



The Application of Menu Planning Principles in Food Waste Prevention by Food Handlers in Supermarket Kitchens in Soweto, South Africa

Abstract

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This study determined how food handlers apply menu planning principles in food waste prevention in supermarket kitchens. The objective was to assess whether menu planning principles that positively impact minimising food waste are applied by food handlers in supermarket kitchens in Soweto, South Africa, and to understand the underlying causes of food waste. The quantitative, structured observation was conducted using a checklist to observe food handlers' practices throughout meal production. The study found that food handlers lacked proper menu planning and execution principles for food waste prevention, including not following standardised recipes, poor food preparation skills, lack of food texture variety, improper meal distribution, and poor food storage practices. The findings revealed that food handlers overlook menus' importance as communication tools in planning, operation, and waste minimisation. This highlights a gap in poor practices that needs to be addressed as a step-in meeting target 12.3 of the Sustainable Development Goals, which aims to halve global food waste and loss per capita by 2030 and recommends developing food waste guidelines specific for food handlers in supermarket kitchen. This paper contributes to the existing theoretical literature. The significant practical implication of this study is to enforce sustainability practices in supermarket kitchens.

Keywords Food waste practices, menu planning, supermarket kitchen, food handlers

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Introduction

Food loss and waste represent economic losses, inefficient use of resources, climate change, and other negative social impacts (Food and Agriculture Organisation [FAO], 2024). Globally, 931 million tons of food waste were generated, with 61% from households, 26% from food services, and 13% from retailers. However, due to insufficient data, these statistics exclude the food retail sector in African countries under upper-middle-income, lower-middle-income, and low-income categories (United Nations Environment Programme [UNEP], 2021). Supermarkets in Africa have experienced rapid growth due to factors such as increased income, urbanisation, and macro policy changes that attract foreign direct investment, enabling convenient consumer goods sales (Stanton & Nandonde, 2022). Despite generating less waste, the retail stage is a crucial gatekeeper in the food supply chain, influencing upstream and downstream food handling (Schneider & Eriksson, 2020). Retailers can influence consumers, pressure suppliers, and redistribute excess food (Huang et al., 2021). However, limited studies on food waste reduction practices have been conducted in supermarkets, particularly in South Africa (Jere et al., 2021). Most studies focus on consumer effects on food waste in supermarkets and households (du Toit, 2018; Machate, 2021; Oelofse et al., 2018). The seventeen global Sustainable Development Goals (SDGs), including target 12.3, aim to halve global food waste and loss per capita at the retail and consumer level by 2030 (UNEP, 2021). However, progress towards this target remains uncertain. Addressing food losses and waste is crucial to achieving the SDGs worldwide (De Steur et al., 2016). Better data is needed to track progress towards SDG 12.3 on food loss and waste (UNEP, 2021). This paper aims to assess whether menu planning principles that positively impact minimising food waste are applied by food handlers in supermarket kitchens and to understand the underlying causes of food waste. Data on food waste prevention practices was collected from supermarkets.

Literature review

Approximately 30% to 40% of the food produced for human consumption worldwide is lost or wasted along the food supply chain (FAO, 2023), including supermarkets and their kitchens. Meanwhile, the world's population is estimated to reach 9.1 billion by 2050, which will require a 70% increase in food availability (Rezaei, 2017; Worldwide Fund [WWF], 2017). Lost and wasted food represents a missed opportunity to feed the growing world population (FAO, 2013; UNEP, 2021). Food waste is defined as food fit for human consumption that is discarded, whether kept past its expiration date or left to spoil due to behavioural issues. Food loss, on the other hand, refers to a reduction in the mass (dry matter) or nutritional value (quality) of food that was intended for human consumption (Consumer Goods Council of South Africa [CGCSA], 2020). Most food waste in supermarkets is from vegetables, fruits, meat, bread, milk, and dairy products. About 80% of food waste comes from perishable foods, including freshly prepared deli food, seafood, and bakery food (Bilska et al., 2020). Food waste in food service units, including supermarket kitchens, occurs due to factors related to the menu, such as lack of careful menu planning, improper procurement, and preparation (Derqui & Fernandez, 2017; Elnasr et al., 2021; Foodwise et al., 2013; Marais et al., 2017; Okumus, 2019). Also, improper refrigeration and storage facilities at optimal temperatures to maintain a product's shelf life contribute to food waste (Eriksson et al., 2016). Food items in storage represent a significant investment in an organisation's assets (Drummond et al., 2022). However, if the monetary value of food in storage is only clear to the management, employees may not grasp the concept of inventory value. Food handlers working in food service outlets are highlighted as the main contributors to food waste (Okumus et al., 2020). Food waste is also related to failure to meet customer demands (Krasteva et



al., 2019). Factors contributing to food waste are short shelf life, quality requirements in colour, shape, size, and demand variability (FAO, 2019).

