



Research Paper

From the shopping basket to the landfill: Drivers of consumer food waste behaviour

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ABSTRACT

The EU, where nearly 57 million tonnes of food waste are generated annually, has set a target to halve this amount by 2030. However, the amount of food waste produced varies greatly between EU countries. While several EU countries are far from reaching this target, the Czech Republic already meets it. Despite this, little to no attention is paid to Czech consumers' food waste behaviour. This study responds to the unfulfilled need by drawing attention to food waste and its reduction, and possibly even serving as a model example for the EU target. We identify key factors influencing food waste by conducting a survey with 1,551 respondents on stated preferences. The results using the PLS-SEM approach show that the price of food does not have as great an impact on the level of food waste as its characteristics or planning, which is part of consumers' purchasing behaviour. Furthermore, consumers' attitudes and awareness of food waste reduce food losses. The causes of food waste remain decidedly similar before and during the pandemic COVID-19, except that people paid more attention to food attributes during the pandemic. Product attributes are an essential part of decision-making, especially for women and people with higher levels of education. We conclude that it is desirable to sufficiently educate and teach consumers to properly plan their consumption and better estimate the amount of food needed when shopping, which should be a conscious decision rather than an impulsive one.

1. Introduction

Food waste and inefficient end use of food has significant environmental costs (Notarnicola et al., 2017). Food waste occurs throughout the entire food chain, and many studies (Katsarova, 2016; Stenmarck et al., 2016; Zhang et al., 2018) indicate that the last part of this chain - households - are one of the major contributors. According to Beretta et al. (2013) most avoidable food waste occurs at the household level, e. g., food waste that is avoidable and has the greatest potential in terms of opportunities for reduction. On the other hand, FUSIONS (Gustavsson et al., 2014) points out that households are one of the parts of the food chain most at risk of increasing waste. Therefore, it is necessary to find out which factors have a significant impact on the food waste in households, so that by knowing these factors, the end links of the food chain can be influenced, and the amount of food waste can be reduced.

Aktas et al. (2018) find that social norms and identity (tradition and culture), habits (eating habits, cooking skills) and external conditions (climatic and economic factors) can largely be used to explain the reasons for food waste in the household. Furthermore, food waste varies

widely even in countries with similar economic level (e.g., EU countries). It ranges from 25 kg/capita/year in the Czech Republic to 133 kg/capita/year in the UK (Monier et al., 2010). Research by the European Commission (Monier et al., 2010) shows that the Czech Republic is one of the most successful countries in terms of household food waste. Also, Secondi et al. (2015) rank the Czech Republic as the most successful of the EU-25 countries. According to their research, 80 % of Czechs waste no food at all or only up to 5 % of the food they buy. Another study (Sosna et al., 2019) even describes that people in rural areas of the Czech Republic waste 10 % of the EU average. Stejskal et al. (2017), reported 53–58.5 kg/capita/year for the Czech Republic. Currently, Nováková et al. (2021), estimates food waste in the Czech Republic at 57.1 kg/capita/year and Kubíčková et al. (2021) 53.6 kg/capita/year.

If food waste in Czech households is low, the question is whether other countries can take inspiration from Czech households. This requires understanding not only the prevailing consumption patterns, the role of education and awareness, or cultural and economic factors, but also whether the history of the region, which has led to a certain autonomy in the cultivation, behaviour and processing of food (especially

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the widespread use of gardening in the Czech Republic), has also influenced the way people perceive food and the reasons why they may waste it.

Although the Czech Republic is one of the successful countries in managing food waste, nowhere has a model of the causes of food waste been presented that quantifies the impact of individual factors and could help to properly target measures to reduce food waste and thus contribute to the EU target of halving food waste per person at retail and consumer level by 2030. The aim is therefore to investigate the causes of food waste in the Czech Republic (Fig. 1) and to develop a model that will help shed light on this poorly described area. It also aims to find out whether the causes of food waste are changing as a result of the COVID-19 pandemic. As the EU’s goal is to reduce food waste, this study, which maps the behaviour of the ‘conscious’ Czech consumer, could help design effective measures to reduce food waste in households.

1.1. Food waste awareness

Many authors (Evans, 2011; Nunkoo et al., 2021; Watson & Meah, 2012) point out that most people perceive food waste as undesirable and feel bad about wasting food. Furthermore, Graham-Rowe et al. (2014) and Quested et al. (2013) have shown that consumers’ perceptions of food waste are important determinants of food waste behaviour. Other authors (Ertz et al., 2021; Visschers et al., 2016) show the relative importance of attitudes, norms and perceived behavioural control as predictors of consumer food waste behaviour (McCarthy & Liu, 2017; van Geffen et al., 2020; Visschers et al., 2016). The level of awareness of food waste is considered by many authors to be an important factor influencing household waste generation, e.g., (Mondéjar-Jiménez et al., 2016; Richter & Bokelmann, 2017; Roodhuyzen et al., 2017). If households become more aware of the social, environmental and economic

impacts of food waste, it could help to reduce the overall amount of food waste. The question, then, is whether the extent of household food waste can be influenced by educating households.

1.2. Households food waste causes

Stöckli et al. (2018) identified four key household food waste risk points where the most common causes of food waste occur: shopping style (poor planning, impulse buying, buying large quantities of food), storage (poor storage skills, poor storage management, preference for fresh produce), food preparation (overcooking, not using leftovers, poor cooking planning) and serving food (using large plates, uniform portion sizes).

