INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: Formulation and Characterization of Catechins Encapsulated Starch Nanoparticles based Functional Tea Product

Name of Thesis Supervisor(s)	:	Prof. Ramagopal VS Uppaluri; Dr. Siddhartha Singha; Prof. Satoshi Nagaoka; Prof. Emiko Yanase
Thesis Submitted to the Department/ Center	:	Yes
Date of completion of Thesis Viva-Voce Exam	:	04/12/2024
Key words for description of Thesis Work	:	Catechin encapsulation, EGCG, Bioaccessibility, Bioactivity, Enzymatic extraction, Functional drink

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On their own, tea catechins are incapable to withstand the severe conditions of gastrointestinal tract and henceforth loose about 95% of their initial concentration. Accordingly, the current Ph.D. thesis aims at the encapsulation of catechin extracts derived from S3A3 tea cultivar leaves using starch nanoparticle as wall material with a goal to enhance its bioaccessibility. This was followed by the formulation of a functional tea drink using black tea and encapsulated catechin extracts as ingredients.

The first objective of the work referred to the catechin profile study of S3A3 and TV18 tea cultivar and subsequent enzymatic extraction. The results affirmed upon the superiority of the S3A3 tea cultivar in terms of the total catechin concentration and with 329.29 mg/g of dried tea leaves. Further, tea catechins were extracted using enzymatic assisted hot water extraction method. Two cell wall degrading enzymes namely cellulase and pectinase were utilized in equal concentrations and the experimental conditions were varied as per the central composite rotatable design (CCRD). Optimal conditions of extraction were achieved at 18.08 min, 88.47ºC, and 188.08 EU/g. In comparison to the best hot water extraction conditions, (30 min and 75ºC) total catechin content yield increased by 51.26% in the optimal condition. The second objective of the thesis involved the synthesis of potato starch nanoparticles (SNP) using ultrasound assisted acid hydrolysis method. Sulfuric acid concentration was varied (3.16M to 5M) along with acid hydrolysis duration and detailed characterization were achieved for the starch nanoparticles. The investigations affirmed best characterizations for the starch nanoparticles prepared at 4M sulfuric acid, 3 days and 90 mins of ultrasound treatment. Accordingly, the best characterization data refers to the average particle size, PDI, yield, melting point, and relative crystallinity values of 66 nm, 0.362, 29%,

318.99°C, and 64.32%, respectively. The third objective involved micellar cholesterol solubility study of the EGCG and catechin extracts (CE) in their raw and nano-encapsulated forms (in the starch nanoparticle system). The in-vitro micellar solubility study affirmed that the EGCG and catechin extracts were subjected to significantly reduced cholesterol concentration and by 91.63% (2.5mg) and 59.03% (5mg) respectively. Further, characterization studies on encapsulated EGCG affirmed enhanced thermal and crystalline properties. The final Ph.D. thesis objective targeted functional tea beverage formulation possessing enhanced bioaccessibility and better organoleptic properties. 6 formulations (F1 to F6) were prepared using encapsulated catechin extracts and black tea. Bioaccessibility studies affirmed enhancement of AA recovery in CE:SNP (1:1, w/w) by 81.94% in dry form. Sensory analysis using 9 point hedonic and fuzzy logic affirms the superiority of F6 formulation which contained 1000 µg/mL of CE:SNP (1:1, w/w). In summary, the Ph.D. thesis traverses a pragmatic roadmap for the formulation of nanoencapsulation based functional tea beverage.