Using menu planning as a tool to reduce food waste

Menus are essential for assessing food waste in food service units, requiring regular evaluations and constant analysis for flexibility and competitive advantage (Yigitoglu, 2020). According to Ngugi et al. (2020), the menu-planning process involves understanding what customers want and need regarding features and attributes. A well-planned menu in food service units can reduce kitchen waste (Heikkila et al., 2016) by considering balance, nutritional quality, aesthetics, variety, customer satisfaction, and management decisions (Egan, 2015). Standardised recipes are essential for minimising food waste in food service kitchens and are integral to menu planning (Lefadola et al., 2023). Payne-Palacio & Theis (2016) define a standardised recipe as a set of ingredients and procedures tailored to a specific food item, considering customer expectations and efficient resource use. Standardised recipes also help reduce production errors (Goonan et al., 2014). Studies confirm that food waste is related to menu adequacy and meal acceptance and suggest implementation strategies to reduce waste, such as using food satisfaction questionnaires in menu planning for better food preferences (Aires et al., 2021; Dinangela et al., 2020). Research shows that meal preparation and cooking are the most problematic kitchen processes, leading to significant food waste in food service kitchens, including supermarkets. The main reasons are the lack of cooking skills, discarded ingredients, and errors in trimming, boiling, and frying. Overproduction and unstable demand also contribute to food waste, which is linked to poor food preparation and menu execution (Filimonau et al., 2023; Watanabe et al., 2021).

Proper food distribution practices prevent food waste

Improper temperature control in delicatessen cabinet displays leads to food deterioration, affecting quality, drying rate, and display in food service units (Hadaway et al., 2019). Garden-Robinson (2022) emphasises the importance of maintaining optimal temperatures for hot and cold foods. Proper tools like spatulas, tongs, and gloves are essential for handling ready-to-eat meals. Inappropriate handling can also contaminate food and waste (Catering Wholesalers, 2019). Food variety, presentation, and display appearance also influence customer satisfaction (Anu & Manorselvi, 2021).

Efficient management practices during storage and inventory as part of the menu planning process

Ineffective stock control management is a significant cause of food waste in supermarkets. Among the other causes are poor food packaging, refrigeration, and temperature challenges (Watanabe et al., 2021). Food waste occurs when food supply chain criteria for proper temperature and handling of food items are not followed (Mercier et al., 2017). Food should be kept as fresh as possible because incorrect storage diminishes shelf life and exposes it to early and rapid deterioration.

Effective food handling practices as part of menu planning to prevent waste

Food waste in food service establishments is a major issue due to food safety concerns (Okumus, 2019). Improper preparation, handling, and storage can lead to cross-contamination and spoilage (Baluka et al., 2015). A strong food safety culture is essential to align best practices with daily operations (Johnson, 2019). Training programs for food handlers can increase safe food handling practices. Personal hygiene is crucial for health preservation, as body parts like skin, hands, hair, eyes, mouth, and nose contribute to food contamination (Ncube et al., 2020). Proper handwashing, general cleanliness, and strict eating, drinking, and smoking policies can help combat food waste (Fernandes, 2018).

Efficient management practices as part of menu planning to prevent food waste

Menu planning in the food service unit influences many aspects, including waste management resources. Inefficient food waste prevention practices in food services are primarily due to factors such as low food waste quantification (Gao et al., 2021; Association of Whistler Area Residents for the Environment [AWARE], 2016), limited waste bin space in commercial kitchens, lack of waste separation (Baul et al., 2021; Jamal et al., 2018), waste management systems primarily for financial reasons (Smith et al., 2020), and low food handlers' engagement and awareness about food waste (Baul et al., 2021; Edjabou et al., 2015; Jamal et al., 2019; Kasavan et al., 2019; Lewis et al., 2017). Research shows that some food service establishments are implementing green practices systems like digital food order prediction, excess food planning, recycling bin labelling, composting, and labelling stored food with serve before and donate before to improve food handling and waste management while enhancing employee engagement (Australian Institute of Food Safety, 2019; AWARE, 2016; Lewis et al., 2017; Loeurng, 2021;; Silvennoinen et al., 2019).

