Quantitative evaluation of disposable cups and leftover food generated by the users of a University Canteen in the State of Rio de Janeiro

Avaliação quantitativa dos copos descartáveis e restos alimentares gerados pelos usuários de um Restaurante Universitário no Estado do Rio de Janeiro

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Abstract

The study aimed to quantify the solid waste generated by users in a University Canteen in the State of Rio de Janeiro. The weight of leftover food in the plates and the consumption (in units) of disposable cups were determined from January to June, 2016. Halfway through this study, an awareness campaign was addressed to the users, with educational material on sustainability, aiming to reduce the generation of solid waste. A semi-structured questionnaire was used to identify the reasons for the generation of leftover food. It was found that 52,896 units of disposable cups were used in January, and 20.8 tons of remains of food in plates were generated in six months. After the awareness stage, it was observed a 34.9% reduction of plate wastes, and the supply of disposable cups was interrupted. Most interviewees reported that "sometimes" (51.1%) they left food on the plate and 55.3% highlighted that the main reason for this was because they didn't like some dish of the menu. Some factors may contribute to the rejection of the prepared meals, such as the supply of poor-quality meals, leading to a low acceptance by users. The awareness and environmental education can change positively the food consumption, avoiding food waste. It was concluded that the data obtained can be used for the decision-making of the managers for adjustments of the menu planning, the way of preparation of the food and the adequate management of solid waste.

Keywords: Solid Waste. Collective Feeding. Food Wastefulness. Waste Management. Food Services.

Resumo

O estudo teve como objetivo quantificar os resíduos sólidos gerados pelos usuários de um restaurante universitário no Estado do Rio de Janeiro. Foi realizada a pesagem dos restos alimentares dos pratos e avaliado o consumo (em unidades) dos copos descartáveis no período de janeiro a junho de 2016. Na metade do estudo, fez-se uma sensibilização, com material educativo, sobre sustentabilidade com os usuários, visando reduzir a geração desses resíduos sólidos. Aplicou-se um questionário semiestruturado para identificar os motivos da geração dos restos alimentares descartados. Verificou-se a utilização de 52.896 unidades de copos descartáveis no mês de janeiro e foram geradas 20,8 toneladas de restos alimentares dos pratos em seis meses. Após a etapa de sensibilização, observou-se redução de 34,9% dos restos alimentares e o fornecimento de copos descartáveis foi interrompido. A maioria dos entrevistados respondeu que "às vezes" (51,1%) deixa alimento no prato e 55,3% destacaram que o principal motivo para este ato foi por não ter gostado de alguma preparação alimentar do cardápio. Alguns fatores podem contribuir para a rejeição das preparações servidas, como o fornecimento de refeições de pouca qualidade, que causam baixa aceitação dos usuários. A sensibilização e a educação ambiental podem alterar de forma positiva o consumo de alimentos, evitando, assim, seu desperdício. Concluiu-se que os dados obtidos podem ser utilizados para a tomada de decisão dos gestores para os ajustes do planejamento, o modo de preparo dos alimentos e o gerenciamento adequado dos resíduos sólidos.

Palavras-chave: Resíduos Sólidos. Alimentação Coletiva. Desperdício de Alimentos. Gestão de Resíduos. Serviços de Alimentação.

Introduction

In current world of advances and transformations, people have increasingly eaten outside the home and, therefore, it has been necessary to increase the number of Food Service (FS) establishments to meet this demand.[1,2] However, in the transformation process of raw materials carried out by these services, various natural resources are used and different kinds of wastes are produced, a clear evidence of the importance of developing environmental practices throughout the food production stages.[3]

Thus, an environmental management system must be implemented in the FS for the control of the entire operation, from planning to production, developing actions and programs that aim to reduce the adverse impacts on biological, physical and socioeconomic resources.[4] The solution of environmental problems, or their minimization, requires a new attitude by entrepreneurs and managers, who must consider environmental issues in their decisions and adopt administrative and technological concepts that aim to increase the planet's support capacity.[5,6]

