Dietética
e promoção da alimentação adequada e saudável
DOI: 10.12957/demetra.2025.80917

DEMETRA
Alimentação, Nutrição & Saúde
e-ISSN:2238-913X

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Evidence of using culinary indicators to evaluate food waste

Evidências da utilização de indicadores culinários na avaliação de desperdício de alimentos

Abstract

Introduction: The Culinary Indicators or Food Transformation Indices (FTI) provide a more conscious approach to menu planning since they support estimating food weight variation during preparations. ***Objective***: Thus, this study sought to clarify the relationship between FTI and waste assessment in food service. ***Method***: The Scoping review of the literature performed by the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) and Methodology for JBI Scope Assessments, presented in the Joanna Briggs Institute Reviewers Manual. Descriptors were used to search for studies in the SciELO and Scopus databases, and through open grey literature. The Parsifal software was used for mapping the studies. ***Results***: Twenty-nine studies made up the final sample. The methodologies used to correlate the FTI with leftover or costs of surplus (37.9%, n= 11); FTI (82.8%, n= 24); relating the FTI with the quantification of solid waste, cost of clean leftovers and rest intake (37.9%, n= 11); and, analyze the FTI for better cost control and standardization of preparations (31.0%, n= 9). ***Conclusion***: Although the FTI have been shown to be important for assessing waste, it was identified a lack of studies that show how much the FTI contribute to waste reduction. It was also noted the need for standardized methodologies to generate the FTI, as well as to expand the acquisition of indicators for a larger number of foods and preparations.

Keywords: Food losses. Index. Cooking. Collective feeding.

Resumo

Introdução: Os Indicadores Culinários ou Indicadores de Preparo de Alimentos (IPA) fornecem uma estimativa da variação de peso dos alimentos durante a elaboração de preparações, tornando o planejamento de cardápios mais consciente. ***Objetivo***: O presente estudo buscou explicitar a relação entre os IPA e a avaliação de desperdícios em Unidades Produtoras de Refeições. ***Método***: Realizou-se uma revisão de escopo da literatura por meio do método *Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews* (PRISMA-ScR) e Metodologia para Avaliações de Escopo JBI, apresentadas no *Joanna Briggs Institute Reviewers Manual*. Descritores previamente definidos foram empregados na busca de estudos nas bases de dados SciELO e Scopus e na literatura não convencional. O *software* Parsifal foi usado para o mapeamento dos estudos. ***Resultados***: Vinte e nove estudos compuseram a amostra final. As formas encontradas de relacionar os IPA e a avaliação de desperdício foram: comparar os IPA práticos e teóricos (82,8%, n=24); relacionar os IPA com o resto-ingestão ou custo de sobra limpa (37,9%, n=11); e, analisar os IPA para melhor controle de custos e padronização de preparações (31,0%, n=9). ***Conclusão***: Embora os IPA tenham se mostrado importantes para avaliar desperdício, foi identificada carência de

estudos que evidenciam, em termos numéricos, o quanto os IPA contribuem para a redução de desperdícios. Notou-se também a necessidade de metodologias padronizadas para gerar os IPA, bem como ampliar a obtenção desses indicadores para um número maior de alimentos e preparações.

Palavras-chaves: Desperdício de alimentos. Índices. Culinária. Alimentação coletiva.

INTRODUCTION

According to the Food Waste Index Report 2024, published by the United Nations Environment Programme, in 2022 approximately 1.05 billion metric tons of food waste (including inedible parts) were generated globally, equivalent to 132 kg per capita. Beyond the social costs associated with food and nutrition insecurity, food loss and waste lead to substantial economic losses (estimated at US$1 trillion). They also result in environmental impacts, including biodiversity reduction due to large-scale cultivation; natural resource depletion; and greenhouse gas emissions, which account for 10% of global emissions.[1]

Food waste appears to be higher in tropical climate countries such as Brazil, possibly due to greater consumption of fresh produce and lack of refrigerated operational logistics. The Food Waste Index in the country is estimated at 94 kg *per capita* annually.[1] Since this data only considers household food consumption, it provides just a partial picture of the national reality. Brazil is estimated to contribute 26 million tons of wasted food, corresponding to about 2.8% of the global total.[2] These sources of waste are varied, occurring from production and transportation to food consumption,[3] which runs counter to UN Sustainable Development Goal 12, which proposes to "halve *per capita* global food waste at retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses, by 2030."[4]

In the context of food systems, food service establishments (FSE) contribute to waste generation, accounting for 28% of global food waste.[1] These establishments serve large groups, handling significant food volumes in short timeframes. Inefficient production process control and lack of technological resources (material, operational, and knowledge-based) are the main factors leading to this outcome, occurring during storage, pre-preparation, preparation or even distribution.[5,6]

Menus are crucial management tools for FSE. These tools are implemented through the development and application of Food Preparation Technical Sheets (FPTS). These sheets facilitate process control by reducing food waste and standardizing meal preparation procedures. FPTS are comprehensive documents detailing ingredients, pre-preparation and preparation methods, number of portions, yield, production costs, nutritional values, and culinary indicators (or indices) or food preparation indicators (FPI). Although FPI reflect foodstuff transformations, particularly regarding weight, their use remains underexplored in technical and scientific literature.[7-11]

The Edible Portion Indicator (EPI), also known as the correction factor (CF), helps predict food losses during the pre-preparation phase, which involves cleaning and removing inedible parts of ingredients. It is calculated as the ratio between gross weight (GW) and net weight (NW) of foods, where GW is the weight of raw food before handling, and NW is measured after pre-preparation.[12,13] It is important to note that the EPI can be influenced by various factors, including food handler training, equipment and utensil condition, raw material quality, preparation techniques, and plating styles.

