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Mini-Review

Kitchen Waste: A Sustainable Approach for Backyard Poultry Farming

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Abstract: Backyard poultry farming is an efficient, sustainable, and economical practice in which kitchen waste serves as a key component. Organic kitchen waste can be used to feed poultry, providing nutrients from vegetable scraps, fruit peels, leftover cooked food, and crushed eggshells, thereby reducing reliance on costly commercial feeds. Eggshells, for example, are an excellent source of calcium, which supports bone strength and improves egg production in laying hens. However, inorganic waste such as plastic, glass, and other non-degradable materials must be excluded, as they pose health risks and endanger poultry. Using kitchen waste not only lowers feed costs and improves economic efficiency but also promotes environmental sustainability by diverting organic waste from landfills, thereby reducing greenhouse gas emissions and contributing to a circular bioeconomy. Kitchen waste offers a sustainable and potentially cost-effective alternative to commercial feed, with nutritional content that varies but can provide valuable protein, fat, and fiber. Studies have shown that certain food waste streams can significantly reduce feed costs by replacing expensive grains, oils, and protein meals, with potential cost savings of up to 25% in some cases. Despite these benefits, challenges such as contamination risks, nutrient imbalances, and seasonal variability in waste availability must be addressed through proper management strategies, including composting, fermentation, and drying. With such measures, the full potential of kitchen waste as an alternative feed source can be harnessed to promote environment friendly and resource-efficient poultry farming.

Keywords: Alternative feed resources; household poultry production; organic waste utilization

Received: May 23, 2025
Accepted: July 25, 2025
Published: September 7, 2025

Citation: Bughio, E.; Hussain, J.; Jatoi, A.S.; Magsi, A.S.; Memon, M.; Usama, M. Kitchen waste: a sustainable approach for backyard poultry farming. *Insights Anim. Sci.* **2025**, *2*(2), 1–9.
https://doi.org/10.69917/ias.02.02-01

Publisher: Insights Academic Publishing (IAP), Lahore, Pakistan

1. Introduction

Backyard poultry farming is considered a sustainable and economical means of raising chickens, particularly in rural and peri-urban areas [1]. Birds are typically confined to houses—either on the ground or floor, on netted floors in cages, or on slats—making it an efficient, convenient, and cost-effective method of rearing chickens. This approach has gained further importance with the increasing global demand for eco-friendly agriculture, including the use of kitchen waste in poultry feeding.

Kitchen waste (KW) such as vegetable peels, fruit remains, and leftover food provide a nutrient-rich, low-cost alternative to commercial feeds, while also helping to address one of the major issues associated with food waste [2]. Recycling kitchen waste enables farmers to reduce their dependence on expensive commercial poultry feed [3]. Moreover, it minimizes environmental impact by diverting organic waste from landfills, where it would otherwise contribute to greenhouse gas emissions [4]. This practice not only

supports environmental sustainability but also promotes a circular economy, benefiting small-scale farmers by lowering input costs [5].

While formulated feed is frequently used in commercial poultry farming, it is often expensive. Under free-range production systems, birds can meet part of their nutritional requirements from household leftovers, primarily kitchen waste, vegetables, and green grasses [6]. However, the effective and safe use of kitchen waste requires careful evaluation of its nutrient composition, proper handling, and contamination control to safeguard poultry health and productivity [7]. Ensuring that kitchen waste is properly sorted and prepared is essential to avoid any adverse effects on poultry [8].

This review explores the potential benefits, challenges, and best practices associated with integrating kitchen waste into backyard poultry farming. By addressing these aspects, the utilization of kitchen waste can contribute to more resilient and resource-efficient farming systems, offering an eco-friendly solution to food waste while supporting sustainable poultry production. Among several strategies to reduce poultry production costs, incorporating kitchen waste into poultry feed represents a particularly viable approach to lowering feed expenses.

2. Kitchen Waste Composition

Kitchen waste is a byproduct of daily food preparation, consumption, and disposal activities [9]. It comprises a wide range of organic and inorganic materials, each with varying nutritional values and suitability for use in poultry farming [10]. Understanding the composition of KW is crucial for determining which types can be used effectively in poultry diets while avoiding potential risks [11]. The waste can generally be categorized into organic and inorganic types, each requiring different handling and processing methods [12].

