Review Article
Food Science and Technology

ISSN 0101-2061 (Print)
ISSN 1678-457X (Online)

DOI: https://doi.org/10.1590/fst.100421

Food waste profile in Brazilian Food and Nutrition Units and the implemented corrective actions

Marcos Rafael Sousa Ferreira MARTINS[1*], Letícia Fleury VIANA[1*], Leandro Pereira CAPPATO[1*]

Abstract

Food waste directly affect food security. It was estimated that the amount of food wasted in the world may be enough to feed roughly two billion people. In Brazil, food waste reaches up to 39,000 tons per day, putting it among the 10 countries that waste the most food in the world. Since Food and Nutrition units (FNUs) are responsible to produce meals for the community, they also generate a large part of this food waste. Several factors can contribute to a high rate of waste, such as insufficient planning, a lack of awareness among consumers, and little menu variety. The objective of this study was to carry out a survey of the profile of food waste involving intake leftovers (Leftover food that was returned on consumer trays or plates) and clean leftovers (Leftovers foods that were produced but not distributed, and that remained in the vats) in regions of Brazil that occurred in FNUs of different types and structures. We also analyzed the main causes of food waste, and the main actions taken to solve this problem. This study advocates for a national awareness campaign against food waste and reducing the cost of FNUs.

Keywords: clean leftovers; intake leftovers; waste in FNUs; law 14.016/2020; food donation.

Practical Application: Knowledge of the waste profile occurring in FNUs of different sizes and structures is fundamental for the implementation of corrective actions in food services and for the development of public policies aimed at combating this problem in Brazil.

1 Introduction

Food waste is a major problem because it directly affects food safety. Approximately 1.3 billion tons of food is wasted each year worldwide, that is, about a third of the food produced. It is estimated that this waste could feed about two billion people (Food and Agriculture Organization, 2013). In 2015, the United Nations released sustainable development goals. Notable among them was the goal to halve global per capita food waste in retail and consumption by 2030 (United Nations, 2015).

The world is currently experiencing increased hunger due to the COVID-19 pandemic. Although the impact of the pandemic has not yet been fully identified and quantified, it is estimated that approximately one-tenth of the global population (up to 811 million people) was already experiencing food insecurity—numbers that may increase in the future (The State of Food Security and Nutrition in the World, 2021).

In Brazil, a survey conducted between June 2017 and July 2018 pointed to a worsening of the diet of Brazilian families (Instituto Brasileiro de Geografia e Estatistica, 2020). In five years, there was an increase of about 3 million people without regular access to basic food, bringing the overall total to about 10.3 million. Although Brazil is a major food producer, a large portion of its food production is wasted. The waste in the country can reach 39,000 tons per day, making it one of the 10 countries that wastes the most food in the world (Food and Agriculture Organization, 2015).

According to Silvério & Oltramari (2014), food waste occurs at various stages in the production chain, such as production, transport, marketing, packaging, and storage. Food services, which include commercial establishments such as restaurants and food and nutrition units (FNUs), are largely responsible for this waste. Approximately 15% to 20% of the food produced is lost in the collective meals and kitchens sector (Kakitani et al., 2014).

The primary objective of FNUs is to provide adequate food for the nutritional needs of its customers. FNUs contribute greatly to food waste, as they prepare meals for various productive sectors, from industries to hospitals (Abreu et al., 2019). Food waste in FNUs can be presented in the following two ways: intake leftovers (IL) and clean leftovers (CL). According to Ferreira et al. (2012), IL is the ratio between the remainder returned on trays or plates (tray leftovers) and the amount of food offered, expressed as a percentage. CL, or usable leftovers, is food that was produced, but not distributed, and remained in the pass-through (vats) (Silvério & Oltramari, 2014).

Based on the amount of waste, the FNUs can be classified in the following manner: "great" when the waste does not exceed 3% of production, "good" when the waste is between 5% and 10% of the total food, "bad" when it is between 10% and 15%, and "very bad" when it is greater than 15% of the production (Vaz, 2006). It is essential to identify the problems related to food waste so that action can be taken to reduce this damage. Among these possible actions is controlling the quantity and type

Received 28 Oct., 2021
Accepted 02 Dec., 2021
[1] *Instituto Federal de Educação, Ciência e Tecnologia Goiano, Rio Verde, GO, Brasil*
*Corresponding author: marcosrrafa@gmail.com; leticia.viana@ifgoiano.edu.br; leandro.cappato@ifgoiano.edu.br

of waste, standardization of the quantities to be prepared, and carrying out campaigns against food waste (Abreu et al., 2019).

