

Article

Food Waste Perception of Workplace Canteen Users—A Case Study

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Abstract: Background: Food waste occurs in all stages of the food supply chain, namely in the food service sector. Understanding how much and why food is wasted and whether consumers are aware of it is essential to design effective interventions in this setting. This case study aims to compare the food waste perception by consumers and measure plate waste in a Portuguese workplace canteen in order to recognize if trained consumers can estimate his/her food waste. Methods: Data were collected from 160 users randomly selected attending a workplace canteen during one month. Plate waste was evaluated by the weighing method. Visual estimation was performed by each participant to evaluate food waste perception at the end of the meal. Consumers were also asked about reasons for wasting food. Results: Plate waste was 8.4% for soup, 9.0% for the main course, and 4.0% for dessert. These values follow the same trend of waste perceived by consumers for soup ($R = 0.722$; $p < 0.001$), main course ($R = 0.674$; $p < 0.001$), and dessert ($R = 0.639$; $p < 0.001$), showing a high relation between self-assessment and measured plate waste. Excessive portions (46.1%), dislike of meal flavor (18.6%), cooking method (8.8%), and texture (3.9%) were identified as the main causes for plate waste. Conclusions: Canteen users showed an accurate perception of their plate waste for all meal components. Excessive portions were identified by consumers as the main reason for plate waste.

Keywords: consumer perception; food service; food waste; plate waste; workplace canteen



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1. Introduction

Each year tonnes of food are lost or wasted, leading to economic, social, and environmental impact [1]. This is unacceptable when 750 million people in the world suffer from severe levels of food insecurity. Additionally, the COVID-19 pandemic may have added between 83 and 132 million people to the total number of undernourished in the world in 2020 [2].

In the EU, around 88 million tonnes of food waste are generated annually, of which 53% at the consumer level, with associated costs estimated at EUR 143 billion [1,3]. However, a recent study concluded that it might be underestimated by a factor greater than 2 (214 Kcal/day/capita versus 527 Kcal/day/capita), presenting strong evidence of a link between food waste (FW) and consumer affluence (affluence elasticity of waste). This means that consumers in developed countries may waste more food than previous estimations [4].

Although food waste occurs along the food supply chain, in developed countries, it is higher in the final steps, closer to the consumer [1]. At the final stages, when the food has already been produced, processed, transported, distributed, and cooked, the negative impacts for the environment, the economy, and society are even higher [5].

The food service sector is responsible for producing and supplying meals to satisfy consumers' nutritional needs, considering safety, sensorial and sociocultural constraints.

The number of out-of-home meals has risen in the past decades as a leisure activity or linked to work and academic life, and it is expected to increase. Drivers that explain the trend towards out-of-home food consumption include urbanization, growing incomes, conviviality, lack of time to prepare meals, and working commitments [6–10].

An increasing number of meals served in the food service sector implies that plate waste represents a relevant issue for this setting. Food service accounts for 12% of all food waste in the European Union, producing around 11 million tons of waste, which corresponds to 21 kg per person per year [5,11–15].

Food waste control in food service is a difficult task since it involves the consumers and their relationship with meals, both factors that may vary on a daily basis [10,16–18]. Both service-related aspects, service quality and personal factors, are relevant to explain food waste [19]. Users' reasons for wasting vary in relation to their relationship with food, food preferences, consumers' emotional state, and appetite at the mealtime [10,17,18], which can introduce some variability and unpredictability in the amount of food wasted. Some consumers may experience contradictory feelings regarding food waste.

On one side, consumers feel pressured by social desirability to avoid throwing food away. On the other hand, they do not want to eat food they dislike nor to eat excessive portions that are usually served [13]. Bell et al. used the theory of planned behaviour (TPB) to analyze the influence of canteen workers' behavioral intentions toward food waste reduction. Loss of appetite, poor taste, low appeal, or lack of time to have meals presented a positive impact on food waste behavior [20]. The same TPB was used to analyze food waste behaviors in mass catering services and concluded that a greater intention not to leave edible food and a higher degree of perceived control over this behavior reduced the quantity of food waste [21].