The Conversion Indicator (CI), also known as Cooking Factor (CF) or Thermal Factor (TF), relates the weight of the prepared food (yield) to the weight of the raw ingredients (sum of the NW of ingredients used). This indicator predicts weight loss or gain during food preparation[7,14] and is influenced by cooking techniques (direct or indirect dry heat, moist heat, or mixed heat), as well as cooking time and temperature.[14,15]

The Rehydration Indicator (RI) applies to foods that require soaking or reconstitution at room temperature, such as legumes, certain grains, and powdered milk.[7] This ratio is determined by comparing the weight of the rehydrated or reconstituted food to the weight of the dry food, as hydration causes the food to increase in size and gain weight from water absorption.[14]

Based on these factors, FPI provide an estimate of food weight gain or loss. This facilitates forecasting the quantity of ingredients needed for planned menus and rationalizing purchase orders, contributing to waste control and cost reduction in FSE.[14,15] Given the importance of FPI as a food production management tool, particularlyin relation to food waste reduction, this study aimed to evaluate evidence of these indicators' use and management in FSE through a scoping review.

METHODS

Study design

This is a scoping review study[16,17] designed according to the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)[18] and the JBI Methodology for Scoping Reviews, as detailed in the Joanna Briggs Institute Reviewers Manual.[19] Therefore, the aim of this study was to address the question: "What are the characteristics of national and international scientific literature regarding FPI, specifically concerning waste in domestic and international FSE?".

The literature search was conducted in November 2021 and May 2022 using the Scientific Electronic Library Online (SciELO), Scopus (ELSEVIER), and gray literature databases. The following keywords were used in Portuguese, English, and Spanish: *Food service establishments; Food and nutrition establishments; Food thermal factor; Food cooking factor; Food conversion indicator; Food correction factor; Edible portion indicator; Culinary indicators; Food rehydration indicator; Menu planning; Food yield; Food preparation technical sheet; Food waste.* Combinations of these terms were also used to broaden the search. Boolean operators AND and OR were used in some instances to combine search terms and exclude irrelevant articles. As each database has different search functionalities, search strategies were adapted accordingly while maintaining similarity in descriptor combinations.

Given the small number of articles initially found, we expanded our search to include additional databases and gray literature, such as undergraduate theses, graduate theses and dissertations from both domestic and international higher education institutions, as well as papers published in scientific conference proceedings. For the gray literature search, the Google search engine was used, which directed to institutional libraries or scientific event websites where the works had been published, using relevant descriptors.

For the mapping process of this review, all identified studies were imported into Parsifal software (https://parsif.al/).[20]

Eligibility criteria

Publications in Portuguese, English, and Spanish addressing relevant concepts, FPI, and/or waste assessment in FSE were included, without a defined time limit due to the scarcity of studies on the topic. Studies that did not fit the conceptual framework of the research were excluded, considering that some descriptors used encompassed subjects not pertinent to this study.

Review and selection of publications

After screening titles and abstracts, the publications were reviewed in full. The most relevant publications were selected for the final sample. Data extracted from Parsifal was organized into a

spreadsheet mapping the following elements: authors, publication year, publication type, country, and study objective.

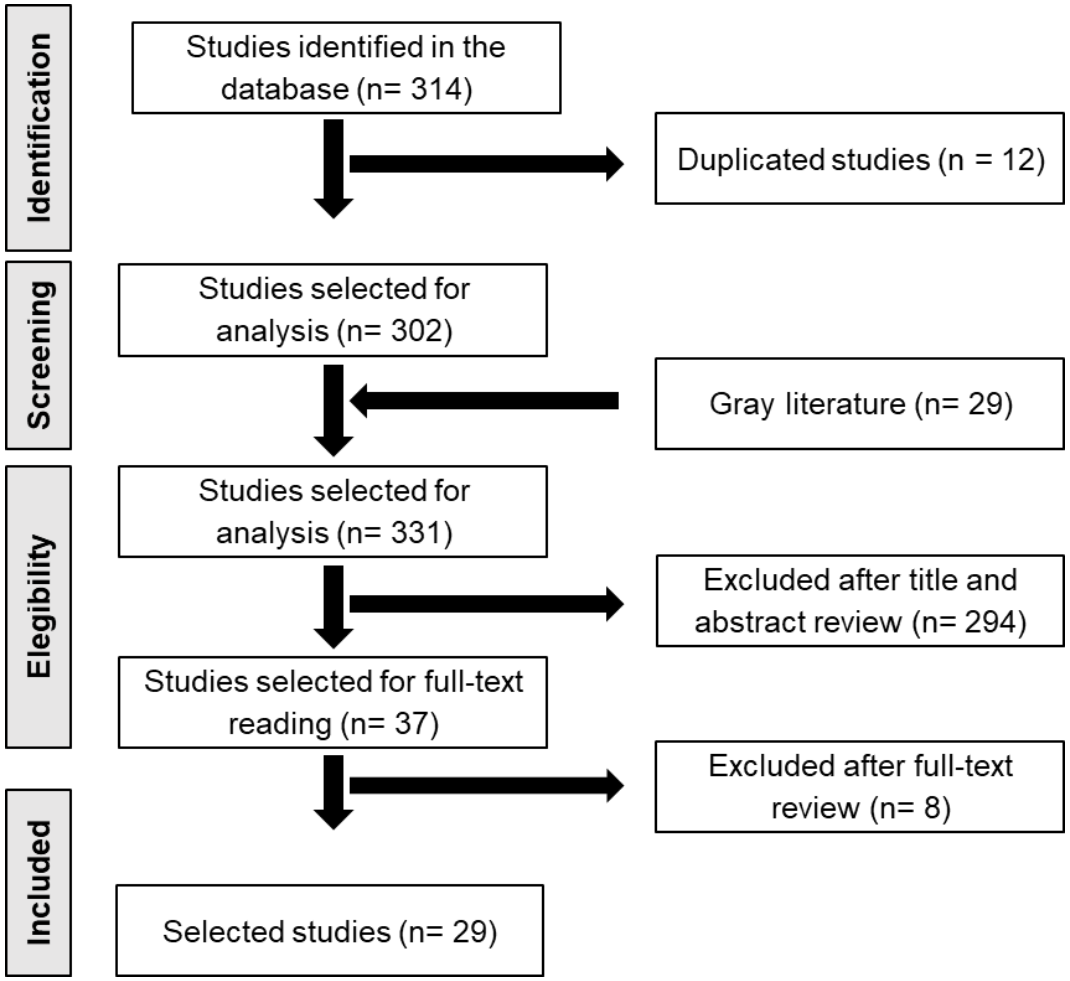
The results were analyzed using descriptive statistics to evaluate relevance (studies across years), scope (number of countries researching the topic), and frequency of FPI use in the studies. Thematic analysis was employed to identify the main approaches to correlating FPI with waste assessment.