Correspondingly, this research aimed to carry out a bibliographic survey of recent literature to assess the profile of food waste (IL and CL) that occurred in the FNUs in different regions of Brazil. Further, the main related causes and actions taken to solve this problem were also analyzed.

2 Development

For the development of the research, a search was carried out in online databases namely Google Scholar, Scopus and SciELO using the following keywords: "waste of food" "leftovers" "Food waste" and "waste in FNUs". For the bibliographical survey, 25 articles referring to waste that occurred in different FNUs in Brazil, published between 2011 and 2021, were analyzed. Articles that were initially selected but did not deal directly with waste in FNUs were excluded. Eleven articles published in the southern, nine in the southeast, five in the northeast, three in the central-west, and two in the northern region of Brazil were used.

3 Profiles of food waste in FNUs

The amount of food waste in UANs can vary widely and several factors can affect it, such as: lack of quality, lack of planning and variety in the menu, lack of use of quality tools, lack of employee training and lack of awareness among diners. One way to determine the real status of each unit is through a specific assessment, which is essential to quantify the loss rates (IL and CL) during a certain period (weekly or monthly), to determine the scale of the problem (Santos et al., 2020).

To quantify waste, most articles used the methodology defined by Vaz (2006), according to the descriptions presented in Table 1. Next, Table 2 shows the profile of waste found in FNUs present in the five regions of the country, as well as the main actions taken to reduce this waste.

The results presented in Table 2 demonstrate that the country has a major food waste problem. High levels of waste were observed, both in relation to IL and CL, as well as the lack of quality tools in food production in the FNUs. Regarding the structure, 11 FNUs with small structures, 12 with medium structures, and 2 with large structures were observed. According to Viggiano (2002), FNUs with up to 500 meals/day are classified as small structures, 501 and 2,000 meals/day as medium structures, and 2,001 to 10,000 meals/day as large ones.

The results presented in Table 2 show that, regardless of the region, structure and type of FNU, high levels of food waste were observed, where most of the FNUs analyzed are classified as bad or very bad in relation to the quantified leftover indexes, according to with the values recommended by Vaz (2006).

In the South region, waste between 2.81% and 28.36% was observed in the ten FNUs analyzed (five of medium-size FNU and five small-size). For the Southeast Region, waste between 4.49% and 19.15% was observed in the six analyzed restaurants (one FNU with a large structure, three medium and two with small structure). Greater waste was observed in small and medium-sized restaurants, which can be explained by the lack of management in these establishments. As for the Northeast Region, the percentage of waste of the analyzed articles (One FNU with medium-sized and 3 with small-sized), ranged between 3% and 9.29%, with the greatest waste being observed in a restaurant of medium size of a company. For the Central-west and North regions of Brazil, greater waste was observed in small and medium-sized restaurants, as well as in other regions of the country.

These results, regardless of the region and size of the analyzed restaurants, are related to several factors, such as the lack of consumer awareness about these meals, the lack of training of employees involved in the food production process, the lack of planning the amount of food production, lack of variety in the menu and ignorance of the costs involved in losses.

According to Teixeira et al. (2017), to reduce waste, it is of utmost importance that a quality effort in planning, monitoring, and training of employees be carried out during all stages, such as receipt, production, storage, and distribution. Simultaneously, awareness of consumers regarding the reduction of waste levels should be increased through lectures, posters, and printed materials. Silvério & Oltramari (2014) point out that awareness campaigns about food waste for consumers constitute one of the most effective actions to reduce high levels of IL. Such actions must be recurrent and continuous.

In Table 2, it can be seen that after the implementation of corrective actions, regardless of the structure and type of the FNUs, food waste rates were significantly reduced. Among the main actions are the training and qualification, awareness campaigns for both employees and consumers, better planning, and improvement in the variety of food on the menu.

Fernandes et al. (2020) reported that after carrying out awareness campaigns with banners on food waste, there was

Table 1. Description of analyzed parameters for intake leftovers and clean leftovers.

INTAKE LEFTOVERS	CLEAN LEFTOVERS
Intake leftovers (kg) = Weight of food discarded - weight of wastebaskets	**% leftover** = clean leftover × 100/weight of the meal distributed.
% Intake leftovers = weight of Intake leftovers × 100 / weight of meal distributed.	
Intake leftovers per capita: Intake leftovers per capita (kg) = weight of leftovers/number of meals served	**Number of people who could be fed with clean leftovers** = Clean leftovers/per capita consumption per meal
Number of people who could be fed with intake leftovers = Intake leftovers/per capita consumption per meal	

Table 2. Profile of food waste in FNUs in Brazil, between 2008 and 2021, and the main corrective actions implemented.

