Program Profile		
Program	Program name	Biochemical, Pharmacological and Toxicological Profiling of Beetroot Cultivated in Bangladesh
	Category	A3

Summary of Program	
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Abstract of Program	Beet**,** (*Beta vulgaris*), a worldwide cultivated plant of the amaranth family (Amaranthaceae), well known for its edible leaves and taproot. Beetroots are frequently roasted or boiled and served as a side dish. They are also commonly canned, either whole or cut up, and often are pickled, spiced, or served in a sweet-and-sour sauce. Despite widespread traditional use, there is a significant lack of scientific validation concerning their safety, efficacy, and active constituents. Reports indicate that climate variations, including temperature, rainfall, and UV radiation, directly influence the concentration and composition of bioactive compounds in plants. These environmental factors can significantly alter the levels of beneficial chemicals produced by plants, leading to variations in the potency and type of bioactive compounds found in a species across different geographical locations. This is because plants adapt to their environment by adjusting their chemical profiles in response to environmental stressors like extreme weather. Thus, this project aims to conduct a comprehensive biochemical, pharmacological, and toxicological evaluation of selected Beetroot cultivated in Bangladesh. The study will identify and quantify bioactive compounds, examine pharmacological activities such as antioxidant, anti-inflammatory, antidiabetic, and anticancer effects, and assess toxicological risks including hepatotoxicity and nephrotoxicity. Biochemical profiling involves the extraction and characterization of phytochemicals, such as phenolics, flavonoids, alkaloids, and terpenoids, which are responsible for the therapeutic properties of BDS. Techniques such as high-performance liquid chromatography (HPLC), Gas chromatography-mass spectrometry (GC-MS), and nuclear magnetic resonance (NMR) spectroscopy are widely used for this purpose. Pharmacological profiling aims to substantiate the claimed health benefits of these supplements by examining their biological effects in vitro and in vivo. Toxicological profiling is equally critical, especially considering the widespread perception that natural products are inherently safe. Reports from both local and international contexts have highlighted cases of hepatotoxicity and nephrotoxicity linked to certain herbal products, often due to improper dosing, contamination, or the presence of bioactive compounds with narrow therapeutic indices. The findings will support the development of evidence-based guidelines for the safe and effective use of these supplements in healthcare.
Details of Program	
Planning	

Objectives	Long-term Goals	1. Development or adoption from allied fields of cutting-edge approaches with the potential to accelerate, improve predictive accuracy, or extend the capacity of methods for botanical/dietary supplement identification and characterization, identification or prediction of toxicity, drug interactions, and/or efficacy. 2. Elucidation of interactions between chemical constituents within a given plant, or between constituents of plants commonly used in combination, that are significant for their effects on human biology. Relevant outcomes may include, but are not limited to bioavailability, distribution, metabolism, safety/toxicity, mechanism of action, and efficacy. 3. Development of in silico, in vitro and/or preclinical in vivo models to accelerate and/or enhance understanding of the activities and mechanism(s) of action of chemically complex botanical preparations/ dietary supplement. Research using in silico models must be closely integrated with parallel research in vitro or in animal models to ensure and validate the biological relevance of the combined approaches.
	Short-term Targets	(1) Phytochemical extraction and profiling of active constituents. (2) Evaluation of pharmacological activities through laboratory-based studies. (3) Toxicological assessments using internationally accepted protocols.
	Rationale	The findings are expected to enhance the scientific understanding of locally cultivated beetroot and inform policy development, clinical practice, and product formulation.
Subject (Leader)	Initiator(s)	ARIFUZZAMAN, Sarder
	Champion(s)	ARIFUZZAMAN, Sarder
	Major team member(s)	RASHID, Md. HARUN-OR-; LABU, Zubair Khalid; LABONI, Farhina Rahman, AKTER, Rahima; SHAKIL, Md.; RAHMAN, Md. Tarekur; RUPON, Farjana Akter;
Environment	Nature/Society	The study is relevant to pharmaceuticals and healthcare, specifically focusing on the safety and efficacy of dietary supplements.
	Industry/Market	Pharmaceuticals and Healthcare
	Citizen/Government	The findings will inform the public about the safe use of dietary supplements and products on the market, and translate dietary supplement research into useful information for scientists and policymakers.
Resources	Human resources	The study required experts in pharmacy, biology and computational biology. One research associate is already engaged. At least four students will be involved in this program for the smooth operation of the research work.
	Financial resources	Funding would be necessary for plant collection, testing, and development. Salaries for researchers and technical staff also contribute to the financial requirements.(3,00,000/- BDT)
	Technological resources	IR spectroscopy, Ultraviolet spectroscopy, High Performance Liquid Chromatography, Gas Chromatography, Mouse model, Computer model, etc.
Mechanism	Strategy (Weight/Sequence)	These include collection, identification, purification, biochemical analysis, in silico, in vitro, preclinical and clinical studies of botanicals.
	Organization	N/A
	Culture	N/A
Doing		