According to the *American Dietetic Association* (ADA), to foster environmentally responsible practices, it is necessary to preserve natural resources and diminish the amount of wastes generated in the processes of foods production, transformation, distribution, access, and consumption.[7]

The law no. 12.305/2010 provides important tools to sustain the necessary progress of the country with respect to the main environmental, social and economic problems that result from an improper management of solid wastes. This policy introduced measures for the prevention and reduction of wastes production using tactics such as the development of sustainable habits and the increased reuse, recycling, proper waste handling and disposal and selective wastes collection.[8]

In public Higher Education Institutions (HEIs), there are University Canteens, which produce and serve meals to a considerable number of students.[9] In these places, during the production process, large quantities of organic and inorganic residues are discarded, such as plastic packages and food remains and scraps. For this reason, due to the adverse environmental impacts that such materials have on the environment, this practice began to be discussed in studies conducted by these institutions.[10]

Organic solid wastes can be classified as every excess of processed, *in natura*, pre-prepared or ready-to-eat food that was not consumed at the day it was produced.[11] Among these classifications, food left uneaten in the plates of users is considered an indicator of acceptance of the dish served by the FS, since such leftover is influenced by the sensory characteristics of the food offered. The causes of this indicator must be evaluated, monitored and verified so that plans for the diners' sensitization and awareness can be developed as well as changes in the preparation of the meals to suit them to the users' preference.[12]

According to Seiffert,[13] environmental awareness and training processes, which are essential to achieve the engagement of all employees and, when exercised, can interfere with the practices of the Environmental Management System (EMS), should be part of the organizational daily routines. In this context, environmental education can be considered the element that creates a new vision of human relations with the environment and new ethical attitudes, which will lead to a critical and transforming vision of reality and the subjects' commitment with an effective participation in defining their personal and social future.[14]

Given the above, this study aimed to quantify solid wastes and identify the reasons that cause their generation by the users of a University Canteen in the state of Rio de Janeiro.

Material and Methods

Characterization of the Food Service

It is a quantitative case study conducted in a University Canteen (UC) in the state of Rio de Janeiro, which serves an average number of 7,000 meals per day (lunch and dinner). The meals are produced in the central kitchen in one of the university campuses and distributed to four external canteens, consisting of a mixed distribution system.

The menu offered is simple, consisting of the main dish, rice and bean, one side dish, two cold salads, one kind of desert and refreshment. The meals serving mode is of the cafeteria fixed type, where the main dish and desert only are portioned by the attendants. The UC has, on average, 150 employees, out of which there are ten nutritionists working in the central kitchen. The users of the UC are students of the university, technical and administrative public servants, outsourced workers, visitors and teachers.

Data collection

From January to June 2016, the amount of remains of food on the plates and disposable cups used by the UC users were quantified. The UC staff was instructed to weight, in separate, for each meal shift, the foods left on the plates and enter the values found into a spreadsheet prepared by the authors.

Due to unavailability of specific trash containers to weight the disposable cups used, it was not possible to quantify it at this stage; so, they were quantified based on the materials requisition forms filled out by UC storage department.

The data relating to the weighting of organic wastes were recorded in tables of the *Microsoft Office Excel*® software, version 2016, and expressed by the total and *per capita* amount of leftover food. To calculate the *per capita* amount, the following formula was provided by the nutritionists of the Food and Nutrition Unit:

Per capita leftover food (g) = total amount of leftover food /number of meals served

Sensitization of UC users

To sensitize users about food losses, educational materials such as banners and illustrative displays were produced, with a focus on food wastes, sustainability, solid wastes and recycling.

Subsequently, halfway through the period of data collection, educational actions using these materials were promoted, addressing food wastes related to the foods left on plates during the meals served by the UC, the importance of minimizing the use of disposable materials and encouraging the use of reusable cups/mugs. This intervention continued throughout March 2016.

