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# Determining the influence of food user value on the intention to waste tomatoes at home

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## ABSTRACT

To date, there is no evidence on how food user value influences the intention to waste food at home. We experimentally tested the influence of the freshness of tomatoes and them being grown in/on one's garden/balcony on the intention to waste tomatoes at home ( $n = 454$ ). We uncovered a significantly lower intention to waste them if they were described as still fresh (versus no longer fresh) and a lower intention to waste them if they were homegrown (versus bought). It did not make a difference whether fresh tomatoes were store-bought or homegrown. However, once the tomatoes were no longer fresh, the purchased tomatoes were much more likely to be thrown away than the homegrown tomatoes.

## 1. Introduction

The terms food loss and food waste refer to edible food intended for human consumption leaving the human food supply chain by a range of disposal routes, including animal feed and bioenergy (Gustavsson and Cederberg, 2011). Globally, around one-third of all edible food for human consumption is lost or wasted (Gustavsson and Cederberg, 2011). At the same time, approximately 25% of the global population is affected by moderate or severe food insecurity (FAO, 2020). While the global population and wealth are increasing, which is linked to higher (food) consumption (Godfray et al., 2010), the earth is already under strain in terms of biodiversity and biochemical flows (Steffen et al., 2015). To feed future generations sustainably, a reduction in food loss and food waste will play a crucial role (Flanagan et al., 2019). Therefore, this paper focuses on food waste with a view to contributing to United Nations Sustainable Development Goal (SDG) 12.3, which has the following target: "By 2030, [to] halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" (United Nations, 2015). Whereas developing countries mainly face food loss problems, developed countries, such as Switzerland, are primarily concerned about food waste (Parfitt et al., 2010). Recent research confirmed that in Switzerland a significant amount of food wastage occurs at the consumption stage, with households bearing a major share of the responsibility (Beretta and Hellweg, 2019). The Federal Office for the Environment (FOEN) named lack of awareness about the amount and value of wasted food, lack of food literacy, and

awkwardness concerning using leftovers as reasons for food waste in households (FOEN, 2019). This is in line with the results of a Delphi study conducted in Barcelona that classified "valuing food and diet" as a highly effective food-waste-prevention measure (Diaz-Ruiz et al., 2019). A German study investigating the value placed on food at point-of-sale declared taste a prerequisite for valuing food (Brombach and Bergmann, 2020). Furthermore, freshness, locality/seasonality, animal welfare credentials, nutrients, and a lack of plastic packaging were named as the five most relevant factors when it came to the willingness to pay more for food (Brombach and Bergmann, 2020). In the corresponding explorative pre-study conducted in Switzerland, the importance of taste was also emphasized (Brombach et al., 2020). Furthermore, health and freshness, as well as fair prices, animal welfare credentials, environmental credentials, and locality were mentioned as being properties that conferred value on food (Brombach et al., 2020). However, factors related to food value often focus on the moment of purchase, while little is known about how users value food in terms of domestic handling of it. Using the concept of "food consumption value", food products can be contextualized by examining the value the user attributes to certain foods (Dagevos and van Ophem, 2013). A Norwegian fridge study confirmed the valuing of food as a decisive moment within domestic food-handling practices, and it named quality; taste; utilization occasions; and "relationship, time and effort" as being factors that influence the food user value (Hebrok and Heidenström, 2019). To the best of our knowledge, the influence of food user value on the intention to waste food in households is not yet known. In a pre-study we aimed to identify the key factors relating to food user value

