Challenging Perfection: A Systematic Review of Suboptimal Food Consumption

Yudum Tuğçe Erkli[a,1] [iD] **, Aslı Tolunay[b]** [iD]

[a] *Yeditepe University, Institute of Social Sciences, İstanbul, Türkiye, yudumerkli@gmail.com*

[b] *Yeditepe University, Faculty of Economy and Administrative Sciences, İstanbul, Türkiye, asli.tolunay@yeditepe.edu.tr*

ABSTRACT

The 12th of the 17 Sustainable Development Goals, established by the United Nations in 2015, is to ensure sustainable production and consumption patterns by 2030. Specifically, a key target of this goal is to halve global food waste, tackling retail, consumer, and supply chain levels. This article guides researchers and practitioners by offering a critical review of current research on food waste reduction, emphasizing suboptimal food consumption (e.g., "ugly" produce) as a key area. In this study, a detailed systematic research on suboptimal foods is conducted with 65 articles selected from the Scopus database, and the existing literature on suboptimal food consumption is analyzed to determine its evolution over the years and gaps by clustering prominent issues, and deficiencies in the literature. Recognizing the potential of suboptimal food consumption as a promising tool for food waste reduction, the findings discuss the effectiveness of interventions aimed at increasing the consumption of suboptimal foods, and offer suggestions for future studies.

Keywords: suboptimal foods, food waste reduction, consumer, consumption

Introduction

Food waste according to the Food and Agriculture Organization (FAO) refers to "all food products allocated for human consumption that are instead discarded, lost, degraded, or consumed by pests at any stage of the food chain". Recognizing the detrimental environmental, social, and economic consequences of food waste, the United Nations Sustainable Development Goal 12.3 sets forth a target to halve per capita global food waste by 2030 (FAO, 2021). This objective underscores the critical importance of addressing food waste management throughout the global food supply chain (Stangherlin et al., 2020), a recognized challenge of considerable magnitude (Göbel et al., 2015).

Failure to properly address food waste creates several negative consequences, impacting various aspects of society and the environment. First, rotting food in landfills produces methane, a powerful greenhouse gas. Methane is significantly more potent – around 20 times more harmful – than carbon dioxide (Payne-Palacio and Thesis, 2016, p. 340) and causes serious damage to the environment and human health (Payne-Palacio and Thesis, 2016). Second, while many people around the world face hunger and malnutrition, food waste raises ethical concerns (Mirosa et al., 2016). Developed and developing countries contribute to and experience food waste differently: poor countries face pre-harvest losses, richer countries experience more waste during consumption (Tekiner et al., 2021), discarding amounts equivalent to the net food production of Sub-Saharan Africa (Özçiçek Dölekoğlu, 2017; FAO, 2019). In Europe and North America, individuals waste 95 to 115 kilograms per year, while in Africa, South Asia and Southeast Asia, the rate is 6 to 11 kilograms (Tekiner et al., 2021).

Nonetheless, food waste contributes to starvation (Mirosa et al., 2016), and therefore, efficient use of food resources is vital in solving global food security problems (Liegeard and Manning, 2020). And finally, food waste represents a loss of resources, including labor, water, energy, and money invested in production and distribution (Tekiner et al., 2021). An estimated one-third of food produced for human consumption (equivalent to approximately 1.3 billion metric tons) is lost or wasted each year throughout the food supply chain, which totals to $990 billion globally (FAO, 2019). The global impact of food waste is expected to worsen due to a growing population that will reach 9.7 billion by 2050 demanding a 60% increase in food production (FAO, 2019; United Nations, n.d.) and due to global warming making food production harder. Without intervention to save food from wasting, estimates suggest that food waste could rise to 2.1 billion tons by 2030, equating to a financial loss of approximately $1.5 trillion (WEF, 2018).

Food waste occurs across the whole food supply chain, from agricultural production through industrial processing and household consumption to retail and restaurant service. Increased attention has been given to consumer and retailer-generated food waste, particularly in developed countries, highlighting the need for effective interventions at these stages (Aschemann-Witzel et al., 2016). While macro-level initiatives, such as the FAO's 'Save Food' campaign and the UK's 'Love Food Hate Waste,' seek to address food waste through sustainable supply chain management and awareness campaigns (Bilici and Parlak, 2022; FAO, 2019; Talukdar, 2018), consumers' choices in retail and dining settings shaped by the suboptimality of eatable food products remain as one of the main contributors to food waste (Giménez et al., 2021). Consequently, promoting the consumption of suboptimal foods presents a practical avenue for waste reduction (de Hooge et al., 2017).

Suboptimal food products are defined as items that slightly deviate from normal or ideal standards – especially in terms of cosmetic properties such as appearance, weight, shape, size, date labeling, or packaging – without compromising actual quality or safety (Aschemann-Witzel et al., 2015). In the academic literature, this concept is variously referred to using terms such as 'ugly food' (Jang and Lee, 2022) or 'imperfect food' (Lagerkvist et al., 2023). While minor nuances exist regarding the specific type of deviation – such as cosmetic appearance versus nearing expiration (Hartmann et al., 2021) – these terms are often used interchangeably to describe products that deviate from standard specifications but remain safe for consumption. For the purpose of this review, 'suboptimal food' is employed as the overarching concept encompassing these terminologies. Reintegrating these readily available products into the food chain minimizes waste and reduces the need for additional production, making it a low-effort, high-impact solution from both business and sustainability perspectives. For instance, initiatives like 'No Food Waste' and 'Food Cloud' (Weymes and Davies, 2017) have successfully implemented strategies to address suboptimal food within the food and beverage industry. Retailers play a pivotal role in food waste reduction, with strategies such as price reductions on suboptimal foods demonstrating effectiveness in encouraging consumer purchase (Kulikovskaja and Aschemann-Witzel, 2017). For instance, mobile apps available in different countries such as "Too Good To Go" in Germany or "Fazla iyi" in Turkey tackle the issue further by connecting businesses with excess food to consumers seeking affordable options (Winnow, n.d.). These solutions offer a trifecta of benefits: reduced post-production food waste, minimized environmental impact, and access to discounted food for consumers (van der Haar and Zeinstra, 2019).