Administration of the questionnaire

During six days in October 2017, a semi-structured questionnaire with eight questions was used, aiming to understand the reasons that influence the disposal of uneaten foods by users. Using simple random sampling, 360 users (students, teachers, technical-administrative servants, visitors and outsourced workers) participated in the research, to whom was delivered the Free Informed Consent Form when they were waiting on the line to be served at the UC. The sampling plan assumed 95% of confidence level and accuracy of five percent points.

The questions of the questionnaire were related to the frequency of meals eaten at the UC, satisfaction with the dishes served, preferences for the dish offered, frequency that the user leaves uneaten foods on the plate, and sustainability-related questions. The responses to the questions were based on the number of meals eaten per week, "yes or no", "never", "sometimes and always" and the Likert scale adapted to the proposed subject.

The work was approved by the Ethics Committee after submission of the Ethics Application Form, certificate number 69909517.3.0000.5243.

Data analysis

The data obtained in the field research was represented graphically using the *Microsoft Office Excel®* software, version 2016, with absolute and relative numbers.

Results and Discussion

In the studied UC, in January 2016 (19 days), 52,896 disposable cups were consumed. In a one-year projection, we have an estimated number of 634,752 disposable cups, representing a considerable volume of this material. It should be noted that the UC does not use selective collection for further recycling, i.e. they are disposed of without proper management.

The use of disposables in FS establishments aims to ensure good hygiene and sanitary control, and sometimes it is necessary in some production stages because this material does not required cleaning and are readily replaced in situations of high demand during the meals. However, disposable cups are manufactured from a nonrenewable raw material, and therefore, their consumption in large scale can be interpreted as a lack of environmental concern. Therefore, it should be used consciously to avoid the excessive generation of plastic wastes, which take more than 200 years to be decomposed in landfill sites.[15]

After sensitizing users for the use of reusable cups or mugs, the UC managers decided to discontinue their use. This measure represented a sustainable action aimed to reduce the generation of inorganic wastes and, consequently, environmental impact, since in this UC they would not be sent for recycling.

During six months of data collection, or 82 non-consecutive days, due to the university strike and period of vacation, it was possible to observe a total amount of 20.8 tons of remains of food in the plates of the users of the studied UC.

The decomposition of organic matter from food wastes causes the production of pollutant gases to the atmosphere and slurry, a dark liquid with unpleasant odor that contaminates groundwater, especially if it contains heavy metals. When this liquid is not treated properly, it is harmful to the environment.[16] Furthermore, the disposal of organic wastes in landfills contributes to reduce their durability and, therefore, will require the construction of new sites to meet nonselective disposal.[17]

However, to reduce food wastes, it is necessary to adopt sound strategies to improve this scenario. Sensitization/awareness of the population on this topic is viewed as a very effective influence to disseminate information about the causes and consequences, as well as the development of communities with new sustainability-related principles.[18]

The remains of food quantified before and after awareness on food waste are presented in Table 1. It was observed that there was a decrease in the total amount, i.e., from 12.6 tons to 8.2 tons, a 34.9% reduction. The *per capita* leftover food before and after sensitization were 61.2 g and 41.8 g, respectively.

Table 1. Quantification of organic wastes before and after sensitization of UC users. Rio de Janeiro, 2016.

Before sensitization			
Month	Total (tons)	Number of meals	Food remains *per capita* (g)
January	4.3	78595	55.2
February	4.4	58550	75.1
March	3.9	69029	56.1
Total	12.6	206174	61.2
After sensitization			
Month	Total (tons)	Number of meals	Food remains *per capita* (g)
April	2.0	21740	92.9
May	3.5	94689	37.2
June	2.7	80706	33.5
Total	8.2	197135	41.8

Foods waste in FS establishments is described by several authors. Viana and Souza,[19] in a study carried out in the city of Porto Velho-RO, during the conduction of an educational campaign in a self-service FS, observed a decrease of 9.8% in the average weight of food wastes.

Coelho et al.,[20] after conducting an educational intervention in a FS located in the city of São Paulo, found, as a result, a reduction of 12.90% of food remains. Silva et al.,[21] when they conducted an awareness campaign with the customers of a hospital self-service FS, achieved a reduction of 43.24% and 27.20%, in the first and second stage of the program, respectively.