2.1. Chemical Composition of Kitchen Waste

The primary elements in KW are carbon (C), hydrogen (H), oxygen (O), nitrogen (N), sulfur (S), and chlorine (Cl) (Table 1). The characteristics of KW are closely influenced by local living standards, dietary habits, and cultural practices. Its composition and properties show significant spatial variation, with common features including high moisture, lipid, organic matter, and elevated salinity.

Table 1. Elemental composition of kitchen waste.

Parameters	**Value, %**
Carbon	46.11
Hydrogen	6.89
Oxygen	37.80
Nitrogen	3.19
Sulphur	0.29
Chlorine	0.21
Carbon	46.11

Values presented here are compiled from previously published study [13].

Typically, KW contains 50–85% moisture [14]. For example, investigations conducted in certain Chinese cities revealed that food residues and bones accounted for more than 90% of the total KW, with the remaining fraction consisting primarily of paper, plastic, and other minor components. The chemical composition of kitchen waste (KW) can vary depending on its source and geographical location. From this perspective, the general and average nutrient composition of KW is presented in Table 2.

Table 2. Chemical composition of kitchen waste.

Components	Value
Dry matter, %	31.6
Organic matter, %	92.1
Ash, %	7.9
Crude protein, %	17.5
Ether extract, %	20.1
Crude fiber, %	3.6
Nitrogen free extract, %	50.9
Gross energy, MJ/kg DM	87.8
Digestible energy, MJ/kg DM	23.9

Values presented here are compiled from previously published study [15].

The nutritive value and digestibility of KW vary and are influenced by its source. Restaurant waste, which is similar to KW but typically contains a higher proportion of meat, has been found to have higher crude protein (CP) content and lower nitrogen-free extract (NFE) values [16].

2.2. Comparative Analysis of Kitchen Waste and Commercial Feed

A comparative analysis of KW and commercial feed reveals notable differences in their nutritional composition, digestibility, and suitability for various applications. KW offers potential as a feedstock for biogas production or as a component of animal feed when properly processed. In contrast, commercial feed is specifically formulated to meet defined nutritional requirements and is optimized for digestibility for livestock or pets. While the composition of KW varies considerably, it can contain substantial amounts of protein, fat, carbohydrates, fiber, and minerals. The comparison is presented in Table 3 [17].

Table 3. Comparative analysis: kitchen waste vs. commercial feed.

Feature	Kitchen waste	Commercial feed
Nutrient profile	Highly variable, but generally rich in protein, fat, carbohydrates, fiber, and minerals (e.g., Fe, Ca, P).	Formulated for specific nutritional requirements (e.g., protein for growth, energy for egg production).
Digestibility	Suitable for anaerobic digestion due to high biomass and moisture content. Digestibility can vary significantly based on composition and processing.	Evaluated through feeding studies (in vivo) to ensure nutrient availability for absorption.
Sources of waste	Generated from households, restaurants, food services, and retail sectors.	Manufactured products designed for specific animal species and life stages.
Potential uses	Biogas production through anaerobic digestion, animal feed after processing (especially for chickens).	Direct feeding to livestock, aquaculture, or pets for growth, maintenance, or production.
Challenges	Inconsistent composition, potential contaminants, and requires pretreatment for optimal use.	Higher cost of production and procurement compared to raw waste materials.

Benefits	Waste reduction, resource recovery, and potential for a circular economy.	Guaranteed nutritional completeness and consistency for optimal animal performance.

3. Types of Kitchen Waste

Organic kitchen waste, consisting of biodegradable materials such as vegetable peels, fruit scraps, and leftover food, holds substantial potential for poultry farming [18]. These materials are rich in essential nutrients, making them a valuable alternative to conventional poultry feed [19]. Incorporating organic kitchen waste into poultry diets can reduce feed costs while recycling food waste efficiently, thereby contributing to sustainable and eco-friendly farming practices [20]. However, proper sorting and preparation of organic waste are essential to ensure its safety and nutritional suitability for poultry consumption [21].