Despite increasing global awareness of sustainability and efforts to mitigate food waste through suboptimal food consumption, consumer reluctance persists. This resistance necessitates a deeper exploration of the causative factors and mechanisms at play, an area where research is currently nascent and fragmented (de Hooge et al., 2022). Unlike prior reviews which have generally categorized drivers and barriers (e.g., Stangherlin and de Barcellos, 2018), or studies predominantly focusing on isolated determinants such as specific visual attributes (Loebnitz and Grunert, 2015) or suboptimal degree (de Hooge et al., 2017), this study offers a holistic integration of the field. It differentiates itself not merely by extending the temporal scope of the literature, but by synthesizing these fragmented insights into a unified conceptual framework. This approach bridges the gap between individual consumer psychology and external marketing interventions, offering a novel perspective that categorizes drivers and barriers to reveal the interplay between consumer attitudes and actual market behavior. Therefore, a comprehensive and systematic investigation, grounded in consumer behavior and marketing principles, is crucial to inform organizational strategies for

promoting suboptimal food consumption. The present study seeks to construct a strategic framework for subsequent investigation and furnish practitioners with the means to promote consumer adoption of suboptimal food, thereby contributing to sustainability outcomes through the attenuation of post-production food waste. The study addresses the following research questions (RQs):

RQ1- How does research in terms of suboptimal food consumption evolve?

RQ2- Who are the most influential authors and journals in the field?

RQ3- What have been the emerging predominant themes?

RQ4- What are the future research avenues?

To address these research questions, this study employed a systematic review approach as discussed by Palmatier et al. (2018), utilizing data from the Scopus database with a primary focus on suboptimal food consumption, in line with the structured review methodology outlined by Littell et al. (2008). Furthermore, bibliographic details pertaining to this research are presented, following the methodology of Kristia et al. (2023). The study initially provides an overview on the evolution of suboptimal research over the years with the analysis of the main themes emerged in addition to influential authors and journals. Then, the reviewed studies were clustered according to their main objectives and findings. Next, the gaps in the literature were identified. Finally, the study concludes with clear avenues for future research.

Literature Review

Suboptimal Food Consumption

Suboptimal food is defined as products that deviate from normal or optimal product standards (Loebnitz and Grunert, 2015). These deviations are based on factors such as appearance, weight, shape and size, near-expiration date or post-date labeling, or any deviation from the original quality or safety of the packaging, such as a torn packaging or a damaged box (Aschemann-Witzel et al., 2015 p. 81).

Consumers' preferences for suboptimal food products are influenced by a variety of factors (Aschemann-Witzel, 2018), including product characteristics such as suboptimal degree (de Hooge et al., 2017) or perceived quality (Aschemann-Witzel, 2018), individual characteristics such as socio-demographic characteristics, gender (de Hooge et al., 2017) and psychographic variables (Stangherlin and de Barcellos, 2018) and situational context such as location of food selection (de Hooge et al., 2017). While some consumers choose suboptimal foods to save costs, reduce waste and promote sustainability (Puteri et al., 2022), others tend to choose optimal products because of the lower value perceptions they associate with suboptimality, such as approaching expiration dates, changes in appearance, or packaging damage (Aschemann-Witzel et al., 2019). Challenges to widespread acceptance of suboptimal food consumption include concerns about diminished quality and increasing concerns about health and safety associated with these items (de Hooge et al., 2017; Melbye et al., 2017). As a result, these negative perceptions lead to negative effects on consumer attitudes and purchasing behavior and contribute to more food being wasted (Melbye et al., 2017). Therefore, there are various initiatives to promote suboptimal food consumption and motivate consumers.

Furthermore, marketing strategies that highlight sustainability aspects associated with food waste and emphasize authenticity within the sustainability framework motivate consumers to adopt more sustainable behaviors and choose suboptimal products which have been found to increase consumers' purchase intention (van Giesen and de Hooge, 2019). Additionally, marketing strategies that address pricing issues, such as offering price discounts on suboptimal products, have proven effective in encouraging consumer adoption of these products (van Giesen and de Hooge, 2019, Aschemann-Witzel et al., 2017).

Methodology

Data Collection and Analysis

This study analyses English-language articles indexed in the Scopus database, spanning from January 2000 to March 2025 addressing a broader spectrum of terms encompassing related terminologies (e.g., 'ugly food') within interdisciplinary suboptimal food literature to capture the overall landscape of suboptimal food research from marketing perspective. The selection of Scopus was predicated on its comprehensive coverage of peer-reviewed academic literature (Veloutsou and Ruiz-Mafe, 2020) ensuring a robust and multidisciplinary foundation for the investigation (Samiee and Chabowski, 2012).