These results indicate that the implementation of educational actions aimed to sensitize and aware users may change foods consumption positively, preventing food losses. It should be emphasized that the FS' nutritionist or manager should proceed continuously with this work, promoting awareness campaigns and training programs to achieve the satisfactory outcomes found.

Abreu et al.,[22] when they studied the food wastes in a cafeteria of fixed service in the city of São Paulo, obtained, by weighting the leftover food on the trays, 72 g per customer, which varied from 34 g to 123 g. The high values found for discarded residues can be due to diverse factors, such as poor customer awareness, quality and presentation of the food dishes, low acceptance, as well as use of inadequate utensils when the meals were served.

Medeiros and Delevati,[23] when they examined the production of meals in commercial restaurants, found that most of the organic wastes discarded consisted of remains of food left in the users' plates. This fact must be taken into consideration by the restaurants' managers, because it shows that a large portion of the meals produced may not be eaten.

Conversely, a different result to that of the present study was found in the study conducted by Lechner and Giovanoni,[24] in which there was no significant difference (p=0.4673) in the amount of remains of food before and after the awareness campaign. Bicalho and Lima[25] also found that the food waste quantities remained practically unchanged after the educational intervention. This outcome indicate that other sensitization method should be used with the users in order to provide an effective effect on the reduction of food wastes.

Some factors may contribute to the rejection of the meals served, such as low-quality meals, repeated dishes, inadequate temperature of the foods served, customer's loss of appetite, large serving utensils and/or plates, which can lead to excessive quantities of the food servings, and customers' lack of environmental awareness.[26]

The use of simple printed messages as a method of raising awareness among university students proves to be effective to reduce the amount of foods left uneaten in the plates. This assumption was confirmed in a six-week study, in which this method contributed to a reduction of 15% of food wastes.[27]

The studied UC uses the cafeteria fixed system, characterized by the presence of thermal counters and serving sizes defined by the FS manager. In the case of the UC studied, only the main dish and dessert are served by the attendants, and the users serve themselves with the other dishes.

According to Sayur and Pinta,[28] the self-service, buffet-style method, allows free selection of the amounts served, which may help increase food wastes because they induce customers to serve themselves with a larger portion that usual, since the quantity of the food served will not change the meal price. A study conducted in a Portuguese university revealed that the quantity of foods produced is significantly higher than that effectively eaten, indicating an excess of foods being prepared and, consequently, disposed of. It was also found that the method of meals preparation is related to the consumer satisfaction. Therefore, a method designed to reduce remains of food on plates could be the use of questionnaires to measure customer satisfaction and foods preference.[29]

In this study, a questionnaire was used to better understand the reasons for the foods left uneaten on the plates of the UC users. The questionnaire allowed to identify the category of the respondents: 89.17% were students of the university; 1.39% did not respond; 1.39% were civil servants or outsourced workers; 8.06% were visitors; and no teacher participated in the study.