1.2.1. Food purchasing process

Setti et al. (2018) evaluated the grocery shopping phase as crucial one. Stefan et al. (2013) document the importance of shopping behaviour for food waste, with the intention not to waste food serving as a significant predictor of shopping behaviour and the perceived ability to influence the outcome (perceived control) among the other important factors. The main causes of food waste associated with shopping include large quantities of purchased food (Graham-Rowe et al., 2014; Radzy-mińska et al., 2016; Stancu et al., 2016). The amount of purchased food is also closely related to the purchase frequency and influence the volume of food waste in households (Jörissen et al., 2015; Roodhuyzen et al., 2017). If the amount of food needed is poorly estimated, the frequency of purchases may increase disproportionately (Giordano et al., 2019). In the context of shopping, many authors cite discounts (or low food prices) as one of the main reasons for buying more food than the household consume and is then wasted (Jörissen et al., 2015; Koivupuro et al., 2012; Van Geffen et al., 2020). The size of food

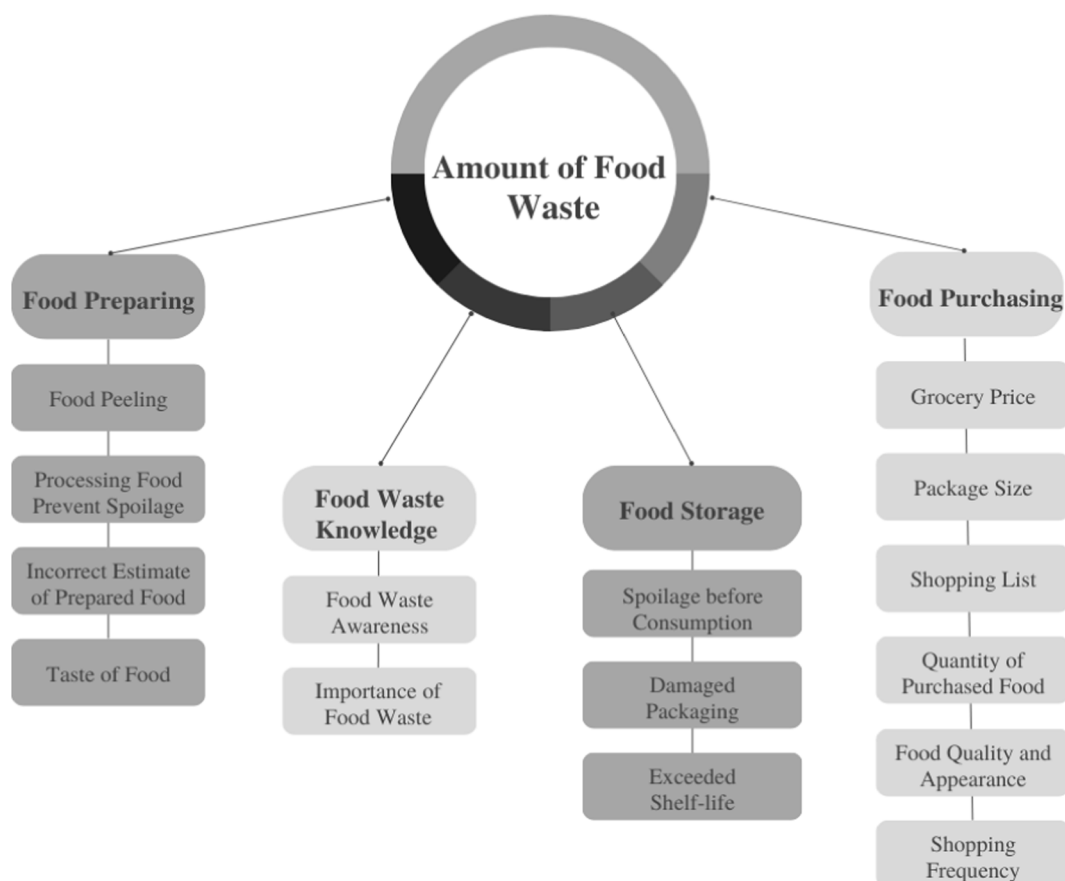


Fig. 1. Mind Map of Food Waste Causes.

packaging purchased is also an important factor in food waste amount (Stancu et al., 2016; Vergheese et al., 2015; Visschers et al., 2016). Following a prepared list and planning food consumption then becomes an effective tool to avoid falling for discounts or special offers (Koivu-puro et al., 2012; Stancu et al., 2016; Visschers et al., 2016). Furthermore, shopping according to a prepared list has an impact on the amount of household food waste (Parizeau et al., 2015; Roodhuyzen et al., 2017; Stancu et al., 2016). Graham-Rowe et al. (2014) and do Carmo Stangherlin et al. (2019) point out that food waste is also closely related to perceived food quality, both at the time of purchase and during storage. The studies by Ammann et al. (2021), do Carmo Stangherlin et al. (2020) and Gracia & Gómez (2020) also report that the amount of food waste is influenced by the quality of the food and its appearance, as consumers prefer fresh food. All things considered, the process of food shopping can be an important factor influencing food waste in households. It is therefore necessary to find answers to the question of whether the extent of food waste in households is influenced by the specifics of the food purchasing process of individual households.

1.2.2. Food preparation

Russell et al. (2017) state that habits are likely to play an important role in the context of food waste, as food waste is likely to have a strong habitual element (Darnton et al., 2011) and behaviours leading to food waste have a strong addictive and emotional component (Quested et al., 2013). Food management as a determinant of food waste is also discussed by e.g., Mallinson et al. (2016), Szymkowiak et al. (2022) and Stöckli et al. (2018). Aktas et al. (2018) state that social norms and identity (tradition and culture) as well as habits (including eating habits and cooking skills) and external conditions (economic factors) can be used to explain the reasons for food waste in the household.

