Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

A COMPREHENSIVE REVIEW ON UPCYCLED FOOD: A WAY TOWARDS ZERO WASTE POLICY

AQSA PARVEEN
Department of Food Science and Technology, Government College Women University, Faisalabad.

EMAN NOOR
Atta-ur-Rahman School of Applied Biosciences (ASAB), National University of Science and Technology, Islamabad.

AMNA SAHAR
Department of Food Engineering, University of Agriculture, Faisalabad.

MADIHA ROHI
Department of Food Science and Technology, Government College Women University, Faisalabad.

NAZIA KHALID
Department of Food Science and Technology, Government College Women University, Faisalabad.

RABIA RAMZAN
Department of Food Science and Technology, Government College Women University, Faisalabad.

AYSHA SAMEEN *
Department of Food Science and Technology, Government College Women University, Faisalabad.
* Corresponding Author Email: dr.ayshasameen@gcwuf.edu.pk

Abstract

Food is wasted globally to the extent of more than one-third. To address this problem and lessen food loss and waste, numerous initiatives have been developed to incorporate food discarded as an ingredient in brand-new foods, or so-called upcycled foods. Moreover, efficient waste/byproduct recovery and recycling can effectively aid in reducing environmental stress by minimizing unnecessary pollutants. Foods that are upcycled are produced with ingredients that are typically wasted but are still usable. Even though upcycled foods can decrease food waste, the best marketing strategy for these items is unknown. Consumers must act more quickly to adopt sustainable product disposal practices including product reuse and life extension. This is because disquiets about today's environmental disputes are becoming more significant. This review's primary goal is to give in-depth knowledge on the valorization of agri-food trashes and byproducts, emphasizing bioactive substances and bioactivity.

Keywords: Upcycled Food; Recycling; Food Waste; Reuse; Valorization; Byproducts; Bioactive Substances.

INTRODUCTION

1. Food waste

Food security, the economy and the environment are all critically affected by food loss and waste (FLW). Since FLW reduces the amount of food that is accessible to humans, it is a serious issue in terms of nutritional insecurity. According to the Food and Agriculture Organization (FAO), almost one-third of all produced food (1.3 billion tons of edible food) is lost or discarded every year along the whole supply chain. FLW has adverse impacts

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

on the environment, the economy, poverty and natural resources. Methane, which has the potential to cause global warming that is 25 times larger than carbon dioxide, and other greenhouse gases are created in significant amounts as FW is disposed of in landfills (Ishangulyyev, Kim, & Lee, 2019). About $1 trillion is expected to be invested yearly in the economic costs of worldwide food loss and waste (FLW) (Spang et al., 2019). The FAO estimates that 25% of vegetables and 15% of fruits are wasted at the final stage in the food production chain based on its evaluation of the impact of food waste on the environment (Edwiges et al., 2018). Waste from fruits and vegetables is used to isolate and extract potentially bioactive substances, like phenolics and phytochemicals, that can be utilized in the food industry, pharmacology, cosmetics, and textile industries (Sagar, Pareek, Sharma, Yahia, & Lobo, 2018).

By the Rethink Food Waste through Economics (ReFED, 2016), Improper storage conditions at each level are the primary cause of most food loss. This food waste is produced at all points throughout the food supply chain from post-harvest at the farm stage to leftovers in commercial institutes, restaurants and homes. Describe in great detail how the waste was distributed during each stage. Food waste from production made up 20% of the total amount generated, processing made up 1%, distribution made up 19%, and consumers and households made up 60% (Ganesh, Sridhar, & Vishali, 2022). In addition to the direct loss of food products, the loss and waste of fruits and vegetables also result in the indirect loss of vital resources such as land, water, fertilizers, chemicals, energy, and labor. Since they decay in landfills and release hazardous greenhouse gases, they contribute to environmental issues (Augustin, Sanguansri, Fox, Cobiac, & Cole, 2020) .

