
WASTE TO WEALTH: EXTRACTING NUTRACEUTICAL (POLYPHENOLS) FROM TROPICAL FRUITS' RESIDUE BY BIOREFINERY APPROACH

Salient features

- Waste Peels considered for polyphenolic antioxidant extraction were: Pomegranate peels, Apple Peels, Potato peels and Onion Peels.
- Green economical Process developed for the extraction of polyphenolic antioxidants from the above peels. All the Extracts depicted excellent antioxidant and antimicrobial properties.
- Process developed for making Nutraceutical using the extracted polyphenolic antioxidants.
- Process developed for the selective recovery of Ellagic acid from Pomegranate peels using customised molecularly imprinted solid phase extraction. About 3.7 grams of high value ellagic acid can be recovered from one Kg of Pomegranate peels. Cost of ellagic acid is Rs 5400/- per gram. The adsorbent developed for this process can be used for ten cycles with 15% loss in efficiency.
- Process has also been developed for the selective recovery of 4-hydroxy benzoic acid from Potato peels using molecularly imprinted solid phase extraction with 77.4% recovery. The adsorbent developed for this process can be used for 7 cycles with 10-15% loss in efficiency

Advantages

- ✓ The Process developed for generating wealth in form of polyphenolic antioxidants from food processing industries waste (fruit peels) is economical, green and can be further used for making nutraceutical. The residue left after the extraction of polyphenolic antioxidants is a source of dietary fibers, which find application in bakery and Functional food.
- ✓ The net effect at the end of the process is zero waste, thus complying with the principle of Circular Bioeconomy.
- ✓ The pilot plant set up on the above process at Merino Industries Ltd., Hapur, U.P. has successfully demonstrated the extraction of polyphenolic antioxidants from Potato and Pomegranate peels.
- ✓ The pilot plant is versatile and can be used for any fruit. Moreover, customized molecularly imprinted solid phase adsorbents can be developed for the

selective recovery of any high value polyphenols individually from the extract.

Pilot Plant at Merino Industries Ltd, Hapur, West U.P



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More information

Status of commercialization / Patent / Publication

Advance and Pilot scale Research:

- Pilot plant trials for the extraction of polyphenols from Pomegranate & Potato peel were conducted at Merino Industries located at Hapur, UP. The extracts are rich source phenolic antioxidants, which can be used as Nutraceutical, a potent dietary supplement. A process has been developed to make Nutraceutical from these polyphenolic extract.
- A process has been developed for the selective recovery of Ellagic acid from Pomegranate peels using customised molecularly imprinted solid phase extraction (MISPE). About 3.7 grams of high value ellagic acid can be recovered from one Kg of Pomegranate peels. Cost of ellagic acid is Rs 5500/- per gram. A customised green molecularly imprinted polymer was developed as adsorbent for MISPE.
- Similarly, a process has also been developed for the selective recovery of 4-hydroxy benzoic acid from Potato peels using molecularly imprinted solid phase extraction (MISPE) with 77.4% recovery. A computationally designed customised molecularly imprinted composite was developed as adsorbent for MISPE.

1. Patents:

- a. Indian Patent filed on “*process for isolation and recovery of antioxidant substances*”

granted **Patent No. 386817**

b. Indian Patent filed on “*bio refinery process, components thereof and products therefrom*” granted **Patent No. – 397096**

c. Indian Patent filed on “**sustained release nutraceutical from fruit and vegetable waste**” Application Number-202321034017, on 15/5/2023. FER received.

d. Recovery of *Ellagic acid* from *pomegranate peel* using *customized molecularly imprinted solid-phase extraction* (Patent draft under preparation) **to be filed by November 15, 2023.**

2. Publications:

- Das, R. S., Mohakar, V. N., & **Kumar, A. (2023)**. Valorization of **potato peel waste**: Recovery of p-hydroxy benzoic acid (antioxidant) through molecularly imprinted solid-phase extraction. *Environmental Science and Pollution Research*, **30(8)**, 19860-19872.
- Das, R. S., **Kumar, A.**, Wankhade, A. V., & **Mandavgane, S. A. (2022)**. Antioxidant analysis of ultra-fast selectively recovered 4-hydroxy benzoic acid from fruits and vegetable peel waste using graphene oxide based molecularly imprinted composite. *Food Chemistry*, **376**, 131926.
- Gaharwar, S. S., **Kumar, A.**, Mandavgane, S. A., Rahagude, R., Gokhale, S., Yadav, K., & Borua, A. P. (2022). Valorization of Punica granatum (**pomegranate**) **peels**: a case study of circular bioeconomy. *Biomass Conversion and Biorefinery*, **1-18**.
- Das, R. S., Wankhade, A. V, **Kumar, A.**, (2021) Computationally designed ionic liquid based molecularly imprinted@ graphene oxide composite: Characterization and validation *Journal of Molecular Liquids*, **Volume 341**, 116925.
- Das, R. S., **Kumar, A**, Wankhade, A. V, Peshwe DR, (2022). “ZrO₂@ chitosan composite for simultaneous photodegradation of three emerging contaminants and antibacterial application,” *Carbohydrate Polymers*, **278**, 118940.
- RS Das, D Lingait, SS Gaharwar, A Kumar, S Gokhale (2023) Green synthesis of reduced graphene oxide with multiple environmental applications, *Journal of Photochemistry and Photobiology A: Chemistry* **444**, 115021.
- A review on versatile applications of biomaterial/polycationic chitosan: An insight into the structure – property relationship. First revision submitted to **International Journal of Biological Macromolecules** Elsevier. Required reviews completed. Manuscript id **IJBIOMAC-D-23-06198R1**.
- Valorization of Malus domestica L. (Apple) peels: A case study of circular bioeconomy. First revision submitted to” **Journal of sustainable chemistry and pharmacy**” Elsevier. Required reviews completed. Manuscript id **SUSCP-D-23-01020R1**.
- Valorization of onion peels using computationally design molecularly imprinted polymer for selective extraction of Quercetin, Manuscript under preparation (**Manuscript under preparation**).
- Book Chapter on “**Value addition of fruit and vegetable waste: a nutraceutical perspective**” by SS Gaharwar, VN Mohakar, **A Kumar** in the Book entitled *Fruit and Vegetable Waste Utilization and Sustainability*, **Pages-253-268**, **Publisher: Academic Press**