Research method

The study population consisted of 11 supermarkets located in Soweto, South Africa, with approximately 20 to 35 food handlers employed per supermarket (\pm 220 total). Soweto is a township that falls under the City of Johannesburg Metropolitan Municipality, has the highest population of 23% of the city's total population, accounting for approximately 1,219,886 people (Grocery retail market inquiry, 2019; City of Johannesburg, 2020). The township has the highest rate of waste collection and illegal dumping (City of Johannesburg, 2019). Therefore, the growth of formal supermarkets in Soweto, its large population in South Africa, and the high rate of waste collection and illegal dumping justifies the importance of selecting this demarcation. Ethical approval for the study was obtained from the Vaal University of Technology through the Research and Innovation Ethical Committee (Reference number: FREC/HS/14/08/2020/6.1.1). Three same-franchise supermarkets were granted



permission, and a total of 107 food handlers participated in the study. The population of the supermarkets were represented by one of the five largest supermarket franchise stores in South Africa. The employees selected to partake in this study from the three supermarkets were those who work with food, including service, food production, scullery staff, chefs, and cooks. Typically, such employees are engaged in food waste procedures within the context of the food service units. As per the nature of convenience sampling, where participants meet certain criteria such as easy accessibility, research geographical proximity, and willingness to participate (Jager et al., 2017), purposive sampling was used to select the supermarkets, and participants were conveniently sampled.

This study is a quantitative structured observational study that was conducted using a checklist to observe food handlers' practices (actual behaviour) to determine the specific actions throughout meal production, which is one of the benefits of observational studies to analyse actual behaviours (Mansell, 2011). Using a quantitative observational method, food handlers' specific behaviours were analysed by counting occurrences to determine frequencies (Leedy & Ormrod, 2015). Structured observations were considered necessary to determine food handlers' waste prevention practices by observing behaviours, environment, and context in a real-world situation without manipulation (Majid, 2018) and observing their practices when they occurred (Gray, 2019). The key factors that contribute to preventing food waste in food service units, as suggested by Kinaz et al. (2015), were observed and reported in this article, which included menu planning, menu execution, practices during meal distribution, management practices during storage, food handling practices, and working conditions. The study employed a combination of observation methods, including continuous monitoring, which uses time-point monitoring to conduct observations at fixed points in time, and a spot check method, which includes recording people's behaviour or physical clues at the initial point of observation (Ruel & Arimond, 2002; Bentley et al., 1994). The effect of reactivity was addressed by creating an environment where participants got used to the researcher's presence through early visits to each site where the study was to be conducted before the data collection. The visits entailed designing a research strategy that could apply to all the sites and observing the staff's working patterns during a shift to estimate reactivity, ensure accessibility to real-time data, and decrease the possibility of interruption of workplace functions. Therefore, direct observation was conducted, with participants aware of being watched (Wilson, 2018). The structured part of the observation was done by not informing the participants about what was being observed to resemble a natural and unchanged setting. Only the management was aware of the role of the researcher. The data was collected twice per supermarket, lasting up to two hours daily. Data were collected during different times of the month and day to measure consistency in food handlers' behaviour. Collective occurrences of food waste practices were observed per supermarket, not per individual participant (food handler). The main observation areas were food production areas, including the bakery, preparation and cooking section, deli/front service areas, and food storage. A checklist with a yes-or-no rating scale was used to determine whether certain behaviours or actions were demonstrated. The time spent on critical behaviours to determine their presence or absence was 30 minutes on average per area.

The Statistical Package for Social Science (SPSS) version 27 was used to analyse the data. Descriptive statistics such as frequencies, percentages, and figures were used to define the proportion of the presence or absence of crucial behaviours or factors that contribute towards preventing food waste in foodservice units. The presence or absence of the practices or the behaviour clues were indicated by selecting a Yes (1) or No (0). When insufficient practice was observed, it was noted on the observation checklist and indicated with 0.5. An average (%) was calculated for all the questions in each observed dimension.

Results

Participants career background

Participants' career backgrounds are indicated in Table 1.

