**Researchers develop eco-friendly packaging material from cucumber peels**

New Delhi, Nov 16 (India Science Wire): Throwing away cucumber peels after preparing your salad could be a past phenomenon. Researchers at the Indian Institute of Technology (IIT) Kharagpur have developed cellulose nanocrystals from cucumber peels with high cellulose content, compared to other peel wastes, which can be used to create food packaging materials.

While single-use plastic is consciously being avoided by consumers, they remain largely in circulation as food packaging items. Natural biopolymers are unable to make a way in this industry as they lack strength, elongation, barrier property, optical property, and in some cases even biological safety. The cellulose nanomaterial developed by Prof. Jayeeta Mitra and research scholar N. Sai Prasanna at IIT Kharagpur's from raw cucumber waste has addressed this challenge.

In India, cucumber finds wide use in salads, pickles, cooked vegetables or consumed raw and also in the beverage industry leading to a large volume of peel biowaste which is rich in cellulose content. "Cucumbers generate about 12% residual wastes obtained after processing either the peels or whole slices as waste. We have used the celluloses, hemicellulose, pectin extracted from this processed material for deriving new bio-materials which are useful as nano-fillers in bio-composites," said Dr. Jayeeta Mitra, Assistant Professor at the Dept. of Agricultural and Food Engineering.

Talking about the findings, she further added, "Our study shows that cellulose nanocrystals derived from cucumber peels possess modifiable properties due to the presence of abundant hydroxyl groups, which resulted in better biodegradability and biocompatibility. These nanocellulose materials emerged as strong, renewable and economic material of the near future, due to unique properties like a high surface area to volume ratio, light in weight, and excellent mechanical properties. Thereby, such nanocrystals, when reinforced as nano-fillers in bio-composites films, can produce effective food packaging materials with low oxygen permeabilities."

The present study revealed that cucumber peels possessed greater cellulose content (18.22%) than other peel waste. It also provided better insights into their crystalline, thermal and colloidal properties of cucumber cellulose. Talking about the uniqueness of the product N. Sai Prasanna said, "The output product has high crystallinity percentage (74.1 %), thermal stability (200 °C negative zeta potential values < -30 mV) as well as acid hydrolysis yield (65.55%) which make the material a strong nano-filler reinforcement as bio-nano composite. This offers the much needed mechanical, barrier, optical, rheological properties, nontoxicity, etc. required for food packaging materials which have the strong market potential to replace plastic."

This non-toxic, biodegradable and biocompatible product has no adverse effects on health and the environment hence could have a huge market potential by rendering management of organic waste with high cellulose content profitable. "Apart from the food packaging and beverage industries the researchers are optimistic about its scope in various fields like thermo-reversible and tenable hydrogels making, paper making, coating additives, food packaging materials, bio-composites, optically transparent films, as stabilizers in the oil-water emulsion. Also, CNCs find good potential applications in

biopharmaceutical applications such as drug delivery and fabricating temporary implants like sutures, stents etc.," added Sai Prasanna.

The researchers further made a note for packaging industry players in our country for substantial investments to improve packaging material properties for better sustainability, disposal and decomposition issues. All these demands for biodegradable packaging will propel the nanocellulose market in the coming timeframe contributing towards a sustainable and plastic-free world, opined Prof. Mitra. "The incremental usage of petroleum-based plastics in food packaging, spanning a few decades, has raised many challenges as these plastics are the indomitable sources of environmental pollution since nearly 60% of it is converted to landfill, and rest is recycled only once. More research and product development focused on various biopolymers from either macromolecules or the microbial polymers would be able to make the sector acceptable to packing material producers with wider awareness, alternative products at economic prices," she said.

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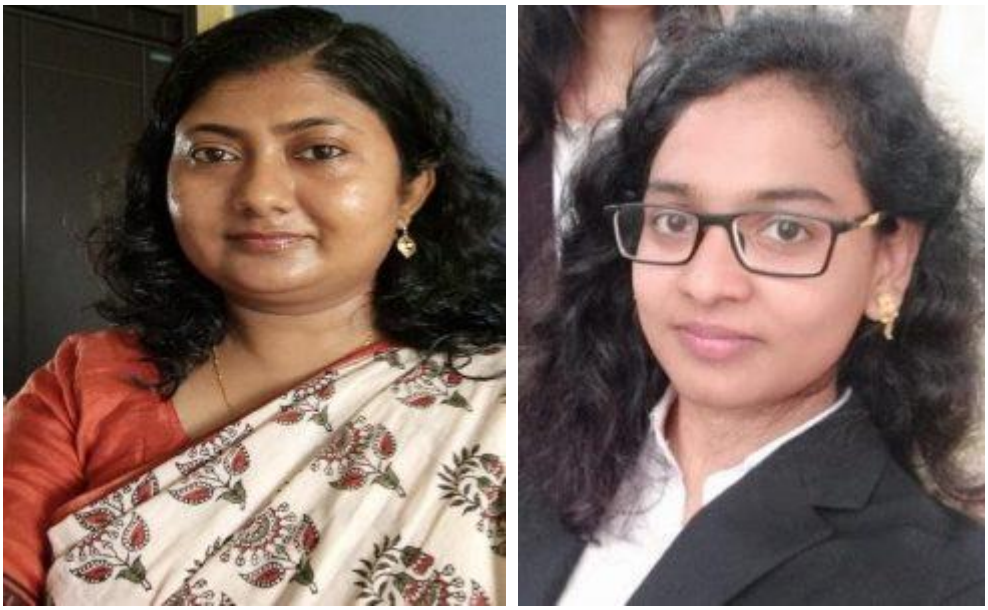

*Jayeeta Mitra (L) and N. Sai Prasanna (R)*

*The product from raw to final form*