

# Evidence for initiating food safety policy: An assessment of the quality and safety of donated food at an Australian food bank

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## ABSTRACT

Food banks play a vital role in addressing the needs of people experiencing food insecurity. Food banks rely on the food industry, particularly supermarkets, for food donations, and on voluntary labor to scrutinize and sort donations for quality and safety. Currently, national food safety laws and policies in Australia regulate food businesses, but do not specifically apply to donations. There are reports of expired, spoiled, and rotten food donations and clients express dissatisfaction with the quality and safety of food provided. This study describes a novel approach to visually identify and assess the safety and quality of food donations at an Australian food bank. Data from an audit of donations to a metropolitan food bank were analyzed. Food safety assessment criterion were developed based on food safety standards and applied to 1217 items (84,996 kg) of donated food. Each product was visually inspected and assessed as 'safe', 'unsuitable', 'potentially unsafe', or 'unsafe for human consumption' upon receipt. Of the 84,996 kg of donated food, 96 % was categorized as satisfactory and 4 % (3761 kg) was categorized as either unsafe (2024 kg), potentially unsafe (1313 kg) or unsuitable (424 kg) for consumption. Supermarket donations comprised 90 % (by weight) of the unsafe and unsuitable food. The overall proportion of visually unsafe and unsuitable foods was low, but consumption of any unsafe, hazardous and/or damaged products poses a risk to the consumer. Given the vulnerability of clients receiving this food, the public health risk is high. The management of potential risk is problematic too as multiple decisions to determine appropriateness for distribution, places demands on food banks and hampers efficiency. The findings underscore the clear need for a specific food safety regulatory framework for donated food in Australia.

## 1. Introduction

Food banks were founded to alleviate sudden, unforeseen hunger, and as a short-term solution to food insecurity (Campbell et al., 2015; Chapnick et al., 2019; Martin, 2021). However, economic rationalism and welfare reforms of the 1980s and 1990s precipitated increases in the rates of food insecurity and the expansion of food banks in economically developed countries (Berg & Gibson, 2022; Lindberg et al., 2015; Riches, 2018; Wakefield et al., 2013). Food banks were established in North America and some parts of Europe (France and Belgium) in the 1980s, Australia in the 1990s, and the United Kingdom (UK) in the 2000s (Berg & Gibson, 2022; Booth & Whelan, 2014; Lambie-

Mumford & Silvasti, 2020; Riches, 2018). Today food banks are an entrenched part of the charitable food system (CFS) spanning six continents and over 50 countries (Global FoodBanking Network, 2022; Riches, 2018) and play a vital role in supporting people experiencing food insecurity.

Food banks evolved from rooms in church basements to sophisticated organizations (Campbell et al., 2013) as their client base changed from those in short-term crisis, to those experiencing chronic and severe food insecurity (Campbell et al., 2015). Low income is a major predictor of food insecurity (Leete & Bania, 2010; Temple, 2008), and clients include those unable to qualify for government benefits, the working poor (the underemployed and underpaid) (Byrne & Just, 2022;

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Campbell et al., 2015; Riches, 2018), and the prevalence is increasing amongst middle-income households as their financial commitments outstrip their income (Kleve et al., 2018). Although essential at times, clients in developed countries use food banks reluctantly and as a last resort due to the stigma associated with failing to make a living (Caraher & Furey, 2017).

In Australia, food banks provide food both 'directly' to clients and 'indirectly' through charitable agencies (e.g., religious, community, welfare or non-government organizations) at no cost, or charge a very low 'handling fee' (Booth & Whelan, 2014; Pollard et al., 2018). In the United States (US), food pantries or food shelves (charitable agencies) are the primary distribution point between clients and food banks (Martin, 2021). Food banks retrieve donations of surplus or unsaleable food from growers, manufacturers, wholesalers, and retailers (Davis et al., 2014), commonly termed 'surplus food redistribution' (SFR). The retail food sector contribute the majority of donations (Feldman & Schwartz, 2018; Hudak et al., 2020; Sengul Orgut et al., 2015) and food banks purchase some food using funds from grants, private donations and handling fees (Booth & Whelan, 2014; Campbell et al., 2015). In the US, federal nutrition programs (e.g., the Emergency Food Assistance Program) are also a significant source of donations.

For food retailers, SFR represents good business. Outdated, expired and unsaleable food is diverted to a secondary market, sparing donors the significant costs associated with waste disposal (De Souza, 2019; Lowrey et al., 2023; Papargyropoulou et al., 2022; Tarasuk & Eakin, 2005), while raising the average quality of items that remain in store (Lowrey et al., 2023). Tax benefits for donation in some countries (e.g., US and France) confer additional financial incentives (De Souza, 2019; Mourad, 2016; Tarasuk & Eakin, 2005). SFR cultivates an image of corporate social responsibility (CSR), often framed by donors as being virtuous and responsible for mitigating the environmental impact of food waste while feeding the hungry (Devin & Richards, 2018; Mourad, 2016; Papargyropoulou et al., 2022). A 2018 review of supermarkets CSR commitments to public health found that two of the top five supermarket CSR policies globally were donating surplus food to charities for redistribution to feed the hungry and reducing and recovering food waste (Pulker et al., 2018).

Food banks have little to no bargaining power in negotiating the type of food they receive, or when they receive it (Papargyropoulou et al., 2022). The unpredictability and variability in frequency, type and volume of donated food is cited as a barrier to providing sufficient and nutritious food to clients (Chapnick et al., 2019; Mossenson et al., 2023). Donor distribution practices are excessively driven by donor supply choices and are dissociated from client need (Tarasuk & Eakin, 2003). Overwhelmingly, people using the CFS desire nutritious food for meals (Booth et al., 2018; Cahill et al., 2019; Caspi et al., 2021; Cooksey-Stowers et al., 2019; Pollard et al., 2019; Verpy et al., 2003), and consider discretionary food items the least important (Booth et al., 2018; Caspi et al., 2021; Cooksey-Stowers et al., 2019). The food distributed by food banks across the developed world has been found to be nutritionally poor (Oldroyd et al., 2022; Simmet et al., 2017). Despite a Western Australian study highlighted that clients were particularly positive about the quality of food received from a food bank (Hardcastle & Caraher, 2021), overwhelmingly clients, although grateful for food, describe dissatisfaction with the quality, safety and appropriateness of food provided (Middleton et al., 2018; Pollard et al., 2019).

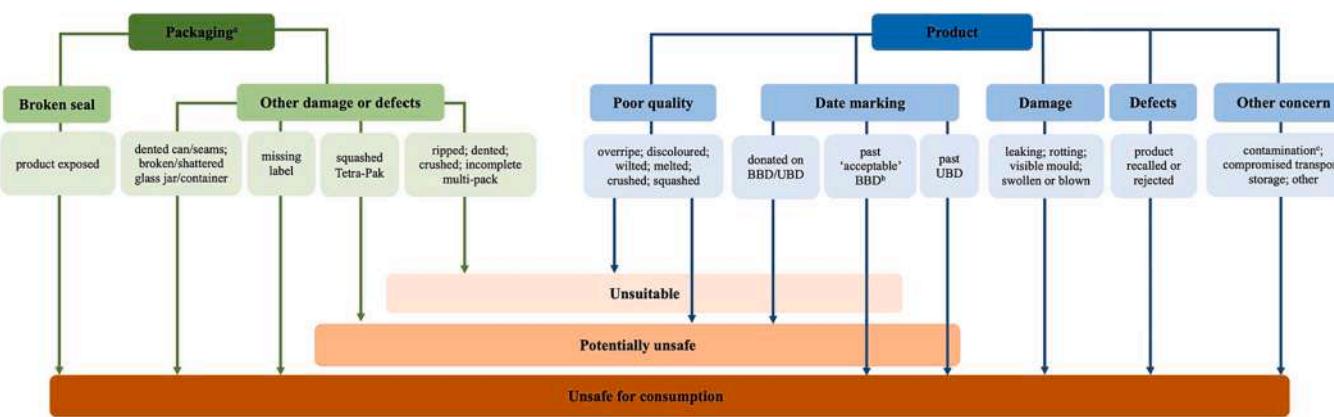
Food banks offering food past their expiration date have frequently been reported (Enns et al., 2020; Kratzmann, 2003; McKay et al., 2018; Neter et al., 2016; Verpy et al., 2003), some up to five years out of date (Verpy et al., 2003) and often cited as a reason clients do not use the foods they receive from food banks (McKay et al., 2018; Neter et al., 2016). There are reports of clients receiving moldy bread, spoiled milk (Verpy et al., 2003), fungus on pizza (van der Horst et al., 2014), and poor quality fresh produce (Loopstra & Tarasuk, 2012; McKay et al., 2018). Some clients describe the risk of becoming sick from sub-optimal food, (McKay et al., 2018; van der Horst et al., 2014) while others have

become ill as a direct consequence (Enns et al., 2020; Loopstra & Tarasuk, 2012). Clients have described the food they received as being from "the bottom of the barrel" (Kratzmann, 2003), and "not fit to feed an animal" (Loopstra & Tarasuk, 2012), sentiments which compound existing feelings of inferiority, stigma and shame associated with accessing the CFS (Booth et al., 2018; Kratzmann, 2003; Middleton et al., 2018; van der Horst et al., 2014).

These negative client experiences occur despite the well-intentioned, labor-intensive efforts of food banks and the largely voluntary workforce supporting them (Caraher & Furey, 2018; Philip et al., 2017; Tarasuk & Eakin, 2005).. Volunteers spend considerable time scrutinizing donations to ensure quality, order, and food safety. This is especially important as some donations are "in no way fit for redistribution" (Papargyropoulou et al., 2022) or if the donation is a 'mixed load', containing unsorted, miscellaneous products. Mixed loads require sorting by volunteers who also inspect for damaged products, and separate out visibly spoiled, rotting or unsafe items (De Boeck et al., 2017; Makhunga et al., 2019; Tarasuk & Eakin, 2005). Volunteers may also check expiry dates on incoming products to ensure unsafe food is disposed of (De Boeck et al., 2017; Higgins et al., 2017). Additional effort is applied to sort squashed or crushed products, those with damaged, dented or ripped packaging, or cull wilted produce, to make donations more 'presentable' to clients (Tarasuk & Eakin, 2005). Decisions on food safety are typically limited to visual observations, often by unskilled volunteers (Makhunga et al., 2019). Microbial analysis of donated food in two European studies revealed the presence of food-borne pathogens that commonly cause foodborne illness, including *Listeria monocytogenes*, *Salmonella* spp and *Enterobacteriaceae* (De Boeck et al., 2017; Milicevic et al., 2016). Inconsistent temperature control during the transport of donated food in Sweden and Belgium has been documented (Ananprakrit, 2017; De Boeck et al., 2017) and more than 12,000 kg of food was recalled in a US food bank in 2017 as required temperatures were not maintained, causing potential contamination and spoilage (United States Department of Agriculture, 2018).