RESULTS

Selected studies

After reviewing, selecting, and removing duplicate studies, 301 studies were identified in databases and 29 in gray literature. Of these, 29 addressed the topic of interest and were included in the final sample. Figure 1 presents the research stages following PRISMA-ScR guidelines

Figure 1. Study selection flowchart, according to PRISMA-ScR.



FPI and its relationship with waste assessment

Table 1 presents a summary of key information extracted from the selected studies. Regarding publication period, the sample included works published between 2010 and 2021. The year 2015 had the

highest number of publications (n=5, 17.2%), followed by 2018 (n=4, 13.8%). Brazil was the predominant country of origin with 27 studies (93.1%), while Chile and Sri Lanka contributed one study (3.45%) each. The sample comprised 22 scientific articles (75.9%), four undergraduate theses (UGT) (13.8%), and three abstracts published in scientific conference proceedings (10.3%). Regarding FPI citations in the studies, 44.9% (n=13) mentioned only CF, 17.2% (n=5) only CI, and 37.9% (n=11) both indicators. No studies mentioned RI.

When examining how studies examined the relationship FPI to waste assessment, 82.8% (n=24) compared practical FPI (obtained by FSE during pre-preparation and preparation) with theoretical ones (available in technical-scientific literature). Only 37.9% (n=11) sought to relate FPI to the evaluation of food waste generated by FSE, such as: quantification of solid waste, costs of clean leftovers, and plate waste. Another 31.0% (n=9) analyzed FPI to achieve better cost control or standardization of preparations, which in turn affects waste

Table 1. Characteristics of studies included in the final sample (n=29).

Authors	Year	Country	Type of work	Assessed FPI	Parameters for assessing waste	Main observation or conclusion
Degiovanni GC et al.[21]	2010	Brazil	Scientific article	CF	-Use of CF for pre-preparation cost calculation. -Use of CF and net yield to assess waste and production costs.	Food waste can vary depending on the quality and quantity of the edible portion of the food. This is because it can be influenced by the quality of the raw ingredients and the training of food handlers.
Cortese RDM et al.[22]	2010	Brazil	Conference paper	CF	Comparison of practical and theoretical CF values.	According to the consulted reference, 47.05% of vegetables showed a higher-than-expected yield factor. Discrepancies were observed among the consulted literature sources.
Soares ICC et al.[23]	2011	Brazil	Scientific article	CF and CI	Use of CF and CI to calculate the cost of clean leftovers (CL).	They observed high CL costs, particularly regarding salads, indicating significant waste.
Lemos AG, Botelho R, Akutsu RDCC[24]	2011	Brazil	Scientific article	CF	Comparison of practical and theoretical CF values.	Variation in CF for analyzed vegetables compared to those in consulted literature. Measures such as using appropriate equipment, methods, and raw materials, along with efficient production techniques, should be implemented to reduce CF and waste.
SILVA PCE et al.[25]	2012	Brazil	Conference paper	CI	Comparison of practical and theoretical CI values.	Given the scarcity of theoretical references for CI, the CI values generated in this study could assist in menu planning and purchasing control, preventing waste.
Goes VF, Valduga L, Soares BM[26]	2013	Brazil	Scientific article	CF	Comparison of practical and theoretical CF values.	They consider the CF as an important indicator of waste and emphasize the importance of employee training to reduce the CF for certain vegetables.

Table 1. Characteristics of studies included in the final sample (n=29) (Continues).

Authors	Year	Country	Type of work	Assessed FPI	Parameters for assessing waste	Main observation or conclusion
Parisoto DF, Hautrive TP, Cembranel FM[27]	2013	Brazil	Scientific article	CF and CI	-Comparison of practical and theoretical values of CF and CI to assess waste and standardize preparations based on FPTS. -Determination of leftover to assess food waste.	After implementing FPTS, they found that 70% of analyzed foods were below the reference values considered for FPI, demonstrating reduced waste.
Lacerda LL, Saraiva BCA, Silva YL, Monteiro, MRP[28]	2014	Brazil	Scientific article	CF	Comparison of practical and theoretical CF obtained in two FSE (hospital and commercial).	60% of foods had higher CF than reported in literature. The hospital FSE showed greater variability in CF compared to the commercial FSE.
Alves MG, Ueno M[29]	2015	Brazil	Scientific article	CF	-Use of CF to assess excessive removal of inedible food parts. -Comparison of practical and theoretical CF values.	They observed that 28.5% of solid waste in a FSE was generated during the pre-preparation stage.
Amorim MMA, Jokl L.[30]	2015	Brazil	Scientific article	CI	-Use of CI to evaluate yield. -Comparison of practical and theoretical CI values.	-They observed that ingredients, cut type, and cooking methods influence CI values. Although not the focus of the study, they mention that the EPI, CI, and FPI are crucial for estimating dish weights. By deducting unconsumed leftovers and waste from the total dish weight, it is possible to estimate the nutritional value of meals consumed by customers.
Ribeiro ABD et al.[31]	2015	Brazil	Scientific article	CF and CI	-Comparison of practical and theoretical values of CF and CI.	They observed significant variation in FPI and, consequently, the need for corrective measures to reduce them and control costs.

Table 1. Characteristics of studies included in the final sample (n=29) (Continues).