Launch date	January, 2025
Responsible organization	World University of Bangladesh
Program content and process	The proposed program, *"Biochemical, Pharmacological and Toxicological Profiling of Beetroot (Beta vulgaris) Cultivated in Bangladesh,"* aims to systematically investigate the nutritional and therapeutic potential of locally cultivated beetroot and ensure its safety for human consumption and therapeutic applications. The program is structured into three major components: biochemical characterization, pharmacological evaluation, and toxicological assessment. In the biochemical phase, fresh beetroot samples from different agro-ecological zones of Bangladesh will be collected and standardized. Phytochemical screening will be conducted to identify key constituents such as betalains, polyphenols, flavonoids, nitrates, and vitamins. Advanced analytical techniques including HPLC, LC-MS/MS, and spectrophotometry will be used for quantification, while antioxidant activity will be assessed through in vitro assays (DPPH, ABTS, FRAP).The pharmacological phase will involve in vitro and in vivo studies to evaluate potential therapeutic benefits. Enzyme inhibition assays will be used to assess antidiabetic and anti-inflammatory properties, while rodent models will be employed for antihyperglycemic, hepatoprotective, and cardioprotective evaluations. Dose-response relationships will be analyzed to establish effective concentrations. The toxicological phase will ensure safety profiling. Acute and sub-chronic toxicity studies will be conducted in experimental animals following OECD guidelines. Parameters such as body weight, food intake, hematological indices, serum biochemistry, and histopathological analysis of major organs will be monitored to identify any adverse effects. Implementation will proceed in sequential stages: (1) site selection and standardized beetroot collection, (2) laboratory-based biochemical analysis, (3) pharmacological assays and animal model studies, and (4) toxicological evaluation. Interdisciplinary collaboration between pharmacologists, biochemists, toxicologists, and agricultural scientists will ensure robust outcomes. Data integration and statistical analysis will be performed to correlate biochemical markers with pharmacological efficacy and safety. This program will generate scientific evidence on the health-promoting properties and safety of Bangladeshi beetroot, providing a foundation for its development as a functional food or nutraceutical resource.
Key highlights of the content/process	Beetroot, Physicochemical, pharmacokinetic, toxicokinetic, preclinical, clinical
Differences from traditional approaches	Traditional botanical dietary supplements pertain to adverse effects and hypersensitivity. Thus, a previously tested dietary supplement with modern technologies in preclinical and clinical trials would be safe and effective for the intended population.
Progress as of today	The literature review, study design, methodology development, and sample collection have already been completed. We performed phytochemical screening, extraction in different solvents, and GC-MS to predict the potential chemical compounds present in the extract. We also performed in vivo toxicology studies using a laboratory mouse model. Two manuscripts have been prepared with the results and submitted to the journal for publication.

Problems in implementation	There is a shortage of all advanced instruments and animal handling facilities in the university.
Approaches to solve the problems	Need all advanced instruments and animal handling facilities in the university.
Completion date, if completed	Not completed yet
Seeing	
Impacts on students	Students can learn various technology to do the research work. This program will also help to widen the arena of knowledge of students in research field.
Impacts on professors	Professors are getting opportunities to contribute the nation through the university and universities qualities are improving.
Impacts on university administration	Due to the addition of modern technology to this project and its high impact on the traditional dietary medicine, the university authority and administrators are highly satisfied with the program's outcomes.
Responses from industry/market	N/A
Responses from citizen/government	N/A
Measurable output (revenues)	N/A
Measurable input (expenses)	N/A
Cost-benefit analysis for effectiveness	N/A
Future Planning	
Where does the project go from here?	In the pharmaceutical industry, for a pilot project.
Addendum	
Exhibits, pictures, diagrams, etc.	Social Media/ Seminar /Symposia
Reports, mimeos, monographs, books, etc.	University, Journal
Others which may help explain the program (including website links)	N/A