The global petition for food and natural resources is frequently rising along with the global human population (Sharma, Gaur, Kim, & Pandey, 2020). Preventing hunger and ensuring that everyone has access to sufficient, safe, and nutritious food year-round is one of the Sustainable Development Goals (SDG) of the United Nations. The second SDG, "Zero Hunger," and SDG goal 12.3, which focuses on halving food waste and minimizing food losses, clearly complement each other. Reducing food waste benefits, the environment and the economy as well as contributing to better global food security. Food upcycling is a technical approach to reducing food waste that keeps food byproducts' economic and nutritive worth. Unfortunately, many of the upcycled foods created are discretionary items like snack foods that do not belong to a balanced diet and should only be consumed occasionally in limited amounts (Thorsen et al., 2022). In light of the significance of providing a sustainable healthy diet, this article explores prospects for producers of upcycled foods to create more nutrient-dense goods. Upcycled food is a novel idea in the inventory of strategies for reducing food waste. Trend reports suggest a huge market potential as the phrase is widely utilized in the food industry. Food rescue presents a significant opportunity to both tackle food insecurity and reduce food waste by food gathering that might have otherwise been wasted and rerouting it for human consumption (Rondeau, Stricker, Kozachenko, & Parizeau, 2020).

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

2. Defining Up cycled foods

Across the whole food supply chain, including the stages of production, processing, transport, shipping, storage, retail, food service, and consumption, food waste occurs. One way to manage waste in the food supply system is to reuse the eatable component of food that is rejected to manufacture food for human use. As that as it may, the food would not be thrown away. Biscuits made with apple pomace or sunflower flour are one example of this method. The term "upcycled foods," which was just recently coined, refers to food products prepared from such ingredients and are considered value-added food goods. Unsellable ingredients are used to make upcycled food. Upcycling is a word that comes from the 1990s and refers to using discarded items or materials in a way that results in a product that is more valuable or of greater quality than the original (Bridgens et al., 2018). Together with the increase in the world's human population, the demand for food and natural resources is frequently rising (Sharma et al., 2020). Hunger must be eliminated and all people must have year-round access to safe, nutritional, and sufficient food for the United Nations to accomplish one of its Sustainable Development Goals (SDG). Reducing food waste has positive financial and environmental effects in addition to contributing to increased global food security. Food upcycling is a technological approach to reducing food waste that keeps food's economic and nutritive worth. Unfortunately, a large portion of the upcycled foods created are optional items like biscuits, crackers, and other snack foods that do not belong to a balanced diet and should only be consumed occasionally in limited amounts. Given how crucial it is to maintain a sustainable healthy diet, this study addresses ways that producers of recycled foods might create more nutrient-dense goods (Thorsen et al., 2022). By eliminating needless pollution, efficient waste/byproduct valorization can effectively aid in reducing environmental stress (Ben-Othman, Joudu, & Bhat, 2020).

The idea of repurposing food is a novel one in the armory of strategies for reducing food waste. Trend assessments indicate that there is a significant market opportunity because the term is spreading like wildfire in the food industry. Other names for food upcycling include waste-to-value, value-added surplus products, and side-stream valorization (Aschemann-Witzel et al., 2023). Recycled foods are made with ingredients that would not typically be utilized in human feasting, they are obtained and produced through a recognized supply system and have a positive effect on the environment (Aschemann-Witzel et al., 2023). Foods that have been "upcycled" make use of leftover materials from the production of other goods. The leftovers are then transformed into something new. For example, leftover grain from beer brewing can be dried and converted into granola rather than being thrown away, and carrot peels can be dried and added to a powdered soup mix (Bhatt et al., 2018).