Region	Goals	Meals served/period of analysis	Main results	Conclusion	References
South	Evaluation of intake leftovers of a university restaurant in Francisco Beltrão-PR,	- 300 Meals (Lunch) - First fortnight of September/2018 (business days)	On average, the intake leftovers per capita was 300 g (8.1 kg of leftovers in 268.20 meals served), making it possible to feed 16 people per day.	Although the intake leftovers are at an acceptable level according to literature, it is important to carry out awareness campaigns and optimization measures in order to reduce the financial losses for the FNU.	Massarollo et al. (2019)
	Quantification of solid waste in an FNU of a metallurgical company in Marau - RS	- 281 meals - October to November 2017 (5 alternate days)	In 5 days, 134,925 g of solid food waste (95.89 g/person) and 27,114 g of non-food waste (19.27 g/person) were generated. Of the total, 32.17% were generated in pre-preparation; 21.21% via intake leftovers; 19.21% from the dirty leftovers; 18.80% was non-food waste; and 7.90% was clean leftovers.	The FNU presented an amount of solid waste per capita, lower than the values reported in the literature, but the waste control must be constantly applied.	Mariosa & Alves (2019)
	Evaluation of the leftover intake index of patients and companions in a hospital FNU in Pato Branco - PR	- 280 to 350 Meals - Four days (period not informed)	After four days, the average leftover intake was 20.80% (equivalent to 137 grams per individual), a value very close to the ideal for patients (20%).	When comparing the obtained result with the recommended one, it is clear that the index is above but at an acceptable value.	Copatti et al. (2018)
	Quantification of intake leftovers from a sick and healthy community in a hospital FNU, in Southwestern Paraná.	- 77 meals - Two weeks in April 2018 (business days))	For the healthy community, a total of 44.19% (44.71 Kg / day) of leftovers was observed. In relation to the sick community, the wasted value was 19.02 kg/day (28.36% of the rest consumed). These leftovers could feed 417 and 148 people, respectively.	The values obtained are much higher than acceptable (above 10%). Thus, there is a need for more elaborate planning on the amount of food offered to diners, staff training and improvements in the presentation of meals.	Beal et al. (2018)
	Evaluation of patient intake leftovers in a hospital FNU in Pato Branco-PR.	- 240 to 400 meals - Four days	After four days, the waste of clean leftovers and intake leftovers of 18.57% (52 kg) and 15% (42.08 kg), respectively were observed.	The rest-ingestion indices were above acceptable for the sick population (20%).	Novinsk et al. (2017)
	Evaluation of the intake leftovers and clean leftovers index of a commercial FNU, in Estrela – RS.	- 740 Meals (lunch) in 14 units - August to October 2014	The percentage of intake leftovers ranged from 6.26 g to 9.74 g, while the average per capita was 15 g. For the clean leftovers, the average per capita value was 19.28 g.	The amount of food leftovers was high, requiring greater control in the production and distribution of meals.	Valllerius & Adami (2016)
	Evaluation of the index of intake leftovers and clean leftovers as indicators for waste in the FNU of a company in RS.	- 1000 meals - January/2015 (22 business days)	The mean values for intake leftovers and clean leftovers were 2.81% and 3.84%, respectively.	The values for intake leftovers and clean leftovers were below those recommended in the literature.	Tirp et al. (2016)

Table 2. Continued...

