An innovative green extraction process for the development of native plant extracts

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Today, life cycle assessment, environmental impact and sustainability drive innovation in the field of plant extraction. Some extraction process came back to the cutting edge like microwaves- or ultrasound-assisted extraction, SFE, and we are witnessing the rise of new renewable solvents. Examining the extraction process, it occurs that the steps of greatest impact are:

- plant cultivation
- plant preparation: drying, grinding
- use of organic solvents (production, evaporation, waste-management)

The new technologies cited above aim to reduce solvent consumption, targeting the last of these steps. But what about the first two steps?

Using fresh plants is the best way to counteract the environmental impact linked to drying and grinding. Usually, plant juice is obtained by pressing the freshly harvested plant. Another way is to perform a solvent extraction directly with fresh plant.

However, during the pressing process, the plant cell walls can restrain the access and recovery of some interesting compounds. Furthermore, it releases enzymes which could potentially modify and alter these compounds: hydrolases, oxidases, deglucosidases, etc.

Unless a cryo-extraction process followed by solvent extraction is employed, product alteration and compound recovery remain limiting factors to the handling of fresh plants.

We found out that the adaptation of a twin-screw extrusion technology, mainly used in food industries for plant juice expression, allows us to obtain an enriched extract, containing unadulterated compounds. Indeed, the combination of high pressure induced by the twin-screw rotation and rapid thermal treatment leads to complete destructuring of plant cell walls and an inhibition of enzyme activity, giving a juice with a higher yield and a higher active content.

For example, in purple coneflower juice, the level of caffeic acids (caftaric and cichoric acids) obtained by this technology is 0.79 mg/g of plant wet weight, whereas it is 0 mg/g by simple juice expression (due to digestion by polyphenoloxidases [2]) and 0.12 mg/g of plant wet weight by water extraction at 100°C. Numerous plants are traditionally used in their fresh form in order to preserve the compounds within and avoid the risk of denaturing occurring during the drying process[1].

Continuing with our example, purple coneflower herb (*Echinacea purpurea* (L.) Moench.) expressed juice has a well-established use for the short-term prevention and treatment of common cold (EMEA/HMPC/104945/2006).

A comparative life-cycle analysis has been undertaken between this new extrusion process and a conventional aqueous extraction, showing important savings on carbon footprint, ozone formation, water resources, etc. Other examples will be given, demonstrating the interest of this green, natural technology using a thermomechanical process without solvents to obtain innovative plant extracts.

Keywords: Green extract, life cycle analysis, Plant juices, Purple coneflower, traditional medicine

References:

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