

Supplementary table S1. Criterion for Quality Appraisal Criteria Used for Included Studies (JBI Method)

Criterion [C]	What counts as YES (practical rule)	Common reasons for NO/Unclear
1. Sample Characterisation	By-product type + sample origin described; key processing variables (e.g., roasting/fermentation/drying) stated or clearly referenced.	Sample identity vague; processing conditions missing; unclear matrices.
2. Analytical Rigour	Validated method or sufficient analytical detail (instrument/method; QC/replicates; calibration or reference method); units defined.	Method not described; no QC/validation; unclear units.
3. Methodological Transparency	Study design, extraction/processing steps, and analysis workflow reported clearly enough to replicate.	Key steps missing; ambiguous design; missing n.
4. Bioactivity Assessment Validity	Appropriate controls and doses; assay choice matches claim; claims limited to evidence level (in vitro vs in vivo).	Single assay overinterpreted; no controls; unrealistic doses.
5. Safety Assessment Completeness	Hazards/toxicology assessed with appropriate endpoints for the claim OR explicitly framed as exploratory with limitations.	Only partial endpoints; no regulatory context; unclear methods.
6. Application-Based Evaluation Quality	Formulation/application described with performance testing (sensory/texture/stability/shelf-life) when relevant.	Only conceptual application; no evaluation; unclear formulation.
7. Sustainability & Circular-Economy Reporting	Functional unit + system boundary stated; key inventory assumptions (energy/water/transport) reported if LCA/LCC claimed.	Sustainability asserted without data; boundary/unit missing; incomplete inventory.
8. Overall Study Coherence & Bias Risk	Conclusions align with data; limitations acknowledged; conflicts and key biases addressed.	Overclaiming; selective reporting; missing limitations/confounders.

Supplementary Table S2. Details of JBI Result Quality Appraisal Criteria Used for Included Studies

Ref ID	Study Reference (First Author, Year)	C1	C2	C3	C4	C5	C6	C7	C8
2	Iriondo-DeHond et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Serna-Jiménez et al. (2022)	Yes	Yes	Yes	Yes	Unclear	Yes	Unclear	Yes
4	Durán-Aranguren et al. (2021)	Yes	Yes	Yes	Yes	No	Yes	Unclear	Yes
6	Klingel et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	Machado et al. (2023)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
8	Bobková et al. (2022)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