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and found that freshness and the food being grown in one's garden were relevant areas for further investigation. Based on these findings, our experimental survey study took the first steps in closing the research gap regarding the influence of food user value on household food waste, by investigating how the description of redundant tomatoes as still fresh (versus no longer fresh) and/or as grown in/on one's garden/balcony (versus bought) influences the intention to waste them at home. As previously suggested by other researchers, different food products must be studied separately, since there might be other drivers or concerns involved in the decision to eat or not to eat a specific type of food (Visschers et al., 2016). Our study focused on tomatoes (including cherry tomatoes) because they are the most popular vegetables in Switzerland (VSGP, 2020), and fresh vegetables represent the largest amount of food waste by mass – in general, as well as at the household level – in Switzerland (Beretta and Hellweg, 2019). Our hypothesis was that the intention to waste tomatoes at home is lower if they are still fresh (versus no longer fresh) and homegrown (versus bought). This sounds obvious; however, no study so far has shown whether there is a direct link between food user value, such as consideration of freshness and whether it is grown in one's garden, and the intention to waste food. It is the duty of researchers to provide evidence to anticipate the efficacy of investment (Flanagan et al., 2019). In this sense, it seems worthwhile to first gather evidence of intervention's impact to develop target-oriented measures in a second step.

## 2. Materials and methods

### 2.1. Pre-study

To the best of our best knowledge, to date, there is no validated questionnaire focusing on food user value. Therefore, we developed a questionnaire in a pre-study, inspired by existing items describing food user value as well as the value placed on food at the moment of purchase, with the goal of identifying relevant factors describing food user value, which would be further investigated in our study. An online survey was created and distributed by email in October 2020 to a panel with 400 German-speaking participants and 97 people within the circles of the corresponding author of this paper (all German-speaking social-media contacts with whom at least one message had been exchanged within the last year, excluding all colleagues with the same professional background), leading to  $n = 120$  responses (response rate of 24%). The survey opened with the invitation to describe, in their own words, what makes a food valuable to the participant. The most

mentioned attributes were taste ( $n = 29$ ), freshness ( $n = 19$ ), healthiness ( $n = 15$ ), the food being local ( $n = 14$ ), means of production ( $n = 11$ ), treatment ( $n = 11$ ), and whether it is organic ( $n = 11$ ). Participants were also invited to use their own words to describe food as valuable enough to be offered to guests. This question relates to the assumption that guests would be served the food with the highest perceived value, whereas family members might be given leftovers or other food with less perceived value (Cappellini, 2009; Cappellini and Parsons, 2012). The attributes the participants provided to describe whether food was valuable enough to be offered to guests were freshness ( $n = 39$ ), the food being local ( $n = 15$ ), and seasonality ( $n = 14$ ). The second section was in the style of Steptoe's Food Choice Questionnaire, which asked respondents to complete this sentence: "It is important to me that the food I eat on a typical day ..." (Steptoe and Pollard, 1995). We asked our participants to complete the sentence, "At home, a food item is highly valuable for me if ..." using a 6-point Likert scale (1 = not at all appropriate, 6 = completely appropriate) to indicate what users value in food. There are 35 listed items. Table 1 presents the top-ranking items.

Table 1 describes what is valuable to participants when it comes to food, including the importance of sensory properties such as taste and smell. However, the wording of a phrase like "... it still tastes/smells good" might imply a health risk. It seems plausible that concerns over food safety are dominant in the home since the literature shows that "odor" and "looks safe to eat" are highly important considerations when deciding on whether to keep food or throw it out (Davenport et al., 2019) and, among US participants, worrying about food poisoning is a strongly prevalent reason to dispose of food (Neff et al., 2015). A study conducted in Italy showed that concerns over health risks have a direct negative influence on the intention to reduce food waste (Barone et al., 2019). Hence, the first two items in Table 1 (... it still tastes good/ ... it still smells good) were excluded for the follow-up-study, similar to a study investigating food value at the moment of purchase, which classified taste as a prerequisite for acceptance (Brombach and Bergmann, 2020). Freshness, already frequently mentioned when the participants described what makes a food valuable, appeared as a top 3 item in Table 1. This finding seems plausible since the literature describes freshness of food as a highly desirable characteristic (Péneau et al., 2006; Neff et al., 2015); thus, this factor was further investigated in the following study. Seasonality was excluded from further investigation due to several confounding factors. At the moment of purchase, sticking to seasonality narrows the food choice options (Hauser, 2010) and accessibility is important when it comes to food choice (Lyerly and Reeve, 2015). Once at home,

**Table 1**

Top-ranking items describing factors of food user value ( $n = 120$ ) indicated on a 6-point Likert scale (1 = not at all appropriate, 6 = completely appropriate), ranked in descending order according to their means while stating the standard deviation (SD).

