ASSESSMENT OF MICROPLASTICS IN THE FOOD CHAIN: DETECTION, QUANTIFICATION, AND POTENTIAL HEALTH IMPLICATIONS

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Introduction:

Microplastics, defined as plastic particles smaller than 5 mm, have emerged as a major environmental contaminant in recent years. Due to their persistence and widespread distribution, they have been detected in water, soil, air, and food systems [1]. Recent studies have reported the presence of microplastics in commonly consumed food items such as sugar, salt, rice, fruits, and beverages, raising concerns regarding human exposure through dietary intake [2]. These contaminants can enter the food chain through agricultural practices, environmental pollution, and food processing [3]. The ingestion of microplastics has been associated with potential health risks, including inflammation, oxidative stress, and toxic effects, although comprehensive understanding is still developing [4].

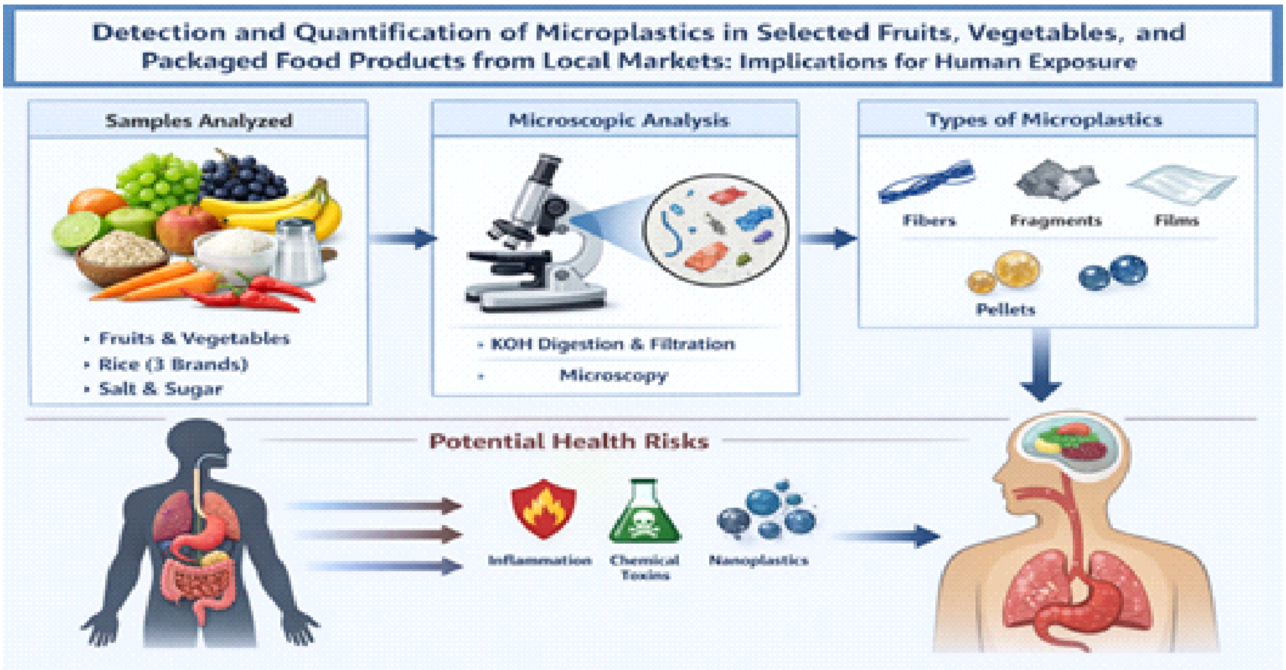

Figure 1: Graphical Abstract

Objectives:

1. To detect the presence of microplastics in selected food samples (fruits, vegetables, rice, salt, and sugar).
2. To quantify microplastic particles in different food categories.
3. To classify microplastics based on shape, size, and color.
4. To evaluate potential sources of contamination and human exposure risks.

Methodology:

The selected food samples, including grapes (green and black), banana, carrot, green chillies, rice (three different brands), salt, and sugar, will be procured from local markets in Bengaluru, representing commonly consumed food items across Karnataka. All samples will be processed under contamination-controlled conditions using pre-cleaned glassware and filtered distilled water to minimize external interference. Organic samples (fruits, vegetables, and rice) will be subjected to alkaline digestion using 10% potassium hydroxide (KOH) at 50–60°C to effectively remove organic matter. In contrast, salt and sugar samples will be directly dissolved in filtered distilled water due to their high solubility. To enhance microplastic recovery, density separation techniques will be employed for selected samples using saturated sodium chloride (NaCl) solution, followed by higher-density separation using zinc chloride ($ZnCl_2$) solution where required. This step facilitates the flotation and isolation of microplastic particles based on their density differences. The processed solutions will then be filtered through Whatman filter paper, and the retained particles will be examined under a stereomicroscope. Microplastics will be identified based on morphological characteristics such as shape, color, and surface texture. Quantification will be performed by manually counting the particles and expressing the results as particles per kilogram of sample. Additionally, particle size will be measured using a calibrated ocular micrometer to obtain accurate dimensional data.

Figure 2: Methodology image

Result and Conclusion:

It is expected that microplastics will be detected in most of the analyzed food samples, with higher concentrations in processed and packaged foods such as rice. Fibers are anticipated to be the dominant microplastic type.