Table 1: Participants' career background

<i>Participants career background</i>		Total groups	
		N=107	%
A1. Gender	Male	42	39.3
	Female	65	60.7
A2. Age	18-24	6	5.6
	25-34	35	32.7
	35-44	52	48.6
	45-54	12	11.2
	55-64	2	1.9
	Above 65	0	0
A3. Current Position at work	Deli assistants	26	24.3
	Supervisors	9	8.4
	Bakery/ confectionery	43	40.2
	Front line/ deli counter	10	9.3
	Managers	2	1.9
	General assistants	17	15.9
A4. Highest grade completed	Secondary	98	91.6
	Diploma	7	6.5
	Other certificates	2	1.9
A5. Number of years at work	3-6 months	8	7.5
	6-12 months	12	11.2
	1- 3 years	17	15.9
	More than 3 years	70	65.4

Most participants were women (60.7%), and most respondents (48.6%) were between 35 and 44 years old. These findings imply that more women were employed in supermarket kitchens in Soweto, with the majority being adults. The findings align

with the employment status report in South Africa (Statistics South Africa [STATS], 2020), which suggests that older adults have better chances of employment due to their experience. The study's portfolio is validated by Goh and Jie (2019) and Abdullah et al. (2018), that most female food service kitchen employees are over 30 years old. Haddaji et al. (2017) study found that the kitchen work environment is physically and emotionally challenging, and it is considered masculine, difficult for women, and highly stressful with extended hours. The study shows that 40.2% of respondents work in the bakery section, followed by deli assistants (24.3%) and general assistants (15.9%). Most had secondary school qualifications (91.6%) and had been employed for over three years (65.4%). This aligns with previous research showing low levels of education among food handlers, with most having only primary education (Ababio & Adi 2012; Okumus et al., 2020). The findings imply a cheaper labour force in supermarket kitchens, with entry-level education being the prerequisite.

Menu planning

Ten menu planning factors that contribute to preventing food waste were observed as presented in Figure 1. These factors were observed as present or absent in supermarket kitchens. There were no identified planned menus that were visible during the observation, nor were the displayed menus indicating the menu of the day, and there were no standardised recipes for any of the food items prepared from all the supermarket kitchens during the observations. This resulted in the absence of 95% of the ten factors and actions observed under menu planning. Only 5% of these factors were observed, indicating incorrect practices by food handlers. The availability of resources for a diverse menu was present in some supermarkets. With the absence of planned menus, it was therefore essential to observe menu planning factors in the prepared meals, considering food yield, seasonality, and regional climate. All supermarkets had pleasing food colour and taste combinations. The results indicated incorrect practices by the food handlers in terms of menu planning. Two of the three supermarkets observed served meals with pleasing texture combinations, while only supermarket A served food that required proper texture combinations. On average, the study found that 56.67% of food handlers' practices were correct, while 43.3% were lacking during kitchen food production.

