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Hidden Treasures on Your Plate: Transforming Leftovers into Health and Wealth

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Food waste is a major global challenge with serious environmental, economic, and social impacts. According to the Food Waste Index Report 2024, households in India generate about 78.2 million tonnes of food waste annually, despite widespread food insecurity. Food waste such as fruit and vegetable peels, seeds, stems, leftover food, and agro-processing by-products like husk and bran are rich in fiber, proteins, vitamins, minerals, and bioactive compounds. These materials can be converted into value-added products such as functional foods, nutraceuticals, animal feed, biofuels, and biodegradable materials. Household practices like composting, reuse of food scraps, biogas production, and food donation, along with government initiatives, can help reduce food waste. Proper utilization of food waste can support environmental sustainability, resource conservation, and economic development.

Keywords: Food waste, value-added products, by-products, sustainability, nutraceuticals

Introduction:

According to the Food Waste Index Report 2024 published by the United Nations Environment Programme (UNEP), households in India generate approximately 78.2 million tonnes of food waste annually. India ranks second globally in food waste, and the amount of food wasted each year is nearly sufficient to feed 377 million people. This waste accounts for approximately 1% of India's GDP, equivalent to about ₹9,200 crores. The per capita household food waste in India is estimated to be around 55 kg /person/ year.

Studies have shown that in hostels and mess facilities, food wastage is higher due to factors such as overfilling of plates, over-purchasing of food, poor meal planning, and cultural habits associated with hospitality. Such practices not only result in economic losses but also significantly impact the environment. Globally, food waste contributes approximately 8–10% of greenhouse gas emissions. Additionally, it exacerbates food insecurity in rural areas, where many people suffer from malnutrition, while simultaneously leading to the excessive use of natural resources.

Plate food waste commonly includes fruit and vegetable peels (such as tomato, banana, potato, citrus fruits, carrots, orange, guava, and bitter gourd), leaves and stems (lettuce, cauliflower, cabbage, and celery), seeds (pumpkin and watermelon), and leftover rice. These wastes are rich in proteins, dietary fiber, vitamins, minerals, antioxidants, and other bioactive compounds. Similarly, food waste generated during milling processes, such as husk and other agri-food by-products produced during harvesting also contains valuable nutrients.

Food scraps and plate leftovers are far from useless—they are a versatile resource with the potential to generate a wide array of new products. By creatively utilizing these remnants, it is possible to expand the variety of offerings, tapping into new opportunities for innovation, sustainability, and economic gain. This approach transforms ordinary waste into a

flexible resource, allowing for the development of diverse and valuable applications while simultaneously reducing environmental impact.

Food waste and its by-products can be effectively utilized as animal feed, fertilizers, poultry feed, and food additives (Torres-Leon et al., 2018). In addition, food waste is increasingly being used for the production of biofuels, chemicals, enzymes, food supplements, nutraceuticals, antimicrobial products, and bioplastics, which plays a dual role by reducing both plastic waste and food waste simultaneously (Ramadhan and Handayani 2020). Furthermore, food waste can also be utilized for single-cell protein production, which provides high-quality protein suitable for human consumption (Sekoai et al., 2024). Black grape seed powder and pomegranate seed powders are rich in antioxidants and total phenolic compounds and can be used in the development of yoghurt with high antioxidant activity (Caliskanlar et al., 2023).

The Forgotten Parts of Everyday Food and Their Nutritional Value

Food waste often includes parts of fruits, vegetables, and other food materials that still contain valuable nutrients. Many of these by-products have a higher concentration of dietary fiber, vitamins, minerals, antioxidants, and bioactive compounds, making them useful for nutritional and functional food applications.

1. **Dairy by-products:** Whey contains high-quality proteins such as **lactalbumin and lactoglobulin**. It also contains **lactose, calcium, and B-vitamins**, making it a valuable ingredient in food and nutraceutical products.
2. **Fruits and vegetable by-products:** Fruit peels, seeds, pomace, and vegetable trimmings are rich in **dietary fiber, phenolic compounds, antioxidants, vitamins, and minerals**. For example, **citrus peels contain flavonoids and vitamin C**, while **apple pomace and grape pomace are rich in polyphenols and fiber**. These by-products can be utilized in the production of **functional foods, dietary supplements, and natural antioxidants**.
3. **Egg and meat by-products:** Eggshells are rich in **calcium carbonate**, while egg yolk residues contain **proteins and lipids**. Meat by-products such as **bones, skin, and connective tissues** are good sources of **collagen, gelatin, and essential amino acids**. These components are widely used in **food processing, pharmaceuticals, and nutraceutical industries**.
4. **Fish and seafood by-products:** Fish processing produces by-products such as **heads, bones, skin, scales, and viscera**. These materials are rich in **high-quality proteins, omega-3 fatty acids, collagen, and minerals** and are used for **fish meal, fish oil, gelatin, and nutraceutical products**.
5. **Cereal by-products:** By-products from cereals such as **bran, husk, and germ** are excellent sources of **dietary fiber, proteins, vitamins (especially B-complex vitamins), and minerals**. Wheat bran and rice bran also contain **antioxidants and bioactive compounds**, which can be used to enhance the nutritional value of bakery and functional food products.
6. **Spice by-products:** Residues from spices such as **turmeric, ginger, garlic, and pepper** contain significant amounts of **essential oils, phenolic compounds, and antioxidants**. These compounds exhibit **antimicrobial, anti-inflammatory, and antioxidant properties**, making them useful in the development of **natural preservatives, nutraceuticals, and functional foods**.