Virtually all countries have national food safety laws and policies, but most do not specify their application to donated food (Plekenpol et al., 2023). This is despite reference to the provision of 'safe' food in both the Food and Agriculture Organization of the United Nations (FAO) definitions for food redistribution and food security (FAO, 2001, 2015). The UK and Israel are two countries that have integrated food donation into food safety or broader food law, respectively (Plekenpol et al., 2023). Providing clarity on food safety provisions for food donation helps to ensure client safety, and reduces the burden for donors (Plekenpol et al., 2023). The UK laws align with the European Food Safety Authority's (EFSA) Food Donation Guidelines, which exist to facilitate compliance with the relevant requirements of the EU regulatory framework (European Commission, 2017).

The Australian & New Zealand Food Standards Code (FSC) is legally binding and exists to ensure food safety and protect public health, yet there is no explicit reference to donated food in food safety standards or other federal laws or guidance related to food donations (Beckmann et al., 2022). Only one Australian jurisdiction references donated food as part of its Food Act (Government of Victoria, 1984). The presumption is that donors will comply with FSC provisions to ensure food safety when donating food (Beckmann et al., 2022). However, food donation decisions by retailers have been found to be largely informal and inconsistent (De Boeck et al., 2017; Lowrey et al., 2023). The lack of clear and comprehensive food safety guidance for food donation may result in the donation of unsafe food or in unsafe donation processes, jeopardizing the health of already vulnerable recipients (Plekenpol et al., 2023). Good Samaritan Laws protect food donors from civil liability arising from potential harm of donated food (Government of Western Australia, 2002), but do not protect food banks in most Australian states and territories (Beckmann et al., 2022). There is also little reassurance or protection offered to clients who bear the ultimate responsibility of deciding what to, and what not to eat (Tarasuk & Eakin, 2005; van der



**Fig. 1.** Food safety decision making tree based on visual product assessment <sup>a</sup> Packaging refers to the product's label, inner and outer packaging; <sup>b</sup> Refer to FBA's Expiry and distribution guidelines (Foodbank Australia, 2023); <sup>c</sup> Refers to physical contamination (FAO, 2011).

Horst et al., 2014). This is of concern given that populations of lower socioeconomic status are suspected to experience greater rates of food-borne illness (Quinlan, 2013), which likely compound the existing adverse physical and mental health effects associated with food insecurity (Eicher-Miller, 2020).

The gap between food safety in the conventional food supply chain and that of the CFS (Makhunga et al., 2019) results in a fragmented approach to food safety (De Boeck et al., 2017). While the need for sector-wide food safety policy and guidance has been articulated (Plekenpol et al., 2023), a process for food banks to appraise the quality and safety of food donations is also required. To the authors knowledge there is no existing method in the literature that assesses food bank donations based on their visual food safety risk. A process to identify, quantify and manage unsafe and unsuitable food donations is needed to provide food banks with the transparency and insight to help manage unsuitable and unsafe donations, and to demand greater accountability from donors. This research describes a novel approach developed to identify and assess the safety and quality of food donations at an Australian food bank.

## 2. Materials and methods

Data collected during a five-day audit of food donated to the Foodbank of Western Australia (FBWA) was used for the food safety assessment. The audit protocol has been previously published by the authors (Mossenson et al., 2023). Briefly, over five consecutive days, upon receipt, all incoming deliveries to the FBWA warehouse were weighed, photographed, and manually annotated with the donor's name, delivery date, and the type of food, product information (brand and product name, variety), weight (kilograms), and date-marking details. The packaging and product itself were visually inspected for damage, with additional images taken and details documented if necessary. Visual inspection was also used to determine temperature control and evidence of thawing in frozen products. Data was assessed against pre-determined food safety criterion (Fig. 1), which were developed by the authors for the purpose of this study, consistent with food safety principles. For frozen mixed loads, only details of the donor and total weight were recorded as the time required to sort, record and repack the load presented a food safety risk (Mossenson et al., 2023).

### 2.1. Type of load

Donations were classified as a 'single load' (SL), or 'mixed load' (ML) based on its composition upon arrival at the FBWA warehouse. A SL contains pallet/s of the same product of identical and/or differing varieties (e.g., assorted flavors of potato chips). MLs are donations that contain unsorted, miscellaneous products, which are typically ambient

but can also be chilled or frozen. MLs are more cumbersome and time consuming than SLs as MLs require sorting and each item must be appraised according to food type and food safety suitability. MLs can comprise any number of products. Donations containing a combination of single and mixed loads are classified as the latter.

### 2.2. Food safety criterion

The definition and categorization of food safety criterion aligned with Food Standards Australia and New Zealand (FSANZ) food safety standards definitions, specifically Standard 2.2.2 Food Safety Practices and General Requirements (FSANZ, 2001). Working within the constraints of a food bank, whereby food safety records are not routinely provided by donors, and laboratory analysis of physical, chemical, and microbial contamination is not conducted, the level of food safety risk for each product was determined by a visual inspection of the product and its packaging, and a review of the date marking information. Products were initially categorized as 'satisfactory' or 'unsatisfactory', and subsequently categorized as either 'safe', 'unsuitable', 'potentially unsafe', or 'unsafe for human consumption'.

'Unsuitable' food is safe to eat but damaged, deteriorated or perished to an extent that affects its reasonable intended use (FSANZ, 2001). In the food banking context, this is typified by ripped, dented, or crushed packaging, or incomplete multi-packs, where the product is intact. Or where the product itself is crushed, squashed or melted, with packaging intact. While packaging flaws do not necessarily indicate a food safety threat, they are a 'contamination cue', triggering food safety concerns and signaling that the product should be avoided (White et al., 2016). The EFSA Food Donation Guidelines specifically require that foods must be donated without damaged packaging (European Commission, 2017). These products require multiple decisions to determine if they are suitable for redistribution or require disposal. Packaging or labelling flaws (e.g., incorrect net weight, upside-down sticker) are not considered unsuitable.

'Potentially unsafe' refers to foods requiring rapid redistribution before they become unsafe for consumption. This includes second quality fresh produce (overripe, wilted, bruised) and food donated on or one day prior to the Use By Date (UBD). The short-lead time of these products necessitates rapid distribution and consumption as foods become unsafe to eat once past the UBD (FSANZ, 2022). Some fresh products donated on their Best Before Date (BBD) are also potentially unsafe. While foods past the BBD are still deemed safe to eat (FSANZ, 2022), 'potentially hazardous' foods are more likely to pose a risk if not transported, stored and prepared with due care. Potentially hazardous foods are defined as foods that have to be kept at certain temperatures to minimize growth of any pathogenic microorganisms that may be present in the food or to prevent the formation of toxins in the food (FSANZ,

**Table 1**

Total number of donations by weight and number of products according to donor type, received by FBWA over 5 consecutive days, in May 2022.

Type of Donor	Total no. donations received	Total no. products received	Weight (kg) of donations	Percentage (%) by weight
Supermarkets	27	860	35,143	41
Transport logistics and distribution	9	19	17,044	20
Food manufacturers	11	45	13,302	15
Meal delivery companies	3	64	6,699	8
Growers and producers	8	15	6,300	7
Intra-organizational	2	11	5,134	6
Other retail businesses	3	18	1,507	2
General public	9	189	921	1
<b>TOTAL</b>	<b>72 donations</b>	<b>1221 products</b>	<b>86,050 kg</b>	<b>100 %</b>

2023). Potentially hazardous foods include, raw or cooked meat, food containing raw or cooked meat (e.g., casseroles, curries, lasagna, meat pies), seafood, eggs, food containing eggs (e.g., quiche), dairy foods, processed fruit and vegetables (e.g., bagged salads), cooked rice and pasta sandwiches and chilled ready meals) (FSANZ, 2023). Bagged salads and pre-cut vegetables require particular attention, as even before the best before date signs of deterioration can be present (Aotearoa Food Rescue Alliance, 2022). A Portuguese study determined that raw products (e.g., meat, poultry and fish products) were not suitable for donation at the end of shelf life due to potential changes in the organoleptic properties derived from spoilage (Maio et al., 2020). Damaged Tetra-Pak cartons are considered potentially unsafe too. The composite packaging of a Tetra-Pak contains layers of plastic (polyethylene (PE)), paper and aluminum, which are laminated together to create a lightweight, aseptic carton, widely used in the food industry (Basharat, 2022). If a package is squashed or crushed, crack defects can affect the inner PE and aluminum layers, compromising the integrity of the packaging (Hsu & Chang, 2007). Potential microbial contamination of the packaging or changes to the sensory qualities of the product may result (Hsu & Chang, 2007), rendering the product potentially unsafe.