Food waste by consumers results from an interaction between individual and social factors, requiring motivation and means to avoid waste, which implies the need to raise consumer awareness of the impact of behavioral changes [16–18]. A study conducted within 253 urban households found that a higher perception of food waste was associated with a smaller amount of food waste [9]. Carvalho et al. in 2015 demonstrated that the consumers' perception of food waste is inaccurate either in quantity or in type of food wasted [22]. Nevertheless, consumers were worried about the environmental, social, and economic impacts of food waste [23].

The European Commission recommends stepping up the fight against food waste by proposing legally binding targets across the EU member states by 2023. This is part of the ambitious EU Green Deal and its Farm to Fork strategy that includes an objective of reducing food loss and waste as key to a sustainable food system [24–26].

Understanding how much and why food is wasted at the food service is vital to implementing food waste minimization actions. For that, it is essential to understand the reasons and how much users waste and whether consumers are aware of their food waste.

Most food service waste studies have been developed on school canteens [27–30], social centers [31], and hospitals [32,33], and only a few studies have performed empirical research on food waste at workplace canteens [20,21,34,35]. In Portugal, the business structure of the accommodation, restaurant, and similar sectors (Canal HoReCa) corresponds to 7.8% of the total registered companies. In 2017, the sector reached a turnover of more than EUR 10.1 billion, representing 2.8% of the total economic activity and employing 293.478 individuals, which corresponded to 8.0% in relation to the active population [36].

In a recent systematic literature review of food waste in hospitality and food services (HaFS), only 2 out of 63 selected studies focused on workplace canteens [10,21].

This case study intends to contribute to filling this gap, aiming to compare food waste perception by consumers and measured plate waste in a Portuguese workplace canteen in order to recognize if a trained consumer can estimate his/her food waste.

2. Materials and Methods

2.1. Ethics and Sampling Characteristics

The present case study was developed at a workplace canteen in the North of Portugal accessible to about 3000 public employees of a Municipality [37].

The canteen provides daily lunch on working days to an average of 120 regular users, without previous meal booking. The catering service is outsourced to a private company.

The sample included all the canteen users that agreed to participate after knowing the objectives and procedures involved. The study complied with all of the principles of the Declaration of Helsinki [38]. Written consent from canteen users, the private company, and Institution was previously obtained.

This study involved 160 participants. The sociodemographic characteristics of the respondents are presented in Table 1. The respondents were equally distributed between genders. The majority of them were aged between 41 and 60 years old and graduated. Our sample is biased towards more graduated respondents.

Table 1. Participants sociodemographic characteristics ($n = 160$).

	Female (%)	Male (%)
Participants	49.4	50.6
Age group (years)		
17–30	5.6	5.0
31–40	8.8	13.8
41–50	16.9	13.8
51–60	9.4	11.3
61+	0.6	1.3
No response	5.0	8.5
Education level		
Basic education (4 years)	0.0	1.3
2nd/3rd cycles (6–9 years)	1.2	2.6
Secondary school (12 years)	15.6	21.3
Graduation	27.5	20.0
Master/Ph.D.	5.0	5.6

Approximately 35.6% of participants had meals at the canteen 4–5 times a week, while another 29.4% had lunch at this place 1–2 times a week.

On data collection days, 40.6% of the participants chose meat main course, 25.6% selected fish main course, and 17.5% diet main course, with vegetarian the least selected option by only 15% of the participants.

2.2. Meal Characteristics

Monthly menus were available on the institutional website.

The menus included: (1) a vegetable soup, presenting two options: with and without potatoes; (2) the main course, to be selected from four options: fish, meat, vegetarian, and “diet” (low-fat meal) combined with a carbohydrate source (rice, pasta, potato, or pulses) and a vegetable component. Composed main courses are those presenting the main protein source in fractions mixed with other components; non-composed main courses have the main protein source separated from the carbohydrate and vegetable components; (3) dessert or fruit (three different options of each one available daily).

2.3. Methods

Food waste evaluation by individual weighing was chosen due to its accuracy, allowing comparisons between meal components, despite its high logistical burden being a relevant disadvantage and the possibility to disrupt normal food service operations [39,40].

