agri-food by-products. SCG-O was used to develop antioxidant alginate/chitosan film, while HBP was used to create a biodegradable active poly (butylene succinate) (PBS) film.

EXPERIMENTAL DESIGNS





RESULTS

Hop powder characterization

Tab. 1. Influence of particle size and thermal treatment on Total (Poly)Phenol Content (TPC) and Antioxidant Activity (AO) of the hop flour

Particle size	Thermal treatment	TPC (mg GAE/g)	DPPH (mg TEAC/g)
S	Non-Thermal treated	104±7	13.0±1.0
	80°C	106±7	14.4±0.5
M	Non-Thermal treated	75±4	10.7±0.9
	80°C	82±6	11.4±0.6
L	Non-Thermal treated	54±4	7.4±0.4
	80°C	57±4	8.1±0.4
Statistical analysis		p	p
Particle size (PS)		0.000	0.000
Thermal treatment (TT)		0.093	0.010
PSxTT		0.752	0.769

Two-way ANOVA, Tukey's test p<0.05

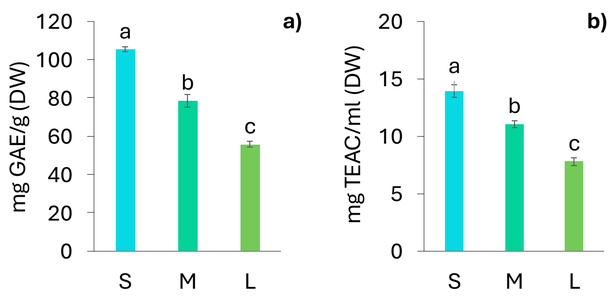


Fig. 1. TPC (**a**) and DPPH (**b**) of hop powder.

Hop based composites and film characterization

PBS/HBP composites mechanical properties were tested. The elastic modulus is preserved by the filler addition while a general embrittlement of the materials is observed.

Fig. 2. Elastic modulus (E), maximum strain (ε_{max}) and maximum stress (σ_{max}) of PBS/HBP composites

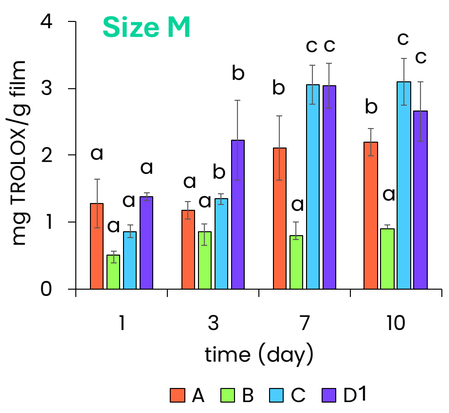


Fig. 3. ABTS assay of ACs release from PBS/HBP (M) film into a food simulants A, B, C and D1 after 1, 3, 7 and 10 days.

HBP-based film exhibited an antioxidant capacity of 2.83 mg Trolox/g film and demonstrated a good release rate into the food simulants. The greatest differences between samples were observed in C and D1 simulants, suggesting that these films could be more effective when applied as packaging of fat-based foodstuffs.

SCG-O film characterization

Tab. 2. Film characterization

	SA	SA/CH	SA+SCG	SA+SCG-O/CH
Water Solubility pH 4 (%)	100^{a}	44±5^{c}	100^{a}	70±8^{b}
Water Solubility pH 6 (%)	100^{a}	62±11^{c}	100^{a}	83±11^{b}
Moisture content (%)	13.6±0.9^{a}	14±2^{a}	12.3±0.3^{a}	13.3±0.7^{a}
WVP x 10^{-10} (g/m /sec /Pa)	1.23±0.1^{c}	1.4±0.1^{c}	2.47±0.02^{b}	2.9±0.2^{a}
Surface density (mg/cm^2)	3.4	3.4	4.4	4.4
Thickness (mm)	0.025±0.002^{b}	0.031±0.001^{b}	0.042±0.002^{a}	0.050±0.004^{a}
Opacity (T%)	5±1^{c}	7.7±0.8^{bc}	33±11^{a}	14±3^{b}

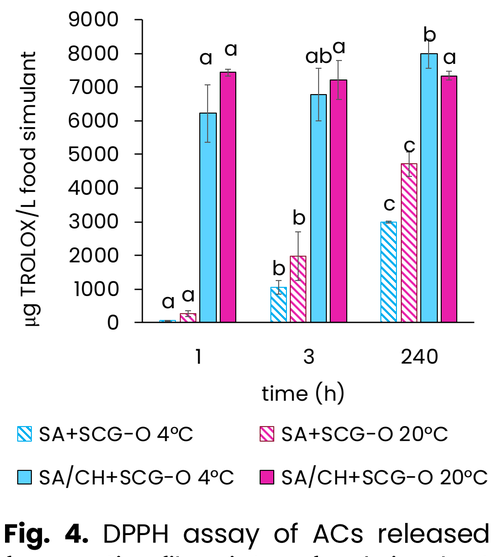


Fig. 4. DPPH assay of ACs released from active films into a food simulant (50% Ethanol) at 4°C and 20°C after 1, 3 and 240 h.

SA films were completely soluble in water, while SA/CH films were partially soluble in water (60%). The active films showed higher WVP values and higher thickness than the control films. Opacity drastically increased after SCG-O inclusion. SA+SCG-O showed a lower antioxidant activity, and a lower release rate of ACs compared to SA+SCG-O/CH, at both temperatures.

REFERENCES

Romano, R., De Luca, L., Basile, G., Nitride, C., Pizzolongo, F., & Masi, P. (2023). The Use of Carbon Dioxide as a Green Approach to Recover Bioactive Compounds from Spent Coffee Grounds. Foods, 12(10), 1–12.

This study was carried out within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.