

 Guinnever Gabrielli de Souza Batista¹

 Tacilla Barbosa Eidam¹

 Nayara Cristina Milane²

 Amanda Gomes Banhos¹

¹ Faculdade Cesumar de Ponta Grossa , Curso de Nutrição. Ponta Grossa, PR, Brasil.

² Universidade Tecnológica Federal do Paraná , Departamento de Ensino de Ciência e Tecnologia. Ponta Grossa, PR, Brasil.

Correspondence
Nayara Cristina Milane
nayaramilane@alunos.utfpr.edu.br

Assistant Editor

 Lucileia Grahen Tavares Colares

Adjustment of the physical-functional layout of the delicatessen in a supermarket in Ponta Grossa, Paraná

Adequação do leiaute da estrutura físico-funcional da rotisseria de um supermercado de Ponta Grossa, Paraná

Abstract

Introduction: Food and nutrition units (FNUs) produce, offer, and sell meals outside the home, serving a varied public without a fixed clientele. Delicatessens are classified as commercial FNUs, and their adequacy contributes to operational efficiency and ensures continuous progress. **Objective:** To adjust the physical arrangement of a delicatessen in a supermarket in Ponta Grossa (PR), comparing it with the original structure. **Method:** This is an applied research with a qualitative approach. Data collection, routine monitoring, and the application of the resolution RDC No. 275/2002 checklist were carried out. **Results:** Inconsistencies in the physical structure of the delicatessen were identified, such as wall cracks, insufficient air circulation, an inadequate exhaust system, and the absence of physical barriers against vectors and pests. Additionally, the poor sizing of some areas compromised the operational flow. **Conclusion:** A new physical arrangement for the delicatessen was developed, including improvements in the physical-functional structure, aiming to minimize food contamination risks and promote the health and well-being of handlers and consumers.

Keywords: Food Contamination. Collective Feeding. Checklist. Food Safety.

Resumo

Introdução: As unidades de alimentação e nutrição (UAN) produzem, oferecem e comercializam refeições fora do domicílio, atendendo a um público variado e sem clientela fixa. As rotisserias se classificam como UANs comerciais e sua adequação contribui para eficiência operacional e garantia da marcha para frente. **Objetivo:** Adequar o arranjo físico da rotisseria de um supermercado localizado no município de Ponta Grossa (PR), comparando-o com a estrutura original. **Método:** Trata-se de uma pesquisa aplicada, de abordagem qualitativa. Foram realizadas coleta de dados, acompanhamento da rotina e aplicação da lista de verificação da Resolução RDC nº 275/2002. **Resultado:** Identificaram-se inconformidades na estrutura física da rotisseria, como fissuras nas paredes, circulação de ar insuficiente, sistema de exaustão inadequado e ausência de barreiras físicas contra vetores e pragas. Além disso, o mau dimensionamento de algumas áreas comprometeu o fluxo operacional. **Conclusão:** Foi elaborado um novo arranjo físico para a rotisseria,

contemplando melhorias na estrutura físico-funcional, visando minimizar riscos de contaminação alimentar e promover a saúde e o bem-estar dos manipuladores e consumidores.

Palavras-chave: Contaminação de alimentos. Alimentação coletiva. Lista de checagem. Inocuidade dos alimentos.

INTRODUCTION

A Food and Nutrition Unit (FNU) is a facility that plays a relevant role in the economy, as it is an establishment responsible for producing and marketing meals consumed outside the home, serving a wide range of customers with daily turnover. Commercial FNUs include restaurants, snack bars, pubs, and resorts, encompassing delicatessen with buffet-by-weight service.¹

Considering the changes in eating habits and the increased accessibility to meals outside the home, supermarkets have implemented food sections that offer a variety of snacks, meals, sauces, and desserts. This provides practicality to customers' daily lives, with the advantage of consuming ready-to-eat food on-site or finishing its preparation at home.²

However, to manage this service, a qualified professional is essential. In this context, the nutritionist plays a key role, as this professional is qualified to implement good practices in daily operations, support the physical-functional planning, and ensure food safety while reducing health risks for consumers.³ According to Sant'Ana,³ every establishment has a unique physical structure with specific features and particularities.

Thus, it is understood that several stages must be followed in properly planning the physical-functional structure of an FNU, requiring the strategic organization of each area to avoid wasted space and optimize workflow without crossovers. This, consequently, contributes to the hygienic and sanitary quality of the establishment.³

Ensuring food safety is directly related to maintaining hygienic-sanitary standards that prevent harm to consumers' health, through measures encompassing everything from structural planning to meal production.^{3,4} Production areas are the most vulnerable to cross-contamination, increasing the likelihood of food borne diseases (FBDs), which result from the consumption of water or food contaminated by microorganisms. These, however, can be prevented through good handling practices and an appropriate physical-functional structure.