Region	Goals	Meals served/period of analysis	Main results	Conclusion	References
	Quantification of food waste in an industrial restaurant in the city of Maringá-PR.	- 880 meals (lunch, dinner, supper) - June to October 2015 (5 random days)	Clean leftovers ranged from 11 to 24%, with a high percentage. Among the five days analyzed, an average of 16.8 kg of wasted leftovers was obtained.	The restaurant has a high percentage of waste, with the percentage of clean leftovers being higher than the rest ingested. More training needs to be implemented to reduce waste.	Galian et al. (2016)
	Analysis of food waste in an FNU in RS.	- 515 meals (lunch and dinner) - July to September 2014	Intake leftovers per capita was within the recommended range, while the clean leftovers were below the recommended amount.	Food waste indicators were in accordance with the recommended values, demonstrating that the FNU has good indicators of low waste.	Battisti et al. (2015)
	Evaluation of intake leftovers and clean leftovers index of a popular restaurant in Maringá-PR	- 1,000 meals - 08 to 12/07, 2013	Regarding the clean leftover, an average of 66.51 kg/day (five days evaluated) was observed, corresponding to 16.13%. For the leftover intake, the average was 36.28 kg (9.49%). During the five days, these losses could feed 320 people.	High levels of food waste were observed, requiring awareness actions among diners, as an alternative to reducing waste.	Canonico et al. (2014)
Southeast	Determination of the leftover intake of diners in a military FNU in São Paulo, after awareness-raising actions.	- 1,200 meals - August to September 2019	After the awareness actions, there was a decrease between the averages of leftover intake from 9.05% (65.6 kg) to 4.49% (12.9 kg).	The decrease in the percentage of leftover intake after awareness campaigns demonstrated the effectiveness of this action.	Fernandes et al. (2020)
	Quantification of clean leftovers from an FNU in São José do Rio Preto/SP.	- 350 Meals (Lunch) - 20 days	On average, 15.6% of the production was wasted, equivalent to 678.6 kg of food.	It is necessary to immediately implement actions to reduce waste and its consequences.	Silva & Vieira (2019)
	Assessment of the impact of actions to reduce food waste in a university FNU, in northern Minas Gerais.	- 1,200 meals (lunch and dinner) - February and May 2014 (business days)	A reduction was observed both for clean leftovers (2.77% to 1.2% per capita) and for intake leftovers (8.68% to 6.20% per capita).	The actions developed with employees and diners were efficient, resulting in a significant decrease.	Borges et al. (2019)
	Quantification of waste generated in a large industrial restaurant in the state of São Paulo.	- 2,000 Meals (lunch/dinner/supper) - 2009 (days not informed)	The average waste generation index was 59.3 g/meal, where the return resulted in the greatest contribution (19.6 g/meal), while the clean leftover was 12.5 g/meal.	The high amount of organic waste generated indicates that the steps of returning the trays, pre-preparation, and clean leftovers should be prioritized to minimize waste.	Ribeiro et al. (2019)
	Analysis of food waste in an FNU in Botucatu/SP.	- 155 meals (lunch) - from 22/03 to 5/04, 2016	On average, high levels of waste were observed for dirty leftovers (19.15%), intake leftovers (8.73%), and for clean leftovers (3.46%). Such waste would feed three times the number of meals served.	A campaign against waste is needed, both for consumers and for employees, in order to improve the results shown.	Aranha & Gustavo (2018)

Table 2. Continued...

Region	Goals	Meals served/period of analysis	Main results	Conclusion	References
	Quantification and evaluation of the cost of clean leftovers in eight FNUs of a steel company, in Ipatinga - MG	- 18,000 meals (breakfast, lunch, dinner 1 and 2; snack 1 and 2) - January to May 2005	The total per capita of clean leftovers ranged between 24 g and 60 g, corresponding to 176 kg to 1,213 kg of food wasted monthly. The monthly cost of leftovers reached 2.2% to 3% of the monthly amount spent on food, representing a cost of 80 to 108 minimum salaries.	Considerable loss of food was observed. Implementing interventions can minimize this loss. The amount spent on this waste could be reverted to improvements in production processes.	Soares et al. (2011)
Northeast	Evaluate the leftover intake rate of an FNU in a city in Maranhão	- 49 meals - One day in 2019	18 diners presented up to 3% of waste, 16 students presented between 3.1 to 10%, and 15 students presented values greater than 10%.	The percentage of leftover intake was considered high, above the acceptable index of 3%.	Macedo et al. (2020)
	Assessment of intake leftovers from an institutional FNU in Fortaleza - CE	- 215 meals (lunch and dinner) - 09/30 to 01 - 04 and 07 of 10/11, 2019	On average, the daily intake leftover index was 3.73 kg (5.26%), where with total waste, it would be able to feed another eight diners per day.	On days of harmonious combinations, reductions in food waste were smaller.	Oliveira et al. (2020)
	Evaluation of intake and clean leftovers index in an FNU of a company in Nossa Senhora do Socorro, SE.	- 1,300 Meals (lunch) - April 1 to 5, 2019 (business days)	The intake leftover and clean leftover index found was, on average, 9.29% and 3.04%, respectively. These leftovers could feed about 251 people.	The leftover intake index was unsatisfactory. Thus, actions such as awareness of diners and portioning are important to minimize waste.	Barbara et al. (2019)
	Evaluation and quantification of food waste in a self-service restaurant in Juazeiro do Norte – CE.	- 100 to 150 Meals (lunch) - Seven consecutive days in May/2016	The average amount of leftovers and intake leftovers obtained were 17.43 kg and 2.6 kg, corresponding to 0.13 g and 10.01 g of leftovers and intake leftovers per capita, respectively. On average, these leftovers could feed 44 people.	Although the amount of leftovers is below acceptable (3%), it is important to implement actions to reduce waste and optimize productivity.	Borges et al. (2017)
Central-West	Check the leftover intake rates of an industrial FNU in Mineiros - Goiás.	- 1,000 meals (lunch)	The average leftover intake was 10.51% weekly. About 2.5 tons of food were thrown in the trash during the month.	Intervention through waste reduction campaigns can be economically successful.	Carneiro (2014)
	Evaluation of the leftover intake index of an institutional FNU in Anápolis – GO, before and after the educational intervention.	- 1,350 meals (lunch) - 09/19 to 10/07/2011	After the educational intervention, the average leftover intake was reduced from 60.9 g to 55.3 g (9% reduction). However, the per capita is still high, above 45 g.	The training and campaigns carried out with the diners were efficient in reducing food waste.	Machado et al. (2012)

Table 2. Continued...