As shown in Fig. 1, 19.2% of the users who responded to the questionnaire eat five meals per week at this UC, considering lunch and dinner. However, it was found that 13.1% (n=47) of the participants have lunch and dinner every day.
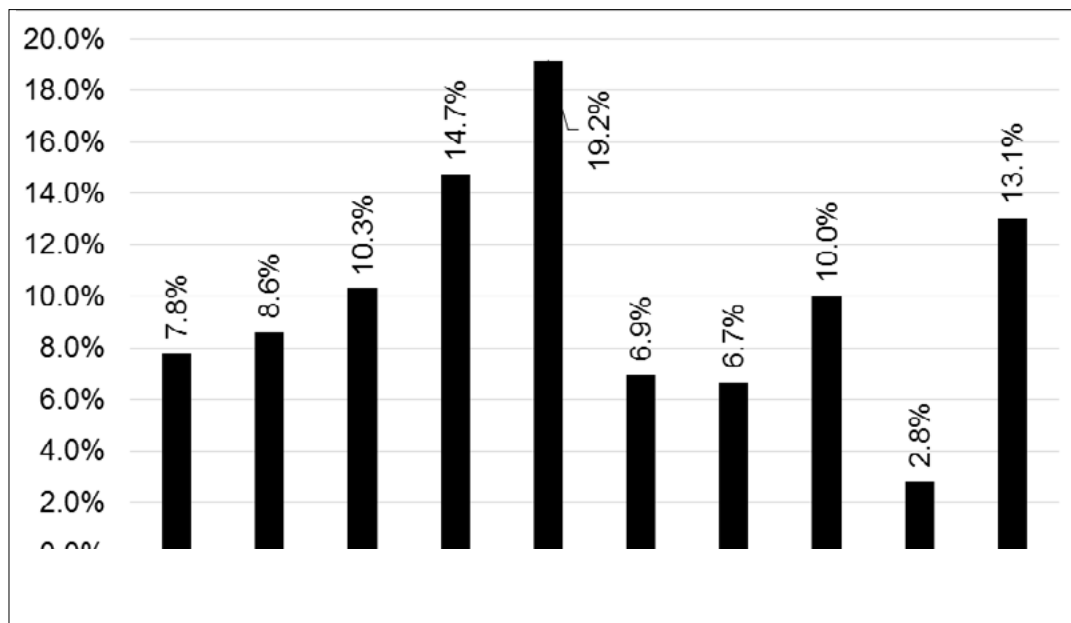

Figure 1. Number of meals consumed per week at the UC (RJ, 2017).

Regarding the evaluation of the food meals served, which is represented in Fig. 2, it was found that 30% of the users responded "like it moderately", and 37.5% "like it very much". The majority of the participants liked the dishes (73.3%) served and no respondent marked the option "dislike it very much". So, the foods offered by the UC are considered satisfactory, according to the users' responses.