Visual estimation was used to evaluate food waste perception by consumers. It is well recognized that this method could overestimate plate waste values compared to the weighing method; it is more difficult to interpret, namely for aggregated food groups. This occurs due to the use of a non-continuous scale in visual estimation [39,40]. However, it is a non-invasive method that is not too time consuming, which makes it a valuable method in food waste studies, highly correlated with actual weighed food [39,40].

2.4. Data Collection

Field work was performed during one month and included five weekly menus. At least six consumers were randomly selected each working day in order to ensure participant follow-up and plate waste determination procedures.

The study flow was organized in four steps, starting with the recruitment of participants who were informed on the objectives of the study and ending with the weighing of plate waste (Figure 1).

A printed form was developed to collect individual plate waste during mealtime, and a questionnaire was designed to allow the collection of information about canteen frequency attendance, meal acceptance, portion served, plate waste (visual estimation and causes), and consumers' perception of the sensory characteristics of meals (flavor, taste, texture, and appearance), as well as social demographic information. Finally, the plate with remaining food was weighed, and the amount of food wasted was determined by subtracting the empty plate weight allowing for the comparison between the self-assessment of plate waste and the measured one.

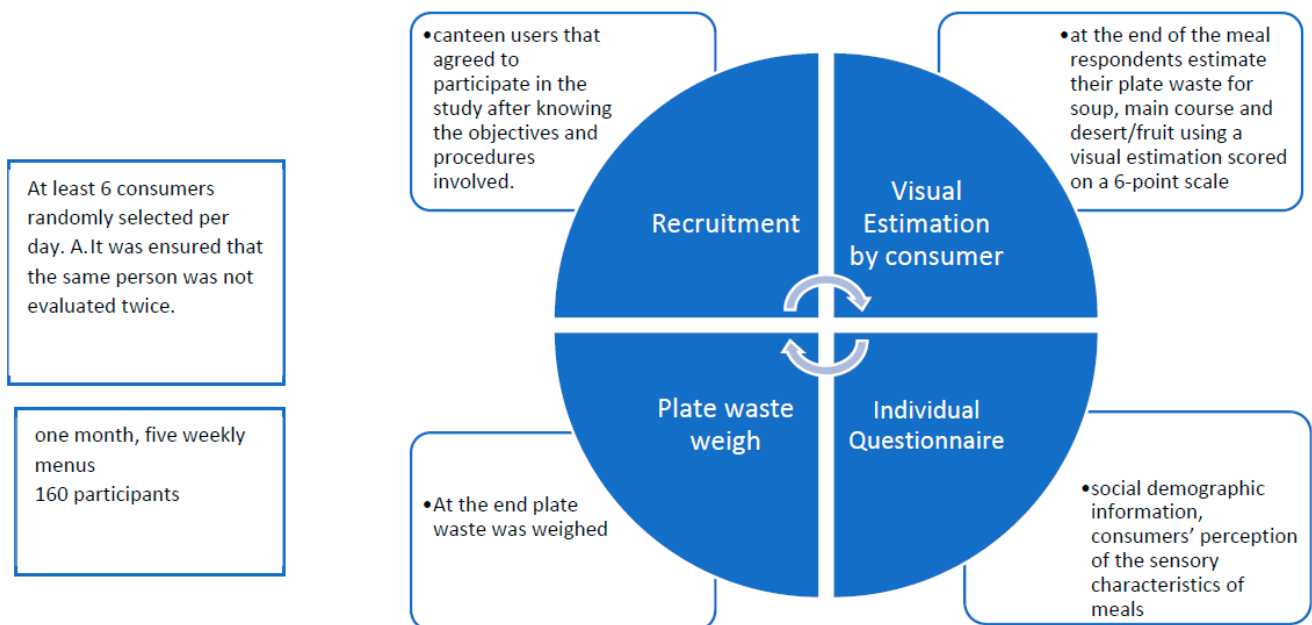


Figure 1. Study flow.