A systematic, three-stage funnel search strategy was employed to ensure a comprehensive retrieval of relevant articles. Figure 1 provides the visual representation of this process, delineating the specific outcomes of each stage. Initially, by utilizing a diverse array of terms related to food product suboptimality across keywords, titles, and abstracts, the study aimed to capture the whole current landscape of research. This led to the inclusion of multiple different terms and writing forms used to describe food suboptimality. These included: "expiring products" (Chang and Su, 2022); "nearing expiration" (Hartmann et al., 2021; Zhang et al., 2023); "expiration date-based products" (Zhang et al., 2023); "ugly food" (Jang and Lee, 2022); "leftovers" (Ang et al., 2021; Hsieh et al., 2021; Lorenz et al., 2017); "short shelf life products" (Gustavo et al., 2021); "surplus food" (Principato et al., 2023); "rescued meals" (de Visser-Amundson et al., 2023); "misshapen and aesthetic beauty" (Hingston and Noseworthy, 2020); "aesthetically imperfect vegetables" (Lagerkvist et al., 2023). In addition, since there is no common agreement in the academic literature on the spelling of the terms suboptimal food and sub-optimal food (e.g. Aschemann-Witzel et al., 2018), both spellings were taken into account. To exclude articles published in food sciences and other disciples, and maintain a consumption-oriented focus, consum* is included to all searches. This initial step resulted in 1,997 articles. The dataset was refined through the second-stage exclusion process to improve analytical precision. Three criteria were used in this stage: (1) restriction to articles within social sciences, business, management and accounting, economics, econometrics and finance, psychology, and decision sciences; (2) inclusion of only peer-reviewed journal articles; and (3) exclusion of non-English language publications with a final purification done through the examination of titles and abstracts of the selected articles. The stage resulted in a final dataset of 286 articles. A final, comprehensive full-text review was undertaken to verify alignment with the study's specific research objectives. Articles were retained only if they explicitly investigated suboptimal food consumption and demonstrated clear relevance to consumer behavior, purchasing decisions, or waste management. Articles failing to meet these criteria were excluded, resulting in a refined dataset of 65 articles for subsequent in-depth analysis and clustering.
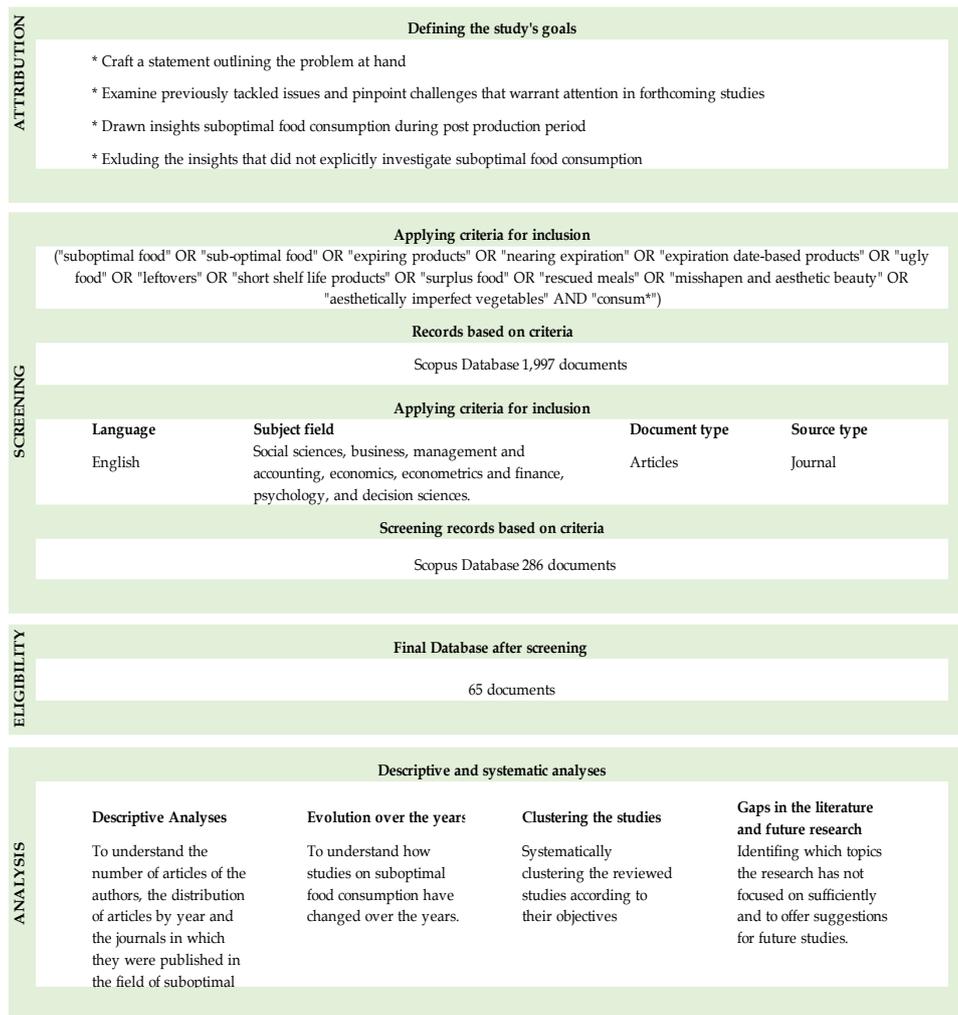
Figure 1. Flowchart of the investigation

Findings

Descriptive Analysis

In order to reveal academic trends in the field of suboptimal food consumption, initially 65 articles were examined in terms of their descriptive features. Within the scope of this analysis, the current state of research in the field was outlined by evaluating data such as the number of publications of the authors, the distribution of the articles by year and the journals in which they were published.

Author Publication Performance

According to the descriptive findings, J. Aschemann-Witzel, – a professor at the MAPP Centre at Aarhus University specializing in sustainable food consumption and consumer behavior – stands out as the most productive author with eight articles, as shown in Figure 2, also showing authors published more than 2 articles on the topic. I. E. de Hooge is the second most productive author with five articles.
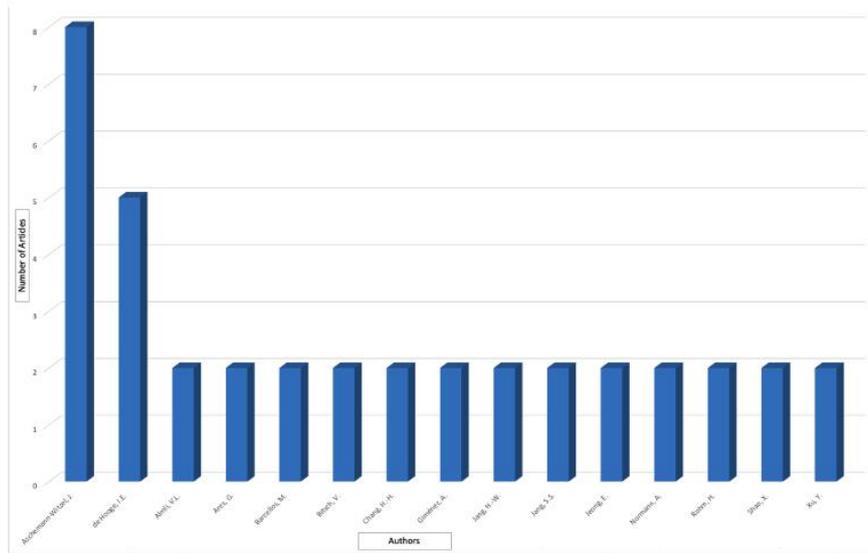
Figure 2. Author publication performance