'Unsafe' for consumption refers to food likely to cause physical harm to a person (FSANZ, 2001). For example, the packaging seal of a product is broken/tampered with, or the packaging/container is broken, leaving, the product exposed to contamination or leaking. Other examples include the presence of visible mold, or the product being swollen/‘blown’, an indication that the physical and microbial integrity of the product has been compromised (Voeller, 2014). The integrity of a damaged can is questionable even when a leak is not evident, so those that appear rusty, dented or have damaged seams are considered unsafe (FSANZ, 2017). Foods past their UBD become unsafe to eat and pose a health and safety risk (FSANZ, 2022). For example, delaying consumption post UBD extends the growth period for *Listeria monocytogenes*, which thrive in cold conditions (Snyder et al., 2018). It is widely accepted that foods past the BBD are still considered safe to eat (FSANZ, 2022), particularly processed foods (Maio et al., 2020), however donated foods may be well beyond their ‘acceptable’ BBD. Products are classified according to Foodbank Australia’s (FBA) ‘Expiry and distribution guidelines’ (Foodbank Australia, 2023), which specifies time periods for which a food can be distributed beyond its original date marking (Foodbank Australia, 2023). Some food categories (e.g., meat, ready meals, bagged salads) are not listed as they are ‘potentially hazardous foods’, the BBD is used as the acceptability threshold, a practice employed by charitable food organizations in New Zealand (Aotearoa Food Rescue Alliance, 2022). Products that have been ‘rejected’ or are part of a ‘product recall’ (as marked on product/packaging labelling) are also deemed unsafe given that the purpose of a food recall is to remove unsafe food from distribution, sale and consumption in order to protect public health and safety (FSANZ, 2018). Missing labelling renders a food unsafe as product information, date marking, handling instructions and allergen declarations are unknown. Fresh produce is considered unsafe if it is rotting, or overripe to the point of splitting and leaking as there is

the potential for pathogen colonization of the surface defects (e.g., bruising, cracked skin), which are typical of secondary quality and overripe produce (Snyder et al., 2016). ‘Other concerns’ are miscellaneous in nature, including physical contamination, the presence of a physical agent or other foreign matter in the food that compromises food safety or suitability (FAO, 2011). Evidence of compromised temperature control during transport/storage (e.g., frozen products thawed upon delivery), or any other concern not previously captured concludes the classification. The authors designed a decision tree (Fig. 1) that was pragmatic and practical, reflecting the process of visual assessment of food donations in a warehouse setting. When visually inspecting food for issues of concern, packaging that is appropriate is the key consideration. For unpackaged food, visual inspection focused on the product. The use of the terms packaging and product are consistent with the terminology used in the Australia and New Zealand FSC. Packaging provides protection against physical damage and deterioration to the internal food product during distribution and storage (Yan et al., 2022). Compromise to a product’s packaging presents food safety risks as previously described, with key defects (e.g., broken seal, dented can, squashed Tetra-Pak) incorporated into Fig. 1. Product refers to fresh food without packaging or reference to the internal product inside the packaging. Elements of a product’s food safety included aesthetic indicators (e.g., discoloration, wilting), physical and microbial integrity cues (e.g., swollen, the presence of mold) or other product information (e.g., date marking) that has a direct bearing on food quality and safety. Other important food safety issues such as temperature control, accurate labelling, and traceability were deemed outside the scope of this study so were not included in the decision tree.

### 3. Results

Fifteen hundred images were taken to document 74 donations, received over five days. Two of these were procured (food sourced and purchased by FBWA) deliveries. The 74 donations described here incorporate the collection (by FBWA) or delivery (by the public) of food at one point in time. A donation can comprise any combination and number of pallets or products. A donor may provide multiple donations on a single day, but each collection/delivery is regarded as a distinct donation. The total weight of all donations and deliveries was 108,509 kg, consisting of 1225 products. Donations accounted for 79 % (86,050 kg) of the total weight of food received and 99 % (n = 1221) of all products. One percent by weight (1054 kg) of all donations were excluded from the food safety assessment (section 3.2 onwards) as described earlier. Table 1 depicts the total number of donations by weight and number of products received according to donor type.

Transport, logistics and distribution refers to third party logistics companies who provide fulfillment services to manufacturers such as warehousing, order processing, shipping and receiving. ‘Intra-organizational’ denotes national and local donations from within FBWA’s network.

**Table 2**

Characteristics of mixed loads (MLs) by donor type.

Donor	Total no. MLs received	No. products received in MLs	Weight (kg) of MLs	Percentage (%) by weight of MLs	Total time (minutes) to sort each ML (lower – upper range)	Average time (minutes) to sort each ML
Supermarkets	23	836	29,974	65	1135 (10 – 267)	49
Transport logistics and distribution	–	–	–	–	–	–
Manufacturers	4	23	7,835	17	43 (10 – 13)	11
Meal delivery companies	3	64	6,699	14	108 (11 – 66)	36
Growers and producers	–	–	–	–	–	–
Intra-organizational	–	–	–	–	–	–
Other retail businesses	2	17	1,434	3	18 (8 – 10)	9
General Public	7	186	565	1	162 (10 – 63)	23
<b>TOTAL</b>	<b>39 donations</b>	<b>1126 products</b>	<b>45,507 kg</b>	<b>100 %</b>	<b>24 h, 43 min (8 – 267)</b>	<b>38 min</b>

### 3.1. Mixed loads (ML)

Fifty-four percent (39/72) of donations were MLs (see Images 1 and 2 for visual examples). This accounted for 92 % (n = 1126) of all products, and 54 % (46,507 kg) by weight of total donations received. The metadata (time stamp) from audit photographs ((Mossenson et al., 2023) was used to determine the total time taken to sort products from MLs (24 h, 43 min), as well as upper and lower ranges (in minutes). The overall average time (38 min) taken to sort MLs and the average time by donor type were also documented, with Table 2 detailing these characteristics. MLs required at least two personnel from the research team to sort, so the results in Table 2 reflect the collective time and effort of two people.

Images 1 and 2. Visual examples of mixed loads (MLs) received by FFWA over 5 consecutive days, in May 2022.



Image 1. Mixed load donation

categorized as unsafe, potentially unsafe or unsuitable (UUP), which comprised 182 products, and accounted for 90 % (3379 kg) of the total weight of UUP received. By weight, supermarkets are responsible for 98 %, 79 %, and 95 % of products categorized as unsuitable, potentially unsafe and unsafe, respectively. 73 % (3048 kg) of UUP were categorized as potentially hazardous foods.

Fifty-four percent (204/3761 kg) of donations categorized as unsafe required immediate disposal, as detailed in Fig. 2.

The types of products past the UBD (964 kg) included chicken-based chilled meals (311 kg), salami (300 kg), frankfurts (234 kg) and pork schnitzels (30 kg). Of the 631 kg meat-based products received past the BBD, three products were delivered frozen, but the products were not relabelled nor was any additional information provided by the donor. Products past their 'acceptable BBD' (211 kg) included a can of coconut cream that was almost three years old, 173 kg yoghurt, 12 L of soy milk and 15 kg of legume-based pasta. The rejected produce (72 kg) and recalled product (70 kg) were fresh fruit and crumbed quinoa burgers,



Image 2. Mixed load donation

### 3.2. Unsafe and unsuitable for human consumption

As explored in Table 3, 38 % of all donations contained products categorized as unsafe or unsuitable (n = 27/72) and they accounted for 4 % (3761 kg) of the total by weight received. 93 % (n = 25/27) of these products were received as part of a ML donation. Supermarkets were responsible for 67 % (n = 18/27) of all donations containing products

respectively. There were 51 kg worth of dented cans donated. Damaged items (21 kg) included a squashed, commercial-sized tub of raspberry baking filling, punctured packets of sugar and salt, a broken glass jar of chutney and open packets of pasta and savory snacks, all of which had leaked throughout their respective loads. The 4 kg of 'other product concerns' comprised items that were either 'blown', had visible mold, were unidentifiable (due to missing labelling), or breakfast cereals

**Table 3**

Characteristics and types of products categorized as unsafe, potentially unsafe or unsuitable (UUP) by donor and load type.

Donor	No. of donations received containing UUP	Weight of UUP (kg)	Percentage by weight of UUP (%)	Type of UUP by weight (kg)	Potentially unsafe	Unsafe
Supermarkets	18	3379	89.9 %	416	1036	1927
Transport logistics and distribution	2*	216	5.7 %	–	205	11
Manufacturers	1	72	1.9 %	–	72	–
Meal delivery companies	2	73	1.9 %	–	–	73
Other retail businesses	1	19	0.5 %	8	–	11
General public	3	2	0.1 %	0.1	–	2
<b>TOTAL</b>	<b>27</b>	<b>3761 kg</b>	<b>100 %</b>	<b>424 kg</b>	<b>1313 kg</b>	<b>2024 kg</b>

\* Denotes SL donation

contaminated with leaking pet food and maggots.

Thirty five percent of donations (1313/3761 kg) were categorized as potentially unsafe, requiring additional consideration, as depicted in Fig. 3.

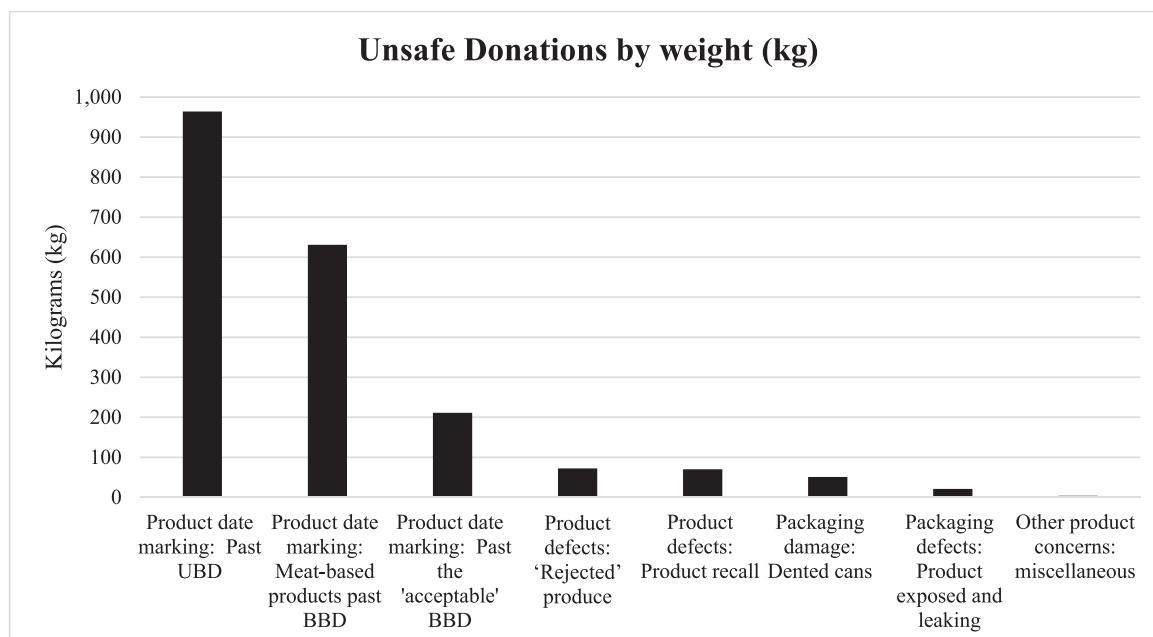
Products donated one day prior to UBD accounted for 78 % (1028 kg) by weight of food categorized as potentially unsafe. This included chicken and rice ready meals (569 kg), apple juice (205 kg), taramasalata dip (28 kg) and 240 bags of baby spinach leaves, all of which required rapid distribution. Overripe fresh produce (207 kg) was characterized by wilting, discoloration and a lack of firmness. Seventy-four kilograms of food was donated on the UBD, a Friday and included chicken noodle bowls (70 kg). Four kilograms of salad bags containing spinach/lettuce (potentially hazardous) were donated on the BBD, also a Friday, meaning that the products were unlikely to be distributed before the UBD/BBD.