Studies have shown that incorporating kitchen waste at levels of up to 50% in the diets of naked neck chickens under a free-range system enhanced growth, morphometric and physiological traits, and improved behavioral responses [6]. Similarly, feeding kitchen waste at levels of up to 75% improved the nutritional composition of eggs. In intensive production systems, kitchen waste inclusion at up to 75% enhanced carcass traits, meat quality and sensory attributes, as well as egg quality and sensory characteristics [22].

3.1. Vegetable Scraps

Vegetable scraps include peels, stems, leaves, and other discarded parts of vegetables. Common examples are potato skins, carrot tops, cabbage leaves, and broccoli stems [23]. These scraps are rich in fiber, vitamins, and minerals, making them a beneficial supplement to poultry diets when properly processed [24].

3.2. Fruit Scraps

Fruit scraps, similar to vegetable scraps, consist of leftover peels, cores, seeds, and other non-edible parts. Examples include apple cores, banana peels, and citrus rinds, which are commonly generated in household kitchens [25]. These materials provide essential nutrients, particularly vitamins (such as vitamin C) and antioxidants, which can positively influence poultry health [26].

3.3. Leftover Cooked Food

Leftover cooked food—including items such as rice, pasta, bread, and vegetable stews—can serve as a valuable source of energy for poultry because of their carbohydrate and fat contents [27]. However, it is crucial to ensure that such food scraps are free from harmful additives, including excess salt, oil, and spices, which may negatively affect poultry health [28]. Proper handling is also essential to avoid contamination and spoilage, as inadequate storage can promote bacterial growth and pose risks to birds [29]. Additionally, portion sizes should be carefully managed, as excessive inclusion of cooked leftovers may disrupt the nutritional balance required for optimal poultry performance [30]. Therefore, appropriate sorting, storage, and monitoring are necessary to ensure the safe incorporation of cooked food into poultry diets while maximizing its nutritional value [31].

3.4. Eggshells

Crushed eggshells provide an excellent natural source of calcium for poultry, which is essential for numerous physiological processes [32]. Calcium plays a critical role in the development of strong bones and a healthy skeletal structure, thereby supporting overall health and mobility. For laying hens, adequate calcium intake is particularly important as it ensures the production of strong, well-formed eggshells [33]. Insufficient calcium levels may result in thin or brittle shells, increasing the risk of breakage [34].

Crushed eggshells also represent an eco-friendly alternative to commercial calcium supplements, reducing waste while offering a sustainable nutrient source [35]. To ensure safety, however, eggshells should be thoroughly cleaned and disinfected to eliminate the risk of contamination or pathogen transmission [36]. When properly processed and

incorporated into poultry diets, crushed eggshells can significantly enhance poultry health and improve egg production efficiency [37].

3.5. Coffee Grounds and Tea Leaves

Coffee grounds and tea leaves are common components of kitchen waste that may offer limited benefits in backyard poultry farming [38]. Although they contain antioxidants and certain minerals, their high caffeine content and residual compounds can pose health risks to poultry, including toxicity and reduced feed intake. Both coffee and tea are good sources of polyphenols, which are beneficial plant compounds associated with various positive health effects [39]. However, their inclusion in poultry feed should be approached with caution, and further research is required to establish safe levels of utilization [40]. Alternatively, composting coffee grounds and tea leaves presents a sustainable option, as it improves soil quality and supports nutrient recycling in backyard farming systems [41].

4. Inorganic Waste

Inorganic waste, including plastic, glass, metal, packaging materials, bones, and hard shells, must be strictly excluded from kitchen scraps intended for poultry feed [42]. These materials provide no nutritional value and pose significant risks to poultry health, such as choking, gastrointestinal blockages, splinter injuries, and toxicity from chemical residues or microplastics [43,44]. Ingesting sharp or indigestible materials can even result in fatal outcomes for birds.

Proper segregation and disposal of inorganic waste are therefore essential to ensure that only clean, organic, and biodegradable materials are incorporated into poultry feed [45]. Effective waste management not only safeguards poultry health and feed quality but also supports environmental sustainability by minimizing pollution and promoting responsible resource use [46,47]. Raising farmer awareness and providing training on waste sorting further enhance the safety and sustainability of integrating kitchen waste into backyard poultry farming [7].