Byproducts and foods that are unfit for commercial sale in the market are among the ingredients that are used in upcycled food products instead of being wasted. Renewal Mill in San Francisco, California, is an illustration of a recycled food business. Renewal Mill uses the soybean pulp produced as a byproduct of making soymilk to make a flour known as okara. These and comparable components can be used to make value-added

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

foods, which is a practical way to cut down on food waste (Spratt, Suri, & Deutsch, 2021). The goal of the upcycled food industry is to lessen food loss and waste, lessen the environmental harm caused by overproduction and waste, and increase global access to healthy, sustainable food supplies. Food that is wasted or lost per year has a market worth of almost $940 billion worldwide. Considering this abundance of food, one in nine people experience food insecurity and hunger worldwide, and over 820 million people are undernourished. The Food Recovery Hierarchy demonstrates that by lowering the production of surplus food, food waste can be reduced. Consequently, researchers suggest preparing food with leftover ingredients. Upcycled food is another name for these foods. Co-streams or byproducts are terms used to describe the food components used in upcycled food, which are frequently wasted near the source of supply. A novel cooking technique that produces upcycled food addresses the issue of food waste. Food waste is the primary ingredient used by food firms to create recycled food. As a relatively new food segment, upcycled food is currently produced by a large number of businesses (Force, 2020).

Food companies and research institutes have begun developing and distributing dishes using leftover food components. These meals, also known as upcycled foods, are safe for humans to eat and offer a promising way to reduce food waste. In response to the demand for producing such meals, numerous food firms have begun producing foods created from surplus components. The Food System Sensitive Model advocates for the use of commonly discarded ingredients in the creation of other food products. These food items are frequently referred to as upcycled foods (Bhatt et al., 2018). Food ingredients used in upcycled foods are frequently referred to as co-streams or byproducts and are typically thrown away close to the point of supply. Other dishes that can be consumed by humans are made with these ingredients. Brewers' wasted grain is a prime example. Beer brewing includes the utilization of grains. There is still significant flavor and nutrition in the grains even after their starch and sugar, which are used to make beer, have been taken. The dried form of these grains can be utilized as a filler in baked dishes and other foods. Similar to how apples are widely consumed, carrots are also consumed widely, although the peel is typically discarded, especially when producing "baby carrots" on an industrial scale. Even though items like carrot peels are nutritious, it has long been customary to discard the peels. Carrot peels can, however, be dried and used to make a recycled powdered soup that is safe for consumption (Bhatt, Ye, Deutsch, Ayaz, & Suri, 2020).

Worldwide, almost one-third of the foodstuff produced is lost. To paraphrase a problem that has been solved many times before (Yilmaz & Kahveci, 2022). A method of reducing food waste that diverts the edible portion of discarded food into the food supply chain is called upcycling. Meals that are upcycled frequently contain elements that aren't typically meant for human consumption, like damaged crops, byproducts, and food industry leftovers. Upcycled foods are a brand-new kind of food in addition to conventional and organic foods. Food waste, together with byproducts and components from the food manufacturing process, can be used to create up-cycled foods. At any step in the food supply chain, food commodities that have been formed, processed, sold, or presented to

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

the customer but have not yet been consumed might cause an excess of food supply (Hanieh Moshtaghian, Bolton, & Rousta, 2023).

Recycled resources from the production of other products are used to make "upcycled" food. Afterward, new goods are created from these byproducts. If properly marketed to customers, culinary products manufactured from excess components that would have otherwise gone to waste could represent a promising waste management strategy. We refer to these items as value-added surplus products (VASP), and we contend that the key to commercializing them is to comprehend and influence customers' perceptions of them to increase their acceptability to consumers (Bhatt et al., 2018). Recycled food provides an additional option to consume food by using components that "otherwise would not have gone to human consumption, are purchased and manufactured through verifiable supply chains, and have a positive impact on the environment. The Upcycled Food Association was established in October 2019 to coordinate and magnify these efforts to provide paths for food to re-enter the human food supply chain, including coming to an agreement on a common definition and creating a ground-breaking certification procedure. According to the Upcycled Food Association's certification program, 137 ingredients and products have been certified in the US to date (Upcycled Food Association, 2022), and the trend is ahead traction across the world among business and research organizations (Grasso, Fu, Goodman-Smith, Lalor, & Crofton, 2023; Spratt et al., 2021; Yilmaz & Kahveci, 2022).

