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Food wasting: A study among Central European four-member families

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Abstract

Food wasting is a serious economic, environmental, social and also nutritional problem. This study focused on description of total amount and structure of food wasting in 17 selected Central European families of four members living in the Czech republic. Observed persons estimated the amount of their food waste for 5 days in average 354,41 g per household, while the real amount was 1011,65 g. Underestimation of waste quantity is highly significant (Wilcoxon pair test p= 0.002278). We found a significant positive correlation between the age difference between children and food waste amount (correlation coefficient 0.5739, p = 0.016). Among the most frequent wasted food there was milk and dairy products, then fresh vegetable, followed by cereals, then unconsumed pre-prepared foods and fruit, together with smoked meat products, followed by residues of food on a plate. Raw meat, fish, preserved products and sweets were not a subject of food wasting. Among the suitable strategies aimed at reducing food waste is also the inclusion of this issue in the education system at all levels.

Introduction

There is no single definition of food wasting – the terminology varies even within the European Union, and the definitions used in the individual countries are different from that of the FAO (2012a; 2012b). Some guidelines for food wasting research, for example, exclude from the definition those food leftovers which are no longer edible. The European Union tries to solve the issue by devising a strategy which would enable reducing food waste to a minimum level. To enhance the quality of obtained data, the EU ran the project "Fusions" (Food Use for Social Innovation by Optimising Waste Prevention Strategies), which coordinates monitoring of waste production with the optimization of waste utilization and development of a unified policy of food waste management within the EU 2012. However, not all EU member states devote the same amount of attention to the issue. For example, the Czech Republic (CR) is one of those Central European countries which have not even introduced a clear-cut definition of food waste. Moreover, the CR does not have access to data essential for clear evaluation of the total amount of food waste and food losses, or for determining which food types are most likely to be discarded, or which link in the food chain produces the greatest volume of food waste. A comparison of the data from the Food Supply 2012 documentation (Czech Statistical Office, 2013) with the data describing individual food consumption in the CR (Zavodska and Benesova, 2010) make us suspect that some food commodities are truly highly susceptible to wasting in the Czech Republic. Although the estimation of average amount of municipal solid waste (MSW) in the Czech Republic – 316 kg per person and year – is lower than the total EU average of 512 kg, Czech citizens recycle a substantially lower proportion of the MSW (mere 4% as compared with the EU average of 40%) (Ferrara and Missios, 2012). In addition, there are no data concerning the role of recycling in food waste management. Reduction in the amount of food waste would have substantial economic benefits, especially in low-income families. Therefore, the objective of our study was to obtain preliminary data on the total volume of food waste in Czech families of four members and on the structure of the waste, as well as on the awareness and estimation of adult consumers regarding the quantity of their own food wasting. Other factors which we took into account included the age of the adults and the children, type of dwelling, the way unconsumed food was disposed of, and, finally, the approximate cost of the food waste.

Material and Methods

Out of 35 originally approached families of four members, 17 finally participated on the study, i.e. 68 persons in total. The remaining 18 families did not

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Table 1. Age structure of families, type of housing and average amount of food waste

No.	Age of children (years)		Gender of children	Parents Age (years)		Type of housing	Average	
	1st child	2nd child		Father	Mother		Amount (g)	Price (CZK)
1	25	20	2 girls	49	50	House	501.4	20.1
2	18	5	1st girl, 2nd boy	35	37	House	1690.0	72.9
3	20	9	2 boys	46	49	Flat	926.4	60.7
4	20	17	2 girls	49	52	Flat	378.6	21.7
5	5	2	1st girl, 2nd boy	32	33	Flat	214.3	14.3
6	17	17	2 boys	42	45	House	711.4	55.1
7	22	14	1st girl, 2nd boy	44	50	House	738.9	105.3
8	5	8	2 boys	34	34	Flat	65.7	3.6
9	11	11	1st girl, 2nd boy	31	35	House	185.7	19.6
10	11	7	2 girls	49	48	House	915.7	58.6
11	17	14	2 boys	53	55	Flat	0.0	0.0
12	20	14	1st boy, 2nd girl	45	47	Flat	321.4	8.7
13	17	9	2 boys	39	18	Flat	465.7	41.7
14	5	3	2 girls	28	32	House	700.6	18.4
15	19	10	2 boys	42	51	Flat	250.0	13.7
16	22	18	2 girls	55	55	House	58.6	3.7
17	23	18	2 girls	43	47	House	328.6	24.0

meet some of the inclusion criteria: To be included, the family had to consist of two adults and two children, with all members sleeping and spending a sufficient amount of time in the same household throughout the duration of the survey. Out of the 17 families, 15 lived in a town of approximately 50,000 residents, one family in a town of 11,000 residents, and one in a village of 600 residents. The age structure and dwelling type of the families are summarized in Table 1.