As illustrated in Fig. 3, the users of the studied UC have preference for the main dish (33.3%), followed by the side dish (28.1%) and bean (24.2%). A small number of the respondents indicated preference for salads (11.4%). The main dish consisted of meats (beef, pork, chicken and fish). The main dishes often served by the UC are diced beef in gravy, baked chicken thighs, minced beef with olives, oven-cooked fish, and chicken dices in gravy.
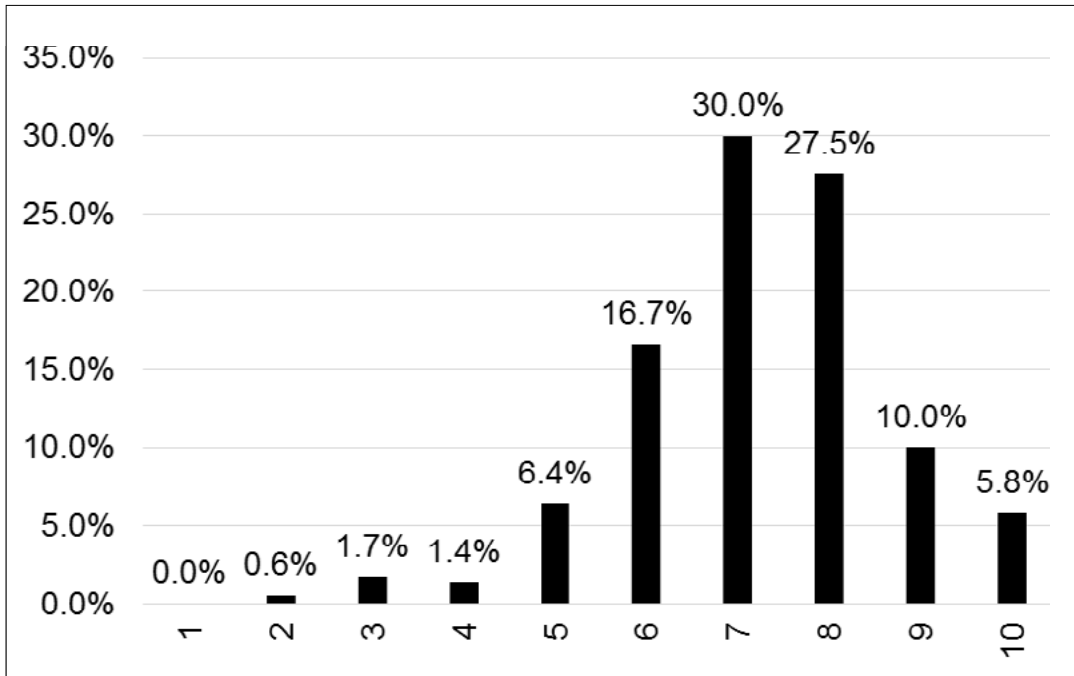
Figure 2. Rating of the dishes served by the UC (RJ, 2017).
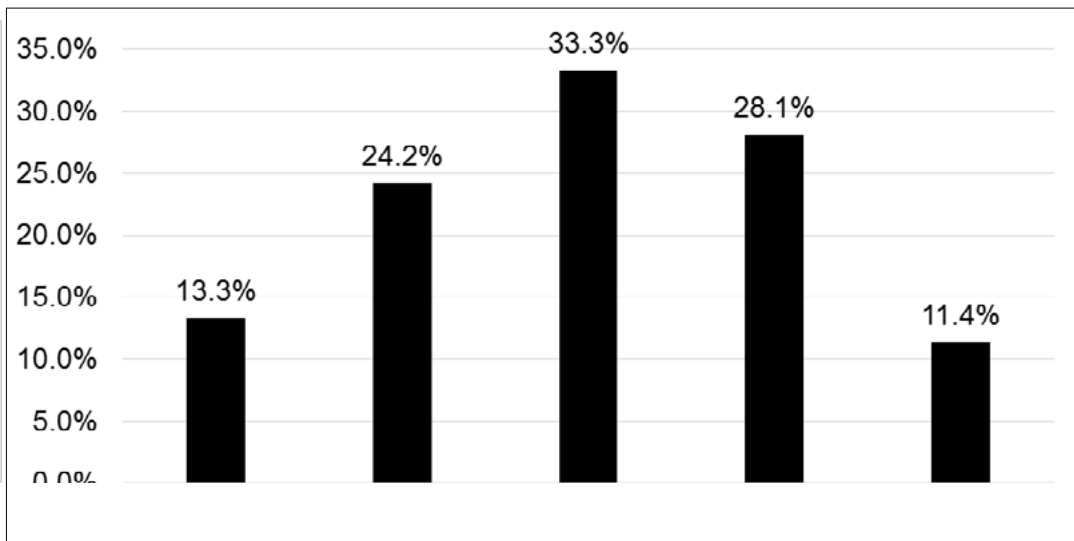

Figure 3. Users' preference for the dishes offered by the UC (RJ, 2017).

According to the data collected, the majority of the participants answered that "sometimes" (51.1%) they leave uneaten food on the plate, and added to those who answered "always" (6.1%), we have a total percent of 57.2% (n=206) of users who have this behavior. The other respondents answered that they "never" leave food in the plate, corresponding to 42.8% (n= 154).

Similar result was found in the study conducted by Carvalho et al.,[30] when they assessed food wastes using a questionnaire, where 56.7% of the users said that they usually leave food in the plate.

In the study conducted in a University Canteen located in Santa Maria-RS, Zanini[31] reported a different result, in which 36% of the respondents said that they do not usually leave uneaten foods in the plate. The quality of the meals produced at different FNUs may have an influence on the amount of food that users leave in the plates. Therefore, the customer satisfaction varies at each location studied, which explains the different results.

Fig. 4 shows the percentages, according to the reasons indicated by the UC users for leaving uneaten foods in the plate. It could be seen that 55.3% of the respondents marked the option "because I did not like some dish(es)", and 53.4% "because I put more food than necessary on the plate". Zanini[31] used the same criteria in the study and obtained a high percentage (51%) of dislikes of the food dishes served, and to serve themselves with more food than necessary was pointed as one of the reasons, in 25% of the responses.