Authors	Year	Country	Type of work	Assessed FPI	Parameters for assessing waste	Main observation or conclusion
Romero G et al.[32]	2015	Brazil	Scientific article	CF and CI	-Comparison of practical and theoretical values of CF and CI. -Use of CF and CI to standardize preparations and reduce costs.	The implementation of FPTS enabled better control of food quantities used and greater waste prevention.
Fioroto CKS et al.[33]	2015	Brazil	Conference paper	CF	Use of CF to assess full food utilization.	Different cutting tools can cause larger or smaller scraps, influencing waste.
Lima APOM, Nóbrega ECM, Nogueira BA[34]	2016	Brazil	Scientific article	CF and CI	Use of CF and CI to determine waste and assess costs.	Waste was within established reference values, and proper planning and control lead to efficient management.
da Silva CS, de Jesus JC,Soares LS[35]	2016	Brazil	Scientific article	CF	Comparison of practical and theoretical CF values.	Significant waste of fruits and vegetables due to poor raw material quality, as well as lack of theoretical references for CF and waste studies.
Zotesso JP et al.[36]	2016	Brazil	Scientific article	CF	-Comparison of practical and theoretical CF values. -Use of CF to quantify food waste.	The CF evaluated were close to or lower than those found in the consulted literature, indicating a smaller loss than expected.
Costa R [37]	2017	Brazil	UGT	CI	-Comparison of practical and theoretical CI values. -Use of the CI to evaluate food yields.	Many preparations had higher CI values than those in the literature, showing higher yields.
Tibellio, T[38]	2017	Brazil	UGT	CF	-Comparison of practical and theoretical CF values. -Quantification of food scraps.	The omission of the methodology used to determine FPI can be a determining factor in the variation.

Table 1. Characteristics of studies included in the final sample (n=29) (Continues).

Authors	Year	Country	Type of work	Assessed FPI	Parameters for assessing waste	Main observation or conclusion
Pereira, T[39]	2017	Brazil	UGT	CI	-Comparison of practical and theoretical CI values. -Use of the CI to evaluate food yields.	All evaluated CI were within the consulted reference values. Prior knowledge of the CI is crucial for establishing *per capita* consumption, aiding in purchase planning and consequently reducing waste.
Menezes RODS, Santana EDM, Nascimento MOL.[40]	2018	Brazil	Scientific article	CF and CI	- Use of CF and CI to standardize preparations and reduce costs. -Comparison of practical and theoretical CF values.	FPTS can control and reduce costs by establishing the exact quantity and actual cost of raw ingredients.
Adikari AM,Thamilini J[41]	2018	Sri Lanka	Scientific article	CI	Establishing reference values for CI to help with cost control.	Various processing methods can affect the CI, which is crucial for cost control and purchasing management.
Weis G. et al.[42]	2018	Brazil	Scientific article	CF	-Use of CF to assess waste and reduce expenses. -Comparison of practical and theoretical CF values.	The CF values aligned with those reported in the literature but exceeded the predetermined standards set by the FSE, indicating higher-than-expected waste levels.
Caldas R[43]	2018	Brazil	UGT	CF and CI	-Use of CF and CI to standardize preparations, control purchasing, and manage food waste. -Comparison of practical and theoretical values of CF and CI.	They found that 18% and 74% of foods had higher CF and CI values than those reported in the literature, respectively. The implementation of FPTS enabled the identification of non-conformities in production.
dos Santos MCA, Basso C[44]	2019	Brazil	Scientific article	CF and CI	-Comparison of practical and theoretical CF and CI values to identify losses.	The implementation of CF and CI led to effective food waste management during pre-preparation and preparation of food.
Pereira, T[39]	2017	Brazil	UGT	CI	-Comparison of practical and theoretical CI values. -Use of the CI to evaluate food yields.	All evaluated CI were within the consulted reference values. Prior knowledge of the CI is crucial for establishing *per capita* consumption, aiding in purchase planning and consequently reducing waste.

Table 1. Characteristics of studies included in the final sample (n=29) (Continues).

Authors	Year	Country	Type of work	Assessed FPI	Parameters for assessing waste	Main observation or conclusion
Lataste C et al.[46]	2020	Chile	Scientific article	CF and CI	Establishing reference values for CF and CI.	This study is the first standardization conducted in Chile, and the generated benchmarks can help FSE avoid or reduce under- or overestimation of food yields.
Silva NB, das Chagas Moura V M, Bezerra KC B[47]	2020	Brazil	Scientific article	CF	Comparison of practical and theoretical CF values.	29.4% of food items had CF values higher than those reported in the literature, indicating waste in the establishment.
Araújo JMED et al.[48]	2020	Brazil	Scientific article	CF and CI	Use of CF and CI to predict waste and yield.	For the most part, CF values fell within established reference ranges. Regarding CI, preparations made using moist heat had a higher yield than preparations made using dry heat.
Dourado STDC, Martins EDA, Alves AN[49]	2021	Brazil	Scientific article	CF	Comparison of practical and theoretical CF values.	They concluded that 77.78% of the vegetables had lower CF than those reported in the literature, and that staff changes between work shifts influenced waste levels.

CF: Correction factor; FPTS: Food preparation technical sheet; CI: Conversion index; FPI: Food preparation index; FSE: Food service establishment; UGT: Undergraduate thesis.

DISCUSSION

This review aimed to identify evidence of the use of FPI to assess waste in FSE. Regarding the origin of publications, Brazil presented the most publications on the subject. This suggests that, unlike in Brazil, other countries may have limited routine application of these indicators or discuss them less frequently in scientific contexts.

Publications comparing practical and theoretical FPI[21-49] revealed that those found, particularly regarding the CF, varied greatly and were generally higher than the values in reference tables. Some practical CF exceeded theoretical ones by over 50% (depending on the literature consulted), significantly highlighting waste. A lack of theoretical values was also noted for both CF and CI for less common foods and preparations, such as whole wheat pasta and couscous, which made some comparisons impossible. Additionally, the theoretical references used in comparisons did not address techniques used, number of repetitions, and other factors that can alter FPI values.

Studies comparing practical and theoretical FPI were conducted across different settings, including commercial and institutional FSE (hospitals and university restaurants), and dietetic technique laboratories, which may have contributed to the variation in FPI values obtained. For example, a study conducted in two FSE (commercial and hospital-based)[28] evaluated the obtained CF and compared them with values found in the literature. The researchers observed that the CF from the commercial FSE were lower or more closely aligned with literature values. A possible explanation for this is that the standardization process for raw ingredients and cutting techniques may be more effective in commercial FSE.