5. Global Trends

In many countries—including the USA, Japan, China, and Korea—kitchen waste is widely utilized in animal, poultry, and aquatic feed, as well as for biogas production and fertilizer in agriculture. In China alone, more than 30 million tons of KW are generated annually [30]. Similarly, in Bangladesh, diverting kitchen waste to biogas plants has been identified as a potential solution for reducing the burden of solid waste while providing a renewable source of energy [48]. Because of its rich nutrient content, KW is extensively used as feed, fertilizer, and a source of methane [49].

Globally, the challenge of food waste is linked not only to resource inefficiency but also to environmental concerns. Large-scale food production requires substantial resource use, and when food is wasted at any point in the supply chain, it contributes unnecessarily to greenhouse gas emissions, environmental pollution, and depletion of natural resources. The UN Food and Agriculture Organization (FAO) estimates that about one-third of the edible portion of food produced worldwide is lost or wasted before reaching the consumer [50]. This means that significantly more food is produced than consumed, a situation that is neither sustainable nor efficient.

In the USA, China, and Korea, the overarching goal of kitchen waste recycling is to improve the welfare and income of local communities by converting waste resources—such as food waste, livestock manure, and biomass—into feed and renewable energy. Policies in these countries emphasize recycling food waste through animal feeding, composting, and biogas generation, with some systems employing incineration to recover energy [51,52].

Japan was among the earliest adopters of recycling food waste into compost. However, demand for compost has historically been limited due to competition with chemical fertilizers [53,54]. More recently, safety and well-being concerns have reinforced the

importance of using compost and other recycled byproducts in sustainable farming systems [55–56].

6. Future Perspectives and Innovations

The integration of kitchen waste into backyard poultry farming presents significant opportunities for innovation and sustainability [57]. Advanced processing methods such as composting, fermentation, and drying can improve the safety, nutritional quality, and shelf life of KW, thereby enhancing its reliability as a poultry feed source [58].

Emerging precision farming tools—including mobile applications and smart devices—can enable farmers to monitor waste composition and track feed quality in real time, ensuring balanced poultry nutrition [30]. Biofortification research also holds promise for enhancing the nutritional value of food scraps, making them more suitable for poultry diets [59].

At the community level, collective initiatives in which households collaborate to collect and process kitchen waste could reduce individual costs, promote shared responsibility, and strengthen local food systems [60]. Educational campaigns and supportive policies will be crucial in guiding safe adoption, providing best practices for handling and feeding, and fostering farmer confidence [61].

With these innovations, KW could evolve into a cornerstone of sustainable poultry farming, simultaneously addressing the challenges of food waste, lowering feed costs, and contributing to resource-efficient agricultural systems [62].

7. Conclusions

The integration of kitchen waste into backyard poultry farming presents a practical, cost-effective, and sustainable solution to feed challenges while simultaneously minimizing environmental impacts. Organic fractions of KW—such as vegetable scraps, fruit peels, leftover cooked food, and eggshells—provide valuable nutrients that support poultry health, growth, and productivity. Compared to commercial feeds, KW is inexpensive and readily accessible at household or village levels, offering an opportunity to enhance smallholder poultry production. Equally important is the exclusion of inorganic waste and the adoption of proper waste management practices to safeguard bird welfare and feed safety. By diverting organic waste from landfills, this approach also contributes to reducing greenhouse gas emissions and advancing a circular bioeconomy.

Nonetheless, challenges such as contamination risks, nutrient imbalances, and variability in waste supply must be addressed. Future progress will rely on the application of innovative processing technologies and adherence to science-based feeding guidelines. If managed effectively, KW has the potential to serve as a cornerstone of sustainable backyard poultry farming, delivering benefits for farmers, the environment, and local food systems.

Author Contributions: Conceptualization, methodology, E.B, J.H., and A.S.J.; data curation, EB, A.S.M., M.M. and M.U.; writing—original draft preparation, E.B., J.H., A.S.J., A.S.M., and M.M.; writing—review and editing, M.M., M.U., J.H., and A.S.J. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: Not applicable.

Data Availability Disclosure: No new datasets were created or analyzed as part of this study.

Funding and Support Disclosure: No external financial support was obtained for this study.

Conflicts of Interest: The authors declare no conflict of interest.

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