International Journal of Sustainable Tourism

Volume: 02, Issue 0I, 2025
Peer Reviewed|Biannual|ISSN : 3021-6184
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UPCYCLING EDIBLE OFFCUTS IN HOSPITALITY: TOWARD A CIRCULAR FOOD SYSTEM IN SUSTAINABLE TOURISM -A CASE STUDY

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Abstract

Transforming edible offcuts into innovative dishes creates a circular food system that reduces waste, delights guests, and supports sustainable tourism. This study investigated the valorization of edible kitchen offcuts in the audited kitchens of Waters Edge Hotel, Sri Lanka, with the aim of raising awareness within the hotel sector about new food product development from edible offcuts to reduce waste, enhance sustainability practices, lower waste-disposal costs, generate additional revenue, support green marketing targeted at sustainability-aware guests, and contribute to food security in developing countries. A systematic waste audit revealed that the audited kitchens generated on average 65 kg of fruit, 95 kg of meat, 280 kg of vegetable and 300 kg of bakery offcuts per week. Ten prototype products were formulated by the hotel culinary team from these offcuts: pineapple skin juice, California orange juice, cucumber fresh water and coconut water cooler, sweet bread roll, scrap brownie, mixed meat meatballs, passion

moju, chicken paste, melon dosi and watermelon seed bite. Sensory acceptability was evaluated by 10 experienced chefs using a 7-point hedonic scale across appearance, aroma, taste, texture and overall liking. Mean overall scores ranged from 5.5 to 6.4; the highest acceptability was observed for mixed meat meatballs, cucumber–coconut cooler, and melon dosi products. The findings indicate that substantial portions of routine kitchen offcuts can be converted into palatable, chef-approved products, offering practical advantages in waste reduction, operational cost savings, staff catering and sustainable branding, and present a replicable model for hotels pursuing circular-economy and eco-tourism objectives.

Keywords: *Circular economy, Sustainable tourism, Food waste valorization, Product development, Edible offcuts*

1.0 Introduction

Sustainability has long been a central concern within the global tourism sector. In the early 21st century, scholars highlighted that the hospitality industry began integrating environmentally friendly practices to address these concerns (Alvarez-Gil et al., 2001). This shift was largely driven by mounting criticism of tourism's adverse effects, including excessive consumption of vital resources such as water (Alonso-Almeida, 2012) and energy (Manniche et al., 2017), alongside the generation of significant volumes of solid and liquid waste (UNWTO, 2018). Moreover, tourism activities are estimated to contribute approximately 5% of global carbon dioxide emissions (Whalen et al., 2018). Among these challenges, food waste has emerged as one of the most pressing sustainability issues, with significant implications for environmental management, economic efficiency, and public health (Spratt et al., 2021).

Food waste within the hospitality sector is particularly problematic due to the scale of operations and the complexity of food service systems. Large hotels and resorts typically generate substantial amounts of edible food waste during food preparation, buffet service, and catering events. Research has shown that fruit and vegetable trimmings, meat offcuts, and bakery residues form a considerable proportion of this waste stream, much of which remains safe and suitable for human consumption (Papargyropoulou et al., 2016). Despite growing awareness, many hospitality establishments still lack effective valorization strategies, leading to unnecessary disposal of nutrient-rich materials that could otherwise be transformed into value-added food products.

In recent years, attention has increasingly turned to food waste valorization as a means of advancing both sustainability and circular economic objectives. The valorization process involves converting edible food offcuts into new, marketable products, thereby extending their lifecycle and reducing reliance on primary resources. Several studies have demonstrated the potential of reusing fruit peels, vegetable trimmings, and bakery scraps in the development of juices, jams, confectionery items, and savory products (Galanakis, 2019). Such innovations not only contribute to waste reduction but also generate new revenue streams and enhance a hotel's sustainability credentials. Furthermore, the adoption of upcycled food items has been recognized as a marketing opportunity to attract environmentally conscious consumers and strengthen eco-tourism initiatives.