Items completing the sentence, "At home, a food item is highly valuable for me, if ..."	Source	Mean	SD
... it still tastes good.	Steptoe and Pollard (1995), Lusk and Briggeman (2009), Lyerly and Reeve (2015) and Parizeau et al. (2015) <sup>a</sup>	5.53	0.74
... it still smells good.	Steptoe and Pollard (1995), Lyerly and Reeve (2015) and Parizeau et al. (2015) <sup>a</sup>	5.40	0.73
... it is still fresh.	Hauser et al. (2013) <sup>a</sup>	5.24	0.90
... it is in season now.	Hauser (2010) <sup>a</sup>	5.22	0.86
... the production was animal friendly.	Hauser et al. (2013) <sup>a</sup> and Dunlap et al. (2000) <sup>b</sup>	5.19	0.95
... it is a healthy food.	Steptoe and Pollard (1995) and Hauser et al. (2013) <sup>a</sup>	5.15	0.89
... it was grown in my own garden.	Ganglbauer et al. (2013) and Hebrok and Heidenström (2019) <sup>b</sup>	4.90	1.45
... it is homemade.	Hebrok and Heidenström (2019) <sup>b</sup>	4.90	1.20

Notes:

<sup>a</sup>Items rephrased.

<sup>b</sup>Items inspired by observations made by the cited source.

seasonal food might be valued for the intensity of its taste, smell, and color. Moreover, seasonality implies locality. However, more resources are invested in non-seasonal food. It seems plausible that seasonality can both increase and decrease food user value. The importance of animal-friendly production seems plausible, since animal welfare plays an important role at the moment of purchase (Hauser et al., 2013; Brombach et al., 2020). However, this is only applicable for animal-based products; therefore, it was excluded due to the study's focus on tomatoes. Food items that contribute to a healthy diet influence food choice (Furst et al., 1996). It seems plausible that this holds true not only at the moment of purchase, but also at home. However, "... it is a healthy food" was excluded in our study since the study only focuses on tomatoes, and it is used to compare different food items. The relevance of the item "... it was grown in my garden" seems plausible, since gardening enhances the relationship between the gardener and the food that is being grown (Ganglbauer et al., 2013). Thus, this factor was investigated in our study as the second attribute.

## 2.2. Design and procedure

An experimental survey study with a completely randomized design with factorial treatment structure and control was conducted in April 2021 as a follow-up study. A total of 6200 flyers with a link and QR code leading to the questionnaire were created and distributed by commercial Promo Post to all postboxes in randomly chosen postal codes of 11 different cantons in Switzerland with German-speaking populations. The number of flyers reaching urban, suburban, and rural areas was adjusted based on the statistical proportions of the living environments of Switzerland's population (FSO, 2021c). The flyers addressed the person mainly responsible for food preparation within the contacted household. After 4 weeks, 483 participants had completed the survey (response rate of 7.8%). We excluded participants who stated they never eat tomatoes in summer ( $n = 6$ ), as their scenarios would not be realistic. Furthermore, we excluded participants who failed the quality assurance question at the end of the questionnaire ( $n = 9$ ), where the participants were asked to check the second out of 5 numbered boxes, assuming they were not attentive while completing the survey. Moreover, we removed participants who did not reply to the main question concerning usual food handling practice after the presentation of the scenarios ( $n = 11$ ), and we excluded participants answering the sociodemographic question about their age inappropriately, indicating an age of 10 or younger ( $n = 3$ ). This led to a sample size of  $n = 454$ . The mean age of the sample population was 51.2 years, while the mean age of the Swiss adult population is 49.5 years. Table 2 displays the sociodemographic characteristics of the sample population in comparison to the Swiss adult population.