2.4.1. Visual Estimation by Consumer (Plate Waste Perception)

Visual estimation was performed by each participant at the end of the meal in order to estimate individual plate waste for soup, main course, and dessert/fruit. Keeping in mind the appearance of full servings and their variability, the amount of food wasted on each plate was scored on a 6-point scale, adapted from the one by Comstock et al. [39]. If the plate was left untouched, a score of 6 was given; if at least one bite was eaten, a score of 5

was attributed, corresponding to 75% of plate waste; if half the food remained, a score of 4 was scored; if one-quarter remained corresponding to 25% of plate waste, the score for the food item was 3; and if less than one quarter was wasted, a score of 2 was given; a score of 1 was assigned when no plate waste occurred [39] (Figure 2).

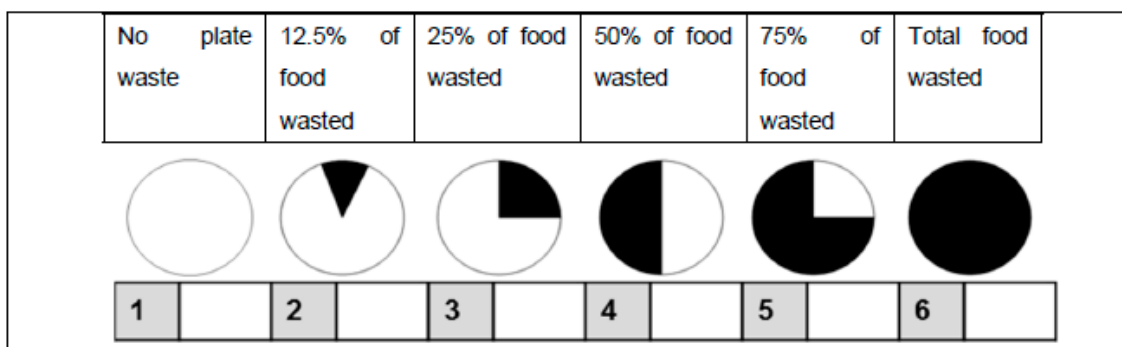


Figure 2. Plate waste estimation. Adapted from Comstock [39].

2.4.2. Plate Waste Determination

For plate waste determination, initially, the plate was weighed empty. Individual meal components were weighed separately after plating (soup, main course, and dessert/fruit). The serving size was determined by subtracting the empty plate weight. At the end of the meal, the plate was collected, non-edible items were removed, the plate with remaining food was weighed, and the amount of food wasted was determined by subtracting the empty plate weight. Aggregated waste across food items was collected when composed main courses were served, while individual plate waste was collected for non-composed main courses, according to the methodology described by Liz Martins et al. [40]. The empty plate was weighed, and the percentage of plate waste was calculated by the ratio of edible food (food available for consumption after removing bones, peels, and stones) discarded per edible food served. Plate waste is referred to in this research as food waste. The weighing was performed on a digital scale accurate to the nearest gram (SECA, model 851, Hamburger, Germany).

2.5. Data Analysis

Statistical software package IBM SPSS Statistics, version 21.0, and Excel Microsoft Office Program Professional Plus 2010 were used for data analyses. Mean, standard deviations (SD), maximum and minimum values were used to provide descriptive analysis. Mann–Whitney test, Kruskal–Wallis tests, and Spearman correlation were used to correlate data collected. The confidence level was set at 95%.

3. Results

3.1. Plate Waste by Meal Components

The percent of plate waste varied from 4.0% for dessert to 9.0% in the main course (Table 2). The proportion of food wasted ranged from 7.1% for vegetables to 11.6% for carbohydrate components (Table 3).

Table 2. Portion served and plate waste according to the meal component.

	Soup (<i>n</i> = 102)			Main Course (<i>n</i> = 108)			Dessert (<i>n</i> = 103)		
	Mean ± SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	Max	Min
Portion served (g)	286.3 ± 64.6	420.0	72.0	382.6 ± 89.4	680.0	158.0	162.4 ± 50.9	268	22
Plate waste (g)	22.4	146.0	0.0	39.9 ± 55.4	248.0	0.0	6.9 ± 17.0	40.0	0.0
Plate waste (%)	8.4			9.0			4.0		

SD—standard deviation; Max—maximum value; Min—minimum value.