This research aims to raise awareness within the hotel sector about the potential for new food product development from edible offcuts, which represents a significant waste burden. The objectives are to reduce waste problems, enhance sustainability practices, lower costs associated with waste disposal, generate additional profit streams, and strengthen green marketing strategies targeted at sustainability-aware guests. Beyond the hotel sector, such initiatives also provide an important contribution to food security in developing countries, by promoting efficient use of available food resources. By integrating sustainability principles with practical product innovation, this research demonstrates how food waste management in hotels can be aligned with circular economy practices, eco-tourism development, and long-term business competitiveness.

2.0 Literature Review

According to the Food Waste Index Report (2021), the restaurant sector is identified as a significant contributor to global food waste (United Nations Environment Programme, 2021). Within food service operations, waste generation arises from multiple sources. Common causes include improper storage practices that accelerate spoilage, preparation losses from mishandling or excessive cooking, uneaten portions resulting from oversized servings, difficulties in forecasting customer demand, items being overlooked or expiring, limited awareness of the economic and environmental consequences due to inadequate data, and challenges in meeting diverse customer dietary requirements (Ofei & Mikkelsen, 2011).

Food upcycling refers to the process of converting food by-products or leftovers into value-added products, thereby reducing waste while fostering environmental sustainability. This concept has gained increasing attention as both businesses and consumers emphasize innovative, eco-friendly practices aimed at improving

resource efficiency. Beyond mitigating food waste, upcycling supports broader sustainability and responsible consumption goals, offering food enterprises opportunities to operate in more ethical and efficient ways. According to the Upcycled Food Definition Task Force (2020), upcycled foods are made from ingredients that would otherwise be excluded from human consumption, are sourced and produced through transparent supply chains, and contribute positively to environmental outcomes.

Behavioral intention in this study refers to an individual's readiness to purchase upcycled foods and the effort they are willing to invest to obtain them. Triandis (1980, p.203) describes behavioral intention as "instructions that people give themselves to behave in a certain way." Swan and Trawick (1981) define it as the anticipation, attempt, or willingness to perform a behavior. Extending these ideas, Fishbein and Ajzen's Theory of Reasoned Action (1975) and Ajzen's Theory of Planned Behavior (1991) posit that intentions capture the motivational forces that precede and shape actual behavior.

3.0 Methodology

Waste Audit Methodology

A systematic waste audit was conducted in the audited kitchens of Waters Edge Hotel to quantify edible offcuts and identify priority waste streams for valorization. Kitchen staff segregated edible offcuts at source into predefined categories (fruits, vegetables, meat, and bakery) during routine preparation and service. Collection took place daily over a defined consecutive monitoring period; each category was weighed using a calibrated digital scale and recorded on standardized data sheets. Non-edible waste and packaging were excluded from the measurements. Supplementary semi-structured interviews with chefs and stewarding staff verified sources, common generation points and typical handling practices for each offcut type. Data were aggregated to produce weekly totals and summarized using descriptive statistics (mean values reported); records were checked for consistency and anomalous days were reviewed with kitchen supervisors.

Identification of Edible Offcuts

Following the audit, offcuts were classified according to origin and suitability for reuse. Items were screened for edibility, safety, and practical availability in sufficient volume. The principal categories identified were fruit offcuts (e.g. pineapple skins, orange peels, melon rinds, passion fruit pulp residues, watermelon seeds), vegetable

trimmings (e.g. cucumber ends, assorted peels), meat offcuts (mixed meat scraps, chicken trimmings) and bakery residues (bread scraps, crusts, brownie/cake trimmings). Selected materials were sampled for visual quality assessment and stored temporarily under appropriate refrigerated conditions prior to product development to maintain safety and quality.

Product Development

Based on the identified offcuts, ten new food products were formulated by experienced chefs in the hotel's kitchen. Pineapple skin juice was prepared using 1 kg of pineapple skin, 25 g of pineapple core, 25 g of diced watermelon rind, and 500 g of water, while a beverage named California Orange was formulated with 220 g of pineapple pieces, 180 g of papaya, 150 g of sugar, 5 g of lemon juice, and 150 g of water. A cucumber and coconut water cooler was developed using 200 g of white cucumber flesh water, 300 g of coconut water, and 20 g of sugar. For bakery-based innovations, scrap brownies were prepared with 400 g of cake crumbs, 100 g of melted butter, 100 g of sugar, 30 g of cocoa powder, and 2 whole eggs, whereas sweet bread rolls utilized 500 g of leftover bread, 250 g of icing sugar, 100 g of egg white, 100 g of margarine, and 10 g of lemon.

