Fresh, frozen, or ambient food equivalents and their impact on food waste generation in Dutch households

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ABSTRACT

In Europe, it is estimated that more than 50% of total food waste – of which most is avoidable – is generated at household level. Little attention has been paid to the impact on food waste generation of consuming food products that differ in their method of food preservation. This exploratory study surveyed product-specific possible impacts of different methods of food preservation on food waste generation in Dutch households. To this end, a food waste index was calculated to enable relative comparisons of the amounts of food waste from the same type of foods with different preservation methods on an annual basis. The results show that, for the majority of frozen food equivalents, smaller amounts were wasted compared to their fresh or ambient equivalents. The waste index (WI) proposed in the current paper confirms the hypothesis that it may be possible to reduce the amount of food waste at household level by encouraging Dutch consumers to use (certain) foods more frequently in a frozen form (instead of fresh or ambient). However, before this approach can be scaled to population level, a more detailed understanding of the underlying behavioural causes with regard to food provisioning and handling and possible interactions is required.

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1. Introduction

About 25% of all food supplied for human consumption is lost or wasted during various phases in the food supply chain (Stancu et al., 2016; Secondi et al., 2015; Kummu et al., 2012). In Europe, it is estimated that more than 50% of total food waste is generated at household level (Stenmarck et al., 2016; Stancu et al., 2016; Secondi et al., 2015; Beretta et al., 2013; Kummu et al., 2012; Gustavsson et al., 2011; Parfitt et al., 2010). Most of this waste is avoidable, as at some point prior to its disposal the food was edible (Quested et al., 2013a; Parfitt et al., 2010). Food waste reduction and prevention are important strategies to increase the availability of food throughout the supply chain in order to feed the global population and to achieve necessary environmental impact savings (Stancu et al., 2016; Secondi et al., 2015).

Studies focused primarily on estimating the amount and general composition of food waste at household level (e.g. Katajajuuri et al., 2014; Silvennoinen et al., 2014; Gutiérrez-Barba and Ortega-Rubio, 2013; Griffin et al., 2009; van Westerhoven, 2010, 2013), irrespective of method of preparation, method of preservation, or way of storage. As a result, there is limited understanding of the various underlying causes with regard to consumers' food waste behaviour (Stancu et al., 2016; Abeliotis et al., 2015; Secondi et al., 2015; Stefan et al., 2013; Gustavsson et al., 2011). Attention is paid to attitudes, habits, and motivations, and to socio-economic characteristics associated with individual consumers' behaviour towards food waste generation. In several studies it has been shown that consumers' planning and shopping routines – determined mostly by their moral attitudes and perceived behavioural control – are important predictors of their food waste generation, i.e. consumers that make a shopping list, plan their meals, and check their food inventories report less food waste than those who report more frequently buying too much food or making unintended food purchases (Stancu et al., 2016; Porpino et al., 2015; Quested and Luzecka, 2014; Stefan et al., 2013; Quested et al., 2013b; Quested et al., 2011). In addition, in a Canadian sample (Parizeau et al., 2015) it was found that households that spend routinely more money per capita on groceries produced more organic waste, even though they differ in their food-related attitudes and behaviours. Aschemann-Witzel et al.'s (2015) review paper points to consumers' lack of sufficient motivation, ability, and opportunity to reduce food waste, including lack of knowledge and planning, as important factors causing food waste generation. Systematic storage practices in the refrigerator might therefore be useful to reduce food waste (Farr-Wharton

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et al., 2012, 2014). Household size was found to be another factor in food waste generation, with smaller households contributing less than larger households to net food waste, whereas at the same time persons living alone were found to produce the highest amounts of waste per person (Koivupuro et al., 2012).

Surprisingly little attention has been paid so far to product-related characteristics and/or attributes that might drive consumers' food waste generation. A study on packaging attributes in relation to household food waste generation reported that too large volumes, packages that are difficult to empty, and packages that have passed the best before date were associated with higher amounts of food waste (Williams et al., 2012). Similarly, based on a supplier–retailer interface assessment, it was suggested that frozen foods were associated with lower levels of food waste, and similar cases were found for some ambient food products. These waste-reducing outcomes were attributed mainly to the extended shelf-life of ambient and frozen foods (Mena et al., 2011). The current recommendation from the Waste & Resources Action Programme (WRAP) research to use the freezer to extend the shelf-life of foods in order to decrease food waste levels is in line with this supply chain-based observation (Quested and Luzecka, 2014; Quested et al., 2013a). On should realise however, whether benefits of reduced waste exceed increased energy costs of maintaining reduced storage temperature, as recently studied by Eriksson et al. (2016) for Swedish supermarkets.