Eleven percent (424/3761 kg) of donated food was categorized as unsuitable, as illustrated in Fig. 4.

All products categorized as unsuitable (424 kg) originated from ML. Eighty-nine percent (376 kg) of unsuitable products had ripped or crushed packaging or label or, a squashed lid. This predominately comprised of crushed cereal boxes and packet cake mixes. Products with soiled packaging/labels due to water damage and oil stains, accounted for 8 % (35 kg) by weight. Incomplete packaging, which accounted for 2.5 % (10 kg) of unsuitable items typically concerned non-perishable fruit tubs and flavored coffee sachets. Crushed biscuits and melted blocks of chocolate accounted for the remaining 3 kg of food deemed unsuitable.

#### 4. Discussion and policy implications

This study describes a novel approach to visually assessing product deliveries as an important first step to identify and assess the safety and quality of food donations at an Australian food bank. The assessment process and food safety criterion were specifically developed as part of a quality improvement process for the Australian food banking context and provided insight not previously available about the characteristics of donated food. This research demonstrates FFWA's commitment to quality improvement and to ensure the distribution of safe and suitable food to clients. Ninety-six percent of the donated food appeared to be of satisfactory quality and safety and 4 % represented an unacceptable health risk to clients. Around 4.3 million kilograms of food was distributed by FFWA in 2022 and they report saving over 3.6 million kilograms from landfill, with 80 full/part-time staff, and the support of 1700 volunteers gifting 65,000 h (Foodbank of Western Australia, 2022). Despite the relatively low proportion (4 %) of donated foods identified as unsafe, potentially unsafe, or unsuitable, on an annual basis this could equate to 170,000 kg of UUP donated. This vast volume of UUP poses a potential risk to clients and would utilize significant volunteer hours to manage this risk. While the overall proportion of foods identified as unsafe and unsuitable was low, the nature of the damaged products was hazardous, for example, 300 kg of salami donated four months past its UBD. This is of major concern, as inadequate quality control procedures resulted in contaminated mettwurst in Australia in 1995 resulting in an *Escherichia coli* outbreak (Desmarchelier, 1997). The incident caused one child fatality, and other illnesses in

**Fig. 2.** Types of donations categorized as unsafe received by weight (kilograms).

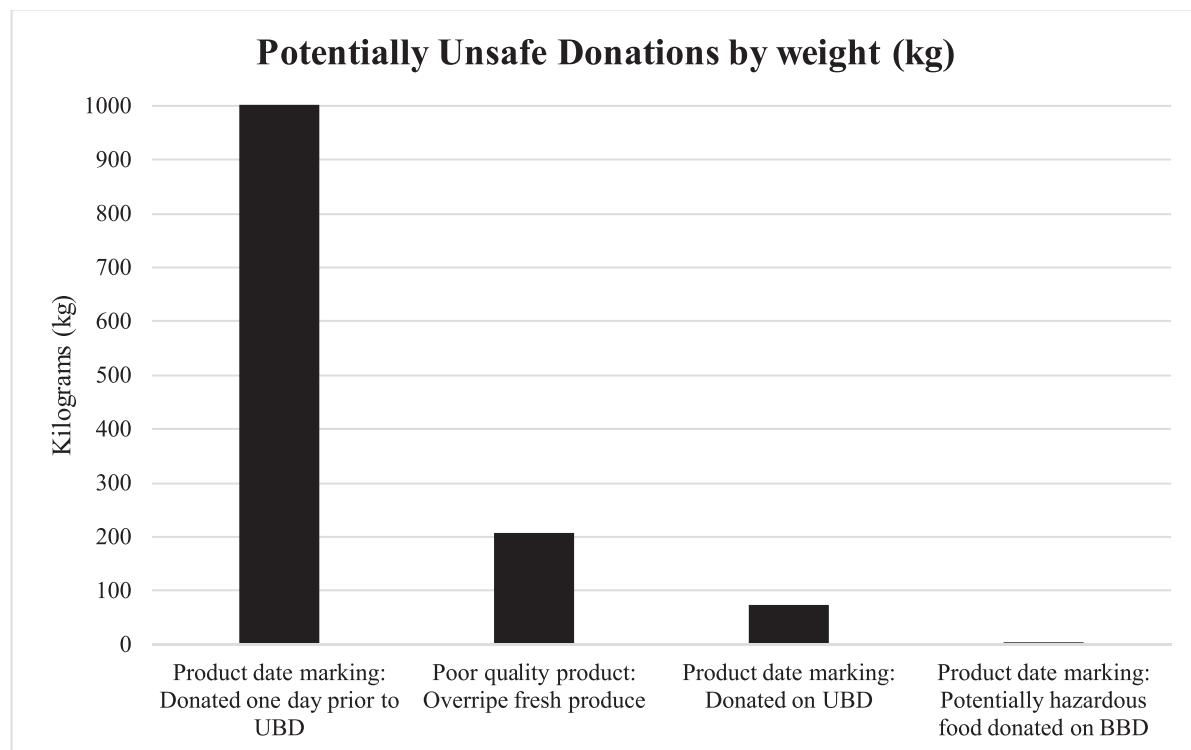


Fig. 3. Types of donations categorized as potentially unsafe received by weight (kilograms).

19 others, including acute renal disease, gastrointestinal and neurological complications (Henning et al., 1998). Not all food safety risks can be identified by visual assessment, for example microbial contamination, so there is a risk that the proportion of foods hazardous to clients is even higher.

Supermarkets were responsible for the largest number of donations, and 90 % of the unsafe and unsuitable donations. These examples demonstrate a failure in the current system, and potentially, a disregard for basic food safety principles by donors. This is surprising given that two of the top 5 supermarket CSR policies globally were: donating surplus food to charities for redistribution to feed the hungry; and reducing and recovering food waste (Pulker et al., 2018). It is likely that the inherent risk in the system is hidden due to a lack of monitoring of the food safety risk of donated food at an operational level. There is a need for increased transparency in supermarket CSR reporting, particularly in relation to public health nutrition, a limitation that has previously been identified (Pulker et al., 2019). Supermarkets should extend their food safety standards to donated products; ensuring that the organizations receiving donations have appropriate transport and storage capacity to maintain the cold chain, as well as providing reports that transparently state the amount of food donated and the reason for donation.

There is an urgent need for food safety guidance to protect food banks from receiving damaged, spoiled, and expired products that pose a risk to their clients. These results are not isolated or an anomaly as there are many examples in the literature demonstrating donations of UUP over the last two decades (Kratzmann, 2003; McKay et al., 2018; Tarasuk & Eakin, 2005; Verpy et al., 2003). In this current study, almost 2000 kg of donated products were potentially unsafe and unsuitable due to some type of damage or degree of uncertainty. The time and multiple decisions needed to assess their appropriateness for distribution places unnecessary demands on volunteer capacity and hampers overall efficiency.

Based on the findings in this current study, current donation practices may threaten the health and safety of already vulnerable and disadvantaged clients, who are more susceptible to foodborne illness

(Quinlan, 2013). Donors are protected from liability under Australian state and territory-based Good Samaritan laws that assume donations are made in good faith, without intent to harm the recipient and for a charitable or benevolent purpose (Government of Western Australia, 2002). In one Australian jurisdiction, if a donor is recklessly indifferent as to the fact the food is unsafe, the donor will not receive liability protection (Government of South Australia, 1936). Food banks in some states and territories are not covered by this legislation, and should consider the potential risk of civil liability due to the inadvertent distribution of unsafe foods given the limitations of current liability protection laws (Beckmann et al., 2022).

Directing supermarkets' food waste disposal to food banks is beneficial but it ultimately shifts the economic cost of food retrieval and waste management to them, as well as the moral burden of unsafe and inappropriate donations (De Boeck et al., 2017; Devin & Richards, 2018; Papargyropoulou et al., 2022). Supermarkets have 'unprecedented and disproportionate power' in the food system (Pulker et al., 2017) and this is at the expense of food banks and other charity organizations (De Boeck et al., 2017; Papargyropoulou et al., 2022). Food banks, already challenged by inconsistent financial resources (Byrne & Just, 2022; Papargyropoulou et al., 2022; Pollard et al., 2018), should not bear the cost of disposing of food industry waste. Supermarkets view food donation as a 'profit-maximizing' strategy (Lowrey et al., 2023). The disposal of unsafe and unsuitable products prior to donation would have economic implications for supermarkets, although minimal given that their mean donation levels are very small relative to the size of sales across product categories (Lowrey et al., 2023). Supermarkets already have rigorous quality assurance practices in place, so cost implications for the identification and removal of unsafe and unsuitable products from donations is likely inconsequential. Supermarkets are the gate-keepers of the food supply and they have private, proprietary food standards that govern the quality of food from their suppliers (Davey & Richards, 2013; Pulker et al., 2017). These standards protect supermarkets' reputation in the commercial food supply and have also led to improved food safety overall (Pulker et al., 2017). However, evidence of similar rigor to protect their reputation in the CFS is lacking.