Studies connecting FPI to waste measurements - including solid waste, clean leftover costs, and plate waste[21,23,27,29,33,34,36,38,42,47,49] found that salad preparation, particularly of fruits and vegetables, generated the most waste. Furthermore, these studies emphasized that using FPI enables effective purchasing management and waste control. Parisoto et al.[27] evaluated the impact of implementing FPTS on plate waste in a community restaurant. The authors observed a reduction in this index, indicating a decrease in food waste.

Studies examining FPI for cost control and recipe standardization[21,27,32,40,41,43-46] found that these indicators can predict food losses and/or gains during pre-preparation and preparation stages and serve as crucial tools for standardizing processes, ensuring quality control, managing costs (particularly in raw material acquisition), and consequently reducing waste.

Most studies focused only on CF or both CF and CI, with few focusing only on CI. This is justified as CF is the most mentioned indicator in literature for loss prevention, highlighting its importance in waste analysis. Findings revealed that the majority of food waste in FSE stems from the pre-preparation of fruits and vegetables, due to their heterogeneity, followed by meats.[29,42,44,46]

These instances of waste resulted from numerous factors. Food handling errors stemming from insufficient training, high employee turnover, high rates of absenteeism and work overload, combined with low wages, contributed to reduced service quality. Equipment inadequacy and lack of maintenance, along with non-standardized cutting tools, can hinder food pre-preparation standardization. Additionally, poor raw material quality and poor conditions in which the food is received and stored increase CF values. Consequently, failing to use this indicator may lead to issues such as increased costs and waste.[22,29,32,33,36,38,44-47,49]

The study[35] that determined CF values in two FSE revealed that leafy vegetables in one establishment had higher CF. The authors attributed this to poor supply conditions and improper handling during selection

and pre-preparation, leading to increased waste. Additionally, this establishment lacked standardized cutting tools. Another publication[26] showed that some vegetables had high CF values compared to reference tables. The authors explain this issue by highlighting potential causes, such as receiving food with advanced ripeness and inadequate storage conditions, as vegetables were kept at room temperature for up to five days, increasing waste.

Some foods showed higher losses during pre-preparation, resulting in elevated CF. Seasonality can significantly influence CF values, as different times of the year directly affect food quality, as seen with Swiss chard, endive, and white cabbage.[24] One study[44] revealed that black beans, pineapple, papaya, melon, carrots, and chicken eggs had the highest CF values. Another study[26] found that garlic, lettuce, potatoes, sweet potatoes, carrots, Swiss chard, onions, cucumbers, and beets had CF values above those established in technical and scientific literature. Additionally, research showed that nearly 20% of analyzed foods had higher CF than reported in literature,[45] with pineapple and smooth lettuce experiencing the greatest processing losses. This variability in CF is attributed to various reasons, from reception and storage to pre-preparation and preparation, where factors such as labor, equipment, utensils, and even seasonality can have an impact.

Minimally processed foods serve as an alternative to fresh produce for reducing waste in FSE.[21,24,44,46] While pre-prepared foods may be more expensive to purchase, kitchens using these products can achieve similar overall costs to traditional kitchens. This is due to savings in equipment usage, labor, energy, water, and physical space. Depending on seasonality, using these foods may be more advantageous.[21,44] However, price fluctuations in these products necessitate ongoing market research to assess the pros and cons of their use, thus ensuring effective management, purchasing planning, and loss control.[21,24,34,44]

Food waste reduction strategies were mentioned, including repurposing and utilizing all edible parts. A lack of knowledge among food handlers regarding full ingredient utilization was noted. Moreover, typically discarded edible components can be incorporated into dishes such as soufflés and stroganoffs, minimizing waste.[24,33,36,38,42,44]

In these studies, the approach to CI focused on determining its values, with waste briefly mentioned as a justification for its calculation. One of the challenges encountered in this review was the difficulty in standardizing CI values due to the time required for weighing food, given that processes in FSE need to be swift.[30] However, measuring this culinary indicator is crucial for assessing recipe yields and accurately forecasting shopping lists, preventing under or overestimation of ingredients.[37,39,40]

Cooking techniques affect recipe yield by altering food volume and weight.[30,37,39] These changes involve multiple factors, including ingredient type, equipment, time, and temperature used. The most commonly cited factors were cooking methods and their effects on water and fat content in foods through retention, reduction, or absorption.[25,41,43]

Foods prepared using dry-heat cooking methods show lower CI values than those cooked with moist-heat methods, though preparation methods can influence weight loss. Consequently, drier foods such as cereals and pseudocereals, which need to absorb water to soften and become edible, increase in weight, resulting in a CI greater than 1. Conversely, foods that lose water during cooking, such as certain meats, fruits, and vegetables, produce a CI less than 1. Tubers typically maintain a conversion factor close to 1, as they lose moisture but also absorb water due to their starch content.[25,39,41,44,46,48]

Selected studies showed that, in salads, vegetables lose more water and have lower CI when cooked, although some approach 1. More complex salads with multiple ingredients can produce varied CI due to the quantity of each food item in the recipe.[25,30,37,44] It was also observed that stewed or sauced meats had higher

yields, while grilled and roasted meats had lower yields due to muscle fiber contraction, protein coagulation, and fat melting/loss. Breaded meat preparations tend to have higher CI as they are coated in a homogeneous batter and deep-fried.[26,30,31,37,39]

Generally, foods with CI below 1, such as sautéed leafy vegetables and roasted or grilled meats, are considered low-yield foods, requiring larger raw ingredient purchases. Conversely, foods with CI above 1, such as soups, beans, and grains such as rice, are considered high-yield foods, necessitating smaller purchases relative to the served amount.[30,32,44,46] This illustrates why CI is a crucial inventory control tool.[27,39]

The calculation of CI values is crucial for determining clean leftovers (CL) in FSE,[30] as these are considered primary indicators of waste.[44] CL include prepared but undistributed food. In this context, recipe yields, CI, and CF enabled one study[23] to determine the cost of CL in eight FSE. The research revealed that, during the studied period (5 months), the total cost of CL was significantly high, amounting to R$24,553.58 in waste.

Of the analyzed publications (n=29), only five (17.2%)[21,23,24,29,46] were sourced from SciELO or Scopus databases. This highlights the need to increase the number of publications on this topic, which is a limitation of this review.