According to Porpino et al. (2015), Silvennoinen et al. (2014) or Stöckli et al., (2018) the lack of appreciation of prepared food seems to be a factor that has a significant impact on the household food waste. Other factors related to eating habits and cooking skills, such as the taste of food or the ability to process the purchased food also play a role in household food waste rates (Coşkun & Özbük, 2020; Graham-Rowe et al., 2014; Szymkowiak et al., 2022). In this context Derqui & Fernandez (2017) and Richter & Bokelmann (2017) mention that attention should be paid to routine activities such as peeling food to reduce food waste. Therefore, food preparation habits in the household should be taken into consideration when identifying the main causes of food waste in the household. Hence, it is necessary to find out whether the extent of food waste in households is influenced by the characteristics of cooking skills and food preparation habits.

1.2.3. Food storage method

Other critical food management issues include the storage of food in the home (Stöckli et al., 2018). Many households waste food because it spoils before they can consume it (Principato et al., 2021; Roodhuyzen et al., 2017; Van Geffen et al., 2020), they do not consume the food due to damaged packaging (do Carmo Stangherlin et al., 2019; Rohm et al., 2017) or they throw away the food because it has passed its expiry (Graham-Rowe et al., 2015; Principato et al., 2021; Roodhuyzen et al., 2017). It can be deduced that household food storage and general food management have an impact on the amount of food waste. This raises the question to what extent household food waste is affected by food storage.

1.3. Impact of the Covid-19 pandemic on food waste

Ananda et al. (2021) identified the extent to which household members eat out or cooking skills as important variables. Changes in these variables could be related to changes in household food management during the COVID-19 pandemic, where people were forced to largely change their dietary habits (Aldaco et al., 2020; Bender et al., 2022; Roe et al., 2021) and eat more at home. Roe et al. (2021) point out

that the pandemic situation has led to an improvement in household food management skills. This change has led to better organisation, planning and consequently less food waste (Jribi et al., 2020; Principato et al., 2020). However, it is important to note that while these studies indicate a reduction in food waste during a pandemic, there is likely to be a subsequent increase in food waste due to over-stocking. Households often freeze food, putting it at risk of being thrown away rather than consumed later (Bender et al., 2022). Roe et al. (2021) also stress that non-perishable and frozen foods can be expected to increase in waste after these storage areas have been cleaned for months or years.

2. Methodology

2.1. Questionnaire design and data collection

In order to clarify the causes of food waste in households, as well as to determine respondents' attitudes toward the issue, the questionnaire was designed based on the previous studies (Fig. 1), e.g., Ananda et al., 2021; Ilakovac et al., 2020; Richter & Bokelmann, 2017; Russell et al., 2017; Setti et al., 2018. Overall, 24 variables were identified (Table 2). All variables were measured on a 10-point Likert scale.

The survey itself was conducted in two periods, collecting a total of 1,551 completed responses. The first survey was conducted from December 2019 to February 2020, a period not yet affected by the pandemic, and a total of 474 households participated. Since the COVID-19 pandemic brought major changes in food management and people were forced to adapt to the new situation (cooking at home, shopping less frequently), the survey needed to be repeated to identify any differences in behaviour in this new situation. The second survey was conducted from May to December 2021, with a total of 1,077 households participating. This allowed the causes of food waste to be compared before and during the pandemic. The detailed structure of respondents can be seen in Table 1. The survey was conducted using the CAPI and during the pandemic CAWI method. Despite the pandemic conditions surrounding data collection, the sample can be regarded sufficiently representative considering the age structure of respondents (15–75 years).

2.2. Theoretical model development

As mentioned earlier, based on previous studies (Table 2), 24 variables of food purchasing behaviour and reasons for throwing away food were identified. To determine the underlying latent variables explaining the relationships among the observed variables, factor analysis using Principal Component Analysis with Varimax rotation was applied as the first step of PLS-SEM analysis (e.g., Aydin and Yildirim, 2021; Garg, 2021; Ojedokun et al., 2022).

As can be seen from Table 5 in the Appendix, all factor loadings are above the suggested threshold, except for factors q4_8 and q5_5.

Table 1
Respondent characteristics.

N = 1,551	Sample	Sample %	CZ population (age 15–75) %
Male	545	35.139	49.115
Female	1,006	64.861	50.885
15–29 years old	462	29.787	29.331
30–44 years old	547	35.268	30.442
45–59 years old	267	17.215	22.573
60–75 years old	275	17.730	17.654
Primary and secondary education without diploma	408	26.306	43.500
Secondary education with diploma	430	27.724	32.500
Higher education	713	45.970	17.600
Before COVID-19	474	30.561	
During COVID-19	1,077	69.439	

Source: CSO (2022).

Table 2
Variables description.

Latent variables	Items	Indicators	Mean of var.	St. dev.
Amount of Food Waste	q0	Amount of Food Waste in your household	3.100	1.841
Food Quantity	q4_8	Planning the purchase and preparation	4.858	2.921
	q5_9	Too much food was cooked	3.399	2.665
	q5_10	Large packages of purchased food	2.466	2.148
	q5_11	Too large own harvest	2.406	2.267
Food Attributes	q5_3	Food spoiled during transport	2.131	2.139
	q5_4	Insufficient food quality	3.604	2.952
	q5_5	Spoilage of food during storage	5.976	2.968
	q5_6	Unattractive food	2.767	2.336
Food Durability	q5_7	Food is not tasty	3.058	2.408
	q5_8	Damaged packaging.	2.474	2.149
	q5_1	The expiration date has passed	4.327	3.245
	q5_2	The “use-by date” has been exceeded	4.532	3.248
Purchase Frequency	q4_1	Shopping less frequently	5.382	3.091
	q4_2	Shopping regularly	6.549	2.904
Food Peeling	q4_10	Vegetable peeling	5.920	3.073
	q4_11	Fruit peeling	4.785	3.123
Food Purchasing	q4_3	Food stock control	7.400	2.683
	q4_4	Shopping according to a list	6.539	2.879
	q4_9	Consumption of all purchased food	6.899	2.514
Price	q4_5	Shopping according to price	5.386	2.624
	q4_6	Preference for large food packages	5.066	2.727
	q4_7	Preference for discounted groceries	5.286	2.828
Food Waste Attitude	q4_12	The issue of food waste is topical	8.075	2.376
	q4_13	Food waste poses a risk	7.616	2.493

Note: Factors q4 related to food purchasing behaviour, 1 → completely disagree, 10 → completely agree. Factors q5 related to the reasons for throwing away food, 1 → less frequently, 10 → most frequently.