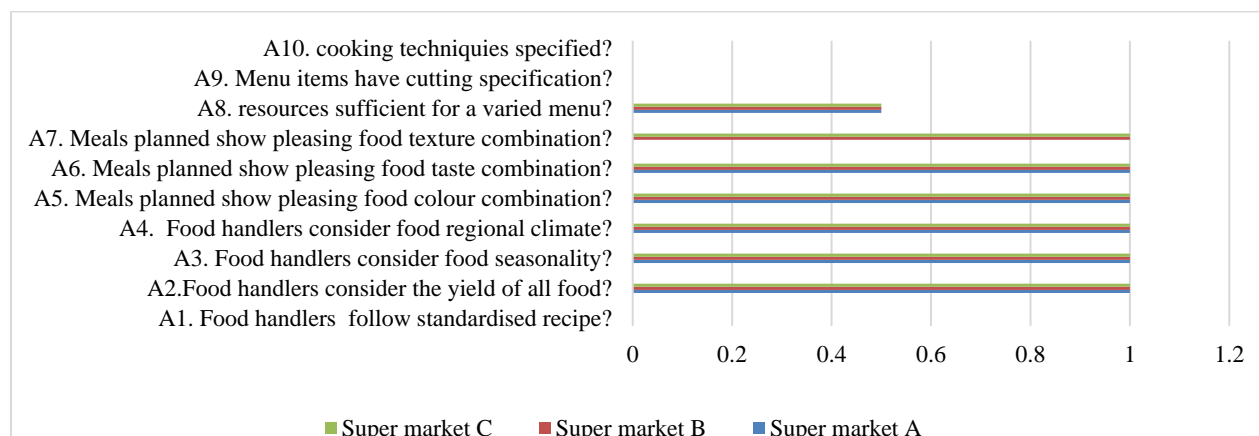


Figure 1. Menu planning factors and actions that contribute towards food waste

The results revealed that three supermarkets lacked proper menu planning principles, including standardised recipes, which led to food waste and negatively affected menu execution. The lack of food texture combinations also affects customer satisfaction and contributes to food waste. This was attested to by Derqui & Fernandez (2017) findings that menu planning is closely related to food waste. This was identified after customers complained about the quality of the food offered. One of the reasons was the need for more food variety offered and the failure to include customers' preferences. Since this study noticed the absence of standard recipes or menus planned, no cooking techniques were specified, and menu-cutting specifications were not specified, which indicates poor menu practices and leads to food waste.

Menu execution

Figure 2 shows menu execution factors and actions that contribute to food waste. It was observed that storage personnel followed kitchen staff's orders, and food was prepared in separate sections in all three supermarkets. Kitchen scales were used for ingredient weighing. Supermarket kitchens A and C incorrectly used colour-coded chopping boards, with Supermarket B being the only one to correctly use them. Supermarket A always peeled all vegetable skins when preparing food, while supermarkets B and C had good practices in vegetable preparation. No standardised recipes were identified for cutting fruits, vegetables, and meat, making it difficult to see the number of food portions prepared in all supermarkets. Three supermarket kitchens prepared various food types with varying textures, using good-quality, fresh ingredients, but no misshapen fruits or vegetables were used. Supermarket A used various preparation techniques, while the other two used limited methods. All food handlers maintained the required holding temperature between preparation and service. Food handlers demonstrated moderate menu execution practices, with 44.4% of factors and actions correct and 55.6% incorrect. None of the supermarket kitchens complied with specified cooking techniques and cutting specifications. Similar findings to those by Geppert et al. (2019) revealed that cooks reused cutting boards for food processing or as table mats without washing them in between. Despite that, improper chopping board usage can cause food contamination, spoilage, and waste, threatening customer health and safety



(Chik et al., 2023; Oladeji et al., 2023). Oliveira et al. (2016) revealed that standardised recipes reduce food waste by providing consistent and accurate information. Peeling all vegetable skins when preparing food implies a lack of food preparation skills among food handlers, which can be one of the causes of food waste. Okumus (2019) also confirmed that food preparation is one of the most critical stages of food waste. Therefore, it is vital to adhere to all food-safe handling procedures in menu execution to reduce food waste. The findings confirm that the absence of a standardised recipe contributes to food waste. The results confirmed that food attributes, including taste, ingredients, nutritive values, and different textures, influence customers' decisions to eat food, as food that lacks food qualities contributes to food waste in menu execution. Inconsistent with Kala's (2019) findings that revealed that freshness and temperature were good in food preparation, but menu variety could have been improved.