Region	Goals	Meals served/period of analysis	Main results	Conclusion	References
	Evaluation of per capita clean leftovers and leftover intake of children aged six months to five years old at a CEINF-MS.	- 600 meals (coffee, cocktail, lunch, snack, dinner) - 26, 28, 29, and 30/09 of 2011	One-third of the food is wasted every day, so after three days, it would be possible to serve a full day of meals.	Actions such as raising employee awareness must be carried out. Controlling leftover intake can be useful to reduce costs, in addition to being an indicator of the quality of the meal served.	Ferreira et al. (2012)
North	Characterization of solid waste generated in a university FNU at INC-UFAM and evaluation of intervention actions.	- 100 first students who consumed the meal - One week in 2021	During five days, an average of the leftover intake of 8.16% at lunch was obtained.	The intervention campaign was positive for changes in the students' behavior, thus raising awareness about food waste.	Silva et al. (2021)
	Evaluate the cost of food waste in a university FNU in Acre	- 2300 meals - 10 days studied/ 2017 for two weeks in September 2016 (business days).	During the 10 days, 804.4 kg of food were wasted, with a daily average of 80.44 kg (referring to 12% of waste in relation to the amount served). This amount would be enough to feed 1,435 people	The lack of awareness of the diners generated high losses for the institution, which is proven through the results obtained in this study.	Costa et al. (2017)

a reduction from 9.05% to 4.49% of IL in a military FNU in São Paulo. In a medium-structure university FNU in Minas Gerais, awareness actions among consumers and employee training resulted in significant reductions, both for CL (from 2.77% to 1.2% per capita) and IL (from 8.68% to 6.20% per capita) (Borges et al., 2019). In the central-west region, in an institutional FNU in Anápolis, Machado et al. (2012) carried out training and educational campaigns aimed at consumers and observed a per capita reduction in food waste from 60.9 g to 55.3 g (9% of reduction).

In addition to awareness campaigns and employee training, one of the strategies for reducing waste at the FNUs is the implementation of quality tools, such as the Toyota Production System (TPS). According to Santos & Lanzillotti (2008), the TPS model adapted for FNUs identified losses in the overproduction of meals, thus avoiding excessive food waste.

Reducing food waste is critical to minimizing costs and consequently increasing the profitability of FNUs. Gratão et al. (2016) evaluated the financial impact that waste causes in UPR - Food Production Unit (average 350 meals/day) and what measures can help to minimize these losses. According to the study, the authors observed an average waste of 27.25 kg, resulting in a financial loss of around R$ 1,852.20 per day. Another important result was obtained by Soares et al. (2011), who found that the monthly cost of CL represented approximately 80 to 108 Brazilian minimum wage in a large FNU (18,000 meals) at a steel mill in Ipatinga-MG. These results demonstrate the importance of knowing the causes that result in waste and the implementation of corrective measures, thereby minimizing these losses.

In addition to financial losses and, consequently, an increase in costs at the FNUs, food waste has socio-environmental and political impacts. According to Vaz (2006), the act of wasting food would be the same as misplacing what can be used for the benefit of another person, or company, or for their own use.

According to Table 2, a large number of people could be fed with the food waste generated in Brazil. Massarollo et al. (2019), after analyzing the amount of leftovers produced in a small-sized FNU, reported that 16 people could be fed per day. Canonico et al. (2014) reported that 320 people could be fed weekly from the amount of waste (IL and CL) generated in a popular restaurant in Maringá, every week. Barbara et al. (2019) observed that the amount of leftovers and CL obtained from a medium-sized FNU would feed 251 people in five days.

The issue of food waste is related not only to costs but also to food security, especially with regard to the high rates of waste associated with CL. According to Damiani et al. (2021), the recovery of clean food leftovers results not only in reducing harmful environmental impacts but also in fighting hunger, as it can guarantee access to food for people who exist in social vulnerability.