Table 3. Portion served and plate waste according to main course component.

Mean \pm SD	Protein Component	Carbohydrate Component	Vegetable Component
Portion served (g)	161.9 \pm 57.8	169.8 \pm 66.2	43.6 \pm 29.5
Plate waste (g)	14.1 \pm 30.8	18.8 \pm 29.9	3.6 \pm 10.4
Plate waste (%)	7.9 \pm 15.7	11.6 \pm 17.9	7.1 \pm 14.2

SD—standard deviation.

Portions served and food wasted according to main course type are presented in Table 4.

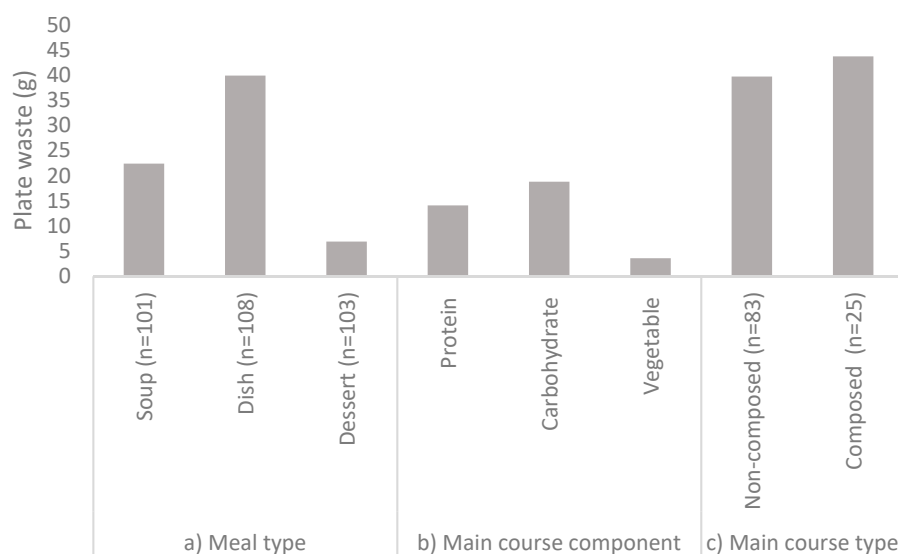
Table 4. Portion served and plate waste according to main course type.

	Non-Composed Main Course (n = 83)			Composed Main Course (n = 25)		
	Mean \pm SD	Max	Min	Mean \pm SD	Max	Min
Portion served (g)	375.3 \pm 86.0	680.0	230.0	412.6 \pm 85.1	650	236
Plate waste (g)	39.7 \pm 52.4	236.0	0.0	43.7 \pm 64.4	248.0	0.0

SD—standard deviation; Max—maximum value; Min—minimum value.

The mean weight of food waste was 39.7 g for the non-composed main courses (SD = 52.4) and 43.7 g for the composed main courses (SD = 64.4).

A synthesis of weight plate waste according to meal type, main course component, and main course type is provided in Figure 3.

**Figure 3.** Plate waste (grams) according to meal type, main course component, and main course type.

3.2. Food Waste Perception by Canteen Users

Visual estimation of food waste perceived by consumers is presented in Table 5. According to the visual estimation scale, approximately about half of the participants (46.3%) reported no waste for soup, 54.4% no waste for the main course, and 58.1% no waste for dessert. Considering meal components, 26.9% of participants reported waste of carbohydrate component, 11.2% of protein component, and 1.9% of vegetable component. There are some missings in this question.

About 87% of participants reported overall satisfaction with meal sensory characteristics, namely flavor, taste, texture, and appearance. Participants identified the main causes

for food waste excessive portions (46.1%), dislike of meal flavor (18.6%), cooking method (8.8%), and texture (3.9%).

Table 5. Visual estimation of plate waste perceived by consumers for soup, main course, and dessert ($n = 160$).