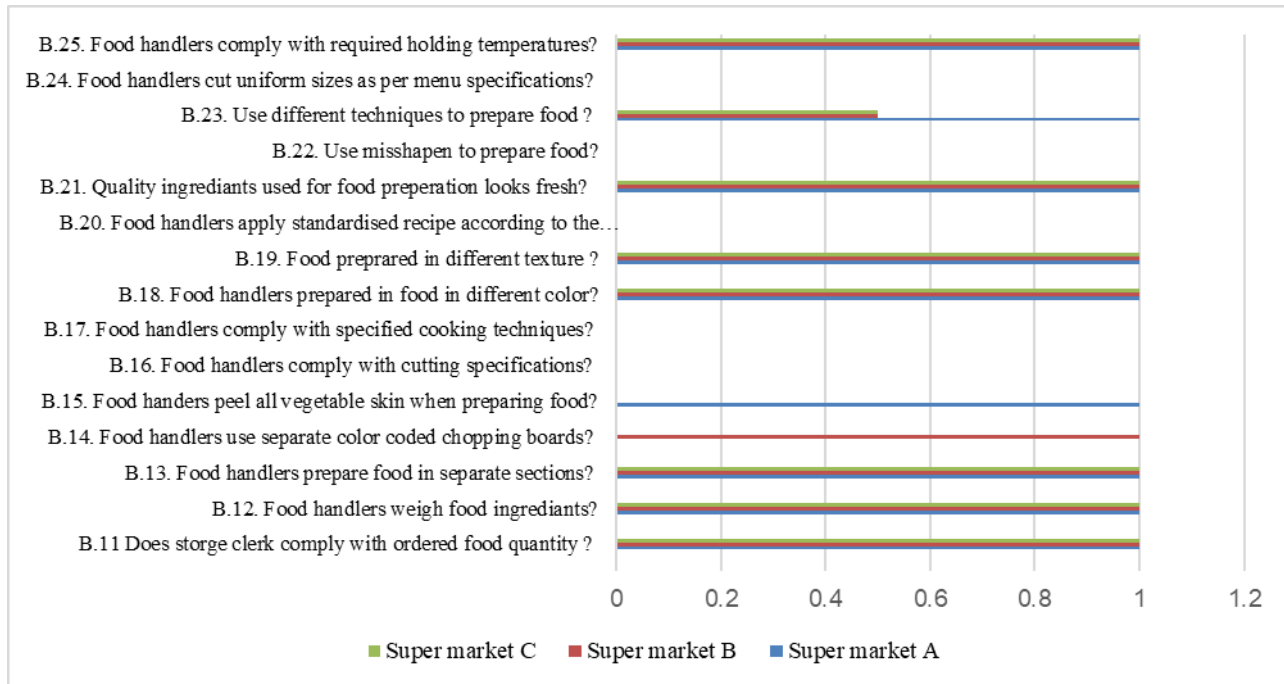


Figure 2. Menu execution factors and actions that contribute towards food waste

Practices during the distribution of meals

Figure 3 presents the practices of food handlers during food distribution that contribute towards preventing food waste. All three supermarkets maintained consistent temperatures and standardised food service utensils at steam and salad buffets. However, supermarkets B and C had piled-up food displays, while supermarket A was monitored and replenished with fresh food. Service was good, with customers served quickly. Only B and C used food garnishes for presentation, while Supermarket A did not. Supermarkets B and C's food displays were more attractive. Food handlers had good practices regarding food waste during meal distribution, with 83.4% of observed factors being correct and 16.6% being incorrect. The results implied that factors contributing to customer satisfaction were considered during meal distribution. It is vital to note that improper practices, such as not monitoring food display levels and excessive edible food garnishes, can lead to food waste. Smith et al.'s (2020) findings also confirm that serving food at the correct temperature, having good taste, serving fresh, healthy food, and maintaining a healthy appearance significantly impact quality food and customer satisfaction.

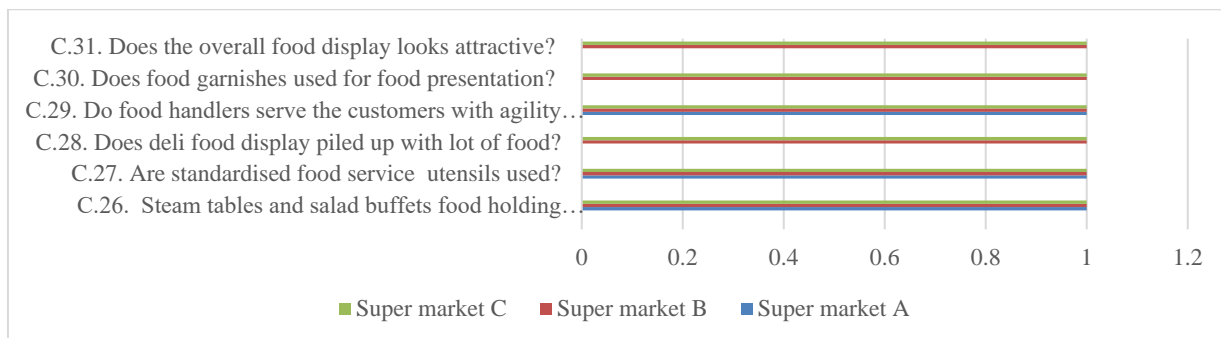


Figure 3. Factors and actions contributing to food waste during the distribution of meals

Practices during storage and inventory control

Figure 4 shows food storage practices in supermarket kitchens. It was observed that food handlers did not label or date food items in the refrigerator. However, potentially hazardous foods like uncooked meat and poultry were stored separately. Food items in the refrigerators and freezers were covered in Supermarkets B and C, but food packed on dry store shelves in Supermarket A had limited air circulation due to overcrowding. No cleaning schedule was identified for storage areas in any of the kitchens. Sucheran & Olanrewaju (2021) also discovered that the majority (91%) of food service units had correct storage control to avoid food spoilage, such as the use of FIFO, ensured deliveries were well-checked and free from contamination; however, some of the supermarket's shelves were overloaded with stock, preventing efficient air circulation. Thus, 41.7% of the factors and actions observed were correct, and the majority (53.3%) of practices lacked storage and inventory control regarding food waste.