Food ingredients that have nutritional value and can be used but are typically wasted are used to make upcycled food. For example, while carrots are frequently consumed, the peels are typically thrown away. Nevertheless, dried and processed carrot peels can be made into a repurposed powdered soup that is suitable for human eating. There are currently numerous businesses supplying these delicacies made with such ingredients all over the world. For instance, a US-based firm called Planetarians has created a plant-based protein that is derived from spent sunflower seeds. The protein is utilized to make a variety of wholesome foods that are safe to eat. Other instances include businesses like Regrained, which incorporate recycled grains into food items like bars and puffs. Upcycled foodstuffs are a better approach to address the issue than alternatives like feeding animals and composting because they cut down on food waste more nearby the source (Zhang et al., 2021). Upcycled meals can offer a lot of nutritional and environmental benefits, even though food industry waste is a rich source of nutrients including proteins and fiber. Sunflower seed oilcake is one such; it is a by-product of the manufacture of sunflower oil and contains significant levels of proteins, fiber, vitamins, and minerals. It can be converted into high-protein, food-grade flour that can be used to make meat and pastry goods. This has previously been researched and tested, and the results have been promising (Asioli & Grasso, 2021; Grasso et al., 2023).

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

Table 1: Upcycled food definitions

Citation/ Source	Definition	Application	Aim/Purpose
Bhatt et al., 2020	Foods made from surplus ingredients or ingredients obtained during the manufacturing of other foods that would have been otherwise wasted	Research	Examining consumer perceptions of upcycled foods by examining the influence of product labelling, advantages, and descriptions
Spratt et al. 2021	"Upcycled ingredients and food products elevate food that would otherwise be wasted to higher uses, and have tangible benefits to the environment and society	Manufacturer	developing an upcycled food definition from the manufacturer's point of view
Upcycled Food Association	"Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment."	Multi-stakeholder including the third-party certification	Providing a uniform and practical definition to the government, industry, academia, and other interested parties

3. Placement of upcycled food in the hierarchy of food waste management

3.1 Food Waste Managing Pyramid

Initially, a waste management hierarchy was created to direct the sequencing of waste management procedures. This plan would prioritize trash treatment and disposal over waste minimization, reuse, and recycling. The general waste management hierarchy's five steps, which are listed from most to least preferred actions, include preventive efforts including reuse, recycling, recovery, and disposal (H. Moshtaghian, Bolton, & Rousta, 2021). The EU Waste Directive mandates that Member States create "waste prevention strategies, concentrating on the important environmental aspects and taking into account the whole life-cycle of products and materials" (EU, 2008, p. 312-6 Regulation 2008/98/EC, 2015).

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

Priorities for legislation and policy governing waste prevention and management should be as follows:

a) Prevention
b) Preparation for reuse
c) Recycling
d) Other recovery, like energy recovery
e) Disposal

(Giordano, Falasconi, Cicatiello, & Pancino, 2020).

The levels of the food waste hierarchy have been expanded to include material recycling to address the significance of regulating nitrogen fluxes and other nutrients. This is because the inevitable food waste has the potential to be economically beneficial (Teigiserova, Hamelin, & Thomsen, 2020). During the most recent version of the food waste hierarchy pyramid, upcycling or valorizing excess food for human use has been acknowledged as a method of recycling food waste. To highlight the potential for food waste biorefineries in the circular economy, they distinguished between "surplus food" and a new category for material recycling. In addition to lists of preferences for consumption, reuse, recycling, and trash treatment, the food waste management hierarchy also advises reducing FLW at the source (Lombardi & Costantino, 2021).