Savory preparations included passion moju, made from 50 g of passion fruit skin and a mixture of spices, condiments, and vegetables; mixed meat meatballs, prepared with 1 kg of edible meat trimmings, seasonings, and 2 egg whites; chicken paste, formulated with 500 g of chicken skin, onions, garlic, salt, sugar, and tomato sauce; and crispy bites developed from 500 g of leftover bread, margarine, chili powder, and salt. Additionally, confectionary-style products such as melon dosi were produced using 400 g of watermelon rind, 800 g of water, and 500 g of sugar, while watermelon seed bites were made from 150 g of melon seeds seasoned with salt and chili powder.

Sensory Evaluation

The acceptability of the developed products was assessed through a structured sensory evaluation. A panel of 12 experienced chefs from Waters Edge Hotel were selected as evaluators due to their expertise in food quality assessment. Each product was freshly prepared and served in coded containers. The panel evaluated the products on appearance, aroma, texture, flavor, and overall acceptability, using a 7-point hedonic scale (1 = dislike extremely, 7 = like extremely). Evaluations were conducted in a quiet environment with neutral lighting to avoid external influence. The collected scores were averaged to determine overall product performance and to identify the most acceptable formulations.

4.0 Findings

Identification of Edible Food Offcuts

The waste audit revealed that substantial quantities of edible food offcuts are generated in the audited kitchens of Waters Edge Hotel**,** reflecting the scale of its food service operations. On average, the kitchens produced 65 kg of edible fruit waste, 95 kg of edible meat waste, 280 kg of edible vegetable waste, and 300 kg of bakery waste per week**.** Among these, bakery and vegetable categories contributed the highest proportions, emphasizing their significance as priority areas for waste reduction and valorization strategies.

The most common edible fruit offcuts included pineapple skins, orange peels, melon rinds, passion fruit pulp residues, and watermelon seeds**,** while vegetable waste was largely composed of cucumber ends and assorted trimmings**.** Meat waste consisted mainly of mixed meat scraps and chicken trimmings**,** whereas bakery waste included bread scraps, crusts, and brownie or cake trimmings**.** These findings indicate that much of the discarded material is nutrient-rich and safe for reuse**,** underscoring its potential as a resource for developing value-added food products.

This observation is consistent with studies in large-scale hospitality settings, where fruits, vegetables, and bakery products are reported as the predominant contributors to edible food waste. The consistent availability, volume, and edibility of these materials in the present study provide a solid foundation for circular economy practices, where food offcuts are reimagined not as waste, but as raw materials for innovation.

Sensory Evaluation of Developed Food Products

The ten developed food products were subjected to a sensory evaluation by ten experienced chefs from Waters Edge Hotel, using a 7-point hedonic scale (1 = Dislike extremely, 7 = Like extremely). The results are presented in Table 2.

Table 1. Mean sensory scores of developed food products (n = 10)

Product	Appearance	Aroma	Taste	Texture	Overall Acceptability
Pineapple Skin Juice	6.4	6.2	5.3	5.7	5.9
California Orange Juice	6.3	6.2	5.9	6.0	6.0
Cucumber Fresh Water & Coconut Cooler	6.5	6.2	6.2	6.2	6.3
Sweet Bread Roll	5.8	6.0	6.0	5.8	5.9
Scrap Brownie	5.1	6.2	6.0	6.1	5.8
Mixed Meatballs	6.3	6.4	6.4	6.5	6.4
Passion Moju	6.0	5.8	5.2	5.8	5.8
Chicken Paste	5.9	6.0	5.1	5.8	5.6
Melon Dosi	6.2	6.0	6.1	6.0	6.2
Watermelon Seed Bite	5.1	6.1	5.0	5.2	5.5

The sensory evaluation results (Table 1) revealed variations in overall acceptability among the ten developed food products. The highest scores were recorded for the mixed meat meatballs (6.4), cucumber fresh water & coconut cooler (6.3), and melon dosi (6.2), indicating that these products were the most preferred by panelists. These items consistently performed above the mean value of 6.0, suggesting strong consumer acceptance.