## 2.3. Questionnaire

Based on findings in the pre-study, four scenarios were created for our study. All scenarios described the following situation in the context of summer: the tomatoes are already at home, not all of them have been used, and the participant will go on holiday the following day (for three weeks). This was a realistic domestic setting where food waste might occur, since unplanned and excessive purchasing has been identified as being linked to increased household food waste (Evans, 2012; Porpino et al., 2015). Depending on the scenario (randomly allocated to the participants), the tomatoes were differently presented:

- Scenario 1: Bought tomatoes that are no longer fresh (control scenario).
- Scenario 2: Bought tomatoes that are still fresh (manipulation of the freshness factor).
- Scenario 3: Tomatoes grown in/on the participant's garden/balcony that are no longer fresh (manipulation of the gardening factor).

**Table 2**  
Participants' sociodemographic characteristics.

Variable	Sample population (%)	Swiss adult population* (%) (FSO, 2021a,b,c,d)
<i>Gender</i>		
Females	68.5	50.8
Males	30.4	49.2
No answer	1.1	–
<i>Age groups</i>		
18–19	0.4	2.4
20–39	24.7	32.1
40–64	51.8	42.6
≥65	23.1	22.9
<i>Residential area</i>		
Urban	69.2	63.0
Suburban	14.1	21.8
Rural	16.7	15.2
<i>Highest education</i>		
Professionals	50.0	77.5
Academics	50.0	22.5
<i>Household size</i>		
1 person	21.1	36.4
2 persons	39.6	32.8
3 persons	17.0	12.9
≥3 persons	22.2	17.9

Note: \*Adult population ≥ 18 years by 12/31/2020.

- Scenario 4: Tomatoes grown in/on the participant's garden/balcony that are still fresh (manipulation of both factors).

The participants were invited to reflect on their usual food-handling practices. Due to the fact there are various ways to handle food at home (Blichfeldt et al., 2015), different options were proposed in randomly assigned order to create a realistic situation:

- I will dispose of the tomatoes.
- I will eat the tomatoes.
- I will gift the tomatoes.
- I will boil down the tomatoes.

Wastage of tomatoes was the main focus of investigation, whereas eating them is a common handling practice. Gifting was incorporated as a way to assess the sharing of redundant food; it has been identified as a possible intervention to tackle household food waste (Hebrok, 2018), while boiling down was included because the tomatoes might be processed/cooked to avoid wasting them (Ganglbauer et al., 2013). A maximum of 100 points could be allocated within the four given options, whereby the points indicated the likelihood of the option being chosen; this is similar to the methodology investigating food waste tendencies used in Dusoruth and Peterson (2020).

## 2.4. Statistical analysis

All the analyses were conducted with SPSS and R using a two-factorial ANOVA model. The significant level was set at <5%. To check the assumption of equal variance, the fitted values were plotted against the residuals for graphical model diagnostics, and Levene's test was used as a quantitative method to check homoskedasticity. The assumption of normal distribution was checked visually using a Q-Q plot, as well as with quantitative model diagnostics using the Shapiro-Wilk test. However, in the case of large samples, normality can be assumed no matter how the data look (Field, 2018). Nevertheless, if the assumptions were not met, the Kruskal-Wallis test was used as a non-parametric method, combined with Dunn's test as a non-parametric post hoc test to confirm the results.