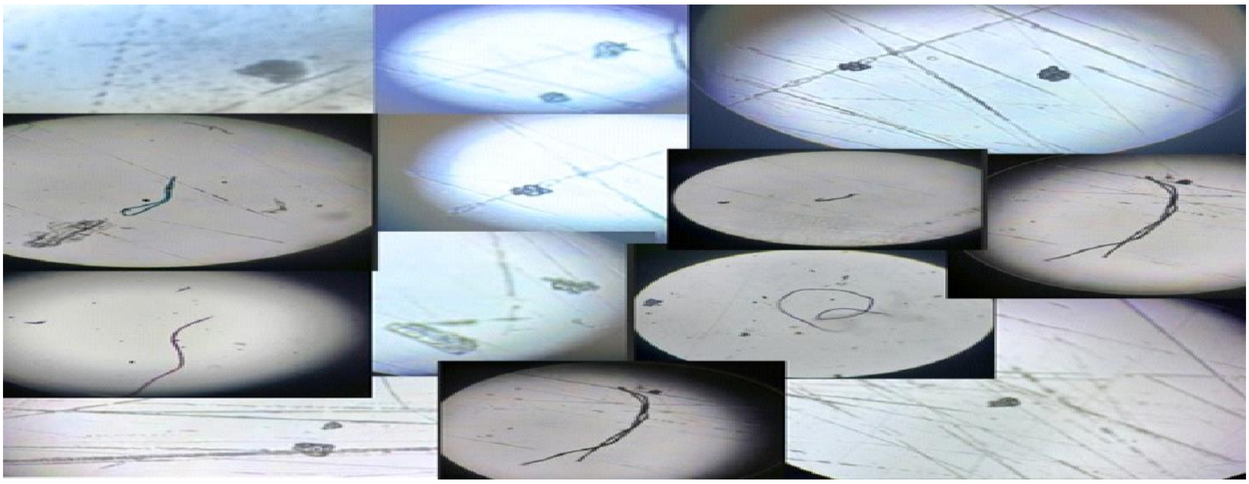

Figure 3: microplastic images in salt and sugar

In conclusion, the study will provide evidence of microplastic contamination in commonly consumed food items, highlighting dietary intake as a potential exposure route. These findings will contribute to understanding the extent of contamination and its implications for human health.

References:

1. [1] M. Hamed, D. M. El-Sherif, S. C. Iheanacho, A. K. M. M. Hasan, K. Niaz, and M. A. Khaled, "Microplastics in food chains: Global evidence, bioaccumulation, spatial distribution and health risks," *Food Control,* vol. 182, p. 111836, 2026/04/01/ 2026, doi: https://doi.org/10.1016/j.foodcont.2025.111836.
2. [2] A. Altunışık, "Prevalence of microplastics in commercially sold soft drinks and human risk assessment," *Journal of Environmental Management,* vol. 336, p. 117720, 2023/06/15/ 2023, doi: https://doi.org/10.1016/j.jenvman.2023.117720.
3. [3] N. N. Lazăr, M. Călmuc, A. Milea Ș, P. L. Georgescu, and C. Iticescu, "Micro and nano plastics in fruits and vegetables: A review," (in eng), *Heliyon,* vol. 10, no. 6, p. e28291, Mar 30 2024, doi: 10.1016/j.heliyon.2024.e28291.
4. [4] P. J. Landrigan *et al.*, "The Minderoo-Monaco Commission on Plastics and Human Health," (in eng), *Ann Glob Health,* vol. 89, no. 1, p. 23, 2023, doi: 10.5334/aogh.4056.

Future Scope:

1. The present study provides a foundational understanding of microplastic contamination in commonly consumed food items, with significant scope for further research. Future work may involve advanced analytical techniques such as FTIR or Raman spectroscopy for accurate polymer identification and improved detection reliability. The study is also planned for wider range of food products, including other packaged foods, beverages, dairy products, drinking water, and seafood such as fish and prawn, to assess broader exposure pathways. Seasonal and geographical variations may also be studied to understand environmental influences on contamination.

2. Further research should investigate the bioaccumulation and toxicological effects of microplastics on human health through in vitro and in vivo studies. Inclusion of nano plastic analysis will be important due to the greater risks posed by smaller particles. In addition, the development of rapid and cost-effective detection methods, along with collaboration with food safety and environmental agencies, can support standardized protocols and regulatory guidelines. Overall, this study creates opportunities for interdisciplinary research in environmental science, food safety, and public health to reduce human exposure to microplastics.

Project Outcomes:
The project successfully developed a standardized protocol for detecting microplastics in food samples. It enabled the identification and preliminary quantification of microplastic particles in commonly consumed foods, along with a comparative analysis of contamination levels between fresh and processed items.

Learnings:
The project provided hands-on experience in sample preparation, chemical digestion using KOH, and density separation using NaCl and $ZnCl_2$. It also enhanced skills in microscopy and microplastic identification, along with a better understanding of pollution pathways into the food chain. Additionally, it improved data analysis and scientific reporting abilities.

Industry Relevance:
The project is relevant to food safety testing laboratories and can support quality control processes in food processing industries. It also provides baseline data that can assist regulatory agencies in monitoring and managing microplastic contamination in food.