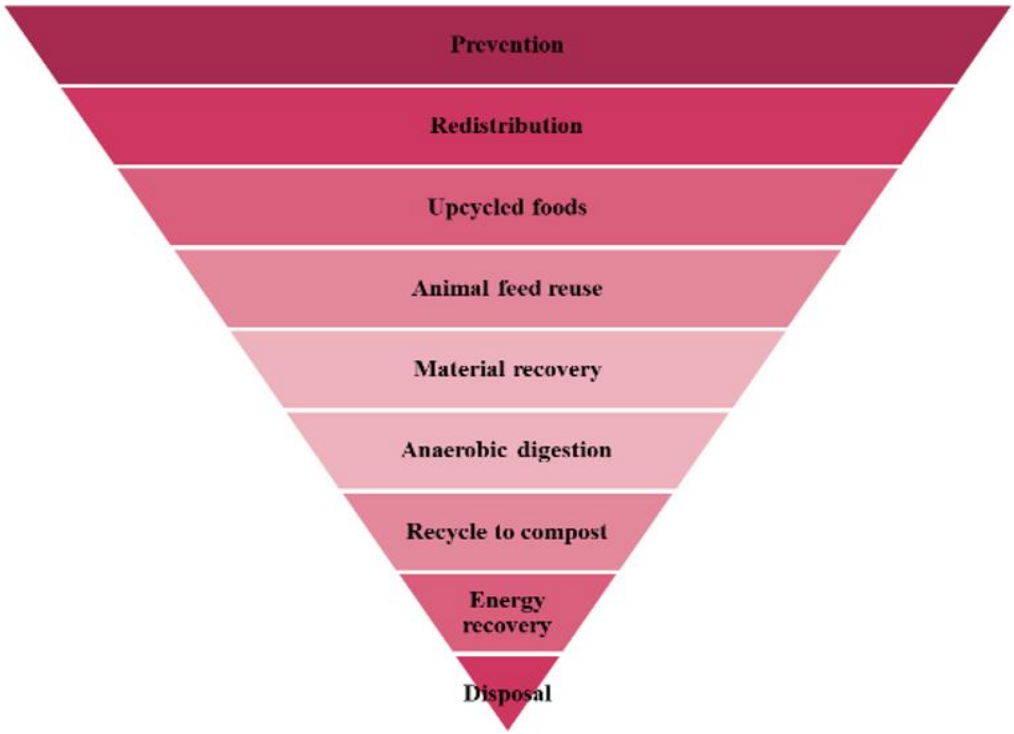

Fig 1: Food waste prevention pyramid

Sources: (Papargyropoulou, Lozano, Steinberger, Wright, & bin Ujang, 2014).