As it is a national problem, as seen in Table 2, the implementation of other mechanisms, such as public policies aimed at the use of clean food leftovers, can be an excellent alternative to minimize these losses, while simultaneously making people aware of food waste. Within this context, Ordinary Law No. 14016/2020 was recently sanctioned in Brazil, which provides for the fight against food waste and the donation of surplus food for human consumption (Brasil, 2020). The law regulates the donation of food, thus authorizing the FNUs and other establishments such as bars, cafeterias, and restaurants to donate processed and fresh food in addition to their CL. Thus, concurrently with the fight against hunger, this law seeks to combat food waste. However, some institutions and associations linked to food security and food safety, in addition to professional regional councils, had certain concerns related to the law guaranteeing food safety. Recently, a joint note was released by the Sustainable Food and Nutritional Security Council of Rio Grande do Sul (CONSEA-RS), the Regional Council of Nutritionists of the Second Region (CRN-2), the Associação Gaúcha de Nutrição (AGAN), Emater/RS-Ascar, and the Social Service of Commerce of Rio Grande do Sul (SESC/RS), expressing certain disagreements to parts of the law.

According to this note, the criteria in ART 1°, which establishes the criteria for the conditions of the food to be donated, are broad and poorly specified and do not guarantee food safety or integrity, thus leaving room for the donation of expired and poorly preserved foods. In addition, in ART 1°, food with damaged packaging can be donated, which can compromise the microbiological stability of these foods. In addition, the note suggests that it is important to have clearer rules to avoid damaging the health of the population that benefits from the donations

Owing to the great relevance of this law in combating waste and hunger, and its contradictions related to food safety, the issue of food donation was included in the agenda of Anvisa's 2021 Regulatory Agenda. This agenda aims to review and prepare regulatory instruments, with the main objective of increasing the sanitary safety of foods donated to the Brazilian population through the publication of a regulatory instrument that presents rules or guidelines for this activity. Furthermore, the establishment of a clear regulatory framework will assist in the inspection of the National Health Surveillance Service by creating a legal basis and establishing guidelines for its performance.

4 Conclusion

This review article identified that FNUs generate high amount of food waste in Brazil (both for IL and CL) in different Brazilian regions. Nevertheless, awareness campaign including both consumers and employees can be used to reduce the amount of food wastage. In addition to these actions, measures such as training and capacity building were also implemented, which led to positive results in the different types of FNUs that were analyzed. Therefore, a national awareness campaign against food waste is necessary to highlight the importance of reducing food waste and FNU costs.

Acknowledgements

The authors would like to thank IFGoiano and CAPES for their financial. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

References

Abreu, E. S., Spinelli, M. G. N., & Pinto, A. M. S. (2019). *Gestão de unidades de alimentação e nutrição: um modo de fazer*. São Paulo: Editora Metha.

Aranha, F. Q., & Gustavo, A. F. S. (2018). Avaliação do desperdício de alimentos em uma unidade de alimentação e nutrição na cidade de Botucatu, SP. *Higiene Alimentar*, 32(276/277), 28-32.

Barbara, D. S., Santos, G. R., Santana, N. N., Silva, L. B., Boudou, F. S. T., & Filha, E. S. (2019). Avaliação de sobras limpas e resto-ingesta em uma Unidade de Alimentação e Nutrição na cidade de Nossa Senhora do Socorro-SE. *Revista Ciência (In) Cena*, 2(9), 52-59.

Battisti, M., Adami, F. S., & Fassina, P. (2015). Avaliação de desperdício em uma Unidade de Alimentação e Nutrição. *Revista Destaques Acadêmicos,* 7(3), 36-42.

Beal, J. C., Fritz, R. E., & Cozer, M. (2018). Índice de resto ingestão e sobras alimentares de um serviço de nutrição e dietética localizado no sudoeste do Paraná. *Revista Simbio-Logias*, 10(14), 93-101. http://dx.doi.org/10.32905/19833253.2018.10.14p93.

Borges, M. P., Souza, L. H. R., Pinho, S. D., & Pinho, L. D. (2019). Impacto de uma campanha para redução de desperdício de alimentos em um restaurante universitário. *Engenharia Sanitaria e Ambiental*, 24(4), 843-848. http://dx.doi.org/10.1590/s1413-41522019187411.

Borges, V. M., Neta, M. V. B., & Lopes, J. N. S. (2017). Controle de sobras e resto-ingesta em restaurante self-service em Juazeiro do Norte-CE. *Revista e-Ciência*, 4(2), 63-69. http://dx.doi.org/10.19095/rec.v4i2.181.

Brasil. (2020). Lei n. 14.016, de 2020. Dispõe sobre o combate ao desperdício de alimentos e a doação de excedentes de alimentos para o consumo humano. *Diário Oficial [da] República Federativa do Brasil*.