When planning the menus, the aspects "taste" and "eating habits" require more attention since, by checking them, it is possible to reach the food preferences and, therefore, a better acceptance of the meals offered, thus diminishing the amounts of foods discarded.[32]

It was also investigated the proper disposal into trash containers, i.e., by sorting them into organic and inorganic wastes. In this context, 91.7% responded that they would do such separation, and only 8.3% said no. Therefore, the possibility of implementing separation of solid wastes when the plates are returned at the end of the service is a viable measure for the UC studied.

With respect to improper disposal of solid wastes in the environment, 38.3% of the respondents answered that they are very much concerned with this aspect, indicating one more reason why the use of specific trash containers, according to the type of material, is a viable practice. It should be noted that the UC does not use selective wastes collection, recycling and composting. Solid wastes management is a sustainable practice that aims to reduce adverse environmental impacts and, consequently, it contributes to a better health of the population.[33]

Thus, selective collection facilitates recycling of inorganic wastes, because the material will be cleaner and more suitable for reuse.[33] As a sustainable practice in solid wastes management, sending the wastes for composting is an appropriate measure for the reuse of food scraps and remains for the production of fertilizer.[20]
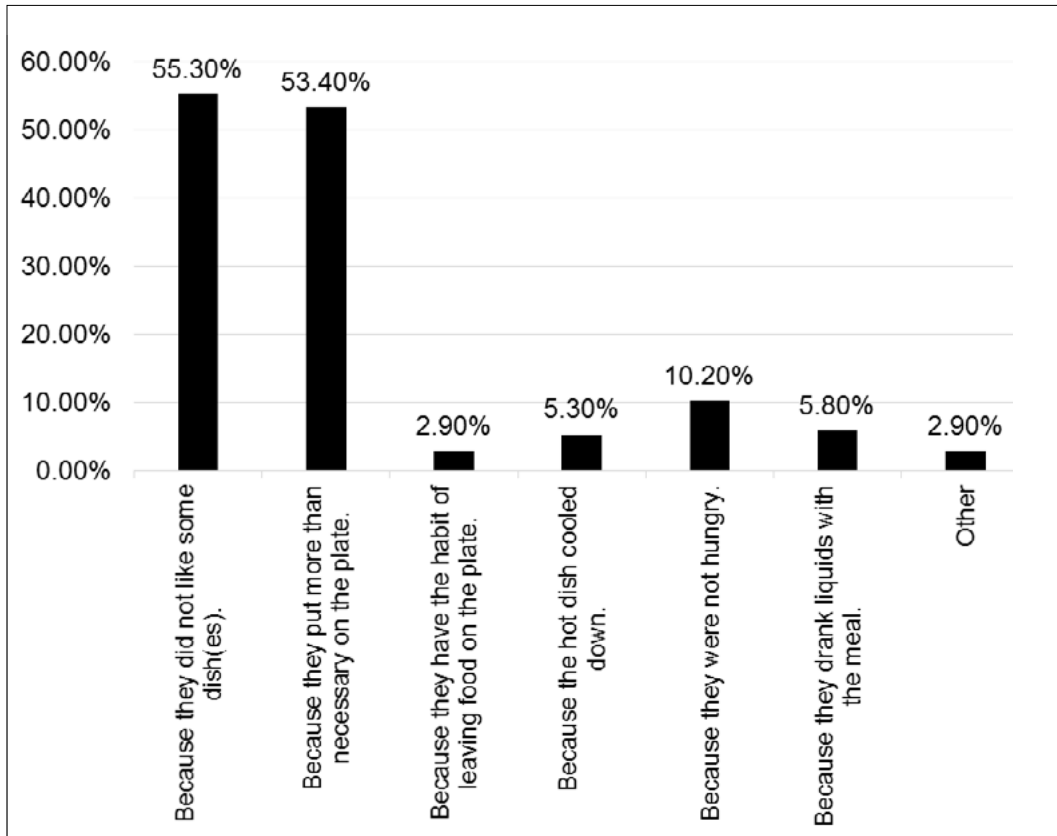
Figure 4. Reasons why the UC' users leave uneaten food on the plates (RJ, 2017).*

*The values correspond to 206 participants who said that they leave foods on the plate.