CONCLUSION

The aim of this review was to provide readers with insights into the usefulness of FPI for assessing or reducing waste and facilitating better purchasing planning. It became evident that the contribution of FPI to waste reduction in FSE is complex, as it is linked to the implementation of technical preparation sheets for the set of preparations planned on the menu.

It seems reasonable, therefore, that additional comparative studies are needed to evaluate production costs before and after implementing technical preparation sheets, as this would make the impact of FPI management on purchasing decisions more evident.

It is well-known that FPI are subject to significant variability, depending on ingredients, pre-preparation and preparation techniques, equipment, and food handlers, which make comparisons challenging. Nevertheless, developing comprehensive technical and scientific resources with numerous tested recipes, well-documented preparation methods, and established FPI could serve as a strategy to guide purchasing plans for various FSE and help reduce waste.

ACKNOWLEDGMENTS

To CAPES for providing access to scientific publications. To FAPERJ for financial support (Grant E-26/202.222/2021).

REFERENCES

1. Food Waste Index Report 2024 [Internet]. Nairobi: United Nations Environment Programme; 2024 [cited 2024 August 09]. 172p. Available from: https://www.unep.org/resources/publication/food-waste-index-report-2024

2. Centro de Estudos e Debates Estratégicos (CEDES). Perdas e desperdício de alimentos: estratégias para redução [Internet]. Brasília: Câmara dos Deputados, Edições Câmara; 2018 [acesso 31 maio 2022]. Disponível em:

https://www.google.com.br/books/edition/Perdas_e_Desperd%C3%ADcio_de_Alimentos_Estra/2ofgDwAAQBAJ?hl=pt-BR&gbpv=1&printsec=frontcover

3. De Melo TCB, De Carvalho RM, Leite DB, Bernardo WR, De Souza WL. Os benefícios do aproveitamento integral dos alimentos em uma unidade de alimentação e nutrição. Nut Brasil [Internet]. 2018;17(2):114-21. https://doi.org/10.33233/nb.v17i2.829

4. Nações Unidas Brasil. Os Objetivos de Desenvolvimento Sustentável no Brasil. Consumo e produção responsáveis. [Internet]; [about 5 screens]. [acesso 31 maio 2022]. Disponível em: https://brasil.un.org/pt-br/sdgs/12

5. Teixeira F, Nunes G, Antonovicz S, Silva CC. Principais fatores associados aos índices de desperdício em Unidades de Alimentação e Nutrição: uma revisão integrativa. Saúde Rev [Internet]. 2017 c17(47):4. https://doi.org/10.15600/2238-1244/sr.v17n47p42-50

6. De Andrade GS, Oltramari K. Desperdício de alimentos em Unidades de Alimentação e Nutrição brasileiras. Ambiência [Internet]. 2014;10(1):125-33. https://doi.org/10.5935/ambiencia.2014.01.10

7. Domene SMA. Técnica Dietética. Teoria e aplicações. 2.ed. Rio de Janeiro: Guanabara Koogan; 2019. 266p.

8. Akutsu RC, Botelho RA, Camargo EB, Sávio KEO, Araújo WC. A ficha técnica de preparação como instrumento de qualidade na produção de refeições. Rev Nutr [Internet]. 2005;18(2):277-9. https://doi.org/10.1590/S1415-52732005000200012

9. Cavaler S, Heilman M, Santos AP, Ferreira H, Fatel E. Informações para planejamento e elaboração de cardápios, contidas em editais de licitação de restaurantes universitários em universidades federais do Sul do Brasil. DEMETRA: Alimentação, Nutrição & Saúde [Internet]. 2018;13(3):713-29. https://doi.org/10.12957/demetra.2018.32140

10. Maciel BLL, Freitas EPS, Passos TS, Salha AMV, Alves AKDA, Bezerra DVF, Souza SRGD. Manual para elaboração de Fichas Técnicas de Preparação e oficinas culinárias. [Internet]. Natal: EDUFRN. 2021. [Acesso 31 maio 2022]. https://repositorio.ufrn.br/handle/123456789/32659

11. Oliveira, TC, Silva DA. (org.). Administração de unidades produtoras de refeições - desafios e perspectivas. 1. ed. Rio de Janeiro: Rubio; 2016. 224p.

12. Silva NB, Das Chagas VM, Bezerra KCB. Avaliação do fator de correção de hortifrútis em uma unidade de alimentação e nutrição de Teresina-PI. Braz J Dev [Internet]. 2020;6(3):13138-46. https://doi.org/10.34117/bjdv6n3-251

13. De Oliveira KP, Pontes CR, Maia SMPC, Vieira JMM, Pereira CP. Intervenção para redução de custos em um restaurante comercial em Fortaleza, Ceará. Pesquisa, Sociedade e Desenvolvimento [Internet]. 2020;9(7):1-20. http://dx.doi.org/10.33448/rsd-v9i7.4472

14. Philippi ST. Nutrição e técnica dietética. 4ª. ed. rev. e atual. Barueri, SP: Manole; 2019. 442p.

15. De Azevedo AMF, Costa AMM. Determinação e avaliação do índice de parte comestível de vegetais em uma unidade de alimentação e nutrição de Fortaleza-Ceará. Rev Simbio-Logias [Internet]. 2017 [acesso 31 maio 2022];9(12):65-82. Disponível em: https://simbiologias.ibb.unesp.br/index.php/files/article/view/162/188

16. Cordeiro L, Soares CB. Revisão de escopo: potencialidades para a síntese de metodologias utilizadas em pesquisa primária qualitativa. BIS, Bol. Inst. Saúde (Impr.) [Internet]. 2019[acesso 31 maio 2022];20(2):37-43. Disponível em: https://docs.bvsalud.org/biblioref/2019/10/1021863/bis-v20n2-sintese-de-evidencias-qualitativas-37-43.pdf

17. Arksey H, O'Malley L. Scoping studies: towards a methodological framework.IntJ Soc Res Methodol [Internet]. 2005 [cited 2022 May 31];8(1):19-32. https://doi.org/10.1080/1364557032000119616