Nevertheless, both factor loadings are above the required minimum (Hair et al., 2013). Consequently, 8 latent variables were identified (Table 2).

After identifying the latent variables, the conceptual model was proposed (Fig. 2). Structural equation modelling (SEM) was used to determine the relationship between the identified latent variables and the dependent variable (amount of food waste). Consumer behaviour cannot be estimated directly, such as consumer attitudes or lifestyles, it is therefore advisable to use SEM (Abdelradi, 2018).

Furthermore other food waste studies comparing relationships between different variables have also used PLS-SEM (Amirudin & Gim, 2019; Diaz-Ruiz et al., 2018; Hameed et al., 2019; Russell et al., 2017). The PLS-SEM approach (using SmartPLS 3 software) was adopted to test the conceptual model as well as the following hypotheses (Fig. 2).

- H1: Food quantity has a positive impact on the amount of food waste.
- H2: Food attributes have a positive impact on the amount of food waste.
- H3: Food durability has a positive impact on the amount of food waste.
- H4: Purchase frequency has a positive impact on the amount of food waste.
- H5: Food peeling has a positive impact on the amount of food waste.
- H6: Food purchasing has a negative impact on the amount of food waste.
- H7: Price has a positive impact on the amount of food waste.
- H8: Food waste attitude has a positive impact on the amount of food waste.

To ensure a satisfactory model specification (Benitez et al., 2020),

five observed variables (q4_1, q4_7, q5_3, q5_4, and q5_11) had to be removed from the proposed conceptual model (highlighted in Table 2).

3. Results

3.1. Reflective model assessment

Given the reflective nature of the model, the reliability and validity of the model were assessed (Table 3). As suggested by Hair et al. (2016), the reliability of the indicators was assessed by evaluating the outer loadings. The model includes five outer loadings (q5_2, q4_3, q4_4, q4_8, and q4_6) that are below the threshold of 0.7 (Diaz-Ruiz et al., 2018). Nevertheless, these outer loadings are above 0.5 (Kline, 2016) and very close to the recommended threshold of 0.7. Moreover, the deletion did not increase the values of Cronbach’s alpha and composite reliability, as well as the values of AVE, above the recommended threshold (Hair et al., 2016). Therefore, all five indicators were retained in the model (Fig. 3).

Additionally, the composite reliability values for all latent variables were above the recommended threshold of 0.7 (Hair et al., 2016), suggesting good internal consistency reliability. On the other hand, Cronbach’s alpha values for three latent variables (Food Quantity, Food Purchasing, and Price) are below the suggested threshold of 0.7 (Nunnally, 1994). According to Xu et al. (2016), Cronbach’s alpha is susceptible to the number of items used in the model, as the items are not weighted. Therefore, it tends to underestimate internal consistency. When composite reliability is also considered, values slightly below the recommended threshold do not indicate problems with internal consistency reliability (Hair et al., 2016). Reliability measurements can be seen in Table 3.

Convergent validity was determined using the Average Variance Extracted (AVE). The AVE values for all examined constructs are above the threshold of 0.5 (Garson, 2016).

The square root of AVE was used to calculate a Fornell-Larcker criterion that assesses discriminant validity (Hair et al., 2016). All correlation coefficients can be viewed in Table 6 in Appendix. Furthermore, when the cross-loadings were evaluated, all indicators loaded highest on their associated constructs. Therefore, discriminant validity is not an issue. This assertion is also supported by the Heterotrait-Monotrait ratio (HTMT) results, where the value for each construct is below the suggested threshold of 0.90 (Henseler et al., 2015) and 0.85 (Kline, 2011), respectively. Even the bootstrapped HTMT, which allows for the construction of confidence intervals, does not contain a value of one in the confidence intervals analysed. This indicates that the constructs are empirically unambiguous and that there is no problem with discriminant validity (Henseler et al., 2015).

3.2. Structural model assessment

Once constructs validity and reliability were established, the structural model could be assessed.

The collinearity of the final model was assessed using the Variance Inflation Factor (VIF). The inner VIF is below the threshold of 5 (Hair et al., 2016) for all variables assessed in this study (Table 3).

Based on the above-mentioned results, it is safe to say that the researched indicators accurately measure the latent variables and that the conceptual model is robust. To evaluate the significance of the path coefficient, the bootstrapping procedure with 5,000 subsamples was used (Fami et al., 2019).

The results (Table 4) show that hypotheses H4 and H7 cannot be supported. Thus, the amount of food waste is not directly related to the price of food, whether it is purchased at a discount or not, or if a family prefers to make large, irregular purchases or not.