For proper physical structure planning, the facility's layout must be developed. This layout project allows visualization of the physical structure, considering factors such as workflows, accessibility, and functionality.³ For this reason, defining the position of each piece of equipment and installation according to the number of employees and meals produced is part of an adequate layout.^{5,6} A well-designed structure benefits food handlers by enabling efficient and safe operations during processes in the FNU, ensuring safe meals for customers.⁷

Developing an appropriate layout requires a multidisciplinary team composed of a nutritionist, an architect, and an engineer, who share their expertise to maintain a suitable and standardized structure.⁸

Therefore, it is understood that layout design is not limited to a esthetics, but when properly adapted, it can bring several benefits, such as operational efficiency. This aims to improve organized workflows, favor forward movement, increase production capacity, enhance employee performance, and minimize errors.⁹

Considering the aforementioned, the objective of this research is to propose an adjustment to the delicatessen layout of a supermarket in Ponta Grossa, Paraná, and to compare it with the original structure, to minimize the risks of food contamination and to safeguard the health and well-being of both customers and employees.

MATERIALS AND METHODS

This research is characterized as applied in nature, seeking a solution to an existing problem. It follows a qualitative approach, since it involves identifying, analyzing, and interpreting the collected data.¹⁰ It is a case study, referring to empirical research that uses evidence obtained through observations.¹¹

The first step in conducting the research was to contact the company's director and the local nutritionist, requesting authorization to carry out the study. After obtaining permission from the supermarket managers, the researchers began data collection.

The researchers monitored operational workflows and processes related to storage, pre-preparation, preparation, packaging, and food distribution areas for the site evaluation.

To obtain information about the site, a checklist from Resolution RDC N°. 275, of October 21, 2002,¹² was applied, verifying physical structure, installations, equipment, ventilation, lighting, furniture, waste management, pest control, sewage, and the production and storage of food.

For better visualization of the areas, measurements of the site dimensions were taken using a 10-meter measuring tape, divided into centimeters, from the brand TaTools®. Based on these data, the researchers prepared the original floor plan of the delicatessen using the Magicplan® software.

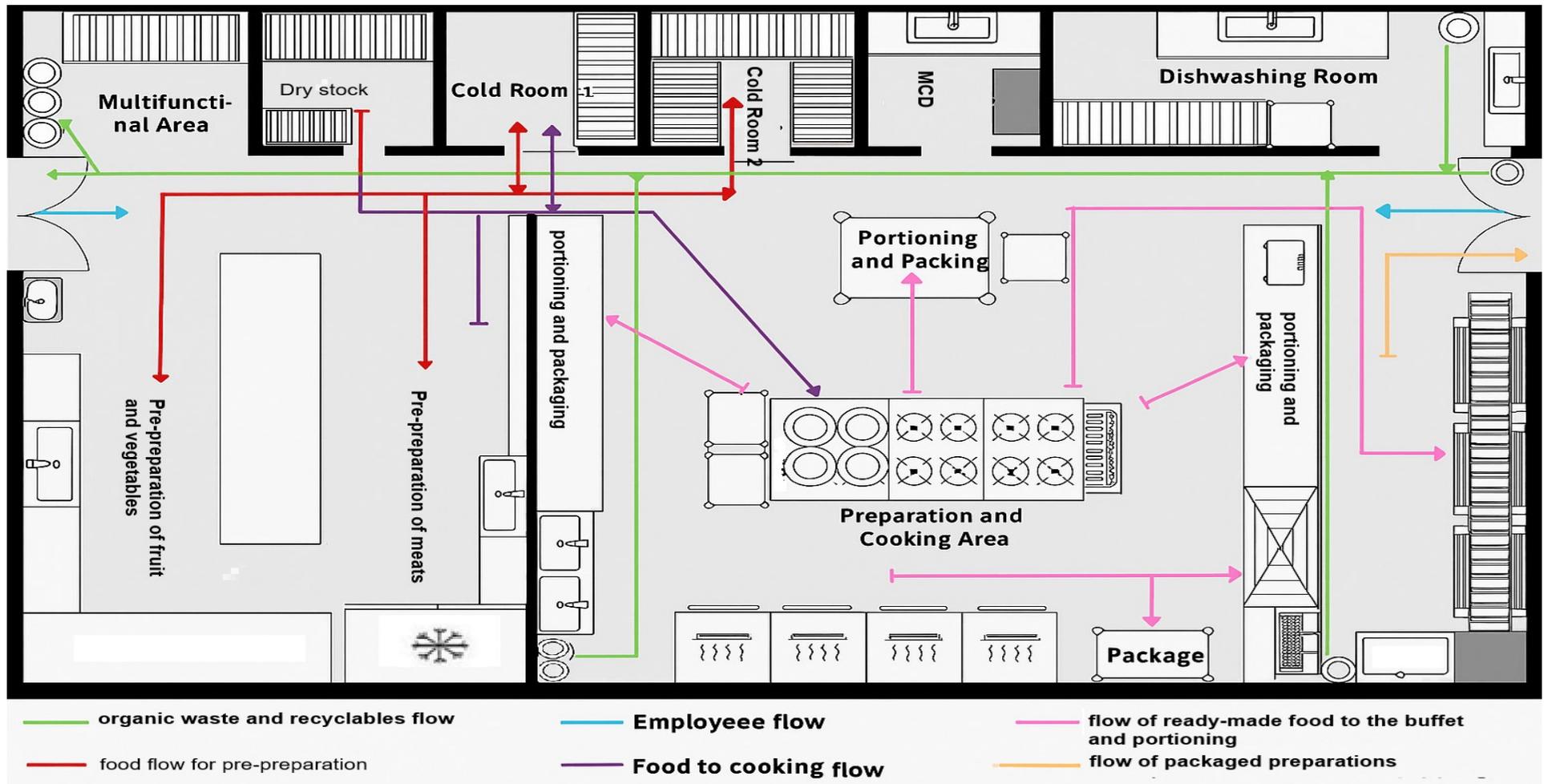
Following the observation and analysis of the delicatessen layout with the checklist application, a proposal for a new layout was presented. To design and create this layout, the Figma® software system was used.