Actual consumer data at household level to support this notion of WRAP are currently scarce. On the basis mainly of food waste data over a relatively short period of time (i.e. a week), Martindale (2014) suggests that food wastage at home was significantly lower for frozen food products compared to their fresh equivalents. However, in this study, neither the actual amounts of the specific foods wasted nor their consumption frequencies were reported. Thus, a relative comparison between fresh, frozen, and ambient food equivalents – taking consumption frequency, disposal frequency, and amounts of food usually wasted into account over a longer period of time (i.e. a year) – is needed to further our understanding.

The aim of the current study is to explore possible impacts of different preservation methods on food waste generation in Dutch households taking both concurrency of frequency and habitual amounts into account. An extended survey on self-reported food waste is performed in a Dutch consumer sample. In addition to general information gathered with regard to Dutch household's routines and general food waste generation, product-specific information is collected for food equivalents with different methods of preservation at the point of sale, namely, fresh, frozen, and/or ambient. It is hypothesized that the use of frozen foods is associated with lower food waste generation in Dutch households than the use of fresh and/or ambient food equivalents.

2. Methods

2.1. Participants and survey

An online survey was developed and implemented in the NIPO Odin software of TNS NIPO. All participants were recruited by TNS NIPO. Data were collected by TNS NIPO in October 2015 in the Netherlands. Filling out the survey took about 20 min.

A total of 1167 households representative of the Dutch population according to age (18–75 years), sex, household size and type, education level, income, and employment status were invited via e-mail to participate in the survey, of which 701 households responded (response rate of 60%). Storage of foods in a freezer was defined as an inclusion criterion as well as disposing of food at least once per year. Sixty households (9%) indicated that they

never stored foods in a freezer and were consequently excluded from partaking further in the survey. Another 125 households (20%) indicated that they never threw food away, and they were also excluded (except from analyses in Table 2 in question C1 on frequency of general food waste generation). Table 1 provides a summary of the socio-demographic characteristics of the households participating in the survey as compared to the general Dutch population.

Participating respondents received a monetary reward.

2.2. Measures

2.2.1. Household routines and general food waste generation

First, some general household routines regarding shopping for groceries and hot meal planning were ascertained (questions A and B in Table 2). Then, the survey requested self-reported measures on general food waste generation (C): (1) how routinely foods were disposed of in the household; (2) food waste generation in relation to the way products were stored at home (in the refrigerator or freezer or at ambient temperature; (3) food product categories into which disposed foods fall; and (4) the main reasons for disposal per way of storage. The first two of these latter four questions are visible in Table 2. Per way of storage, food categories from which respondents could choose were (question C3): meat, poultry (such as chicken), meat substitutes; fish, fish products; vegetables; fruit; potatoes, potato products; pasta; rice; soups; sauces, oils, fats; milk, dairy products; bread, bakery products; sweet spreads; savoury spreads; candy, snacks, ice; readymade meals; (leftover) homemade meal. All options that applied could be indicated. Reasons for disposal from which respondents could choose were

Table 1
Socio-demographic background characteristics of respondents (sample of the study) compared to the Dutch population in 2015. Source: TNS-NIPO

Characteristic	Sample of the study (%)	Dutch households in 2015 (%)
Sex		
Male	45.8	49.9
Female	54.2	50.1
Age		
18–34 years	23.3	28.6
35–54 years	41.5	39.6
55+ years	35.2	31.8
Household size		
1–2 persons	57.7	54.5
3–4 persons	36.4	31.7
≥5 persons	5.9	5.8
Household type		
1 person	17.1	18.9
Adult household	50.6	48.7
Households with children ≤17 year	32.4	32.3
Education		
No, basic	1.4	3.8
Low	12.6	13.9
Middle	47.1	46.2
High	38.8	35.9
Occupation		
Full/part-time work	61.8	58.9
Retired	14.8	15.8
Unemployed	19.0	18.2
Pupil, student	4.3	7.1
Income		
≤26,200 €	16.7	20.3
26,200–38,800 €	14.2	15.0
38,800–65,000 €	34.4	29.2
65,000–77,500 €	11.7	10.9
≥77,500 €	23.1	24.6