18. Tricco AC, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med [Internet]. 2018;169(7):467-73. [cited 2022 May 31. Available from: https://www.acpjournals.org/doi/10.7326/M18-0850

19. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2015 edition / Supplement [Internet]. Adelaide: The Joanna Briggs Institute; 2015 [cited 2022 May 31]. 24p. Available from: https://reben.com.br/revista/wp-content/uploads/2020/10/Scoping.pdf

20. Parsifal [Internet]. 2.2 version 2021 [cited 2021 Nov 01]. Available from: https://parsif.al/

21. Degiovanni GC, Japur CC, Sanches AM, Mattos CS, Martins LS, Reis CD, Vieira MM. Hortaliças in natura ou minimamente processadas em unidades de alimentação e nutrição: quais aspectos devem ser considerados na sua aquisição? Rev Nutr [Internet]. 2010;23:813-22. https://doi.org/10.1590/S1415-52732010000500011

22. Cortese RM, Pich PC, Góes VF, Vieira RD. Determinação do fator de correção e consequente avaliação do desperdício de hortaliças preparadas em um restaurante self-service na cidade de Guarapuava-PR. In: Anais do XIX Encontro Anual de Iniciação Científica [Internet]. 2010 Oct 28-30; Guarapuava, PR. 2010 [acesso 31 maio 2022]. Disonível em: https://anais.unicentro.br/xixeaic/pdf/2074.pdf

23. Soares IC, Silva ED, Priore SE, Ribeiro RL, Pereira MS, Pinheiro-Sant'Ana HM. Quantificação e análise do custo da sobra limpa em unidades de alimentação e nutrição de uma empresa de grande porte. Rev Nutr [Internet]. 2011;24:593-604. https://doi.org/10.1590/S1415-52732011000400008

24. Lemos AG, Botelho R, Akutsu RC. Determinação do fator de correção das hortaliças folhosas comercializadas em Brasília. Hortic Bras [Internet]. 2011;29:231-6. https://doi.org/10.1590/S0102-05362011000200017

25. Silva PE, Josino R, Aurenice M, Gadelha LG, Menezes JC, Arruda CD, Pereira AM. Análise do fator de cocção de alimentos. In: Anais do VII CONNEPI - Congresso Norte-Nordeste de Pesquisa e Inovação [Internet]. 2012 Oct 19-21; Palmas (TO); 2012 [acesso 31 maio 2022]. Disponível em: https://propi.ifto.edu.br/ocs/index.php/connepi/vii/paper/viewFile/1564/3083

26. Goes VF, Valduga L, Soares BM. Determinação e avaliação do fator de correção de hortaliças em uma unidade de alimentação e nutrição de Guarapuava–PR. UNOPAR Cient Ciênc Biol Saúde [Internet]. 2013 [acesso 31 maio 2022];15(ESP):339-42. Disponível em: https://journalhealthscience.pgsscogna.com.br/JHealthSci/article/view/568 http://dx.doi.org/10.17921/2447-8938.2013v0n0p%25p

27. Parisoto DF, Hautrive TP, Cembranel FM. Redução do desperdício de alimentos em um restaurante popular. R Bras Tecnol Agroindustr [Internet]. 2013;7(2):1106-17. http://dx.doi.org/10.3895/S1981-36862013000200010

28. Lacerda LL, Saraiva BCA, Silva YL, Monteiro MRP. Avaliação do desperdício de hortifrútis em Unidades Produtoras de Refeição. DEMETRA: Alimentação, Nutrição & Saúde [Internet]. 2014;9(3):823-31. https://doi.org/10.12957/demetra.2014.8522

29. Alves MG, Ueno M. Identificação de fontes de geração de resíduos sólidos em uma unidade de alimentação e nutrição. Rev Amb & Água [Internet]. 2015;10:874-88. https://doi.org/10.4136/ambi-agua.1640

30. Amorim MMA, Jokl L. Determinação dos fatores térmicos das preparações de uma unidade de alimentação e nutrição de Minas Gerais. Nut Brasil [Internet]. 2015;14(1):28-34. https://doi.org/10.33233/nb.v14i1.239

31. Ribeiro ABDL, Diógenes AK, Marques MM, Silva SF, Dos Santos AT, Uchoa FNM, Lima APOM. Investigação dos fatores de correção, fator de cocção e perda em diferentes tipos de carnes em uma Unidade de Alimentação e Nutrição hospitalar. Revinter [Internet]. 2015 [acesso 31 maio 2022];8(3):71-8. Disponível em: http://autores.revistarevinter.com.br/index.php?journal=toxicologia&page=article&op=view&path%5B%5D=219 https://doi.org/10.33233/nb.v14i1.23910.22280/revintervol8ed3.219

32. Romero G, Angst CA, Basso C, Mesquita M, Back C. Serviço de Alimentação e Nutrição hospitalar: elaboração de fichas técnicas. Disciplinarum Scientia [Internet]. 2015 [acesso 31 maio 2022];16(2):265-73. Disponível em: https://periodicos.ufn.edu.br/index.php/disciplinarumS/article/view/1017

33. Fioroto CS, Benitez MS, Turchetto Q, Calderelli VA. Determinação do índice de parte comestível (IPC) em hortaliças e tubérculos na promoção da sustentabilidade. In: Anais do IX Encontro Internacional de Produção Científica UniCesumar [Internet]. 2015 Nov 03-06; Maringá, PR; 2015 [acesso 2022 May 31];(9):4-8. Disponível em: http://www.cesumar.br/prppge/pesquisa/epcc2015/anais/carla_kelly_santos_fioroto.pdf

34. Lima APOM, Nóbrega ECM, Nogueira BA. Análise nutricional, desperdício e custos em unidade de alimentação e nutrição hospitalar em Fortaleza-CE. Hig Alim [Internet]. 2016 [acesso 31 maio 2022];30(252/253):33-7. Disponível em: https://docs.bvsalud.org/biblioref/2017/07/846564/separata-33-37.pdf