The variable of food purchasing (-0.314, H6) has the greatest impact on the amount of food waste compared to the other latent variables, followed by food quantity (0.292, H1) and food durability (0.138, H3). Therefore, the ability to buy the right amount of food, carefully planned

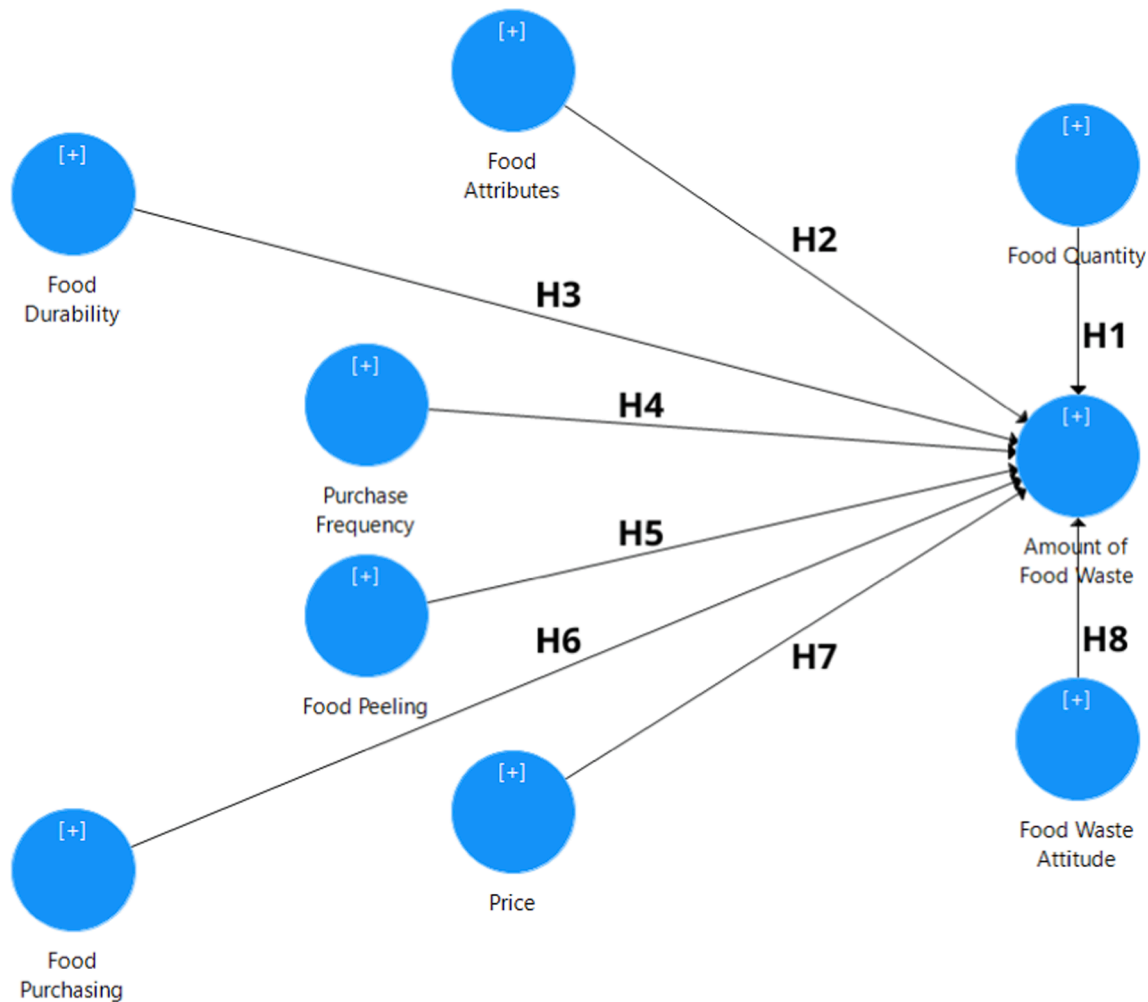


Fig. 2. Proposed conceptual model.

Table 3
Reliability measurements, convergent validity and inner VIF.

Construct	Cronbach's Alpha	Composite Reliability	AVE	Inner VIF
Amount of Food Waste	1.000	1.000	1.000	
Food Quantity	0.636	0.805	0.580	1.544
Food Attributes	0.703	0.819	0.533	1.366
Food Durability	0.893	0.949	0.903	1.238
Purchase Frequency	1.000	1.000	1.000	1.077
Food Peeling	0.741	0.880	0.787	1.107
Food Purchasing	0.653	0.770	0.535	1.427
Price	0.571	0.787	0.660	1.152
Food Waste Attitude	0.841	0.924	0.859	1.135

and preferably purchased according to a prepared list, will be crucial (Principato et al., 2020; Quedsted et al., 2013; Romani et al., 2018). According to the results, people waste less when they have a higher level of ability to plan their food purchases and consumption, regardless of how frequently they do so. Also throwing away food due to its expiration date is the most frequently cited reason for food waste in households. Respondents gave an average score of 6.4 on a scale of 1 to 10.

The overall explanatory power of the amount of food waste in presented model is 32.6 % ($R^2 = 0.326$), which is within the range of other studies addressing food waste (Barr, 2007; Stancu et al., 2016; van der

Werf et al., 2020). In addition, a blindfolding procedure was used to assess the predictive relevance of the model (Hair et al., 2016). The Q^2 value for the amount of food waste (0.319) was greater than zero. This indicates sufficient predictive relevance (Diaz-Ruiz et al., 2018).

To test for measurement invariance, the MICOM procedure was performed. The data show only configural invariance, indicating that multigroup analysis is not meaningful. Therefore, to test for significant differences between the perception of food waste before and during COVID-19 and between specific personal characteristics, the data were analysed separately (Henseler et al., 2016).