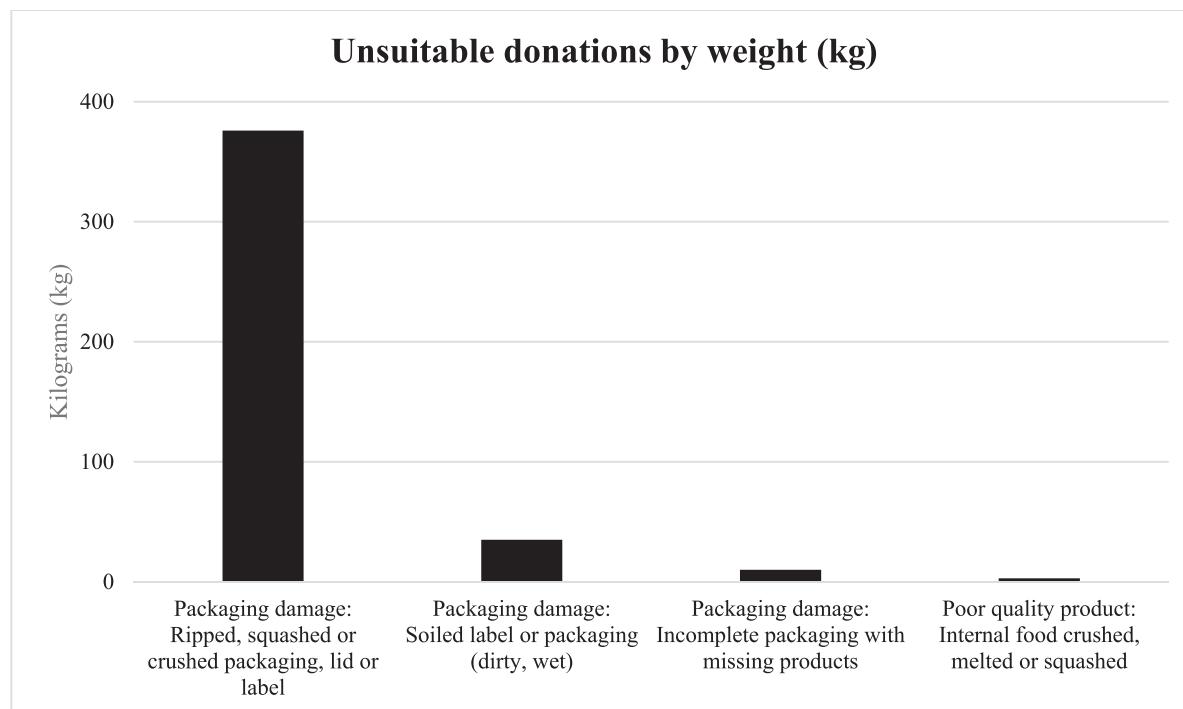


Fig. 4. Types of donations categorized as unsuitable received by weight (kilograms).

Supermarkets should be expected to apply their own quality standards to food destined for donation and pay waste disposal fees where they are due. For food banks, the overall volume of usable donations would proportionally increase, which would aid overall efficiency given that the handling of inappropriate products requires considerable volunteer effort and labor (Tarasuk & Eakin, 2005).

Food banks rely on a volunteer workforce to undertake the labor-intensive inspecting, sorting, and classifying donations (Landers, 2020; Philip et al., 2017; Ritches, 2018; Shimada et al., 2013; Wakefield et al., 2013), which presents its own organizational challenges due to labor insufficiency and unreliability (Caraher & Furey, 2017; Philip et al., 2017; Ritches, 2018). The handling of damaged, spoiled and expired food demands additional effort (Tarasuk & Eakin, 2005). For instance, when only one or some units are unsafe within a multiple-unit product, volunteers need to open a bag of oranges to remove the moldy produce; separate a multi-pack of yoghurts when one has a broken seal; or retrieve and dispose of broken eggs from a carton (European Commission, 2017). Volunteers with minimal training are responsible for judging food safety based on visual assessment only (Makhunga et al., 2019; Philip et al., 2017; Tarasuk & Eakin, 2005). This is despite evidence of their food safety knowledge being poor and inconsistent (Chaifetz & Chapman, 2015; De Boeck et al., 2017; Landers, 2020; Makhunga et al., 2019). The UK has implemented food safety training among volunteers and staff to better recognize and manage food safety risks, (Food Standards Agency UK, 2022) but this approach is not standard practice across the global CFS. Mixed loads are an additional challenge for volunteers as they are cumbersome and time-consuming to sort (Feldman & Schwartz, 2018; Shimada et al., 2013). Indeed, the time taken to sort and appraise each mixed load in this study ranged from 10 min to almost 5 h. This not only reflects the unpredictability of donations, but also the variable and labor-intensive nature of mixed loads, which has both workforce capacity and economic implications for food banks. This current study also found that 64 % of mixed loads contained unsafe or unsuitable products, making them onerous to manage. The ergonomic risks associated with mixed loads, and the accumulation of packaging waste have been documented (Higgins et al., 2017). This was experienced during the current study when unpacking a mega-bin of

carbonated drinks which required repetitive and un-ergonomic movements. Damaged and leaking products within mixed loads makes sorting difficult, unpleasant and potentially dangerous. Exposed contents seep onto the warehouse floor rendering it sticky, slippery and an occupational hazard. Lastly, how sequestered inappropriate food is handled and disposed of remains unknown (Makhunga et al., 2019).

The results of the audit underscore the importance and clear need to incorporate the donation of safe and appropriate food in the food regulatory system to protect the public health and safety of people seeking food assistance. This echoes recommendations from the Global Food Donation Policy Atlas Project (GFDPA), a partnership between the Harvard Food Law and Policy Clinic and the Global Foodbanking Network, which aims to encourage better laws pertaining to productive and safe food donation (Plekenpol et al., 2023). A key recommendation of the GFDPA is for countries to adopt a donation-specific food safety law or policy (Plekenpol et al., 2023). This seems both logical and long overdue given the increasing and chronic demand for food banks and the vulnerability of the client group. For Australia, it is recommended that the FSC should be amended to explicitly include food safety provisions applicable to food donation (Beckmann et al., 2022). Given Australian food banks charge a 'handling fee' to clients for food, they may be inadvertently considered a food business, and therefore already required to be comply with the FSC (FSANZ, 2001).

Concurrent to the need for legal provisions, priority must be given to the development of national food donation guidance. Clear food safety protocols for donors to comply with and food banks to enforce will help contribute to a safer and more effective food donation system. Supermarkets are the gatekeepers of the Australian food system and have instigated quality standards that food producers are required to meet in order to become suppliers. They set quality standards that are more stringent than government food safety standards and include rules about 'acceptable food safety, product quality and the cosmetic appearance of fresh produce' (Pulker et al., 2017). Given food banks' inherent limitations related to 'insufficiency' (inability to generate resources on a scale that is both adequate and reliable enough) and 'amateurism' (association with amateur approaches' to coping with human problems) (Pollard et al., 2019; Salomon, 1987), supermarkets should extend their

expertise and leadership to better support food banks and take responsibility to ensure the safety of donated food. The development of food safety guidance for the CFS must identify feasible ways the predominantly volunteer workforce can implement such standards. The EFSA guidelines are a useful example for Australia to consider and contextualize. This guidance should encompass the following food safety principles:

#### 4.1. Date marking - UBD

Guidance needs to explicitly state that food past its UBD cannot be donated to and will not be accepted by food banks. This provision is consistent with Standard 1.2.5 of the FSC, which specifies that food must not be sold after its UBD (FSANZ, 2016b). For foods approaching the UBD, donors must ensure that there is sufficient shelf-life available upon donation to allow for safe distribution and use by the client prior to the indicated UBD. In France, a law has been enacted that requires food with a UBD to have at least 48 h available shelf-life upon donation to food banks (European Commission, 2017). It is acknowledged that this may present operational and logistical challenges for food industry who likely want to maximize the potential sales value of products up until the end of trade on the UBD (Papargyropoulou et al., 2022).

Freezing foods prior to the UBD is an acceptable practice within the CFS as it provides more distribution flexibility (De Boeck et al., 2017). A study in Italy demonstrated that freezing a range of products at the end of shelf life avoided the loss of edible food and maintained food safety standards under the testing operating parameters for indicator micro-organisms (Bonaccorsi et al., 2016). Both the UK and Belgian Food Safety Authorities specify that ambient or chilled food which are to be frozen require re-labelling indicating the date of freezing and 'immediate consumption after thawing' on the label (Federal Agency for the Safety of the Food Chain, 2023; Food Standards Agency UK, 2020). This is worth exploring in the context of the Australian regulatory setting given the current study's findings, noting that the FSC expressly prohibits altering labels unless permitted by the relevant regulatory authority on application by the food supplier (Food Regulation, 2016; FSANZ, 2016a).

#### Date marking - BBD.

It is widely accepted that food past its BBD can still be safely eaten but with some loss to quality (FSANZ, 2016b). Existing FBA guidelines outline how to determine the safety and acceptability of foods past the BBD (Foodbank Australia, 2023). When used to support this current assessment, it was evident that the guidelines are a useful foundation for decision-making but given the variety of items donated, additional product categories across and within food groups are needed, with a specific emphasis on 'potentially hazardous foods'. A description of sensory qualities that may be affected if a food is passed its BBD will provide further context to aid decision-making. While it is seemingly conventional to consume foods past their BBD, particularly to avoid edible food from going to landfill, the dignity of clients experiencing food insecurity must be emphasized. For example, De Souza (2021) describes how a food pantry client in the US specifically requested an unexpired cake mix to celebrate her granddaughter's birthday, because "*it doesn't rise after the expiration date*" p.77 (De Souza, 2019). These types of experiences reinforce existing feelings of shame and stigma and the inequities associated with food insecurity (De Boeck et al., 2017; De Souza, 2019; van der Horst et al., 2014).