RESULTS AND DISCUSSION

The FNU observed in this study is located on the ground floor of a supermarket, has an area of 141.6 m², a rectangular shape, and two access routes for employees.

The delicatessen layout (Figure 1) includes eight areas: pre-preparation (divided into fruit and vegetable pre-preparation and meat pre-preparation), preparation and cooking, dry storage, cold chambers, cleaning material storage (CMS), multifunctional area, utensil washing area, and utensil dispensing area. In addition, the floor plan includes the identification of workflows, accompanied by their respective legends..

Figure 1. Supermarket rotisserie layout.



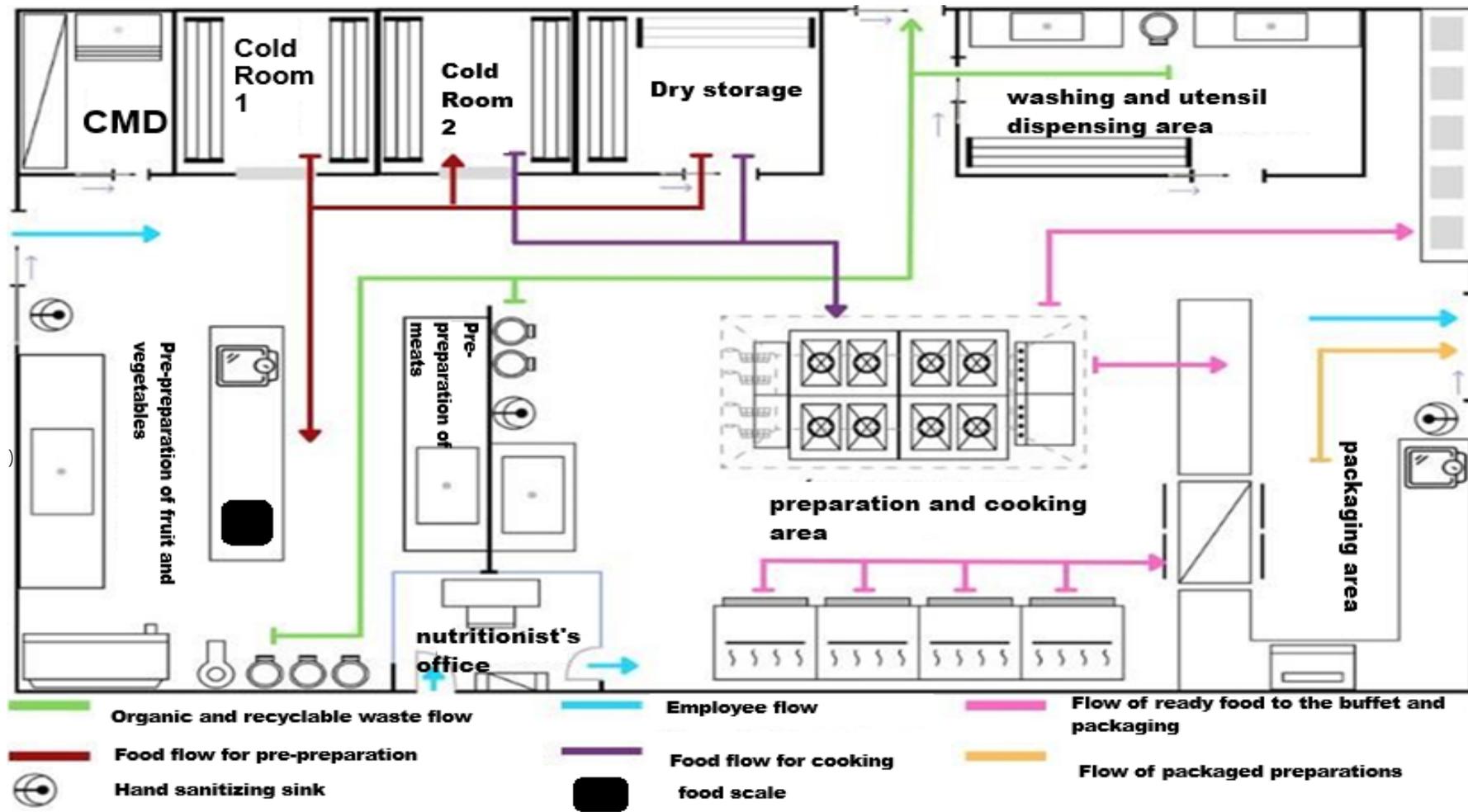
Source: The authors (2024)