The results indicate that, with a confidence level of 95 %, consumers attached greater importance to food peeling and the food waste attitude before COVID-19 than during the pandemic. In addition, consumers paid more attention to food attributes during the pandemic. Consumers were often forced to change their shopping habits during the pandemic; for example, many began ordering food online. When the quality, appearance, or taste of food does not match perceptions, these changes can be attributed to variables that fall under this factor. Food characteristics may have changed because consumers are less likely to buy larger quantities, which could cause food to spoil during storage, and the method of delivery could also change. This is consistent with the finding that the greatest influence on the amount of food waste during COVID-19 was food quantity (path coefficient: 0.315, t-statistic: 8.971). On the other hand, before COVID-19 food purchasing (path coefficient: -0.353 , t-statistic: 8.204) has the greatest influence on the amount of food waste compared to other latent factors. Thus, there is a difference in the relative importance of the various waste causes, where, aside from the

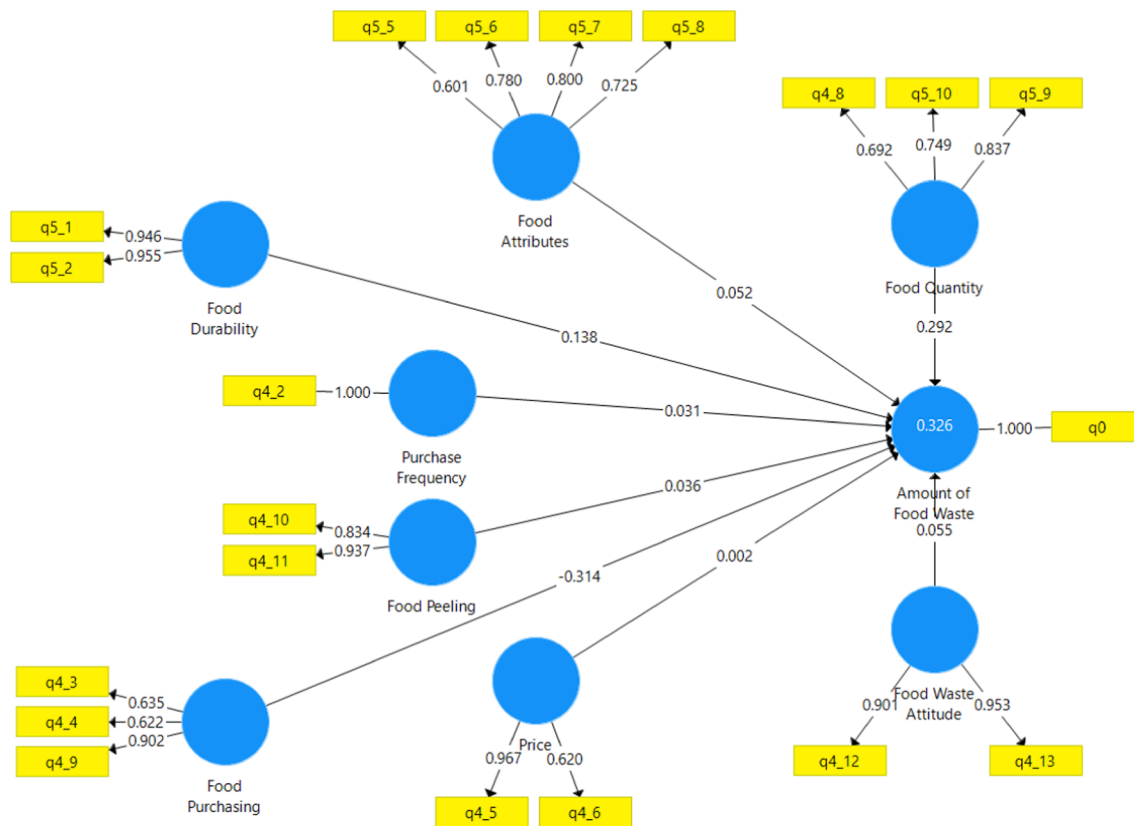


Fig. 3. Measurement model with outer loadings and path coefficients.

Table 4
Path coefficients of the structural model.

Hypotheses	Path	Path Coefficient	t-statistic	p-value
H1	Food Quantity → Amount of Food Waste	0.292	10.323	0.000
H2	Food Attributes → Amount of Food Waste	0.052	1.996	0.046
H3	Food Durability → Amount of Food Waste	0.138	6.012	0.000
H4	Purchase Frequency → Amount of Food Waste	0.031	1.500	0.134
H5	Food Peeling → Amount of Food Waste	0.036	1.701	0.089
H6	Food Purchasing → Amount of Food Waste	-0.314	11.323	0.000
H7	Price → Amount of Food Waste	0.002	0.056	0.955
H8	Food Waste Attitude → Amount of Food Waste	0.055	2.107	0.035

pandemic situation, as in the proposed model, planning purchases based on one’s food stocks and shopping according to a prepared list plays a crucial role.

Some differences can also be seen in various personal characteristics of consumers. Regarding consumer gender, food attributes were statistically significant for females but not for males. In addition, food quantity (path coefficient: 0.322, t-statistic: 6.544) had the greatest impact on the amount of food waste for men, and food purchasing (path coefficient: -0.313, t-statistic: 9.733) for women. Considering the consumers’ education, food attributes and food waste attitudes were statistically significant only among consumers with higher education. In addition, food purchasing (path coefficient: -0.340, t-statistic: 8.990) had the greatest influence on the amount of food waste among

consumers with higher education.

4. Discussion

Not only the socio-demographic indicators, but also the rate of subjective food waste is influenced by the overall food management in the household (Aktas et al., 2018; Mallinson et al., 2016; Russell et al., 2017; Szymkowiak et al., 2022).