#### 4.2. Damaged packaging and products

Packaging flaws such as ripped or dirty labels, crushed or squashed packaging do not necessarily indicate an immediate food safety threat, but they do induce food safety concerns (White et al., 2016). In this study, all unsuitable products were from mixed loads, and all items required considerable scrutiny and some level of aesthetic restoration to determine appropriateness for distribution, a skill readily inherent in the

research team but not in volunteers. To ensure client safety, consideration must also be given to how these products are appraised and managed. The acceptability of these products is not always easy to judge, so food banks and donors must come to a mutual agreement on what constitutes acceptable (De Boeck et al., 2017). The EFSA guidelines recommends a thorough assessment be carried out, including consideration of the type and composition of the product and/or the integrity of the packaging and date marking details (European Commission, 2017). Damaged products should also go through a similar assessment process, and include an appraisal of the sensory properties of the food (European Commission, 2017). Thought must also be given to how to manage products when only one or some units are unsuitable or unsafe within a multiple-unit product. The decision tree (Fig. 1) could be used by volunteers to assess the safety and suitability of donated food to make the sorting and appraisal process more streamlined and efficient, complimenting other potential initiatives like food safety training (Food Standards Agency UK, 2022). Further use of the decision tree, particularly within a busy warehouse setting would enable its utility and visual efficacy to be determined. A systematic process for disposal of damaged products must also be considered. Lastly, food banks need to contemplate the benefits of mixed loads. Food banks undertake complex decisions daily to optimize operational effectiveness and efficiency, and achieve equity in distribution, which are influenced by supply, demand and capacity (Mossenson et al., 2023; Sengul Orgut et al., 2015). Mixed loads must be considered within this context and whether they represent a valuable source of food (supply) or an unproductive use of volunteer time (capacity), or how they can be better managed to improve overall efficiency.

#### 4.3. Other considerations – Transport and cold chain management

Compromised temperature control during transport/storage to the food bank is categorized as 'other' under the Food Safety Decision Making Tree (Fig. 1). While there was no evidence of this in the current study (likely due to evidence of temperature control being limited to visual inspection), the challenge of maintaining cold chain during transport and storage has been cited in the literature owing to insufficient refrigerated capacity (storage and transport), multiple donor pick-up points and the perishability of donated food (Ananprakrit, 2017; De Boeck et al., 2017). In a study of donated poultry products in Sweden, unusual temperature spikes were recorded as a result of being near the rear truck door, exposing the product to direct sunlight during door opening at receiving and dispatch points (Ananprakrit, 2017). The primary reason for compromised food safety in a Belgium study of donated items was due to difficulty maintaining the cold chain (De Boeck et al., 2017). The current system of food donation doesn't require donors to provide any documentation assuring cold chain management of high-risk foods prior to being collected by food banks, but maintenance of the cold chain is a key obligation under food law and has implications for liability (European Commission, 2017).

#### 5. Strengths and limitations

A key strength of this research was the implementation of a systematic, yet practical approach to assess food donations based on their visual food safety risk at an Australian food bank. To the authors knowledge, this is the first of its kind and has elucidated data not previously accessible to food banks about the food received from donors. An additional strength was that this research was undertaken with the full support and engagement of FBWA. The approach has only been implemented at one food bank for 5 days at one point in time. Routine monitoring is recommended to determine seasonal variations and to quantify and manage food safety risk. The methodology used can be replicated at the same food bank or other sites within the (global) charitable food system to overcome this limitation and ensure generalizability. Evidence of temperature control of potentially hazardous food

was limited to visual inspection rather than measuring the temperature of foods using a device and as a result, this research may have underestimated the volume of potentially hazardous foods donated to the Food Bank. The results are an important contribution to the literature and will help to strengthen the awareness and understanding of the unique food safety challenges facing food banks. The food safety assessment is only one component of a broader public health assessment of donated food. Further research regarding the nutrition quality and suitability for meals of donated food is required. This is especially important as food banks report increasing demand and have a duty of care to provide safe and appropriate food for their clients.

## 6. Conclusions

There is a critical need to establish a food safety framework in Australia pertaining to donated food to ensure the provision of safe and appropriate food for clients experiencing food insecurity. The existing donation practices of the food industry, particularly supermarkets, revealed a somewhat indifferent approach to food safety, which puts the health and safety of an already vulnerable and disadvantaged client group at risk. Food banks should not be morally and economically encumbered with disposing of supermarkets' discards and clients have the right to expect the food that they receive to be safe and suitable for consumption.

## CRediT authorship contribution statement

**Sharonna Mossenson:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Roslyn Giglia:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Claire E. Pulk**: Conceptualization, Methodology, Formal analysis, Writing – review & editing, Supervision. **Miranda Chester:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Catrina McStay:** Writing – review & editing. **Christina M Pollard:** Conceptualization, Methodology, Writing – review & editing, Supervision.

## 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.

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## References

Food Standards Agency UK. (2020). *Bulk freezing of ambient and chilled foods*. <https://www.food.gov.uk/business-guidance/bulk-freezing-of-ambient-and-chilled-foods>.

Food Standards Agency UK. (2022). *Qualitative research exploring community food provision*. <https://bit.ly/UKcommunityfoodprovision>.

Aotearoa Food Rescue Alliance. (2022). *Food Safety Guide*. <https://afra.org.nz/wp-content/uploads/2022/02/AFRA-Food-Safety-Guide.pdf>.

Ananprakrit, N., Esbjörnsson, M.E. (2017). *Traceability in charitable food redistribution system – ensuring food safety and quality in a cold chain* [Master's thesis, Lund University]. Lund, Sweden <https://lup.lub.lu.se/student-papers/search/publication/8909440>.

Foodbank Australia. (2023). *Expiry and Distribution* <https://www.foodbank.org.au/expiry-and-distribution/?state=au>.

Basharat, N., Dar, M., Ahmad, S.A., Shabir, A., Mir, 2022. *Shelf Life and Food Safety*. CRC Press.

Beckmann, J. S., Broad Leib, E. M., Shapiro, M., Adams, K., DeBode, S., & Russo, H. (2022). *The Global Food Donation Policy Atlas - Australia*. <https://www.foodbank.org.au/wp-content/uploads/FBA/Documents/Australia-Legal-Guide-6.22.22.pdf>.

Berg, J., Gibson, A., 2022. Why the world should not follow the failed united states model of fighting domestic hunger. *Int. J. Environ. Res. Public Health* 19 (2), 814. <https://doi.org/10.3390/ijerph19020814>.

Bonaccorsi, G., Lorini, C., Pieralli, F., Pieri, L., Sala, A., Tanini, T., Nasali, M., Dall'Olio, B., Santomauro, F., 2016. The right to food, food donation and microbiological problems of food safety: an experience in the territory of Florence. *Ann. Ist. Super. Sanita* 52 (1), 119–122. <https://doi.org/10.4415/ann.16.01.19>.

Booth, S., Begley, A., Mackintosh, B., Kerr, D., Jancey, J., Caraher, M., Whelan, J., Pollard, C., 2018. Gratitude, resignation and the desire for dignity: lived experience of food charity recipients and their recommendations for improvement, Perth, Western Australia. *Public Health Nutr.* 21, 1–11. <https://doi.org/10.1017/S1368980018001428>.

Booth, S., Whelan, J., 2014. Hungry for change: the food banking industry in Australia. *Br. Food J.* 116 (9), 1392–1404. <https://doi.org/10.1108/bfj-01-2014-0037>.

Byrne, A.T., Just, D.R., 2022. Review: private food assistance in high income countries: a guide for practitioners, policymakers, and researchers. *Food Policy* 111, 102300. <https://doi.org/10.1016/j.foodpol.2022.102300>.

Cahill, C.R., Webb Girard, A., Giddens, J., 2019. Attitudes and behaviors of food pantry directors and perceived needs and wants of food pantry clients. *J. Hunger Environ. Nutr.* 14 (1–2), 183–203. <https://doi.org/10.1080/19320248.2017.1315327>.

Campbell, E.C., Ross, M., Webb, K.L., 2013. Improving the nutritional quality of emergency food: a study of food bank organizational culture, capacity, and practices. *J. Hunger Environ. Nutr.* 8 (3), 261–280. <https://doi.org/10.1080/19320248.2013.816991>.

Campbell, E., Webb, K., Ross, M., Hudson, H., Hecht, K., 2015. Nutrition-focused food banking. *Natl. Acad. Med. Perspect.* 5 <https://doi.org/10.31478/201504a>.

Caraher, M., Furey, S., 2017. Is it appropriate to use surplus food to feed people in hunger? Short-Term Band-Aid to More Deep-Rooted Problems of Poverty. <https://foodresearch.org.uk/publications/is-it-appropriate-to-use-surplus-food-to-feed-people-in-hunger/>.

Caraher, M., Furey, S., 2018. The economics of emergency food aid provision. *Palgrave Pivot Cham.* <https://doi.org/10.1007/978-3-319-78506-6>.

Caspi, C.E., Davey, C., Barnes, C., Bliss, Gordon, N., Bohen, L., Canterbury, M., Peterson, H., Pratt, R., 2021. Needs and Preferences Among Food Pantry Clients. *Prev. Chronic Dis.* 18, E29. <https://doi.org/10.5888/ped18.200531>.

Chafetz, A., Chapman, B., 2015. Evaluating north carolina food pantry food safety-related operating procedures. *J. Food Prot.* 78 (11), 2033–2042. <https://doi.org/10.4315/0362-028x.jfp-15-084>.

Chapnick, M., Barnidge, E., Sawicki, M., & Elliott, M. (2019). Healthy Options in Food Pantries-A Qualitative Analysis of Factors Affecting the Provision of Healthy Food Items in St. Louis, Missouri. *Journal of Hunger & Environmental Nutrition*, 14(1-2), 262-280. <https://doi.org/10.1080/19320248.2017.1284027>.

European Commission. (2017). *European Union (UN) Food Donation Guidelines (2017/C 361/01)*. [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC1025\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC1025(01)).

Cooksey-Stowers, K., Martin, K.S., Schwartz, M., 2019. Client preferences for nutrition interventions in food pantries. *J. Hunger Environ. Nutr.* 14 (1–2), 18–34. <https://doi.org/10.1080/19320248.2018.1512929>.

Davey, S.S., Richards, C., 2013. Supermarkets and private standards: unintended consequences of the audit ritual. *Agric. Hum. Values* 30 (2), 271–281. <https://doi.org/10.1007/s10460-012-9414-6>.

Davis, L.B., Sengul, I., Ivy, J.S., Brock, L.G., Miles, L., 2014. Scheduling food bank collections and deliveries to ensure food safety and improve access. *Socioecon. Plann. Sci.* 48 (3), 175–188. <https://doi.org/10.1016/j.seps.2014.04.001>.