	No Food Waste	12.5% of Food Wasted	25% of Food Wasted	50% of Food Wasted	75% of Food Wasted	Total Food Wasted
Soup	46.3%	0.6%	3.1%	2.5%	1.3%	0.0%
Main course	54.4%	27.5%	12.2%	1.3%	2.5%	0.6%
Dessert	58.1%	5.0%	0.0%	0.6%	0.0%	0.6%

The majority of participants indicated wasting food once or twice a week (30.6%), while 44.4% indicated that they never wasted food.

3.3. Measured Food Waste versus Food Waste Perception by Consumers

Reported food waste by participants was similar to measured food waste for all meal components (Table 6).

Table 6. Measured food waste and consumers perceived food waste according to meal components.

	Reported Food Waste by Consumers	Measured Food Waste (%)	p^*
		Mean \pm SD	
Did you waste soup?	Yes ($n = 25$)	28.3 \pm 16.2	<0.001
	No ($n = 75$)	1.9 \pm 7.5	
Did you waste main course?	Yes ($n = 70$)	17.6 \pm 12.4	<0.001
	No ($n = 88$)	2.1 \pm 5.6	
Did you waste dessert?	Yes ($n = 11$)	23.4 \pm 17.4	<0.001
	No ($n = 92$)	1.6 \pm 5.2	

* p value according to the Mann–Whitney test at a confidence level of 95%; SD—standard deviation.

Measured food waste follows the same trend of waste perceived by consumers for soup ($R = 0.722$; $p < 0.001$), main course ($R = 0.674$; $p < 0.001$), and dessert ($R = 0.639$; $p < 0.001$).

3.4. Food Waste According to Sociodemographic Characteristics and Meal Cost

Age and education level had no influence on plate waste values for different meal components. Women wasted more of the main course than men (11.3% \pm 12.7% versus 6.7% \pm 11.0%; $p = 0.003$). For other meal components, no differences were observed between genders.

The frequency of canteen attendance did not influence plate waste value for soup ($R = 0.057$; $p = 0.572$), main course ($R = 0.002$; $p = 0.978$), and dessert ($R = 0.134$; $p = 0.176$).

Consumers that wasted more main course also wasted more soup ($R = 0.211$; $p = 0.035$) and dessert ($R = 0.196$; $p = 0.005$). Menu option (meat, fish, vegetarian, and diet) had no influence on food waste ($p = 0.343$).

4. Discussion

Our findings showed that participants of this case study have a good perception of plate waste for all meal components. The amount of food waste reported by canteen users, through the visual estimation method, is in line with the food waste assessed by the weighing method. Those reporting waste of soup, main course, and dessert also presented high food waste values for all meal components. In the case of the main course, the plate waste represents 9% of the portion served; the overall waste value of the main course is lower than the acceptable limit of 10% for plate waste, in line with other studies [41–47].

One of the reasons contributing to this low plate waste may be that 87% of participants reported overall satisfaction with meal sensory characteristics, which was already identified as a factor that influences food waste in food services [43].

According to visual estimation, 46.3%, 54.4%, and 58.1% of the respondents mentioned “no food waste” for soup, main course, and dessert, which is in line with another study where even higher values of 72% of consumers indicated that they had no food waste [10]. High standard deviations observed on plate waste may result from consumers’ preferences, meal characteristics, and appetite.

A preference for meat main courses was observed, in line with results found by others in different settings [22,28,44]. Nevertheless, in this study, no significant differences were found between plate waste for different menus. The type of the main course chosen was not a trigger for waste in the form of plate waste. This contradicts the results found in a study carried out in a Brazilian university canteen, where menus influenced plate waste, pointing to the low variety of menus served as a contributor to food waste [34]. A study on the attitudes of employees toward food offered in staff canteens indicated a desire for variety, including vegetarian dishes, as well as health-promoting dishes [16]. The possibility of choosing between fish and meat and other options, as is the case of the workplace canteen where the study was conducted, allows higher satisfaction of consumer expectations and consequently lower waste values.

Bell’s study (2020) reported a relationship between food waste and level of education [20]; on the opposite, no significant relationship was found between food waste and education level and frequency of attendance to the canteen in the present study, probably due to the homogeneity of participants’ graduation level.

An influence of gender on main course plate waste was observed, with higher waste values for women, which can be explained by standardization of portions served, frequently excessive for women [21,48].