In the first part of the survey, we met with the families, inquiring about the age and gender of the children and type of dwelling (flat or house). Since the families were generally reluctant to provide information about their annual income, we excluded data about the family's socioeconomic status from the survey. The participants were instructed in the method of daily logs of waste production and keeping records of which food items they purchased and how much they cost. The participating households also received plastic bags into which they threw the food waste. All family members except very small children were instructed how to fill in the food waste logs. All discarded food was recorded in the logs throughout a period of three weekdays and one weekend. The content of the waste bags was compared with the records after the bags and the logs were collected. To obtain an estimate of a weekly amount of food waste, the average amount from the three weekdays was multiplied by a coefficient of 1.666 and added to the waste volume produced during the weekend.

The logs for food waste records contained the following ten categories: scraps from the plate, unconsumed leftovers (e.g. boiled potatoes or meat), fresh fruits and nuts, fresh vegetables and mushrooms, bread and cereals, raw meat and fish, smoked meat products, milk and dairy products, canned food, and other food. All family members could fill in the records by themselves. The records were obtained in November 2012 and January 2013 to avoid the interference of Christmas holidays. All data was transcribed in a single table and analysed using the R software (R Development Core Team, 2010).

Family representatives (in most cases mothers) also provided an estimate of the family's food waste for 5 days. This was compared with the actual weighed amount of discarded food in the plastic bags. In the next step, we evaluated the original cost of the food items in the bags by amount, compared food waste produced during weekdays and the weekend, and tested differences between households with different types of dwelling and ages of family members. We also inquired about how food waste was utilized or disposed of in each household, e.g. using leftovers as animal feed, composting vegetable waste, grating dry bread for breadcrumbs, etc., and tested differences in food disposal between various dwelling types.

The respondents were asked to state the reasons for throwing the food away by choosing from the provided options: "spoilt food", "past expiration date", "excessive amount purchased", "did not taste good", and "other". Finally, we also asked about the respondents' subjective views of their own food wasting and about their suggestions how the amount of food waste could be reduced.

Results and Discussion

The actual records about the discarded food were usually made by adult family members, especially women. The average estimate of food waste produced in a single household in five days was 354.41 g; however, the real average weighed amount was 1011.65 g per household. The respondents underestimated the amount of food waste produced both during the weekend and the weekdays. This underestimation was highly significant when tested by the Wilcoxon signed-rank test ($p = 0.002$). Yet, the estimates of individual respondents strongly correlated with the actual amount of food waste (Spearman's Rho = 0.61, $p = 0.009$).

The average cost of the discarded food for the five days of study was 53.0 CZK, with mode and median both amounting to 30 Czech crowns (CZK). The exchange rate at the time of the study was 19.6:1 CZK/USD. A daily average was thus 10.6 CZK. The variance of food waste costs was 15.4 CZK. No significant difference was found between food waste produced during weekdays and weekend days.

Weak inverse correlations were observed between the amount of food waste and the age of all family members (younger/older child, mother and father). However, these were not significant. A significant positive correlation was found between the difference in ages of both children and the amount of food waste ($r = 0.57$, $p = 0.02$).

The food category most likely to be discarded was milk and dairy products, followed by fresh vegetables and mushrooms, then bread and cereals, unconsumed pre-processed foods, fruits and nuts, smoked meat, and finally food scraps from the plate. Raw meat, fish, canned food and "other" food (such as sweets and snacks) did not appear in the food waste in any of the respondents (Table 2).

The most frequently cited reason for throwing the food away was that the food was spoilt, followed by food being past the expiration date in the second place, an excessive amount of food purchased in the third place, and unpalatable food and "other reasons" in the fourth place.

Means of food waste utilization and disposal are shown in Table 3. Concerning waste amount and means of disposal, no significant differences were found; the greatest difference was in composting vegetable waste (Fisher's exact test: $p = 0.13$). As consequences of food wasting, the participants argued mainly that food wasting was uneconomical and environmentally unfriendly. Apart from that, two respondents cited the impact of food wasting on the overall food shortage in the world, and one mentioned the risk of rat infestations.