Article Distribution by Year

Figure 3 displays the annual distribution of the 65 scientific articles, revealing their spread over time. Since our analysis includes data only up to March 2025, the figure doesn't show any articles from the current year. While research on sustainability and waste management has experienced a notable surge, the analysis reveals that investigations into suboptimal food consumption are relatively nascent, with publications appearing only since 2015 (Aschemann-Witzel et al., 2015). 2024 stands out as the year with the highest number of publications, with 14 articles. This clearly shows that food consumption; especially suboptimal food consumption, has received increasing academic attention in recent years (e.g., Li et al., 2025; Sun et al., 2024). This increase shows that reducing suboptimal food consumption and food waste has become a global priority and that interest in scientific studies in this field is increasing.

Upon examining studies from 2021 and 2022, several key themes emerge: marketing strategies aimed at fostering sustainable food consumption (e.g., de Hooge et al., 2022; Moltene and Orsato, 2021), approaches designed to mitigate suboptimal food waste (e.g., Bai et al., 2022), and investigations into consumer perception and behavior (e.g., Heng and House, 2022; Xu et al., 2021) are particularly prominent.
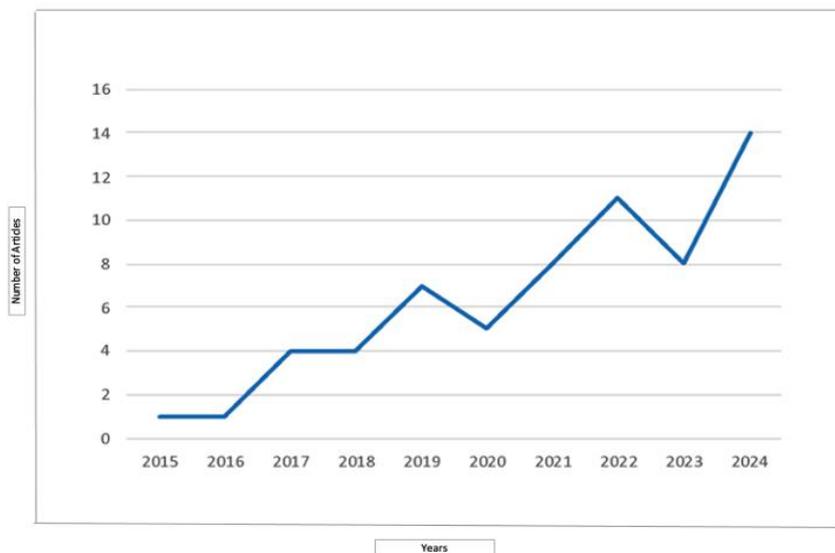

Figure 3. Article distribution by year

Article Distribution in Journals

Figure 4 illustrates that the Journal of Retailing and Consumer Services is the most frequently utilized publication outlet, accounting for seven articles within the analyzed journals. This journal, which has a respected position in the field of consumer behavior and marketing, frequently includes studies on food consumption (e.g., Chang et al., 2024). Furthermore, Foods which has a wide impact in the literature is in second place with six articles, while Sustainability (Switzerland) and Journal of Cleaner Production are in third place with five articles each, focusing on sustainability-themed research (e.g., Tufail et al., 2022; Bai et al., 2022).
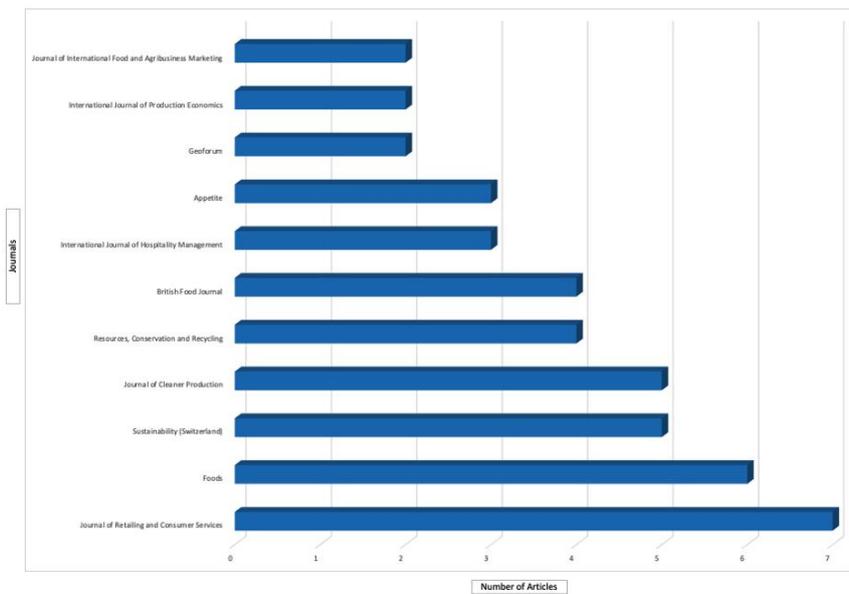

Figure 4. Article distribution in journals

Evolution of Suboptimal Food Research Over the Years

Research on suboptimal food consumption has diversified significantly over time, leading to a substantial and expanding body of literature. Table 1 provides a thematic overview of this literature from the past decade, outlining major research themes, their focal areas, and key contributors.