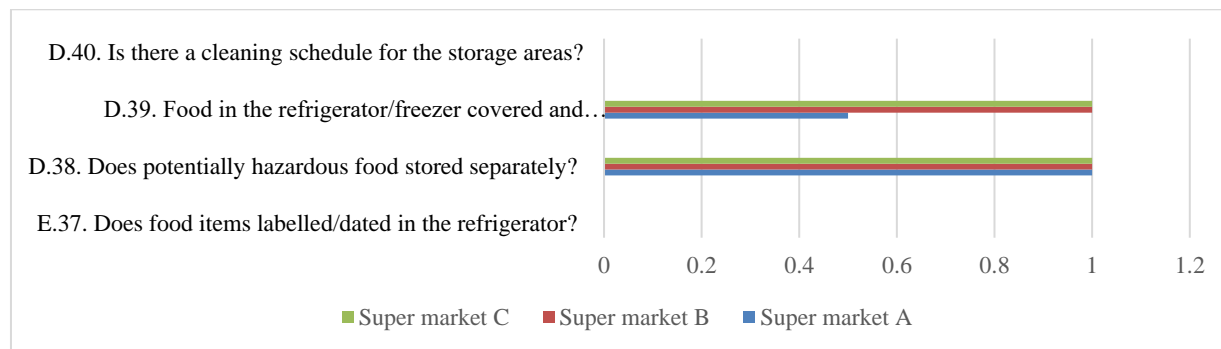


Figure 4. Factors contributing to food waste include storage practices and inventory control.

Food handling practices

The study found that respondents adhered to food handling rules, including personal hygiene during meal preparation processes, resulting in no influence on food waste, as shown in Figure 5, contrary to Geppert et al. (2019) findings that wiping dirty hands with tea towels during food preparation is the most common mistake, followed by not washing hands after coughing, sneezing, wiping the nose, sweating, or touching hair and eyes.