Canonico, F. S., Pagamunici, L. M., & Ruiz, S. P. (2014). Avaliação de sobras e resto-ingesta de um restaurante popular do município de Maringá-PR. *Revista UNINGÁ*, 19(2), 05-08.

Carneiro, N. S. (2014). Desenvolvimento de campanha contra desperdício de alimentos em uma unidade de alimentação e nutrição na cidade de Mineiros GO. *Revista Saúde Multidisciplinar*, 2(1), 19-29.

Copatti, L. C., Bruger, V. B., Baratto, I., & Brufati, A. (2018). Avaliação de resto de ingesta em uma unidade de alimentação e nutrição hospitalar na cidade de Pato Branco-PR. *Revista Brasileira de Obesidade, Nutrição e Emagrecimento*, 12(75), 976-983.

Costa, N. A., Farias, L. S., Araújo, L. P., Rodrigues, B. T. C., Oliveira, R. L., & Dias, F. S. B. (2017). Análise do custo do resto ingestão do restaurante universitário da Universidade Federal do Acre. *South American Journal of Basic Education, Technical and Technological*, 4(1), 208-218.

Damiani, M., Pastorello, T., Carlesso, A., Tesser, S., & Semenzin, E. (2021). Quantifying environmental implications of surplus food redistribution to reduce food waste. *Journal of Cleaner Production*, 289, 125813. http://dx.doi.org/10.1016/j.jclepro.2021.125813.

Fernandes, V., Scotá, G., Narchi, M., Casagrande, I., Beneton, C., & Corrêa, F. F. (2020). Comparação do resto ingestão alimentar em uma Unidade de Alimentação e Nutrição Militar na cidade de São Paulo. *Disciplinarum Scientia: Ciência da Saúde*, 21(1), 35-45. http://dx.doi.org/10.37777/dscs.v21n1-004.

Ferreira, J. A., Santos, C. H. P., Pereira, A. J. S., Britto, M. B., Santos, D. R., & Britts, L. T. (2012). Avaliação da sobra limpa e resto ingesta de um CEINF em Campo Grande-MS. *Ensaios e Ciência Biológicas Agrárias e da Saúde*, 16(1). 83-94.

Food and Agriculture Organization – FAO, United Nations – UN. (2013). *Food wastage footprint: Impacts on natural resources*. Retrieved from http://www.fao.org/docrep/018/i3347e/i3347e.pdf

Food and Agriculture Organization – FAO, United Nations – UN. (2015). *Food wastage footprint & climate change*. Retrieved from http://www.fao.org/3/a-bb144e.pdf...cience/article/pii/S2211912417300159#f0005.

Galian, L., Santos, S. S., & Madrona, G. S. (2016). Análise do desperdício de alimentos em uma unidade de alimentação e nutrição. *Revista GEINTEC: Gestao Inovação e Tecnologias,* 6(2), 3121-3127.

Gratão, L. H. A., Silva, C. A., Aguiar, S. M. R., Rocha, T. E. S., & Silva, J. F. (2016). Impacto financeiro do desperdício de alimentos em uma unidade produtora de refeições. *Desafios-Revista Interdisciplinar da Universidade Federal do Tocantins*, 3(2), 36-42. http://dx.doi.org/10.20873/uft.2359-3652.2016v3n2p36.

Instituto Brasileiro de Geografia e Estatistica – IBGE. (2020). *10,3 milhões de pessoas moram em domicílios com insegurança alimentar grave*. Retrieved from https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/28903-10-3-milhoes-de-pessoas-moram-em-domicilios-com-inseguranca-alimentar-grave

Kakitani, R., Silva, T. I. F. F., & Shiino, E. T. (2014). Desperdício de alimento no pré-preparo e pós-preparo em um refeitório industrial. *Revista Ciências do Ambiente On-Line,* 10(1), 30 - 35.

Macedo, J. L., Brito, A. N. M., Carvalho, S. L., Oliveira, J. V. F., & Brito, F. N. M. (2020). Avaliação do índice de resto-ingestão em unidade de alimentação e nutrição de um município do Maranhão. *Research, Society and Development*, 9(1), e140911817. http://dx.doi.org/10.33448/rsd-v9i1.1817.

Machado, C. C. B., Mendes, C. K., de Souza, P. G., Martins, K. D. S. R., & Silva, K. C. C. (2012). Avaliação do índice de resto ingesta de uma unidade de alimentação e nutrição institucional de Anápolis-GO. *Ensaios e Ciência: Ciências Biológicas, Agrárias e da Saúde*, 16(6), 151-162.