The Czech consumer is no exception, and the proposed model can be used to conclude that the consumers’ key behaviour, which affects the level of food waste in the first place, is their shopping style, consumption planning, as well as the way they store food. Not buying an excessive amount of food in the form of larger packages (q5_10), properly planning the amount of cooked food (q5_9) according to the number of people in the household, and planning the items needed for cooking (q4_8) become essential for purchasing the right amount of food (Food Quantity, H1). Koivupuro et al. (2012) also touch on the positive correlation of food waste with how aware an individual is not to buy large packages of discounted food. The amount of food then figures into the proposed model as the second most fundamental factor that affects the rate of food waste. Therefore, it can be said that with the increasing amount of food purchased, the rate of food waste also increases to a certain extent. People find it difficult to correctly estimate this quantity; the less experience they have, the more they stock up and subsequently waste. Richter & Bokelmann (2017) also discuss the unnecessary food purchases meant for storage, often in connection with a larger number of members in the household, and it is more difficult for larger families to predict consumption correctly. Thus, it is important, and particularly substantial for consumers, to be able to at least estimate the amount of food needed for each person and possibly provide households with practical advice and tips on what they can do with surpluses, what is crucial in the fight against food waste (Ananda et al., 2021; Teng et al., 2021). Therefore, the importance of food quantity is in agreement with

current knowledge, and the Czech consumer does not differ in this respect.

The properties of food, especially, the perceived quality of food (Food Attributes, H2), certainly influence the amount of food waste. The consumers clearly prefer fresh food (q5_5), which is well packaged (q5_8), tastes good (q5_7), and has a nice appearance (q5_6). The analysis of the data shows that the more educated the respondents are, the more influence the characteristics of food have on the extent to which they waste food. In addition, the characteristics of food in connection with the rate of food waste are more significant for women, while contrarily for men, this relationship cannot be considered conclusive. This is in line with Richter & Bokelmann (2017) who point to these different attitudes by gender as well. The negative correlation between how food tastes and how it is wasted is also confirmed by other authors (Coşkun & Özbük, 2020; Szymkowiak et al., 2022), who discuss the influence of the overall lifestyle. On the other hand, according to Do Carmo Stangherlin et al. (2019), it cannot be unequivocally confirmed that imperfect food items always lead to an increase in the rate of food waste. This depends on the consumers' attitudes and, oppositely so, some individuals with environmental preferences are inclined to give preference to these food items. Similarly, De Hooge et al. (2017) draw attention to a different approach to suboptimal food according to age, attitudes towards the environment, or involvement in the cooking process. Makhal et al. (2021) see the core of the consumers' excessive demands in their upbringing and behavioural patterns, which is based on the setting in the family. We could state that for the Czech consumers, it is not statistically significant that consumers evaluate the product to be of insufficient quality (q5_4) or that it has spoiled before it was brought home (q5_5) in relation to the rate of food waste. In addition, the consumers' need to remove the peel from fruit or vegetables can also be related to food quality requirements. This hypothesis (Food Peeling, H5) was refuted at the 5 % level of significance, and therefore, this factor cannot be considered pivotal for the household food waste. We cannot unequivocally confirm the conclusions of studies Derqui & Fernandez (2017) and Richter & Bokelmann (2017), that consider this routine activity to be essential.

However, the "Food Durability (H3)" factor (q5_1 and q5_2) can be similarly to Thompson et al. (2020) or Fan et al. (2022) clearly identified as the bottleneck of household food management. Lack of knowledge about the differences between the use-by date and the expiration date exacerbate improper food storage by consumers.

From the data analysed regarding the frequency of purchases (H4), we cannot conclusively confirm that a higher frequency of purchases results in increased food waste, as suggested by Giordano et al. (2019). They propose that when the amount of required food is poorly planned, the frequency of purchases may disproportionately rise. Contrarily, for Czech consumers, regular shopping (q4_2) of smaller quantities of food can efficiently optimise household food management without necessitating complex planning.

In fact, the skill of consumers to plan what to buy based on what is missing at home (q4_3) is one of the most important skills and has a significant impact on the food purchasing process (Food Purchasing, H6). Furthermore, it is important not to be subject to discounts and various sales tactics, instead opting to buy according to a prepared list, where there is only a small possibility in deviation from the purchased items at the point of sale (q4_4), thus allowing the households to consume all of the purchased food (q4_9). These abilities are then inversely correlated with how wasteful the household is (Cequea et al., 2021; Oroian et al., 2021; Setti et al., 2018; Teng et al., 2021).

Interestingly, households do not consider food price as a key factor (q4_5, q4_6) of subsequent food waste, however e.g., Van Geffen et al. (2020) viewed discounts as a determinant of food waste. Even though the Czech consumer is highly price-oriented and secondary data shows that discount promotions play a vital role for sellers in their local environment (Krnáčová & Závodský, 2018), the price variable (q4_7) was excluded from the model as being statistically insignificant. Thus,

the price perception (Price, H7) was reflected in the model as predicting the rate of waste, and it is not appropriate to remove it from the model (it improves its predictive power). However, the hypothesis that the price fundamentally affects the rate of food waste cannot be confirmed. The impact of using a reduced price when shopping is also refuted by Giordano et al. (2019). Moreover, consumers with a lower income are often price-oriented customers and that they also have a lower rate of food waste (Aschemann-Witzel et al., 2017).

Finally, the amount of food waste is influenced by the consumers' attitude (Food Waste Attitude, H8) towards sustainability and how they perceive the issue of food waste as urgent (q4_12 and q4_13). The more they are aware of the urgency of this issue, the more intensively they perceive the food waste, and therefore, evaluate the level of food waste in their household at a higher level (Parizeau et al., 2015; Stancu et al., 2016). There is a gradual increase in those who are aware of the gaps in food management in their household and state that they too are wasting food.