Table 1. Evolution of suboptimal food consumption research between 2015-2025

Year	Focus and Research Topics	Authors
2015-2016	Introduction and basic concepts: Early studies focused on the concept of perishable food and its definition within consumer behavior, as well as, the retail strategies' (e.g. periodic dynamic pricing or inventory decisions).	Wang et al. (2015); Hu et al. (2016)
2017-2018	Expanding areas of study: Awareness raising regarding food waste, consumer perceptions, management of suboptimal products in the supply chain, use of digital technologies.	Hermsdorf et al. (2017); Aschemann-Witzel et al. (2017); Kulikovskaja & Aschemann-Witzel (2017); Rohm et al. (2017); Symmank et al. (2018); D'Ambrosi (2018); Aschemann-Witzel et al. (2018); de Hooge et al. (2018)

2019-2020	Digitalization and behavioral approaches: Digital platforms, social media influence, moral norms, pricing strategies, innovative solutions to reduce food waste and behavioral analysis.	Schmidt & Matthies (2019); Midgley (2019); Aschemann-Witzel et al. (2019b); Choi et al. (2019); Normann et al. (2019); Stangherlin et al., (2019); Aschemann-Witzel et al. (2019a); Stangherlin et al. (2020); Hashemi et al. (2020); Makhal et al. (2020); Aschemann-Witzel et al. (2020); Shao et al. (2020)
2021-2022	Sustainability and marketing strategies: Studies on sustainability, environmental awareness, ethical marketing, awareness raising through digital platforms and consumer motivations.	Huang et al. (2021); Majhi et al. (2021); Moltene & Orsato (2021); Herbon (2021); Aschemann-Witzel et al. (2021); Xu et al. (2021); Do et al. (2021) ; Cao & Miao (2021); Qi et al. (2022) ; Lin (2022); Heng & House (2022); Lehtokunnas & Pyyhtinen (2022); Jang & Lee (2022); Jang & Cho (2022); Bai et al. (2022); Kayikci et al. (2022); Tufail et al. (2022); Bolos et al. (2022); de Hooge et al. (2022)
2023-2024	Cultural and geographic diversity: Cultural contexts, geographical differences, international comparisons, supply chain management, effectiveness of consumption-based interventions.	Chang (2023); de Visser-Amundson et al. (2023); Yang et al. (2023); Berri & Toma (2023); Lim et al. (2023); Pandey et al. (2023); Wu & Honhon (2023); Lehn & Schmidt (2023); Rana (2024); Morais & Ishida (2024); Sun et al. (2024); Setiawan et al. (2024); Ma & Chang (2024); Hwang et al. (2024); Donato et al. (2024); Fratini & Bitsch (2024); Chang et al. (2024); Young et al. (2024); Agmapisarn et al. (2024); Hong et al. (2024); Chen et al. (2024); Tait et al. (2024)
2025*	Technology and innovative solutions with artificial intelligence: The impact of artificial intelligence, machine learning and digital innovations on food waste management and suboptimal food consumption.	Li et al. (2025); Ruetgers et al. (2025)

*until March 2025

The research direction, while initially limited to consumer behavior and interventions to prevent food waste, has expanded to cover a wider range of topics. For instance, in the early stages of suboptimal food research (2015-2016), research identified the boundaries of the concept (e.g. Wang et al., 2015), while at the same time focusing on the retail strategies' (e.g. periodic dynamic pricing or inventory decisions) impact on consumers' purchasing decisions (e.g. Wang et al., 2015; Hu et al., 2016). In the 2020s, studies increasingly focused on new factors such as digital platforms (e.g. Moltene and Orsato, 2021), environmentally sensitive marketing strategies (e.g. Ruetgers et al., 2025), social media influence (e.g. Young et al., 2024) and social norms (Bai et al., 2022). In addition, studies examining the effects of cultural contexts (e.g. Rana, 2024), technology-based solutions (e.g. Moltene & Orsato, 2021), and more specific sustainability strategies (e.g. Fratini & Bitsch, 2024) on suboptimal food consumption have also begun to take on an important place.

During this period, strategies to increase consumer acceptance and the integration of various behavioral theories (e.g., Theory of Planned Behavior, Norm Activation Theory) have allowed research to become deeper and more multidimensional (e.g. Setiawan et al., 2024). This trend indicates that future research aims to develop more comprehensive and applicable solutions, and is going to focus especially on innovative business models and technology-supported solutions to reduce waste in the food supply chain.

Comprehensive and Systematic Review of the Articles within Clusters

The primary objective of this investigation is to analyze and present the current landscape of research on suboptimal food consumption. The articles reviewed with this aim address different factors such as acceptance, interventions and strategies implemented to encourage consumption, as well as social and environmental impacts, economic and supply chain aspects and present the effects of these factors on suboptimal food consumption in detail. Each article was categorized into clusters based on its principal objective and key findings. These clusters, essential for comprehending suboptimal food consumption and fostering sustainable consumption patterns, are summarized in Appendix A, which details the authors, publication years, aims, methodologies, sample sizes, and findings of the reviewed articles, alongside their respective cluster assignments. Notably, several articles were assigned to multiple clusters, reflecting the inherent multidimensionality of research in this domain.

Cluster 1: Consumer Perceptions and Suboptimal Food Acceptance

Studies within this cluster focus on consumer perceptions and acceptance levels of suboptimal foods varying on the type of product defect, cultural factors, and the consumer's level of knowledge.

Suboptimal Food Types

Consumers have varying perceptions of different types of suboptimal foods (Lim et al., 2023). Consistent with the conceptual heterogeneity of suboptimality within academic discourse, consumers' perceptions and acceptance of suboptimality also exhibit variability. The level of acceptance of various types of suboptimal foods, such as foods with visual defects, products nearing expiration dates is influenced by many factors (Aschemann-Witzel et al., 2020; Cao and Miao, 2021). Visually defective fruits and vegetables are often associated with poor quality by consumers, while price reductions can increase the acceptance of such products (Huang et al., 2021). However, some consumers perceive suboptimal foods as having lower taste and health value compared to fresh products (Yang et al., 2023). Consumer decisions regarding suboptimal foods are not limited to the appearance of the product. Packaging damage can negatively affect taste perception and reduce purchase intention (Cao and Miao, 2021). Yet, certain marketing strategies, such using a "natural" label, can positively change consumer perceptions and increase purchase intentions (Yang et al., 2023; de Hooge et al., 2022).