In Fig. 5, it can be identified an overall environmental concern of the UC users. The scale "it concerns me greatly" was the alternative most chosen by the users (38.3%); 21.4% consider that "it concerns me somewhat"; and 5.6% of the respondents reported to be "indifferent". Although most of the participants were concerned with the environment, this percentage is an information that require reflection, given that some users still lack environmental awareness.
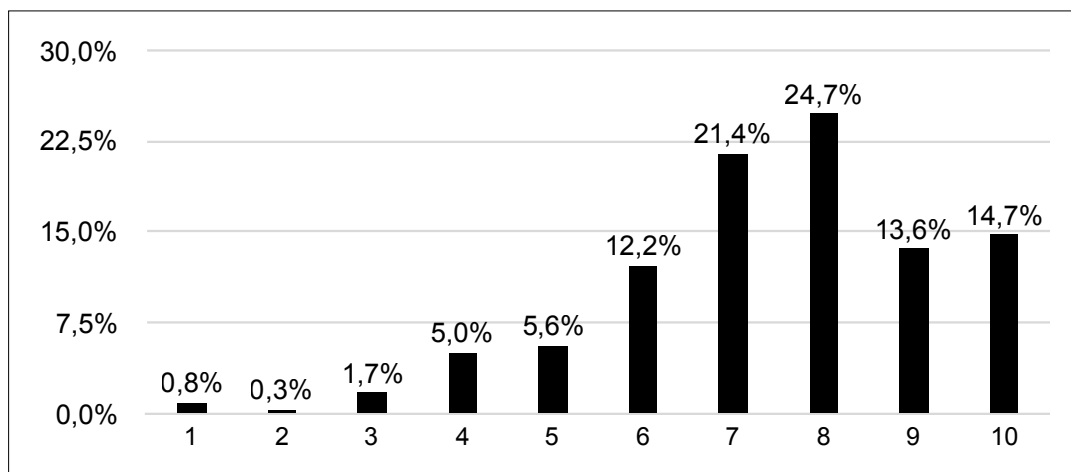
Figure 5. Environmental concern of the UC users (RJ, 2017).

Thus, environmental education should be included in college disciplines, research and projects, in order to expand the students' awareness and obtain their engagement.[34]

The role of universities in strengthening environmental awareness is vital and reveals that it is a promotion strategy for reflections and discussions among college students, aiming to analyze the interface between the consumption of disposables and consumption of foods/meals regarding the production of solid wastes with adverse environmental impact.

Conclusion

According to the objectives proposed in this work, it was possible to conduct a quantitative evaluation of remains of food in the plates of users of a University Canteen in the state of Rio de Janeiro. Based on the data obtained, considerable amounts, of approximately 21 tons of organic wastes, were found in 82 days of study.

Sensitization of users was effective in reducing the amount of uneaten foods left in the plates, but educational actions must be implemented regularly because improper disposal of organic wastes is harmful to the environment.

With respect to the number of disposable cups used in the UC, we can say that this material was overused, considering that some users consumed individually more than one plastic cup per day. The inorganic wastes produced were not sent to recycling and were not properly handled

and managed. It should be noted that, during the research, the provision of this material was discontinued, a clear demonstration of sustainable practice.

Thus, the data obtained in this study can be used for the decision-making of the managers of the FS and to collaborate to the required adjustments in planning, ways of preparation of foods and adequate handling and management of solid wastes produced in the University Canteen, and thus contribute to environmental preservation.

It is suggested that sustainability themes be increasingly included in the disciplinary contents of university courses due to the key role that they play in disseminating fundamental concepts of conscious consumerism, in order to strengthen the environmental awareness of the academic community and society as a whole.

Collaborators

Araujo CL and Pires FM participated in the conception, analysis and administration of the questionnaire, interpretation of data, manuscript drafting and final revision; Carvalho LR and Lourenço MS participated in the study conception, design, drafting and final revision of the manuscript.

Conflict of interests: The authors declare no conflict of interests.

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