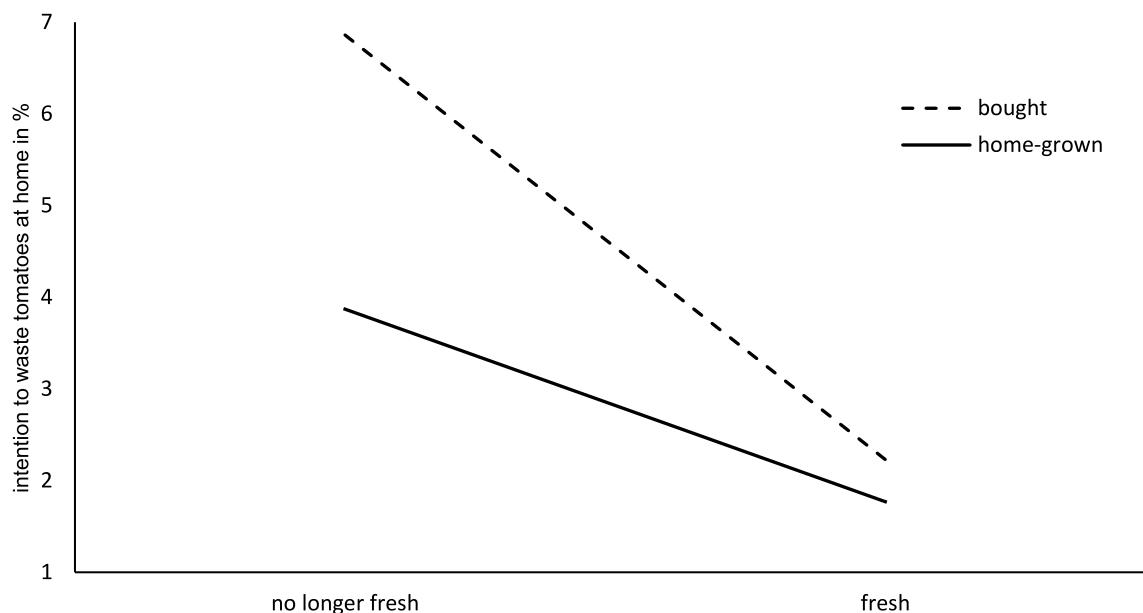


Fig. 1. Intention to waste tomatoes at home depending on their freshness and whether they are homegrown or bought.

### 3. Results and discussion

#### 3.1. Analysis of variance

Fig. 1 displays the results. A two-factorial ANOVA model revealed the significance of freshness on the intention to waste the tomatoes. The participants who were told that the tomatoes were no longer fresh wasted them more often ( $M = 5.35$ ,  $SD = 16.14$ ) than the participants who were told that they were still fresh ( $M = 2.01$ ,  $SD = 8.42$ ),  $F(1,450) = 7.93$ ,  $p = 0.005$ . This seems plausible, since tomatoes that are no longer fresh might mean the participants perceive a health risk and that they throw away the food for reasons of food safety (Graham-Rowe et al., 2014; Meah, 2014; Neff et al., 2015). The main effect of growing food at home was not significant:  $F(1,450) = 2.08$ ,  $p = 0.150$ .

Although this analysis did not reveal an interaction between freshness and growing food at home that reached a conventional level of significance,  $F(1,450) = 1.12$ ,  $p = 0.291$ , a simple main effect analysis revealed that the significant main effect of freshness was primarily due to the fact that the participants who had bought tomatoes intended to throw them away if they were no longer fresh ( $M = 6.86$ ,  $SD = 19.03$ ), in comparison to the participants with bought tomatoes that were still fresh ( $M = 2.23$ ,  $SD = 9.85$ ),  $F(1,450) = 7.56$ ,  $p = 0.006$ . For homegrown tomatoes, there was no significant difference concerning the intention to throw them away if they were fresh or no longer fresh:  $F(1,450) = 1.54$ ,  $p = 0.216$  ( $M = 1.77$ ,  $SD = 6.62$  vs.  $M = 3.87$ ,  $SD = 12.63$ ). It seems that growing tomatoes at home protects them from being wasted if they are no longer fresh. This tendency is in line with qualitative findings stating that people who grew and harvested vegetables in/on their own garden/balcony had a relationship with their food that prevented them from throwing it out (Ganglbauer et al., 2013). Food grown in/on one's garden/balcony seems to be something people more strongly identify with due to the amount of time, effort, energy, and attention they invest (Blichfeldt et al., 2015). Wasting the product would also be wasting invested resources.