De Boeck, E., Jacxsens, L., Goubert, H., Uyttendaele, M., 2017. Ensuring food safety in food donations: case study of the Belgian donation/acceptation chain. *Food Res. Int.* 100 (Pt 2), 137–149. <https://doi.org/10.1016/j.foodres.2017.08.046>.

De Souza, R., 2019. Feeding the other: whiteness, privilege, and neoliberal stigma in food pantries. *The MIT Press*. <https://doi.org/10.7551/mitpress/11701.001.0001>.

Desmarchelier, P.M., 1997. Enterohemorrhagic escherichia coli—the australian perspective. *J. Food Prot.* 60 (11), 1447–1450. <https://doi.org/10.4315/0362-028X-60.11.1447>.

Devin, B., Richards, C., 2018. Food waste, power, and corporate social responsibility in the australian food supply chain. *J. Bus. Ethics* 150 (1), 199–210. <https://doi.org/10.1007/s10551-016-3181-z>.

Eicher-Miller, H.A., 2020. A review of the food security, diet and health outcomes of food pantry clients and the potential for their improvement through food pantry interventions in the United States. *Physiol. Behav.* 220, 112871. <https://doi.org/10.1016/j.physbeh.2020.112871>.

Enns, A., Rizvi, A., Quinn, S., & Kristjansson, E. (2020). Experiences of Food Bank Access and Food Insecurity in Ottawa, Canada. *Journal of Hunger and Environmental Nutrition*, 15(4), 456-472. <https://doi.org/10.1080/19320248.2020.1761502>.

FAO. (2001). *The State of Food Insecurity in the World 2001*. Rome. <http://www.fao.org/docrep/003/y1500e/y1500e00.htm>.

FAO. (2015). *Global Initiative on Food Loss and Waste Reduction*. <https://www.fao.org/save-food/news-and-multimedia/news/news-details/en/c288692/>.

FAO. (2011). *Codex Alimentarius General Principles of Food Hygiene CXC 1-1969*. <https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fwww.fao.org%252Ffao-who-codexalimentarius%252Fsh-proxy%252Fen>

252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252Fstandards%252FCXC %2B1-1969%252FCXC\_001e.pdf.

Federal Agency for the Safety of the Food Chain. (2023). *Circular letter on food donations*. [https://www.favv-afsc.be/professionnels/denreesalimentaires/circulaires/\\_documents/20230323\\_EN\\_Circularonfooddonations\\_v1.pdf](https://www.favv-afsc.be/professionnels/denreesalimentaires/circulaires/_documents/20230323_EN_Circularonfooddonations_v1.pdf).

Feldman, M., & Schwartz, M. (2018). *A Tipping Point: Leveraging Opportunities to Improve the Nutritional Quality of Food Bank Inventory*. <https://amazon.org/wp-content/uploads/MAZON-Report-TippingPoint.pdf>.

Foodbank of Western Australia. (2022). *Annual Report 2022*. <https://reports.foodbank.org.au/foodbank-wa-annual-report-2022/>.

FSANZ. (2016a). *Standard 1.2.1 Requirements to have labels or otherwise provide information*. <https://www.foodstandards.gov.au/code/Documents/1.2.1%20Labelling%20requirements%20v157.pdf>.

FSANZ. (2017). *Canned foods: purchasing and storing*. <https://www.foodstandards.gov.au/consumer/safety/cannedfoods/Pages/default.aspx>.

FSANZ. (2022). *Use-by and best-before dates*. <https://www.foodstandards.gov.au/consumer/labelling/dates/Pages/default.aspx>.

FSANZ. (2001). *Standard 3.1.1 Interpretation and Application*. [https://www.foodstandards.gov.au/publications/documents/3\\_1\\_1.pdf](https://www.foodstandards.gov.au/publications/documents/3_1_1.pdf).

FSANZ. (2016b). *Standard 1.2.5 Information requirements – date marking of food for sale*. <https://www.foodstandards.gov.au/code/Documents/1.2.5%20Date%20marking%20v157.pdf>.

FSANZ. (2018). *Food recalls*. <https://www.foodstandards.gov.au/industry/foodrecalls/Pages/default.aspx>.

FSANZ. (2023). *Safe Food Australia A Guide to the Food Safety Standards: Chapter 3 of the Australia New Zealand Food Standards Code*. [https://www.foodstandards.gov.au/publications/SiteAssets/Pages/safefoodaustralia3rd16/Safe%20Food%20Australia\\_edn%204%20whole%20book%20-%2020170723.pdf](https://www.foodstandards.gov.au/publications/SiteAssets/Pages/safefoodaustralia3rd16/Safe%20Food%20Australia_edn%204%20whole%20book%20-%2020170723.pdf).

Global FoodBanking Network. (2022). *Annual Report*.

Government of South Australia. (1936). *Civil Liability Act*. [https://www.legislation.sa.gov.au/\\_legislation/lz/c/a/civil%20liability%20act%201936/current/1936.2267.auth.pdf](https://www.legislation.sa.gov.au/_legislation/lz/c/a/civil%20liability%20act%201936/current/1936.2267.auth.pdf).

Government of Victoria. (1984). *Food Act*. <https://www.legislation.vic.gov.au/in-force/acts/food-act-1984/115>.

Government of Western Australia. (2002). *Volunteers and Food and Other Donors (Protection from Liability) Act*. [https://www.legislation.wa.gov.au/legislation/statutes.nsf/law\\_a4339.html](https://www.legislation.wa.gov.au/legislation/statutes.nsf/law_a4339.html).

Hardcastle, S.J., Caraher, M., 2021. The role of foodbanks in the context of food insecurity: experiences and eating behaviours amongst users. *Appetite* 163, 105208. <https://doi.org/10.1016/j.appet.2021.105208>.

Henning, P.H., Tham, E.B.C., Martin, A.A., Beare, T.H., Jureidini, K.F., 1998. Haemolytic-uraemic syndrome outbreak caused by *Escherichia coli* O111:H-: clinical outcomes. *Med. J. Aust.* 168 (11), 552–555. <https://doi.org/10.5694/j.1326-5377.1998.tb139083.x>.

Higgins, N.A., Talone, A.B., Fraulini, N.W., Smither, J.A., 2017. Human factors and ergonomics assessment of food pantry work: a case study. *Work* 56 (3), 455–462. <https://doi.org/10.3233/wor-172511>.

Hsu, C.-L., Chang, K.-S., 2007. Development of a novel method for detecting the integrity of aseptic paperboard laminate packages containing aluminium foil. *Food Control* 18 (2), 102–107. <https://doi.org/10.1016/j.foodcont.2005.08.012>.

Hudak, K., Friedman, E., Johnson, J., Benjamin Neelon, S., 2020. Food bank donations in the united states: a landscape review of federal policies. *Nutrients* 12, 3764. <https://doi.org/10.3390/nu12123764>.

Kleve, S., Booth, S., Davidson, Z.E., Palermo, C., 2018. Walking the food security tightrope-exploring the experiences of low-to-middle income melbourne households. *Int. J. Environ. Res. Public Health* 15 (10). <https://doi.org/10.3390/ijerph15102206>.

Kratzmann, L.V.M., 2003. More than food: An exploration of the food bank experience in the Halifax Regional Municipality [Master of Arts, Dalhousie University]. Halifax, Nova Scotia. [https://central.bac-lac.gc.ca/..item?id=MQ83639&op=pdf&app=Library&is\\_thesis=1&oclc\\_number=56921324](https://central.bac-lac.gc.ca/..item?id=MQ83639&op=pdf&app=Library&is_thesis=1&oclc_number=56921324).

Lambie-Mumford, H., Silvasti, T., 2020. *The Rise of Food Charity in Europe*. Bristol University Press.

Landers, B., 2020. Food safety knowledge, training and practice among food pantry volunteers in franklin county, oh [undergraduate thesis, ohio state university]. Ohio. <https://kb.osu.edu/handle/1811/92132>.

Leete, L., Bania, N., 2010. The effect of income shocks on food insufficiency. *Rev. Econ. Househ.* 8 (4), 505–526. <https://doi.org/10.1007/s11150-009-9075-4>.

Lindberg, R., Whelan, J., Lawrence, M., Gold, L., Friel, S., 2015. Still serving hot soup? Two hundred years of a charitable food sector in Australia: a narrative review. *Aust. N. Z. J. Public Health* 39 (4), 358–365. <https://doi.org/10.1111/1753-6405.12311>.

Loopstra, R., Tarasuk, V., 2012. The relationship between food banks and household food insecurity among low-income Toronto Families. *Can. Public Policy* 38 (4), 497–514. <https://doi.org/10.3138/CPP.38.4.497>.

Lowrey, J.D., Richards, T.J., Hamilton, S.F., 2023. Food donations, retail operations, and retail pricing. *Manuf. Serv. Oper. Manag.* 25 (2), 792–810. <https://doi.org/10.1287/msom.2022.1185>.

Maio, R., García-Díez, J., Saraiva, C., 2020. Microbiological quality of foodstuffs sold on expiry date at retail in portugal: a preliminary study. *Foods* 9 (7). <https://doi.org/10.3390/foods9070919>.

Makhunga, S., Mashamba-Thompson, T., Hlongwa, M., Hlongwana, K., 2019. Evidence on food control in charitable food assistance programs: a systematic scoping review. *Syst. Rev.* 8 (1), 240. <https://doi.org/10.1186/s13643-019-1164-8>.

Martin, K.S., 2021. *Reinventing Food Banks and Pantries: New Tools to End Hunger*. Island Press.

McKay, F.H., Bugden, M., Dunn, M., Bazerghi, C., 2018. Experiences of food access for asylum seekers who have ceased using a food bank in Melbourne, Australia. *British Food Journal* 120 (8), 1708–1721. <https://doi.org/10.1108/BFJ-04-2018-0271>.

Middleton, G., Mehta, K., McNaughton, D., Booth, S., 2018. The experiences and perceptions of food banks amongst users in high-income countries: an international scoping review. *Appetite* 120, 698–708. <https://doi.org/10.1016/j.appet.2017.10.029>.