If we focus on how the subjective rate of food waste changes in connection with the outbreak of the COVID-19 pandemic, it can be concluded that there are some changes in behaviour leading to food waste. In essence, the primary factors (amount of food, purchasing behaviour, and shelf life of the food) are the most significant for both periods. During the pandemic, people paid more attention to the properties of food, and their attitudes towards food waste and the acuteness of this issue do not have a statistically significant effect. Thus, the hypothesis (H8) was rejected for the pandemic period. On the other hand, the ability to plan the proper amount of food had the greatest influence on the amount of food wasted (Food Quantity, H1). Therefore, better organization may result in a general decrease in food waste (Roe et al., 2021; Jribi et al., 2020; Principato et al., 2020). However, forcing homes with members who do not have good cooking skills to do so, the opposite effect occurs. In addition, during this period, households tended to stockpile a lot of supplies. Food waste can increase as a result of large food pre-stockings (Bender et al., 2022), and future one-time freezer purges may exacerbate the issue (Roe et al., 2021).

If we compare the final food waste model with studies from other countries, not only can we state objectively that people waste less in the Czech Republic (Monier et al., 2010) but we can also subjectively evaluate the Czech consumer as wasting at a particularly low level (Kubíčková et al., 2021). If we look at the main determinants of food waste in other countries the shopping discipline, the prevention of waste (which is conditioned by environmental knowledge), the suppression of materialism and excessive shopping are crucial for Italian consumers (Diaz-Ruiz et al., 2015). For Turkish consumers shopping habits, the ability to plan correctly, and moral attitudes, which are closely related to one's knowledge of the food waste issue are essential too (Aydin & Yildirim, 2021). In Romania, knowledge of the issue and the formation of correct attitudes are crucial (Pocol et al., 2020), negative impact of impulsive purchases and various sellers' marketing and sales tactics on consumers' unconscious behaviour and subsequent food waste are important for Spanish and Italian consumers (Mondéjar-Jiménez et al., 2016). On the contrary, for Hungarian consumers excessive cooking and incorrectly estimating the amount of food they need is essential (Szakos et al., 2021). Thus, it is evident that the significantly different causes of food waste among the Czech consumer compared to other European countries are not observed. Nevertheless, we can say that some variables, which were identified as crucial for the amount of food waste in households in previous studies, cannot be considered as key for the Czech consumer. These primarily include the price of food, which does not play such a role in food waste for respondents, and also the frequency of shopping is statistically insignificant. In this case, a clear line between the frequency of shopping and the amount of wasted food cannot be identified.

If the EU is to be successful in its efforts to reduce unwanted consumer behaviour, it is necessary to provide people with practical advice and tips on how to prevent food waste in households. Above all, it is

necessary to teach consumers to plan their consumption correctly and to better estimate the amount of food they need when shopping, which should be a conscious decision rather than an impulsive one. In addition, it is necessary to continuously educate consumers on what the expiration dates mean. Education in this area is highly important because it shapes the consumers' attitudes towards food waste, subsequently influencing their level of food waste in a substantial way (Adelodun et al., 2021).

One of the limits of this study is that the representativeness was not reached for all the intended characteristics (gender, housing type) in the data collection, as the collection took place exclusively online during the pandemic. However, with considerable care, it is possible to conclude that the results are generalizable because the sample is sizable ($N = 1,556$) and the age structure corresponds to the population in the Czech Republic. To find possible differences in behavioural patterns, a deeper qualitative analysis would be needed, to identify even minor nuances and place the behaviour in a historical and cultural framework. For further research, it would be appropriate to focus on the specifics of urban and rural areas and pay closer attention to the differences between individual generations.

5. Conclusion

It can be stated that the Czech Republic is one of the successful EU countries in terms of the amount of food waste per capita per year. However, the issue of food waste has not yet received sufficient attention. This study responds to this unmet need by drawing attention to food waste and its reduction, and possibly even serving as an example for achieving EU goals. The model of food waste causes in Czech households will not only contribute to the national experience of this type of research, but also fill a gap in European and international statistics. Where the prevailing consumption patterns may have unique characteristics as a result of a long post-communist history. When comparing the amount of waste produced within EU countries, post-communist countries exhibit lower levels of household food waste. While the EU average is 70 kg/capita/year, for post-communist countries such as Bulgaria (26 kg/capita/year), Slovenia (36 kg/capita/year), Croatia (53 kg/capita/year), Poland (60 kg/capita/year) or Estonia (61 kg/capita/year), the values (Eurostat, 2023) are similar to the actual measured values in the Czech Republic (53,6 kg/capita/year) (Kubíčková et al., 2021). Therefore, we can assume that there is a certain difference in household food management in post-communist countries, and our proposed model may provide a theoretical basis for consumer behaviour.

The most significant phase of food management in the household starts right from the beginning, where good consumer knowledge and acquired skills are needed to properly plan the consumption and, subsequently, to purchase the food itself. This is true both for the time before, and during the COVID-19 pandemic. The model affirms that it is crucial to be able to estimate the amount of food so that the household has time to consume it and so that the quality of the food remains the same. It is not possible to clearly determine which purchasing frequency is optimal. It depends on the correct planning of meals prepared at home, whether one shops less often and makes larger purchases, or more often but with a smaller volume of food. It is always advisable to know the household supplies and buy only what is missing and currently needed by the household. The best practice is to buy from a prepared shopping list, which can help optimise the amount purchased and prevent impulsive purchases. Surprisingly, even the price of food cannot be currently considered as the main determinant of the amount of food waste. On the contrary, the food attributes (appearance, taste, packaging, freshness) are particularly important, especially for women and educated consumers. We can also consider the family's attitude towards food waste, as a determinant of food waste. Although it is incredibly difficult to change established consumer habits, there is a need for effective, practical tools and persistent education on this issue, which will gradually strengthen the conscious consumption of food in

households.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: [Lea Kubíčková reports financial support was provided by Technology Agency of the Czech Republic (TA CR).]

Data availability

Data will be made available on request.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.wasman.2023.07.002>.

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