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PGX – Technology: A versatile technology for generating advanced biopolymer materials

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Title: PGX – Technology : a versatile technology for generating advanced biopolymer materials.

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Abstract:

A novel technology is presented utilizing Pressurized Gas eXpanded (PGX) liquids for processing aqueous solutions or dispersions of high molecular weight biopolymers, such as starch, polysaccharides, gums, pectins or cellulose nanocrystals into open-porous morphologies, consisting of nano-scale particles and pores. The highly tune-able PGX process can generate exfoliated nano-composites and highly porous morphologies ranging from sub-micron particles (50nm) to micron-sized granules (2mm), as well as micro- and nanofibrils, granules, fine powders and aerogels with porosities of >99% and specific surface areas exceeding 300 m²/gram. The technology is based on a spray drying method, operating at mild temperatures (40°C) and moderate pressures (100-200 bar) utilizing PGX liquids, which is comprised of a mixture of food grade, recyclable solvents, generally regarded as safe (GRAS), such as pressurized carbon dioxide and anhydrous ethanol. The unique properties of PGX liquids afford single phase conditions and very low or vanishing interfacial tension during the spraying process. This then allows the generation of extremely fine particle morphologies with high porosity and a large specific surface area resulting in favorable solubilisation properties. This platform drying technology has been successfully scaled up from lab scale to pilot scale with a processing capacity of about 200 kg/hr of aqueous solutions.

Furthermore, the PGX Technology can be utilized for the following processing applications:

- **Dry** aqueous solutions or dispersions of polymers derived from agricultural and/or forestry feedstock, such as polysaccharides, gums, biopolymers at mild processing conditions (40°C).
- **Purify** biopolymers by removing lipids, salts, sugars and other contaminants, impurities and odours during the precipitation and drying process.
- **Micronize** the polymer to a matrix consisting of highly porous fibrils or spherical particles having nano-scale features depending on polymer molecular structure.
- **Functionalize** the polymer matrix by generating exfoliated nano-composites of various polymers forming fibers and/or spheres simply by mixing various aqueous polymer solutions/dispersions prior to PGX processing.
- **Impregnate** the polymer matrix homogeneously with thermo-sensitive bioactives and/or hydrophobic modifiers to tune solubility of the final polymer bioactive matrix all in the same processing equipment at mild conditions (40°C).
- **Extract** valuable bioactives at mild conditions from fermentation slurries, while drying the residual biomass.

This novel processing technology facilitates biopolymer processing at a new level for generating unique highly porous biopolymer morphologies that can be impregnated with bioactives/APIs or functionalized with other biopolymers to generate exfoliated nano-composites and novel advanced materials for applications ranging from functional foods, nutraceuticals, drug delivery, cosmetic systems to advanced technical applications.