These findings suggest the importance of considering freshness as food user value being important to users in the discussion about how to prevent food waste at home. This might include information about how to correctly store tomatoes to prolong shelf life, or food-technological solutions like packaging or storing-boxes that reduce perishability, and which also promote the accessibility of fresh foods like vegetables in that users can buy smaller quantities. Also, growing food at home

should be considered as potentially relevant food user value. However, it remains possible that gardeners also have better cooking skills, which might prevent food waste at home since tomatoes might be cooked instead of thrown out (Delley and Brunner, 2017).

#### 3.2. Transferability

The situation of a long absence has been described as a realistic scenario in which domestic food waste behavior could occur. However, it remains to be confirmed whether the findings can be transferred to other food-waste-generating situations. It is possible that different situations lead to different practices. The transferability of the findings to suboptimal (blemished) tomatoes must be confirmed by future studies. This seems to be of major interest, since the perception of suboptimality is, aside from the existence of food scraps and leftovers, an important driver of food waste at the household level (Aschemann-Witzel et al., 2015). The transferability to other vegetables is possible but must also be confirmed; transferring the results to other food categories may be inadvisable since the drivers to eat and the concerns associated with eating certain foods (e.g. food safety concerns about fish) differ between different food items (Visschers et al., 2016). Moreover, it is important to understand the additional influencing factors of wastage of vegetables, since a healthy diet containing reasonable amounts of vegetables makes it more likely perishable food like vegetables will be wasted (Conrad et al., 2018). It must also be acknowledged that, for example, busyness, prompts, or feedback reflecting social expectations can create an intention-behavior-gap (Vermeir et al., 2020), and the influence of sociocultural context on pro-environmental behavior seems to be stronger than personal values (Chan, 2020). However, behavioral intention is a prerequisite of observable behavior (Vermeir et al., 2020). Furthermore, the literature focusing on food waste at home suggests that habits and intention both strongly influence behavior (Thompson et al., 2020).

#### 3.3. Limitations

Information concerning the intention to waste or not waste food at home relied on self-reporting. Distortion of results due to a social desirability bias has not only been discussed for taboo topics (Krumpal, 2013); the validity of self-reporting measures has also been questioned by the research community focusing on pro-environmental



behavior (Kormos and Gifford, 2014; Cerri et al., 2019). Therefore, data collection was conducted anonymously to minimize systematic error.

#### 4. Conclusion

To the best of our knowledge, this is the first study to demonstrate through experiment how food user value affects the intention to waste food. It was found that freshness seems to be crucial in influencing the intention to waste or not waste tomatoes at home. Moreover, this study shows the food waste “protecting power” of growing food at home. Tomatoes grown in one’s garden or on one’s balcony tended not to be wasted as often as tomatoes that were purchased. For fresh tomatoes, it did not make a difference whether they were bought or homegrown. However, once the tomatoes were no longer fresh, the bought tomatoes were much more likely to be thrown away than the homegrown tomatoes. Taken together, these findings show that food user value seems to be an important element in deciding whether to waste food that is still edible. This supports our hypothesis that considering a food to be of high value reduces food waste. Of course, much more research is needed to investigate the measures needed to practically increase food user value.

Further studies investigating how freshness and growing food at home influences the intention to waste other vegetables, such as carrots, cabbage, or broccoli, would make it possible to verify that the intention to waste vegetables at home depends on their freshness and whether they are homegrown or bought.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

Data and questionnaires can be found at: <https://doi.org/10.34914/olos:6a47e7xepbrbmj73jr6kgfbhii>.

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