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

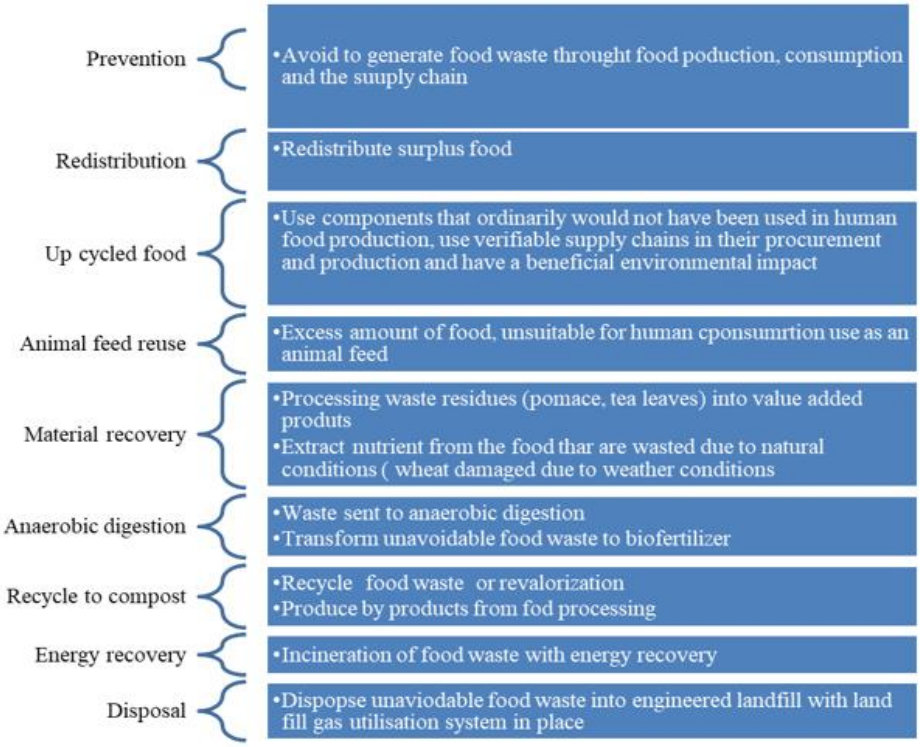

Fig 2: Food Waste Prevention Pyramid Explanation

Sources: (Spratt et al., 2021).

4. Upcycled Food Association

The Upcycled Food Association also established the Upcycled Certification Program Standard to guarantee the accuracy of the claims made by food manufacturers about upcycled products and to support the dissemination of a positive narrative about the upcycling of food (Force, 2020). The Standard is a third-party certification process that ensures that materials or goods that promote themselves as being recycled use verified supply chains and have a positive impact on the environment. On products that contain upcycled ingredients (Yang et al., 2021) or ingredients that have been upcycled (PUI) and satisfy the standards of the Standard, it is acceptable to use an upcycled food logo for front-of-pack labeling. For items whose waste diversion efforts are admirable but which do not achieve the standards set forth by the Standard, a "less than PUI" emblem is provided for back-of-pack labeling. As a result, since 2020, an increasing number of upcycled foods have been highlighted on the website of the Upcycled Food Association. For instance, high protein flour manufactured from brewery leftover grain, effervescent beverages made from the whey that would otherwise be thrown away, and snacks made from cacao fruit that was formerly thrown out are all examples (Upcycled Food Association, 2021). The Upcycled Food Association (UFA) was recently established to handle any policy, infrastructural, networking, and communications challenges that may emerge in this new business. The UFA wants to establish a network of food recyclers. By

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

promoting the upcycled food industry, the Upcycled Food Association seeks to reduce food waste. www.upcycledfood.org; Upcycled Food Association. According to UFA's mission statement, upcycled foods are advantageous to both society & environment. By minimizing food waste, which is the 3rd most efficient way to combat climate change, the association hopes to benefit the environment. They also hope to offer a consumer-focused approach to reducing food waste, whereby increasing demand for upcycled goods will aid in lowering the amount of wasted food. The overall goal of UFA is to establish a food system where all food is used to its fullest potential by creative companies and conscientious consumers (Spratt et al., 2021).

5. Upcycled food brands or companies

The market introduction of upcycled foods by food makers is not surprising. In the US, companies like Regrained (regreained.com) and Planetarians (planetarians.com) sell food produced with upcycled materials. Global markets are starting to see the emergence of upcycled foods, including New Zealand, where shops are now carrying upcycled products like Perfect Deli Fresh and Citizen Collective introduced upcycled pet food and upcycled beer, respectively (Goodman-Smith et al., 2021). Food waste serves as the primary ingredient for upcycled food produced by food manufacturers (Yang et al., 2021). The ingredients in these foods are leftovers from the production of other goods. Afterward, new goods are created from these byproducts.

Fig 3: Upcycled Food Brands

(Bhatt et al., 2020; Goodman-Smith et al., 2021).

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

Acknowledgments

Authors are thankful to the Government College Women University, Faisalabad, Pakistan for providing the facilities used for this study.

Disclosure statement

Zero conflicts of interest have been declared by all authors.

Funding

The author has no funding to report for this research.

Data availability

Enough data are provided in the forms of tables. Additional data provide on the basis of request.