Cultural Factors

Consumers' attitudes towards suboptimal foods also vary greatly across cultural contexts. The level of acceptance of upcycled foods is found to be shaped by cultural differences. For instance, in the United States, upcycled foods tend to be perceived as more healthy and environmentally friendly, while in Hong Kong they are perceived as more of a novelty. (Hwang et al., 2024).

Research conducted in China has revealed that the concept of face which is rooted in Confucianism, reflecting an individual's concern with maintaining dignity and managing how they are perceived by others in social interactions, and traditional customs are among the important barriers that limit the consumption of suboptimal foods (Bai et al., 2022). Similarly, demographic characteristics also affect consumer behaviors differently across cultures. For instance, having children has been found to reduce food waste among consumers in the United States, but the opposite effect occurs in the United Kingdom.

It has also emphasized that price- and advertising-sensitive consumers tend to produce more food waste in European countries, but this trend is not observed in Canada, France and the United States (Heng and House, 2022).

Information and Knowledge

Research indicates that consumer knowledge significantly modulates acceptance levels of suboptimal foods. Studies demonstrate that environmental information and awareness campaigns enhance ethical judgments and purchase intentions (Chang, 2023). Specifically, marketing strategies emphasizing sustainability and authenticity have been shown to increase sales of these products (de Hooge et al., 2022). Furthermore, heightened awareness of food waste positively influences consumers' intention to purchase 'ugly' foods by altering threat perception and coping mechanisms (Jang and Lee, 2022). Conversely, a reliance on expiration dates diminishes the likelihood of suboptimal food consumption

(Heng and House, 2022). However, price sensitivity and environmental consciousness emerge as key drivers of positive consumer attitudes towards these products (Tufail et al., 2022; Xu et al., 2021). Notably, perceived quality concerns constitute a substantial barrier to suboptimal food purchase (Tufail et al., 2022).

Cluster 2: Interventions and Strategies to Promote Suboptimal Food Consumption

Studies within this cluster, primarily focus on marketing strategies in the form of communication, pricing and innovative product development that increase consumers' awareness and positively affect their purchasing decisions to increase the acceptance of suboptimal foods and to contribute to the reduction of food waste.

Marketing and Communication

Empirical evidence demonstrates the critical role of marketing and communication strategies in promoting suboptimal food consumption. Specifically, sustainability and authenticity messages enhance consumer perception (de Hooge et al., 2022), and reference groups and message framing modulate sustainable food consumption behaviors (Lin, 2022). Additionally, message source significantly influences consumer response, with AI-generated messages excelling in factual communication and human-generated messages in emotional engagement (Li et al., 2025).

Pricing and Discounts

Pricing strategies and discount offerings demonstrably influence consumer purchasing decisions regarding suboptimal foods. For instance, research investigating the impact of 'Buy One, Get One Free' (BOGOF) promotions on retail profitability and food waste revealed a waste-reduction potential under specific parameters (Wu and Honhon, 2023). Moreover, studies on consumer engagement with subscription-based platforms for surplus food distribution indicate a correlation between platform adoption, perceived benefits, and environmental consciousness (Ma and Chang, 2024).

Product Development and Innovation

Research indicates that innovative food waste prevention strategies can expand consumer access to suboptimal foods. Specifically, studies suggest that upcycling, the process of recycling materials to create higher-value products, holds potential for enhancing consumer welfare (Donato et al., 2024). Furthermore, the conversion of surplus food into processed products demonstrates economic viability, although the environmental implications are contingent upon process management (Lehn and Schmidt, 2023). Notably, marketing strategies employing dual-messaging and emphasizing the 'naturalness' of 'ugly' foods have been shown to increase consumers' willingness to pay (Qi et al., 2022).

Cluster 3: Social and Environmental Impacts of Suboptimal Food Consumption

Studies in this cluster provide a more macro focus on suboptimal food consumption.

Food Waste Reduction

Suboptimal food consumption plays an important role in reducing food waste. In particular, digital platforms have been shown to encourage consumers to accept suboptimal foods and to increase consumer awareness through real-time listing of foods and sharing sustainability messages (Agmapisarn et al., 2024). Similarly, Hong et al. (2024) state that awareness campaigns promoting that highlight the social and environmental benefits of reducing food waste increase the appeal of the platform to both socially responsible businesses and consumers. In addition, preventing food waste is very critical in the food service and retail sectors. In this regard, it has been revealed that waste at the household level is most related to shopping habits and expiration date perception (Schmidt and Matthies, 2019).

Sustainability and Ethical Consumption

While ethical and sustainability considerations can contribute to suboptimal food consumption, existing research indicates that religious beliefs and cultural habits (Rana, 2024) and personal norms (Setiawan et al., 2024) can foster sustainable consumption practices within this domain. Furthermore, the framing of salvaged meals significantly influences consumer perception. When salvaged meals are

presented with an emphasis on their environmental benefits, consumers tend to evaluate them more positively. Conversely, highlighting financial savings associated with these meals tends to increase purchase intentions (de Visser-Amundson et al., 2023). It is also noteworthy that environmental goals appear to remain stable over time, while profit-oriented goals may diminish (Bolos et al., 2022).

Cluster 4: Supply Chain Considerations

The focal point of this cluster is strategies from the perspective of supply chain members to improve suboptimal consumption acceptance.

Pricing Strategies

Pricing strategies for suboptimal foods can directly affect consumers' purchasing decisions in the retail setting. For example, price discounts and ethical framing have been shown to improve consumers' attitudes toward suboptimal foods (Chang et al., 2024). In addition, big data analysis has shown that retailers can reduce food waste by creating dynamic pricing strategies (Kayikci et al., 2022). In addition, volume-based promotions were found to be profitable for retailers by shifting some stock burdens to households; however, such strategies are often perceived by consumers as incentives for over-purchasing and generating eventual waste (Wu and Honhon, 2023).