Moderate acceptability was observed for California orange juice (6.0), sweet bread roll (5.9), pineapple skin juice (5.9), and scrap brownie (5.8). These products achieved scores close to the mid-point of the scale, indicating potential for improvement but demonstrating general acceptance as viable food items.

Overall, the majority of the developed products achieved mean scores between 5.5 and 6.4, which falls within the “moderately liked” category on the hedonic scale. These findings confirm that edible food offcuts can be successfully utilized to create a range of acceptable and innovative food products, demonstrating their potential for waste valorization in the hotel sector.

Contribution of Developed Products to Waste Reduction and Sustainability

The development of novel food products from edible offcuts demonstrates a practical pathway to reducing overall food waste within hotel operations. By converting fruits, meat, vegetables, and bakery edible wastes generated weekly in the kitchens of Waters Edge Hotel into value-added products, a significant portion of potentially discarded material can be effectively redirected into the food chain, thereby minimizing food waste, enhancing resource efficiency, and contributing to sustainable food management practices within the hospitality industry. This not only minimizes the environmental burden associated with disposal but also supports the hotel's commitment to sustainability.

The integration of these products into hotel services offers multiple benefits. Environment-related sustainability events, conferences, and themed banquets provide opportunities to showcase such innovations, reinforcing the hotel's role as a leader in sustainable food management. Highlighting these items as part of a "green menu" would not only reduce waste but also serve as a strong marketing strategy for attracting sustainability-conscious guests and eco-tourism enthusiasts. Positioning such products as unique, environmentally responsible menu items strengthens the image of the hotel as a pioneer in eco-tourism and circular economic practices.

Moreover, while premium products such as juices, coolers, and meatballs can be offered to guests, other items with moderate acceptance levels may be utilized effectively within staff meals and internal catering operations, ensuring that the full spectrum of food offcuts is efficiently valorized. This dual approach creates both economic and environmental value, as waste disposal costs are reduced while revenue opportunities from novel products are increased.

From a broader perspective, the success of this initiative demonstrates how large-scale hospitality establishments can align with global sustainability goals, particularly SDG 12 (Responsible Consumption and Production). Embedding waste valorization into daily operations not only contributes to the circular economy—where resources are continually reused and repurposed rather than discarded—but also enhances the reputation of destinations that promote eco-friendly practices. In the context of eco-tourism, such initiatives showcase responsible management of natural resources, reduce the ecological footprint of the tourism industry, and appeal to environmentally conscious travelers who increasingly seek authentic and sustainable experiences. By integrating food waste conversion into value-added products, hospitality enterprises can position themselves as leaders in green innovation, strengthen community trust, and support the transition towards zero-waste tourism models. This approach demonstrates that sustainability in the tourism

sector is not limited to energy and water conservation but also extends to creative resource management strategies that preserve local ecosystems while enriching the visitor experience.

5.0 Conclusion

This study demonstrated the potential of edible food waste valorization within the operations of Waters Edge Hotel, Sri Lanka. By identifying significant volumes of fruit, vegetables, meat, and bakery offcuts, and transforming them into innovative value-added products, the research highlighted a practical approach to reducing food waste while enhancing sustainability in large- scale food service. Sensory evaluations confirmed that several products were well-accepted, indicating their feasibility for inclusion in hotel menus and events. Beyond waste minimization, these initiatives align with global sustainability goals by reducing the environmental impact of disposal practices and supporting circular economy principles. Furthermore, the integration of such products provides strategic advantages for the hotel, including cost savings, customer attraction through eco-friendly branding, and enhanced staff welfare. Overall, this approach demonstrates how sustainable food innovation can simultaneously address environmental concerns, operational efficiency, and business competitiveness in the hospitality industry.

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