Table 2. Order of food waste

Order	Food cathegory
1.	Milk and dairy products
2.	Raw vegetables and mushrooms
3.	Bread, cereals and cereal products, rice
4. - 6.	Unconsumed and again stored ready meals (e.g. boiled potatoes, meat)
	Raw fruit and nuts
	Smoked meat products
7.	Residues of food on a plate
8. - 10.	Raw meat and fish
Not wasted	Preserved products, Others

Most commonly listed suggestions for reducing food waste included buying lower amounts of food in the first place, followed by better planning of food consumption with respect to the expiration date, preferring high-quality foods with longer expiration dates bought from small retailers, and more synchronized shopping among individual family members.

The frequency of purchases of individual food types are summarized in Table 4. Families consisting of four members – 2 adults and 2 children – were specially chosen to allow better comparisons between the individual aspects of food wasting (FAO, 2012b). Naturally, food wasting is affected by many factors (Barr *et al*., 2005; Evans, 2012; Quested *et al*., 2013). The most influential ones include the country's socioeconomic status, sufficient or short food supply, quality of distribution, promotion and advertising, or even the number of immigrants (Bolton and Alba, 2012; Doron, 2013; Graham-Rowe *et al*., 2014). In addition, the type of the family plays an important role, which is why our study focused on a similar type of families to exclude the impact of this variable (Maulbach *et al*., 2009). Another factor influencing food consumption, and hence also the amount of food waste, are seasons of the year and holidays (Griffin *et al*., 2009). The effect of this variable was eliminated

Table 3. Use of food residues in households

% of households	Use of food waste
41	2-3 methods
35	1 method
24	Not used
% of households	**Method of use of food waste**
47	Feeding domestic animals
35	Composting
29	Production of crumbs from the old bread
18	Other method

by the exclusion of Christmas holidays from the period in which food wasting was monitored.

Food waste is often composted and used as an organic fertilizer (Slater *et al*., 2008). In our study, 35% households composted vegetable waste. Similar findings were reported by other authors (Zavodska and Benesova, 2010; Zidiniaki, 2013). One group of consumers makes attempts to reduce their amount of food waste, while other consumers remain indifferent to this matter. In general, consumers tend to underestimate the quantity of food waste they produce, which was demonstrated in our study as well as previous research in Romania (Stefan *et al*., 2013). The present study also revealed an indicated negative correlation between food wasting and the age of the participants. An even more interesting finding, however, was a significant relationship of the age difference between the two children in the family to the quantity of food waste. This can be caused by the fact that children of very different ages require different types of meals to be prepared, so there are generally more food scrapes left.

Several studies also address the issue of food wasting in relation to the financial position of the family (Stefan *et al*., 2013). One problem concerning research on food wasting is that one cannot apply the same approach to countries with different socioeconomic statuses (Quested *et al*., 2011). It turns out that in countries where much attention is paid to the issue of food wasting strategies for food waste reduction also involve educational interventions and procedures for increasing awareness of this problem in the population (Cox *et al*., 2010; Gustavsson *et al*., 2011). One means of reducing food wasting are discount stores where food products short before or (after examination) even shortly after the sell-by date are sold at substantially lower prices. These food products are explicitly meant for immediate consumption, and one can thus expect that buyers will pay more attention to the expiration dates, or consume the food right after they buy it.

Table 4. Frequency of purchase of food according to food groups

Food groups	1 – 3 monthly	1 a week	2 – 3 a week	4 – 6 a week	Daily	Modus
Fruit and vegetable	0	3	9	2	3	2 – 3 a week
Bread, cereals, rice	0	0	5	8	4	4 – 6 a week
Meat, smoked meat	3	6	5	1	1	1 a week
Milk,dairy products	0	8	4	1	4	1 a week
Others	2	12	0	0	3	1 a week

Conclusions

Food wasting is a very widespread phenomenon which is also found in families who are generally aware of this problem and make resolutions to avoid this kind of behaviour. Apart from other factors, food wasting seems to be affected by the age difference between children living in a single household. Many of our participants expressed a wish to utilize food waste for further purposes, i.e. recycle it, which was not related either to the type of dwelling or the age of the family members. The participants also greatly underestimated the amount of food waste they produced. One of long-term strategies of reducing the amount of food waste and hence food wasting as such might be the inclusion of this issue in the curricula at all levels of education, both general and specialized in the field food production and distribution.

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