35. Da Silva CS, De Jesus J, Lilian S. Fator de correção de frutas e hortaliças em unidades de alimentação e nutrição de Salvador-BA. Hig Alim [Internet]. 2016 [acesso 31 maio 2022];30(262-263):26-31. Disponível em: https://docs.bvsalud.org/biblioref/2017/02/831762/262-263-compressed-26-31.pdf

36. Zotesso JP, Cossich ES, Colares L, Tavares CG. Avaliação do desperdício de alimentos e sua relação com a geração de resíduos sólidos em um restaurante universitário. Engevista [Internet]. 2016 [acesso 31 maio 2022];18(2):294-308. Disponível em: https://www.researchgate.net/profile/Jaqueline-Zotesso/publication/314276152_Avaliacao_do_desperdicio_de_alimentos_e_sua_relacao_com_a_geracao_de_residuos_em_um_restaurante_universitario/links/58becd5caca2727fdb7b90f3/Avaliacao-do-desperdicio-de-alimentos-e-sua-relacao-com-a-geracao-de-residuos-em-um-restaurante-universitario.pdf

37. Costa R. Determinação de fatores de cocção em preparações [undergraduate thesis on the Internet]. Natal: Universidade Federal do Rio Grande do Norte; 2017 [acesso 31 maio 2022]. 35 p. Disponível em: https://repositorio.ufrn.br/bitstream/123456789/40161/2/Determina%C3%A7%C3%A3ofatorescoc%C3%A7%C3%A3o_2017_Trabalho%20de%20Conclus%C3%A3o%20de%20Curso.pdf

38. Tibellio TF. Fator de correção em carnes de uma unidade de alimentação e nutrição no Rio de Janeiro[undergraduate thesis on the Internet]. Rio de Janeiro: Centro Universitário IBMR/Laureate International Universities; 2017 [acesso 31 maio 2022]. 21p.

39. Pereira TL.Desenvolvimento de um Catálogo de Fator de Cocção de Alimentos Comumente Consumidos na Região do Curimataú Paraibano [undergraduate thesis on the Internet]. Cuité: Universidade Federal de Campina Grande; 2017 [acesso 31 maio 2022]. 56p. Disponível em: http://dspace.sti.ufcg.edu.br:8080/xmlui/handle/riufcg/7255

40. Menezes ROS, Santana EM, Nascimento MOL. Elaboração de fichas técnicas das preparações oferecidas em serviço de alimentação e nutrição de hospital público de Salvador, BA. Hig Alim [Internet]. 2018 [acesso 31 maio 2022];(284-285):46-50. Disponível em:https://docs.bvsalud.org/biblioref/2018/11/965437/284-285-set-out-2018-46-50.pdf

41. Adikari AM, Thamilini J. Cooking conversion factor of commonly consumed Sri Lankan food items. MOJ Food Process Technol [Internet]. 2018 [acesso 31 maio 2022];6(4):371-4. https://doi.org/10.15406/mojfpt.2018.06.00190

42. Weis GC, Saquet LD, Kretzmann AP, Simões TT, Mesquita MO. Avaliação do desperdício de hortaliças em um restaurante universitário da região central do Rio Grande do Sul. Nut Brasil [Internet]. 2018 [acesso 31 maio 2022];17(2):136-42. https://doi.org/10.33233/nb.v17i2.1173

43. Caldas RA. Padronização da produção das refeições oferecidas em um berçário institucional no Distrito Federal [undergraduate thesis on the Internet]. Brasília: Universidade Federal de Brasília; 2018 [acesso 31 maio 2022]. 38 p. Disponível em:https://bdm.unb.br/handle/10483/25088

44. Dos Santos MCA, Basso C. Análise do fator de cocção e de correção dos alimentos em instituição hospitalar. Disciplinarum Scientia [Internet]. 2019 [acesso 31 maio 2022];20(2):505-16. Disponível em: https://periodicos.ufn.edu.br/index.php/disciplinarumS/article/view/2911

45. Pereira IGS, Lemos LW, Lemos KGE, de Almeida RDCC, Botelho RBA, Camargo EB. Construção e implementação de fichas técnicas de preparação de unidade de alimentação e nutrição. J Health NPEPS [Internet]. 2019 [acesso 31 maio 2022];4(1):210-27. Disponível em: https://periodicos.unemat.br/index.php/jhnpeps/article/view/3388 https://doi.org/10.30681/252610103388

46. Lataste C, Sandoval S, Maturana D, Delgado C, Gajardo S, Cáceres P. Indicadores de transformación de alimentos consumidos en Chile para su uso en planificación de minutas. Arch Latinoam Nutr [Internet]. 2020;70(1):8-19. https://doi.org/10.37527/2020.70.1.002

47. Silva NB, Moura VM, Bezerra KC. Avaliação do fator de correção de hortifrútis em uma unidade de alimentação e nutrição de Teresina-PI. Braz J Dev [Internet]. 2020 [];6(3):13138-46. https://doi.org/10.34117/bjdv6n3-251

48. Araujo JME, Teles AM, Cavalcante MVS, Boudou F, Bernardino L, Cavalcanti JLS. Indicadores de rendimento de carnes em uma unidade de alimentação hospitalar. Revista Eletrônica Estácio Saúde [Internet]. 2020 [acesso 31 maio 2022];10(1):1-6.

49. Dourado ST, Martins ED, Alves AN. Análise do fator de correção e desperdício alimentar no pré-preparo de hortaliças em uma unidade produtora de refeições de grande porte do município de São Paulo. Hig Alim [Internet]. 2021 [acesso 31 maio 2022]; e1012-e1012. Available from:https://higienealimentar.com.br/wp-content/uploads/2021/08/HA-Artigo-Analise-do-fator-de-correcao-e-desperdicio-alimentar-no-pre-preparo-de-hortalicas-em-uma-unidade-produtora-de-refeicoes-de-grande-porte-no-municipio-de-Sao-Paulo.pdf https://doi.org/10.37585/HA2021.01fator

Contributors

Soares RM and Mata GMSC contributed to the study conception and design, data analysis and interpretation, manuscript revision, and final approval. Volino-Souza M and Abranches MV contributed to data analysis and interpretation, manuscript revision, and final approval.

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

Received: December 20, 2023
Accepted: October 10, 2024