Supply Chain Coordination and Collaboration

Coordination and collaboration in the supply chain play a critical role in reducing suboptimal food waste. Hashemi et al. (2020) emphasizes that supply chain coordination is important in reducing food waste by analyzing how competition between new and old products affects pricing and inventory decisions. In addition, corporate social responsibility (CSR) investments and supply chain coordination show that both increase economic performance and reduce waste (Majhi et al., 2021). In addition, when considering the positive impact of food sharing platforms on the supply chain, it is stated that especially low logistics costs make these systems more sustainable (Choi et al., 2019). Finally, it is stated that food waste is not only a managerial but also a situational practice, and different valuation methods can complicate circular economy efforts (Lehtokunnas and Pyyhtinen, 2022).

Gaps in the Literature and Future Research Directions

The dynamic literature on suboptimal food consumption reveals a significant expansion beyond traditional consumer behavior paradigms, encompassing multifaceted areas such as social norms, digital platforms, environmentally sensitive strategies, and cultural factors. A cluster analysis of existing studies on suboptimal food consumption identifies four principal thematic areas: (1) consumer perceptions and acceptance, (2) interventions and strategies, (3) social and environmental impacts, and (4) economic and supply chain dimensions. While these themes underscore the interdisciplinary nature of the field and its diverse levels of impact, several critical gaps persist within the current body of literature. Addressing these through contemporary research is imperative for refining sustainable food consumption paradigms. The subsequent sections delineate these identified gaps and propose avenues for future research.

Cultural Context and Food Consumption Habits

Cultural values play a determining role in suboptimal food consumption. For instance, in some societies, religious or traditional beliefs create strong norms to minimize food waste, while in Western countries, such consumption is driven more by economic and environmental concerns (Rana, 2024). However, existing studies mostly focus on a specific cultural context and provide limited information on how these differences are shaped internationally (Hwang et al., 2024). Future research could prioritize an in-depth analysis of consumer segments and behavioral profiles, with particular attention to cultural contexts. Establishing precise definitions for concepts such as "low involvement" within developing countries will be crucial for discerning differences between urban and rural consumer behaviors. Furthermore, future studies ought to adopt a broader perspective when examining the influence of cultural factors on attitudes towards suboptimal food, investigating how these behaviors can be effectively promoted across diverse societies.

Consumer Segmentation and Behavioral Profiles

Consumer attitudes toward suboptimal food exhibit considerable heterogeneity. For instance, some consumers prioritize economic advantages, while others are driven by ethical considerations or environmental consciousness (Pandey et al., 2023). Identifying distinct consumer segments is crucial for discerning which groups are more receptive to suboptimal food and for developing effective appeal strategies. However, extant research frequently concentrates on narrow demographic profiles, such as specific age or income brackets, thereby overlooking broader demographic variations (Lim et al., 2023). Future research should therefore prioritize expanding investigations to identify diverse consumer segments, particularly to understand how consumption behaviors are shaped within younger generations and low-income households.

The Role of Emotions and Sensory Perceptions

How suboptimal foods are perceived by consumers is shaped not only by rational factors but also by emotional responses. For example, foods perceived as "ugly" or "spoiled" can create negative emotions in consumers, which can reduce purchase intentions (Yang et al., 2023). However, it has also been shown that emotional framing and positive messages can change these perceptions (Chang et al., 2024). Future research should examine how sensory perceptions, emotional responses, and visual presentation techniques interact to influence decision-making. Understanding these dynamics is crucial to explaining – and potentially bridging – the persistent gap between consumer attitudes and actual behavior. At the same time, greater consideration on the role that emotions and sensory perceptions play in consumer decisions may help explain the gap between attitudes and behavior. In particular, how emotions such as guilt, disgust or empathy, together with sensory cues such as product appearance, smell or presentation style, affect the difference between consumer attitudes and actual behaviors could be investigated in depth. In this context, cognitive psychology and intuitive decision-making models could also be used to explain the attitude-behavior gap.

Effectiveness of Interventions in Real-World Settings

While studies conducted in laboratory settings or using online surveys provide important information to measure attitudes toward suboptimal foods, there is still a large knowledge gap regarding the effectiveness of these interventions in real-world settings (de Visser-Amundson et al., 2023). For example, field studies in restaurants and supermarkets could provide a better understanding of how ethical labels or different pricing strategies affect consumer behavior (Chang et al., 2024). Future research could conduct more field studies to observe the long-term impact of strategies implemented in retail settings and to test the sustainability of these interventions over time.

Longitudinal Studies and Behavioral Change

While most studies on consumer behavior are limited to measuring immediate decisions and short-term effects (Ruetgers et al., 2025), consumer behavior can evolve significantly over time. Consequently, longitudinal studies are crucial for comprehending the long-term impact of strategies aimed at increasing the consumption of suboptimal foods. Key questions, such as the evolution of consumer attitudes toward food waste, the sustained efficacy of awareness campaigns, and the establishment of permanent behavioral changes, remain underexplored (Setiawan et al., 2024). To address this critical gap, future research could prioritize longitudinal investigations that track consumer behaviors over extended periods.

The Role of Technology and Innovation

Digital platforms hold substantial promise for broadening the accessibility of suboptimal foods. For instance, mobile applications and AI-driven recommendation systems designed to mitigate food waste can empower consumers with more informed decision-making (Agmapisarn et al., 2024). Nevertheless, several critical aspects remain under-explored, including user trust in technology, the efficacy of user-friendly interfaces, and the impact of personalized recommendations (Ma and Chang, 2024). Future research could explicitly address these gaps by investigating mechanisms through which digital platforms can enhance user experience, focusing on factors that foster trust and perceived safety (Li et al., 2025). This includes examining the differential impact of AI-based recommendations on various consumer segments, considering factors such as demographic characteristics and prior attitudes towards technology. Furthermore, leveraging advanced technologies for supply chain

optimization and consumer engagement is crucial. Future studies could explore the application of artificial intelligence, big data analytics, and algorithmic systems to optimize supply-demand matching within the suboptimal food supply chain. Complementing these digital solutions, research should also address the physical aspect of waste prevention, specifically by investigating how packaging manufacturers can develop more durable and protective materials to minimize the structural damage that often renders products suboptimal. Finally, the impact of consumer-oriented technologies on perception and acceptance warrants further research. This involves analyzing how technologies like smart packaging systems, freshness-monitoring sensors, and mobile applications reshape the perception and acceptance of suboptimal food, and conducting comprehensive evaluations to ascertain their success not only at a functional level but also in influencing consumer perceptions and attitudes.