Turning Scraps into Value

The availability and generation of food waste are influenced by several factors, including **seasonality, geographical location, dietary habits, prevailing market trends** and **socio-cultural factors** (Alsheyadi and Bathmanathan, 2025).

S. No.	Source of food waste	Value added products
1	Dairy products	Whey protein powder, whey protein concentrate, lactose powder, whey based beverages, fermented milk products

2	Fruits and vegetable products	Fruit peel powders, Dietary fiber powders, natural colorants, pectin, Dry fruits, fruit powders, and neutraceuticals
3	Egg, poultry and meat products	Gelatin, collagen supplements, animal feed, fertilizers, and pharmaceutical ingredients
4	Fish and seafood products	Fish sauce, fish oil, fish meal, gelatin, collagen peptides, and neutraceutical products
5	Cereal products	Breakfast cereals, high-fiber bakery products, animal feed, bioethanol, and biodegradable packaging materials
6	Spice products	Natural preservatives, antimicrobial extracts, neutraceuticals and flavoring agents.

Scrap Usage at Domestic Level

- **Animal feed:** Kitchen scraps such as vegetable peels and leftover food can be used as feed for livestock and poultry.
- **Preparation of food products:** Fruit peels can be used to prepare **fruit peel powders, marmalades, crystallized peels, and soup stocks**.
- **Composting:** Household food waste can be composted to produce **organic manure for home gardens and agriculture**.
- **Food donation:** Excess cooked food can be **donated to needy people or food banks** to reduce food waste.
- **Biogas production:** Organic kitchen waste can be utilized for **biogas generation**, which serves as a renewable energy source.
- **Regrowing vegetables:** The roots and stems of certain vegetables such as **onions, celery, and lettuce** can be reused to **regrow vegetables at home**.
- **Natural cleaning agents: Citrus peels** can be used to prepare **natural household cleaners and deodorizers**.
- **Herbal infusions:** Peels, seeds, and herb residues can be used in the **preparation of herbal teas and infusions**.

Impact on Environment and Society

- **Composting of food waste** improves soil health by increasing organic matter and enhancing soil fertility.
- Food waste can be used as a **natural fertilizer**, reducing the dependence on chemical fertilizers and lowering agricultural production costs.
- Reusing food waste helps **reduce the total amount of waste generated** and decreases **methane emissions**, a major greenhouse gas that contributes to climate change.
- Utilization of leftovers reduces **food wastage at the household level** and promotes better food management practices.
- Effective food waste management helps **families save money by avoiding excessive food purchases**.
- Food waste utilization can also support **small-scale enterprises and start-ups** that focus on converting food scraps into value-added products.
- Proper management of food waste reduces the **risk of contamination and environmental pollution**, thereby contributing to improved **family and public health as well as economic well-being**.

Policy Interventions and Government Schemes to Reduce Food Waste in India

Several government initiatives have been introduced in India to minimize food loss and waste by improving food processing, storage, distribution, and awareness (MoFPI, 2023; FSSAI, 2021).

- **Pradhan Mantri Kisan Sampada Yojana (PMKSY):** A comprehensive scheme aimed at developing modern infrastructure for food processing, reducing post-harvest losses, and increasing farmers' income.

- **Operation Greens (TOP to TOTAL):** Launched to stabilize the supply of **Tomato, Onion, and Potato (TOP)** and later expanded to **TOTAL crops**, aiming to reduce price fluctuations and minimize post-harvest wastage.
- **Pradhan Mantri Formalisation of Micro Food Processing Enterprises Scheme (PMFME):** Supports small and micro food processing units through financial assistance, training, and infrastructure development to reduce food losses and promote value addition.
- **Save Food, Share Food Initiative:** Launched by the Food Safety and Standards Authority of India (FSSAI), this initiative encourages safe redistribution of surplus food to the needy through food donation networks.
- **Repurpose Used Cooking Oil (RUCO):** Another initiative of the Food Safety and Standards Authority of India (FSSAI) that promotes the collection and conversion of used cooking oil into **biodiesel**, reducing environmental pollution and waste.
- **Mega Food Parks Scheme:** Aims to establish modern food processing infrastructure with efficient supply chain management to reduce post-harvest losses and enhance food preservation.
- **Integrated Cold Chain and Value Addition Infrastructure Scheme:** Focuses on strengthening cold storage, transportation, and distribution systems to reduce food spoilage and extend shelf life.

Conclusion

Food waste contains valuable nutrients and bioactive compounds that can be utilized for the production of various value-added products such as functional foods, neutraceuticals, animal feed, and biofuels. Proper management and utilization of food waste at household and industrial levels can reduce environmental pollution, greenhouse gas emissions, and economic losses. Promoting awareness, sustainable practices, and government initiatives can help transform food waste into valuable resources and contribute to a more sustainable food system.

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