Results from these studies are relevant to support awareness campaigns and other strategies to reduce food waste as there is a solid business case for reducing food loss and waste at the food service sector with a triple win: for the economy, for food security, and for the environment [49,50].

A study conducted in Brazil in different restaurant configurations revealed that variable price buffet service had an average plate waste of 23.9 g/plate, while the fixed price buffet/canteen service had 45.8 g/plate. Interviews conducted with users show they are sensitive to monetary incentives, like paying according to quantity served, and tend to be more careful and accurate when selecting the quantity of the food to put on their plates. The same study concluded that when dessert is not included in the meal and consumers have to pay for it separately, no waste of desserts was observed, while when dessert was offered for free, it was the most wasted food product during that day [51]. Considering that saving money was reported to be a primary motivator for food waste reduction, along with moral values [23], the variable price based on the amount of food served could be a solution in workplace canteens, as well as using smaller plate size [52]. This is similar to household research that showed money was a key motivator to reduce food waste and that using it as a key part of an intervention yielded significant food waste reduction results [53]. Another solution could be to offer different plate sizes and let the consumer choose which plate would suit him or her best [21,54].

Similar to the results of a study on household food waste that concluded that the higher household consumer perception, the smaller the amount of food waste per meal [55]; the high accuracy of the perceived food waste of the majority of this workplace canteen canteens users can also contribute to explain the lower volumes of plate waste.

In the present study, the main reason reported for plate waste was the excessive amount of food served, mentioned by 46.1% of the participants, pointing to the need of evaluating and monitoring plating regularly in order to reduce unnecessary overproduction and plate waste [49]. The second most cited reason for wasting food was dislike of the taste, mentioned by 18.6% of the participants, that is related to the acceptability of the menu

and meal sensory characteristics. This is in line with other studies that identified taste as having the greatest direct impact on food waste behavior in a catering company [10] and that recommended focus on interventions designed to improve food quality and make portion sizes more flexible [21]. Reasons identified in other studies, like lack of appetite, not enough time for having the meal, or appearance of plate were rarely mentioned by the participants of this study.

The information collected could be an indicator that increasing consumers' perception of their waste will promote waste reduction. This could be used in awareness campaigns, helping to change consumers' behavior.

There is also a solid business case for reducing food loss and waste in the food service sector with a triple win: for the economy, for food security, and for the environment [50]. Taking into account that thousands of people eat in workplace canteens every day, these results can help to design more personalized awareness campaigns that, in addition to contributing to combat food waste, can also play a role to encourage the adoption of healthier eating habits [16,56,57]. In addition, to be considered a good place to introduce healthy eating habits, canteens could also be used to promote consumer's behavior changes related to food waste. In this sense, awareness campaigns towards increasing consumers' perception of their plate waste and of its environmental and economic impact could contribute to that aim.

5. Conclusions

This study uses primary data on measured and perceived food waste at a workplace canteen. A key finding of this case study was the alignment of self-reported versus measured food waste for all meal components, as the amount of food waste assessed by the weighing method confirmed the food waste reported through the visual estimation method. The higher perception of plate waste was associated with higher measured plate waste. Study participants reporting waste of soup, main course, and dessert also presented high food waste values for all meal components.

Excessive portions were identified by consumers as the main reason for plate waste. The information gathered in this study has practical implications for more efficient management of canteen service; namely, they reinforce the need to implement campaigns focusing on the user's awareness about the importance of controlling food waste and choose adequate portions according to their needs and appetite. Considering that consumers seem to have a good perception of their food waste but, nevertheless, still waste food, even if it was below the limit of acceptability for food waste in this setting, we hypothesized the need, on the one hand, to reinforce food waste campaigns and also to develop strategies to counteract the identified barriers and, on the other hand, the need to regularly monitor the quality and the portions served in order to reduce food waste.

We hypothesized awareness campaigns developed by the Municipality supported by research on self-reported versus measured food waste are effective in the reduction of food waste.

Data collection was performed only by one researcher, impairing the possibility to follow more participants on the same day. Additional data collected at other workplace canteens are required to further add more insights to these results.

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