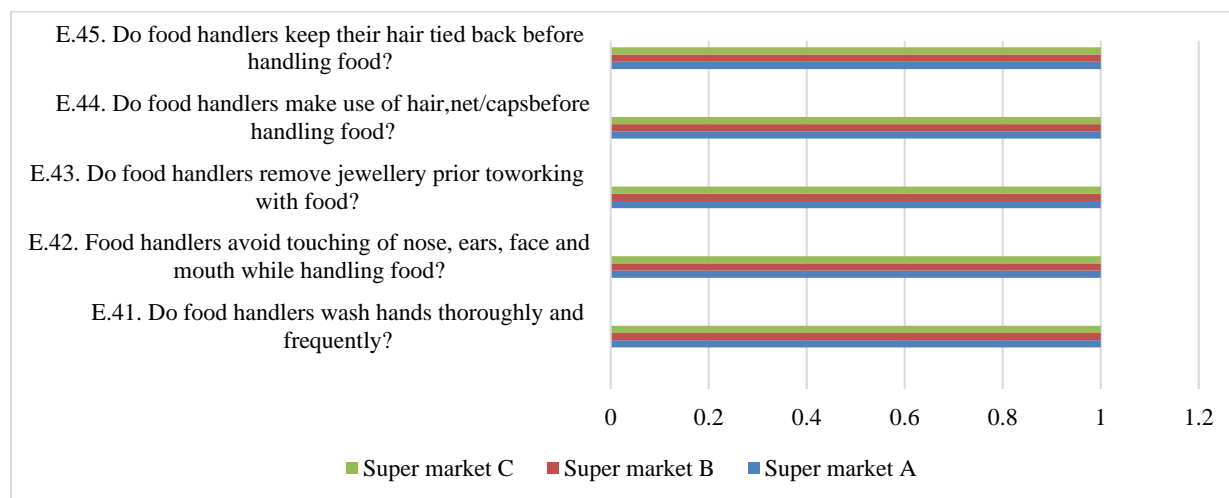


Figure 5. Food handling practices

Discussion of the results

The results indicated that most employees working in supermarket kitchens had secondary school qualifications. The lower level of education indicates a need for food handlers training and continued refreshing courses to remind staff of the practices they should adhere to to reduce wasted food along the supply chain. These demographics are similar to what is evident in other studies. Menu planning principles that positively minimise food waste were not applied by the supermarket kitchens. All the supermarkets observed in this study did not apply the major principle, which is to have properly planned menus available and displayed in any of the kitchens. Supermarket kitchen staff did not make use of standardised recipes. Therefore, the underlying cause of food waste that was observed in this study was the lack of standardised recipes. Recipes that are standardised include instructions on how to reliably cook food for a given goal in a recognised quantity and quality, which helps to simplify work. Regardless of following the recipe, a standardised recipe yields nearly the same quantity and taste every time it is produced. An effective standard recipe should contain the following: the name of the menu item, the batch and portion sizes, a quantified ingredient list, preparation instructions, cooking temperatures and times (including HACCP), special instructions, mise en place, serving instructions, and information on hot or cold storage and plating. Furthermore, nutritional analysis and recipe



costs may be included. This indicates a need to reiterate the importance of planned menus that make use of standardised recipes in any food service facility, as non-compliance to menu planning principles leads to food waste, as evident in the literature. Although planned menus were unavailable, the researcher observed that slightly more than 50% of the food handlers applied menu planning factors. All supermarkets had pleasing food colour and taste combinations, which was a positive result as the lack of food texture combinations can affect customer satisfaction negatively, which can ultimately contribute to food not being bought, leading to food waste. When the menu execution factors and actions were observed, storage personnel issued stock according to the kitchen staff's orders. Kitchen staff used scales for weighing ingredients, although standardised recipes were unavailable, indicating that the staff possibly worked from memory, resulting in different yields, which contributed to food waste.

Positive practices observed in all the supermarket kitchens indicated that food was prepared in separate sections, the staff used good-quality, fresh ingredients, and various food types and textures were included during meal preparation. All the food handlers maintained the required holding temperature between preparation and service. These practices are important to limit food contamination and reduce food waste. It was observed that uncooked meat and poultry were stored separately, indicating staff knowledge of this important practice. The observation results indicated that respondents adhered to some food handling principles, including personal hygiene during meal preparation. Two supermarket kitchens were found to have incorrect use of colour-coded chopping boards, and not all staff practised correct vegetable preparation methods. There were no standardised instructions for cutting fruits, vegetables, and meat, resulting in unidentifiable food portions. This lack of food preparation skills among staff contributes to food waste. Despite these issues, all three supermarkets maintained consistent temperatures and used standardised food service utensils at steam and salad buffets. Good practices during meal distribution were above 80%, indicating customer satisfaction. Proper practices like serving fresh, healthy food, monitoring food display levels, and serving food at the correct temperature can significantly impact customer satisfaction and reduce food waste. Incorrect food storage practices included not labelling or dating food items in the refrigerator, not adhering to stock rotation principles, and not having a visible cleaning schedule in storage areas. Over 50% of staff lacked storage and inventory control practices regarding food waste.

Conclusion

This paper determined how food handlers apply menu planning principles to food waste prevention in supermarket kitchens. The study results prove that supermarket kitchen management overlooks the significance of standardised recipes as part of the menu as communication tools for kitchen planning, operation, and waste minimisation. The study contributes to the theoretical literature and aids future research in developing food handlers' guidelines on food waste suitable for supermarket kitchens. This study's significant practical implication is enforcing sustainability practices in supermarket kitchens. Food waste policy should emphasise that each food service should implement sustainable practices by adhering to menu planning principles. The study identified a gap in practices that needs to be addressed to meet target 12.3 of the Sustainable Development Goals, which aims to halve global food waste and loss per capita at retail by 2030. therefore, this study recommends developing food waste guidelines based on menu planning principles for supermarket kitchens. In conclusion, it was evident that there is a lack of application of menu planning principles that impact food waste prevention in supermarket kitchens. Lastly, the study's main limitation was the difficulty in accessing kitchens to observe food handlers during food production due to the busy nature of supermarkets. Future research could use video recordings that are for security reasons to obtain detailed data.

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