Policy Interventions and Regulations

Policy interventions to promote suboptimal food consumption and reduce food waste are of great importance. Research on the effectiveness of regulations such as food labeling standards, tax incentives, and awareness campaigns can help inform policy-making. Such research will play an important role in determining the most effective policy strategies to promote sustainable food consumption practices.

Finally, life cycle analyses should be used more extensively in environmental impact assessments and common measurement criteria should be developed in this area. Not only the reduction of waste, but also the use of resources in areas such as transportation, storage and packaging should be addressed in a holistic manner. The integration of these products, which have the potential to contribute to food security, into public policies should be encouraged, especially in public procurement (e.g. institutions such as schools and hospitals).

In this context, future research may focus on greater interdisciplinary collaboration, leveraging integrated insights from evolutionary trends. Additionally, examining regional nuances, emerging trends, and the intersection of technological and behavioral solutions can offer a detailed understanding of the evolving landscape.

Sectoral Expansion: The Tourism and Hospitality Context

While the existing literature predominantly focuses on retail and household settings, the food service sector – comprising hotels, restaurants, and catering services – remains a critical but under-researched arena for suboptimal food utilization (Filimonau and De Coteau, 2019). This sector presents unique dynamics compared to retail; specifically, the 'back-of-house' operations in professional kitchens allow for the valorization of aesthetically imperfect produce (e.g., in soups, sauces, or sliced fruit platters) where visual deviations are invisible to the consumer (Gössling et al., 2011). However, the barrier here may lie less with the consumer and more with the operational standards and quality perceptions of managers (Filimonau and De Coteau, 2019). Furthermore, open-buffet operations in hotels are significant generators of food waste (Coşkun and Özbük, 2020). Future research should investigate the feasibility of introducing suboptimal ingredients into high-volume hospitality settings. Specifically, scholars could examine how 'rescued' or 'upcycled' menu items are perceived by tourists in luxury or holiday contexts, and whether explicit communication regarding the sustainability of these ingredients enhances or diminishes guest satisfaction (de Visser-Amundson et al., 2023).

Conclusion and Discussion

Encouraging the consumption of suboptimal foods offers a practical and effective approach to reducing food waste. Reintegrating these products, which are easily overlooked in the food supply chain, not only helps reduce waste but also minimizes the need for additional production, providing a sustainable solution that combines environmental and economic benefits for consumers (Lehn and Schmidt, 2023). In this respect, the consumption of suboptimal foods is considered as a vital strategy that requires low effort but has a high impact potential towards achieving sustainability goals.

However, despite the increasing global awareness of sustainability and the implementation of various initiatives at the policy level, consumers continue to be reluctant towards such products. This situation is an obstacle directly related to consumer psychology, perception management and marketing

strategies (de Hooge et al., 2022). Similarly, research on suboptimal food consumption has evolved into a dynamic and interdisciplinary field, yet still lacks coherence and thus necessitates a more systematic approach. This study endeavors to provide a framework that addresses this imperative, thereby laying the groundwork for strategies aimed at promoting suboptimal food consumption

With this aim, this systematic review offers several contributions to the literature on suboptimal food consumption. Firstly, it presents a synthesis of the field, providing a holistic assessment of the current state of research. By integrating findings from 65 articles from the Scopus database, this review elucidates general trends and key thematic areas within suboptimal food consumption. Descriptive findings indicate a growing body of literature in the field, with a notable surge in publications during the 2020s. While consistent contributions from scholars such as J. Aschemann-Witzel have significantly shaped this evolution, high-impact journals, including the "Journal of Retailing and Consumer Services" and "Foods", have also been instrumental in the field's development.

Secondly, this paper functions as a valuable resource for researchers, enabling the leverage of existing knowledge and the formulation of novel research inquiries in alignment with EU sustainability objectives. Furthermore, the identification of several significant gaps within the extant literature has led to the delineation of impactful research directions. Addressing these gaps will facilitate the development of more efficacious intervention strategies aimed at promoting suboptimal food consumption and mitigating food waste.

Finally, the review provides practical implications for various stakeholders. Different stakeholders such as food retailers, marketers, policy makers, and consumers can use these findings to develop more effective strategies to promote suboptimal food consumption and reduce food waste (e.g. Kayikci et al., 2022; Choi et al., 2019). By providing stakeholders with practical knowledge, this review helps in the development of effective interventions aimed at promoting sustainable food consumption practices. This approach enables continued progress in solving the complex challenge of reducing food waste and aims to contribute actionable insights specifically designed to promote sustainable food practices and minimize waste.

In conclusion, consumption of suboptimal foods has a multidimensional potential in terms of sustainability, environmental responsibility, and economic efficiency. Effective evaluation of this potential will only be possible by considering the micro factors that direct consumer behavior and the macro strategies that include supply chain and policy makers together. Adopting this holistic approach in future studies will make significant contributions to both theory and practice.

Limitations

While this study aimed to provide an in-depth analysis of existing research on suboptimal food consumption, it has some limitations. One major limitation is that this research was conducted solely on articles in the Scopus database. Despite Scopus is recognized for its rigorous selection criteria, particularly in the social sciences including marketing (Samiee and Chabowski, 2012), making it a trusted source of high-quality, peer-reviewed literature (Veloutsou and Ruiz-Mafe, 2020), this may exclude other potentially important studies and limit the scope of the overall research findings. Another limitation is that the study mainly focused on post-production and did not extend its scope to encompass sustainable food production, despite its inherent link to sustainable food consumption.

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