Mariosa, S. T., & Alves, M. K. (2019). Identificação de resíduos em uma Unidade de Alimentação e Nutrição. *Ensaios e Ciência: Ciências Biológicas, Agrárias e da Saúde*, 23(2), 161-165.

Massarollo, M. D., Fagundes, E. M., & Prieto, L. M. (2019). Avaliação do resto-ingesta em um restaurante universitario do municipio de Francisco Beltrão-PR. *RBONE: Revista Brasileira de Obesidade, Nutrição e Emagrecimento*, 13(81), 703-708.

Novinski, A. P. F., Araújo, G. C., & Baratto, I. (2017). Resto ingesta em uma unidade de alimentação e nutrição hospitalar na cidade de Pato Branco-PR. *RBONE: Revista Brasileira de Obesidade, Nutrição e Emagrecimento,* 11(66), 451-458.

Oliveira, R. S., Moura, M. F., Maia, S. M. P. C., Oliveira, K. P., Moreira, M. R., & Coutinho, B. R. C. O. P. (2020). Avaliação do resto ingestão de uma UAN institucional em Fortaleza. *Brazilian Journal of Health Review*, 3(3), 4929-4939. http://dx.doi.org/10.34119/bjhrv3n3-076.

Ribeiro, M. L., Carvalho, R. D. C. R., Castro, M. C. A. A., Alcorinte, M. G., Araújo, D. S., & Cazeiro, L. F. (2019). Índices de geração de resíduos sólidos em restaurante industrial de grande porte. *Revista Pretexto*, 20(1), 28-37.

Santos, J. M. P., & Lanzillotti, H. S. (2008). Aplicação do modelo sistema Toyota de produção em unidades de alimentação e nutrição. *CERES: Nutrição & Saúde*, 3(1), 9-18.

Santos, K. L. D., Panizzon, J., Cenci, M. M., Grabowski, G., & Jahno, V. D. (2020). Perdas e desperdícios de alimentos: reflexões sobre o atual cenário brasileiro. *Brazilian Journal of Food Technology*, 23, e2019134. http://dx.doi.org/10.1590/1981-6723.13419.

Silva, D. R., Rosas, L. V., & Lima, R. A. (2021). Resíduos gerados no restaurante universitário em uma universidade pública no alto

solimões, Amazonas, Brasil. *Revista EDUCAmazônia: Educação. Sociedade e Meio Ambiente*, 13(1), 215-238.

Silva, M. F., & Vieira, V. B. R. (2019). Avalição de sobras de uma unidade produtora de refeições de São José do Rio Preto/SP. *Revista Científica*, 1(1), 110-116.

Silvério, G. A., & Oltramari, K. (2014). Desperdício de alimentos em Unidades de Alimentação e Nutrição brasileiras. *Ambiência*, 10(1), 125-133.

Soares, I. C. C., Silva, E. R. D., Priore, S. E., Ribeiro, R. D. C. L., Pereira, M. M. L. D. S., & Pinheiro-Sant'Ana, H. M. (2011). Quantificação e análise do custo da sobra limpa em unidades de alimentação e nutrição de uma empresa de grande porte. *Revista de Nutrição*, 24(4), 593-604. http://dx.doi.org/10.1590/S1415-52732011000400008.

Teixeira, F., Nunes, G., & Antonovicz, S. (2017). Principais fatores associados aos índices de desperdício em Unidades de Alimentação e Nutrição: uma revisão integrativa. *Saúde em Revista*, 17(47), 42-50. http://dx.doi.org/10.15600/2238-1244/sr.v17n47p42-50.

The State of Food Security and Nutrition in the World – SOFI. (2021). *Transforming food systems for food security, improved nutrition and affordable healthy diets for all*. Retrieved in http://www.fao.org/documents/card/en/c/cb4474en

Tirp, A. S. L., Conde, S. R., & Adami, F. S. (2016). Avaliação do índice de resto ingesta e sobras em unidade de alimentação e nutrição. *Revista Uningá*, 48(1), 99-110.

United Nations – UN (2015). *Transforming our world: the 2030 agenda for sustainable development*. Retrieved in http://www.agenda2030.org.br/sobre/

Valllerius, A. P., & Adami, F. S. (2016). Avaliação do índice do resto ingesta e sobras em uma unidade produtora de refeições. *Revista Uningá*, 48(1), 17-21.

Vaz, C. S. (2006). *Restaurantes: controlando custos e aumentando lucros*. Brasília: Metha.

Viggiano, C. E. (2002). Como funciona o setor de alimentação coletiva no Brasil. *Nutrição Brasil*, 1, 26-27.