

Executive Summary



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1): Title of the Project:

Prototype development for catechin extraction & production of low cost antioxidant powder/tablets

2): Date of Start of the Project: 01/10/2020

3): Aims and Objectives:

- a) Separation and purification of catechin compounds (antioxidant) from green tea leaves.
- (b) Formulation of Catechins (using suitable excipients chosen after pre-formulation studies with catechins) for making antioxidant powder/tablets.
- (c) Formulation of catechine based health supplement & to evaluate the antioxidant potential of such formulation.
- (d) Establishment of linkage with at least two renowned tea gardens of Assam for field trial and demonstration of catechin tablet production from their green tea leaves.
- (e) Establishment of a startup company for commercial production of catechins based health supplement powder/tablets.

4): Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc)

- i) Membrane based technology (prototype) is developed to get high purity, efficient and low cost antioxidant compounds (catechins) from green tea leaves.
- (b) Formulation of health supplement are developed for making antioxidant powder, suspensions, capsules and tablets.
- (c) Collaboration with 3 renowned tea gardens of Assam are in advanced stage for field trial and demonstration of antioxidant powder production from the green tea leaves in their garden.
- (e) Establishment of a startup company for commercial production of catechins based health supplement powder, capsules, tablets etc are in progress.

Publications

- **Patents: 3** (Granted = 1, Submitted = 2), 2 more are under preparation
- **Books: 4** (Authored: Academic Press = 1, Elsevier = 1 and CRC press = 2)
- **Book Chapters: 2**
- **Journal Papers: 8** (Published = 7, Under review = 1)

Summary of works:

One of the main objectives of the project is to fabricate a prototype for the separation and purification of green tea catechins (GTC's) including other polyphenolic antioxidants from green tea leaves (at production rates of 1.5 kg/ h) for commercial scale production using membrane-based technology for separation/ purification. Prototype for demonstration/field trial of polyphenol separation from green tea leaves has been developed. The novelty of outcome is the development of green and sustainable technology for catechins (antioxidant) extraction from plant sources. The technology uses water (a green solvent) as extracting medium instead of conventional techniques that utilizes various organic solvents (acetone, chloroform, acetonitrile etc). The purity of catechins produced in this technique is high, requires less energy and cost-effective compared to the conventional organic solvent-based extraction processes. From the results of this work, a patent on extraction and purification technology has been applied (**Indian Patent Application No. 202231059038 (TEMP/E-1/67974/2022-KOL)**). Two research papers related to the green methods of extraction process has been published. Additionally, one book on advancement in the extraction technology for

valuable bioactives from plant-based sources (*Advances in extraction and applications of bioactive phytochemicals* (1st ed.) Elsevier, ISBN: 9780443185359) have been published along with the two journal papers.

Another objective and consequent deliverable of our work is the formulation of GTC's into solid dosage forms for formulation antioxidant powders, capsules & tablets (using suitable excipients chosen after pre-formulation studies with GTC's) and formulation of catechin based health supplement & evaluate the antioxidant potential, stability, shelf-life & bioavailability of such formulations. From the results of formulation of health juice based supplement, a patent on enhancing the shelf-life of GTC's and total polyphenolic content has been **applied (Indian Patent Application No. 202231059038 (TEMP/E-1/67974/2022-KOL))**.

Another patent on formulation of the capsules using 'liquid carbon' from waste tea leaves as an efficient diluent/ bulking agent will be shortly submitted for patent application. Further, the utilization of the tea waste after the extraction GTC's & polyphenolics has been also studied for subsequent value-addition. A pharmaceutical grade activated carbon has been produced utilizing the spent / waste tea leave using our own designed reactor. A patent on the process for preparation of high surface area activated carbon by using waste tea leaves has been applied from the outcome of this study (**Indian Patent Application No. 202131062319 (TEMP/E-1/70593/2021-KOL)**). Further, three books related to various types of utilization of waste tea has been published namely, *Recovery of Bioactives from Food Wastes* (1st ed.) CRC Press. (ISBN: 9781003315469), *Lignocellulosic Biomass to Value-Added Products: Fundamental Strategies and Technological Advancements*, Elsevier (ISBN: 9780128235911), and *An understanding on technological advancements for the valorization of Tea waste*, Elsevier (**with production section**). Additionally, three journal papers have been published on the utilization of the tea waste.

The last two objectives and of our work is to establish linkage with at least two renowned tea gardens of Assam for field trial and demonstration of production of developed formulations from GTC's green tea leaves & procurement of tea waste from their tea processing factories is been negotiated with Suyash Tea Co. Pvt. Ltd. & Deroi Innovations Pvt. Ltd. for 'transfer of technology' & capacity building for develop sufficient skills employing youth from interiors of north eastern states for efficient production using GMP's at their production facilities. Establishment of a startup company for commercial production & marketing of GTC's based health supplement powder/tablets is been negotiated with Brahmaputra

TechnoPharmaceuticals Pvt. Ltd. Assisting them in capacity building & applying for various startup funds at their pre-revenue stage is presently been initiated. The startup company has already been assisted to obtain an incubation space at the BioNEST incubation facility inside the IIT Guwahati campus to start initiate operations.

5): Concluding remarks

- (i) Green tea catechins being an unstable molecule requires unique pharmaceutical strategies of stabilization / protection at every step of production from extraction to formulation of catechin powder and tablets.
- (ii) Potential stakeholders capable of using our developed technology are not ready for quickly shifting from their existing products (raw processed green tea leaves) towards moving to value added green tea products (green tea based formulations such as antioxidant powders, suspensions, capsules and tablets).
- (iii) Much effort needs to be made for dissemination of our developed technology and products to the tea industries.