References

1) Aschemann-Witzel, J., Asioli, D., Banovic, M., Perito, M. A., Peschel, A. O., & Stancu, V. (2023). Defining upcycled food: The dual role of upcycling in reducing food loss and waste. *Trends in Food Science & Technology*. doi:https://doi.org/10.1016/j.tifs.2023.01.001

2) Asioli, D., & Grasso, S. (2021). Do consumers value food products containing upcycled ingredients? The effect of nutritional and environmental information. *Food Quality and Preference, 91*, 104194. doi:https://doi.org/10.1016/j.foodqual.2021.104194

3) Augustin, M., Sanguansri, L., Fox, E., Cobiac, L., & Cole, M. (2020). Recovery of wasted fruit and vegetables for improving sustainable diets. *Trends in Food Science & Technology, 95*, 75-85. doi:https://doi.org/10.1016/j.tifs.2019.11.010

4) Ben-Othman, S., Joudu, I., & Bhat, R. (2020). Bioactives From Agri-Food Wastes: Present Insights and Future Challenges. *Molecules, 25*(3), 510. doi:https://doi.org/10.3390/molecules25030510

5) Bhatt, S., Lee, J., Deutsch, J., Ayaz, H., Fulton, B., & Suri, R. (2018). From food waste to value-added surplus products (VASP): Consumer acceptance of a novel food product category. *Journal of Consumer Behaviour, 17*(1), 57-63. doi: https://doi.org/10.1002/cb.1689

6) Bhatt, S., Ye, H., Deutsch, J., Ayaz, H., & Suri, R. (2020). Consumers' willingness to pay for upcycled foods. *Food Quality and Preference, 86*, 104035. doi:https://doi.org/10.1016/j.foodqual.2020.104035

7) Bridgens, B., Powell, M., Farmer, G., Walsh, C., Reed, E., Royapoor, M., . . . Heidrich, O. (2018). Creative upcycling: Reconnecting people, materials and place through making. *Journal of Cleaner Production, 189*, 145-154. doi:https://doi.org/10.1016/j.jclepro.2018.03.317

8) Edwiges, T., Frare, L., Mayer, B., Lins, L., Mi Triolo, J., Flotats, X., & de Mendonca Costa, M. S. S. (2018). Influence of chemical composition on biochemical methane potential of fruit and vegetable waste. *Waste Manag, 71*, 618-625. doi:https://doi.org/10.1016/j.wasman.2017.05.030

9) Force, U. F. D. T. (2020). Defining upcycled foods: A definition for use across industry, government, and academia. *Denver, CO: Upcycled Food Association*, 20.

10) Ganesh, K. S., Sridhar, A., & Vishali, S. (2022). Utilization of fruit and vegetable waste to produce value-added products: Conventional utilization and emerging opportunities-A review. *Chemosphere, 287*(Pt 3), 132221. doi:https://doi.org/10.1016/j.chemosphere.2021.132221

11) Giordano, C., Falasconi, L., Cicatiello, C., & Pancino, B. (2020). The role of food waste hierarchy in addressing policy and research: A comparative analysis. *Journal of Cleaner Production, 252*, 119617. doi:https://doi.org/10.1016/j.jclepro.2019.119617

12) Goodman-Smith, F., Bhatt, S., Moore, R., Mirosa, M., Ye, H., Deutsch, J., & Suri, R. (2021). Retail potential for upcycled foods: evidence from New Zealand. *Sustainability, 13*(5), 2624. doi: https://doi.org/10.3390/su13052624

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 57 Issue: 03:2024
DOI: 10.5281/zenodo.10868382

13) Grasso, S., Fu, R., Goodman-Smith, F., Lalor, F., & Crofton, E. (2023). Consumer attitudes to upcycled foods in US and China. *Journal of Cleaner Production, 388*, 135919. doi:https://doi.org/10.1016/j.jclepro.2023.135919

