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The tomato skin by-product : a source of innovation for the market

[Article]

SUM-UP: Two examples of tomato skin valorization : on the cosmetic market and on biopolymers

Tomatoes (*Solanum lycopersicum L*), one of the world's most beloved fruit, have a rich history as a culinary staple. According to FAO data, $186\ 821.10^6$ kg of tomatoes were produced worldwide in 2020, covering an area of 5 051 983 hectares. The volume of tomatoes produced increased by 3.35% compared to 2020. China was the world's largest tomato producer, representing 34 % of total world tomato production. India was the 2nd most producing country of tomatoes, followed by Turkey, USA and Egypt.

The processing of tomato fruit into puree, juices, sauces, etc, produce numerous by-products in the form of tomato pomace, which includes peel and seeds. These by-products are rich in water and difficult to transport and must be consumed quickly after their production. Furthermore, in addition to the technical difficulty of their exploitation, the economic reality of valuing such a by-product is also an issue.

Tomato skin is an interesting source rich of lycopene and other carotenoids like β-carotene and vitamin C. Bioactive compounds of tomato skin are described in the literature [1] [2] [3] [4] :

Chlorogenic der (33–141.10 mg/kg),
p-Coumaric (07.38–26.58 mg/kg), p-Coumaric der (16.70–101.99 mg/kg),
Quercetin (5.04–13.68 mg/kg),Rutin (107.06–410.13 mg/kg), Rutin der (36–109.75 mg/kg),Naringenin (73.52–287.62 mg/kg),
Lycopene (167.43 mg/kg dw), β-carotène (55.20 µg/g dw), lutein (065–1.54 mg/100 g),
tocopherols (1.62 g/100 g dw),
Caffeic acid-glucoside isomer (0.74 mg/100 g), Caffeic acid (0.55 mg/100 g)
Syringic acid (0.547–1.122 mg/100 g), Di-Caffeoylquinic acid (0.812–1.113 mg/100 g), Tri-Caffeoylquinic acid (0.591−0.662 mg/100 g).

[1] E. Gharbi, et al. (2016)- Salicylic acid differently impacts ethylene and polyamine synthesis in the glycophyte Solanum lycopersicum and the wild-related halophyte Solanum chilense exposed to mild salt stress
[2] Navarro-Gonzàlez et al. (2011)- Chemical profile, functional and antioxidant properties of tomato peel fiber
[3] Szabo et al. (2021)- Evaluation of the bioactive compounds found in tomato seed oil and tomato peels influenced by industrial heat treatments
[4] Kumar et al. (2021) - Tomato (Solanum lycopersicum L.) seed: A review on bioactives and biomedical activities
Author links open overlay panel

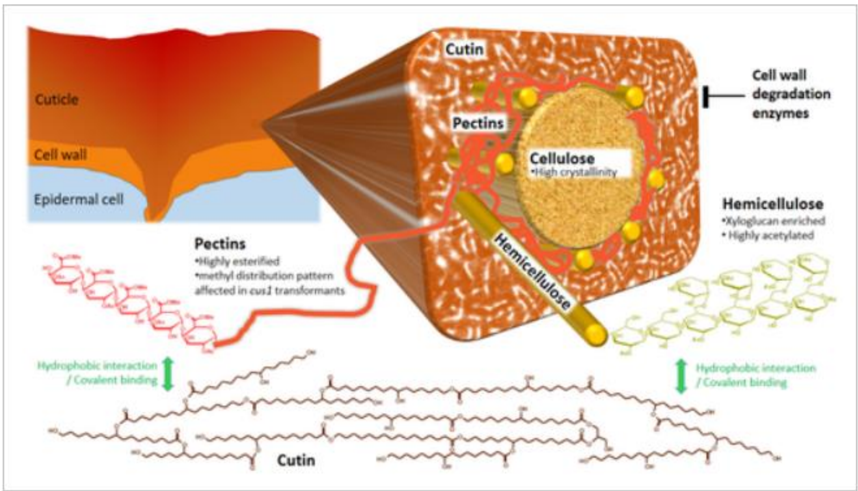
These compounds have properties which are looked for in cosmetics, nutraceutical or functional ingredients. For example, lycopene is a well-known compound for its antioxidant activity in nutraceuticals.

A cosmetic market application of tomato skin

On the market, a French company called “Phenix en Provence” has developed a range of high quality French origin ingredients from tomato by-products for skin, hair, and body care and with beneficial effects clinically proven. For example, this company offers a liposoluble cosmetic active ingredient, which is a unique wax from tomato skin. This innovative ingredient has soothing and an anti-redness clinically-proven effects on sensitive skin[5]. Phenix en Provence’s innovation lies in its unique model designed to be globally compliant: itintegrates cosmetics and food product that link the valorization of local farmers, a low carbon footprint, the local sourcing and green extraction processes (such as supercritical CO_2 extraction) as well as research, development, and distribution of the ingredient

The skin cutin of tomatoes for new polymers

Also, tomato skin contains cutin. The cutin polyester is the structural component of cuticle with cell wall polysaccharides. The cuticle is ubiquitous biological polymer composite covering aerial plant organs .



SCHEME OF STRUCTURAL FEATURES OF CUTIN-EMBEDDED POLYSACCHARIDES (CEPS) (SHEME FROM PHILIPPE ET AL. 2019[6])

Reseachers from INRAE (the national research institute for agriculture, food and environment in France) have studied the nature of the cutin-embedded polysaccharides and their association with cutin polyester. They discovered the complex architecture of the plant cuticle, cutin-embedded polysaccharides. This highlights a specific structural features that involves cellulose, hemicellulose and pectins. This discovery bring new insight into the structure–function relationship of the plant cuticles and for construction of new bio-inspired materials. This research team can deconstruct

[5] https://www.phenixenprovence.com/home-desk/

[6] Philippe et al. (2019) -Assembly of tomato fruit cuticles: a cross-talk between the cutin polyester and cell wall polysaccharides

polymers to isolate monomers and also reassemble these molecules to build a modified polymer like a rubber. [7]

This work opens the way to create new polymers from tomato skin but also from other vegetables such as apples, for intance.

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DATE OF PUBLICATION: (ex.14th September2023)
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[7] https://www.tomatonews.com/fr/innovation-un-caoutchouc-a-base-de-tomate-inrae_2_1802.html