Milicevic, V., Colavita, G., Castrica, M., Ratti, S., Baldi, A., Balzaretti, C.M., 2016. Risk assessment in the recovery of food for social solidarity purposes: preliminary data. *Italian J. Food Safety* 5 (4), 6187. <https://doi.org/10.4081/ijfs.2016.6187>.

Mossenson, S., Giglia, R., Pulker, C.E., Chester, M., Pollard, C.M., 2023. Dietary risk of donated food at an Australian food bank: an audit protocol. *BMC Nutrition* 9 (1), 67. <https://doi.org/10.1186/s40795-023-00719-8>.

Mossenson, S., Pulker, C.E., Giglia, R., Pollard, C.M., 2023. Policy approaches to nutrition-focused food banking in industrialized countries: a scoping review. *Nutr. Rev.* <https://doi.org/10.1093/nutrit/nuad004>.

Mourad, M., 2016. Recycling, recovering and preventing “food waste”: competing solutions for food systems sustainability in the United States and France. *J. Clean. Prod.* 126, 461–477. <https://doi.org/10.1016/j.jclepro.2016.03.084>.

Neter, J.E., Dijkstra, S.C., Visser, M., Brouwer, I.A., 2016. Dutch food bank parcels do not meet nutritional guidelines for a healthy diet. *BJN* 116 (3), 526–533. <https://doi.org/10.1017/S0007114516002087>.

Oldroyd, L., Eskandari, F., Pratt, C., Lake, A.A., 2022. The nutritional quality of food parcels provided by food banks and the effectiveness of food banks at reducing food insecurity in developed countries: a mixed-method systematic review. *J. Hum. Nutr. Diet.* 35 (6), 1202–1229. <https://doi.org/10.1111/jhn.12994>.

Pataprygopoulou, E., Fearnough, K., Spring, C., Antal, L., 2022. The future of surplus food redistribution in the UK: Reimagining a ‘win-win’ scenario. *Food Policy* 108, 102230. <https://doi.org/10.1016/j.foodpol.2022.102230>.

Philip, D., Hod-Ovadia, S., Troen, A.M., 2017. A Technical and Policy Case Study of Large-Scale Rescue and Redistribution of Perishable Foods by the “Leket Israel” Food Bank. *Food Nutr. Bull.* 38 (2), 226–239. <https://doi.org/10.1177/0379572117692440>.

Plekenpol, R., Beckmann, J. S., Cohen, M., Findley, T., Broad Leib, E. M., Akwii, E., & De Faria, M. (2023). *The Global Food Donation Policy Atlas Issue Brief: Food Safety for Donation Law and Policy*. [https://www.foodbanking.org/wp-content/uploads/2023/06/The-Global-Food-Donation-Policy-Atlas\\_Food-Safety-For-Donation\\_English\\_2023.pdf](https://www.foodbanking.org/wp-content/uploads/2023/06/The-Global-Food-Donation-Policy-Atlas_Food-Safety-For-Donation_English_2023.pdf).

Pollard, C., Mackintosh, B., Campbell, C., Kerr, D., Begley, A., Jancey, J., Caraher, M., Berg, J., Booth, S., 2018. Charitable Food Systems' Capacity to Address Food Insecurity: An Australian Capital City Audit. *Int. J. Environ. Res. Public Health* 15 (6), 1249. <https://doi.org/10.3390/jerph15061249>.

Pollard, C., Booth, S., Jancey, J., Mackintosh, B., Pulker, C., Wright, J., Begley, A., Imitiaz, S., Silic, C., Mukhtar, S., Caraher, M., Berg, J., Kerr, D., 2019. Long-Term Food Insecurity, Hunger and Risky Food Acquisition Practices: A Cross-Sectional Study of Food Charity Recipients in an Australian Capital City. *Int. J. Environ. Res. Public Health* 16 (15), 2749. <https://doi.org/10.3390/jerph16152749>.

Pulker, C., Trapp, G., Scott, J., & Pollard, C. (2017). What are the position and power of supermarkets in the Australian food system, and the implications for public health? A systematic scoping review. *Obesity Reviews*. <https://doi.org/10.1111/obr.12635>.

Pulker, C.E., Trapp, G.S.A., Scott, J.A., Pollard, C.M., 2018. Global supermarkets' corporate social responsibility commitments to public health: a content analysis. *Glob. Health* 14 (1), 121. <https://doi.org/10.1186/s12992-018-0440-z>.

Pulker, C.E., Trapp, G.S.A., Scott, J.A., Pollard, C.M., 2019. The Nature and Quality of Australian Supermarkets' Policies that can Impact Public Health Nutrition, and Evidence of their Practical Application: A Cross-Sectional Study. *Nutrients* 11 (4). <https://doi.org/10.3390/nu11040853>.

Quinlan, J.J., 2013. Foodborne illness incidence rates and food safety risks for populations of low socioeconomic status and minority race/ethnicity: a review of the literature. *Int. J. Environ. Res. Public Health* 10 (8), 3634–3652. <https://doi.org/10.3390/jerph10083634>.

Food Regulation. (2016). *Granting Permission to Alter Date Marks: Guidance for Regulators*. <https://foodregulation.gov.au/internet/fr/publishing.nsf/Content/publication-Altering-Date-Marks-on-Foods-Guidance-Material>.

Riches, G., 2018. Food Bank Nations: Poverty, Corporate Charity and the Right to Food. *Routledge*. <https://doi.org/10.4324/9781315184012>.

Salamon, L.M., 1987. Of Market Failure, Voluntary Failure, and Third-Party Government: Toward a Theory of Government-Nonprofit Relations in the Modern Welfare State. *Nonprofit Volunt. Sect. Q.* 16 (1-2), 29–49. <https://doi.org/10.1177/089976408701600104>.

Sengul Orgut, I., Brock Ili, L. G., Davis, L. B., Ivy, J. S., Jiang, S., Morgan, S. D., Uzsoy, R., Hale, C., & Middleton, E. (2015). Achieving Equity, Effectiveness, and Efficiency in Food Bank Operations: Strategies for Feeding America with Implications for Global Hunger Relief. In In: Zobel, C., Altay, N., Haselkorn, M. (Eds) *Advances in Managing Humanitarian Operations. International Series in Operations Research & Management Science* (pp. 229–256). Springer International Publishing. [https://doi.org/10.1007/978-3-319-24418-1\\_11](https://doi.org/10.1007/978-3-319-24418-1_11).

Shimada, T., Ross, M., Campbell, E.C., Webb, K.L., 2013. A Model to Drive Research-Based Policy Change: Improving the Nutritional Quality of Emergency Food. *Journal of Hunger & Environmental Nutrition* 8 (3), 281–293. <https://doi.org/10.1080/19320248.2013.821963>.

Simmet, A., Depa, J., Tinnemann, P., Stroebele-Benschop, N., 2017. The Nutritional Quality of Food Provided from Food Pantries: A Systematic Review of Existing Literature. *J. Acad. Nutr. Diet.* 117 (4), 577–588. <https://doi.org/10.1016/j.jand.2016.08.015>.

Snyder, A.B., Perry, J.J., Yousef, A.E., 2016. Developing and optimizing bacteriophage treatment to control enterohemorrhagic *Escherichia coli* on fresh produce. *Int. J. Food Microbiol.* 236, 90–97. <https://doi.org/10.1016/j.ijfoodmicro.2016.07.023>.

Snyder, A., Shumaker, K., Nelsen, N., 2018. Ensuring food safety as demand for improved food system efficiency increases. *J. Ext.* 56 (7) <https://doi.org/10.34068/joe.56.07.22>.

Tarasuk, V., Eakin, J.M., 2003. Charitable food assistance as symbolic gesture: an ethnographic study of food banks in Ontario. *Soc Sci Med* 56 (7), 1505–1515. [https://doi.org/10.1016/s0277-9536\(02\)00152-1](https://doi.org/10.1016/s0277-9536(02)00152-1).

Tarasuk, V., Eakin, J.M., 2005. Food assistance through “surplus” food: Insights from an ethnographic study of food bank work. *Agric. Hum. Values* 22 (2), 177–186. <https://doi.org/10.1007/s10460-004-8277-x>.

Temple, J.B., 2008. Severe and Moderate Forms of Food Insecurity in Australia: Are They Distinguishable? *The Australian Journal of Social Issues* 43 (4), 649–668. <https://doi.org/10.1002/j.1839-4655.2008.tb00124.x>.

United States Department of Agriculture. (2018). *The Idaho Foodbank Recalls Coconut Beverage, Broccoli Cheddar Soup, Eggs, and Cheese Product Because Of Possible Health Risk*. <https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts/idaho-foodbank-recalls-coconut-beverage-broccoli-cheddar-soup-eggs-and-cheese-product-because>.

van der Horst, H., Pascucci, S., Bol, W., 2014. The “dark side” of food banks? Exploring emotional responses of food bank receivers in the Netherlands. *Br. Food J.* 116 (9), 1506–1520. <https://doi.org/10.1108/BFJ-02-2014-0081>.

Verpy, H., Smith, C., Reicks, M., 2003. Attitudes and Behaviors of Food Donors and Perceived Needs and Wants of Food Shelf Clients. *J. Nutr. Educ. Behav.* 35 (1), 6–15. [https://doi.org/10.1016/S1499-4046\(06\)60321-7](https://doi.org/10.1016/S1499-4046(06)60321-7).

Voeller, J.G., 2014. *Food Safety and food security*. John Wiley & Sons.

Wakefield, S., Fleming, J., Klassen, C., Skinner, A., 2013. Sweet Charity, revisited: Organizational responses to food insecurity in Hamilton and Toronto. *Canada. Critical Social Policy* 33 (3), 427–450. <https://doi.org/10.1177/0261018312458487>.

White, K., Lin, L., Dahl, D.W., Ritchie, R.J.B., 2016. When Do Consumers Avoid Imperfections? Superficial Packaging Damage as a Contamination Cue. *J. Mark. Res.* 53 (1), 110–123. <https://doi.org/10.1509/jmr.12.0388>.

Yan, M.R., Hsieh, S., Ricacho, N., 2022. Innovative Food Packaging, Food Quality and Safety, and Consumer Perspectives. *Processes* 10 (4), 747. <https://www.mdpi.com/2227-9717/10/4/747>.