14) Ishangulyyev, R., Kim, S., & Lee, S. H. (2019). Understanding food loss and waste—Why are we losing and wasting food? *Foods, 8*(8), 297. doi:https://doi.org/10.3390/foods8080297

15) Lombardi, M., & Costantino, M. (2021). A hierarchical pyramid for food waste based on a social innovation perspective. *Sustainability, 13*(9), 4661. doi:https://doi.org/10.3390/su13094661

16) Moshtaghian, H., Bolton, K., & Rousta, K. (2021). Challenges for Upcycled Foods: Definition, Inclusion in the Food Waste Management Hierarchy and Public Acceptability. *Foods, 10*(11), 2874. doi:https://doi.org/10.3390/foods10112874

17) Moshtaghian, H., Bolton, K., & Rousta, K. (2023). Upcycled food choice motives and their association with hesitancy towards consumption of this type of food: a Swedish study. *British Food Journal*. doi:DOI 10.1108/BFJ-09-2022-0757

18) Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., & bin Ujang, Z. (2014). The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production, 76*, 106-115. doi:https://doi.org/10.1016/j.jclepro.2014.04.020

19) Rondeau, S., Stricker, S. M., Kozachenko, C., & Parizeau, K. (2020). Understanding motivations for volunteering in food insecurity and food upcycling projects. *Social Sciences, 9*(3), 27. doi:https://doi.org/10.3390/socsci9030027

20) Sagar, N. A., Pareek, S., Sharma, S., Yahia, E. M., & Lobo, M. G. (2018). Fruit and vegetable waste: Bioactive compounds, their extraction, and possible utilization. *Comprehensive reviews in food science and food safety, 17*(3), 512-531. doi: https://doi.org/10.1111/1541-4337.12330

21) Sharma, P., Gaur, V. K., Kim, S.-H., & Pandey, A. (2020). Microbial strategies for bio-transforming food waste into resources. *Bioresource technology, 299*, 122580. doi:https://doi.org/10.1016/j.biortech.2019.122580

22) Spang, E. S., Moreno, L. C., Pace, S. A., Achmon, Y., Donis-Gonzalez, I., Gosliner, W. A., . . . Winans, K. S. (2019). Food loss and waste: measurement, drivers, and solutions. *Annual Review of Environment and Resources, 44*, 117-156. doi:https://doi.org/10.1146/annurev-environ-101718-033228

23) Spratt, O., Suri, R., & Deutsch, J. (2021). Defining upcycled food products. *Journal of Culinary Science & Technology, 19*(6), 485-496. doi:https://doi.org/10.1080/15428052.2020.1790074

24) Teigiserova, D. A., Hamelin, L., & Thomsen, M. (2020). Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the circular economy. *Sci Total Environ, 706*, 136033. doi:https://doi.org/10.1016/j.scitotenv.2019.136033

25) Thorsen, M., Skeaff, S., Goodman-Smith, F., Thong, B., Bremer, P., & Mirosa, M. (2022). Upcycled foods: A nudge toward nutrition. *Front Nutr, 9*, 1071829. doi:https://doi.org/10.3389/fnut.2022.1071829

26) Yang, X., Huang, Y., Cai, X., Song, Y., Jiang, H., Chen, Q., & Chen, Q. (2021). Using imagination to overcome fear: how mental simulation nudges consumers' purchase intentions for upcycled food. *Sustainability, 13*(3), 1130. doi:https://doi.org/10.3390/su13031130

27) Yilmaz, E., & Kahveci, D. (2022). Consumers' purchase intention for upcycled foods: Insights from Turkey. *Future Foods, 6*, 100172.

28) Zhang, J., Ye, H., Bhatt, S., Jeong, H., Deutsch, J., Ayaz, H., & Suri, R. (2021). Addressing food waste: How to position upcycled foods to different generations. *Journal of Consumer Behaviour, 20*(2), 242-250. doi: https://doi.org/10.1002/cb.1844