Access to the delicatessen is restricted solely to food handlers, with no entry permitted for visitors or customers. The pre-preparation area is separated from the preparation area; however, due to the lack of equipment in the pre-preparation area, employees cross the cooking area to weigh raw foods on the same scale used for the final product (ready-to-eat foods that are packaged and displayed in the sales area). These occurrences increase the incidence of cross-contamination, which elevates consumers' vulnerability to food borne diseases (FBDs)¹³

After cooking, the products intended for consumption are placed in the buffet or packaged. However, the portioning and packaging flow is carried out inadequately, as it occurs in whichever locations are available, using carts or auxiliary countertops, without a designated area for this purpose. Santos¹⁴ states that finished foods should be handled in locations separate from other types of preparation, and the separation of areas should be sized according to each activity to avoid contamination and enhance the efficiency and organization of the sector.

The delicatessen has a multifunctional area, so named due to its lack of a specific function, which is currently disorganized and unplanned. This space serves as storage for miscellaneous utensils and a transport cart, and it houses the organic and recyclable waste bins from the pre-preparation area. These bins are not strategically positioned, being distant from the handlers for waste disposal, which compromises workflow. Waste disposal occurs through the same entrance used for merchandise, resulting in significant crossover between flows. Data collected by Maia et al.¹⁵ also indicated issues such as inadequate sizing of waste flows. The waste flow came into contact with several areas, including storage, production, and food distribution. In this regard, the author proposed implementing a segmented waste disposal system, removing the waste from these areas, and transporting it outside the FNU. Using this study as a reference, it was recommended that the same system be adopted for the delicatessen analyzed in the present research (Figure 2).

Figure 2. Proposal to adapt the layout of the supermarket rotisserie.



Source: The authors (2024)

Another issue compromising the continuous workflow of the handlers was observed: the only handwashing sink in the kitchen is located in the pre-preparation area, while other areas lack sinks, which are essential to maintain hygiene during food handling. According to RDC No. 216, of September 15, 2004,¹⁶ careful hand hygiene is mandatory before handling food. Therefore, sinks must be equipped with automatic faucets, disposable paper towels, liquid soap, and antiseptic for employees. Hand hygiene is a simple yet fundamental procedure to prevent the proliferation of microorganisms during food handling.¹⁷

Regarding the building and facilities of the delicatessen, several nonconformities were observed, such as the poor condition of the ceiling, floor, and walls, which showed cracks and corrosion due to oxidation. Under proper conditions, according to RDC N°. 216/2004,¹⁶ these items should be easy to clean, waterproof, smooth-finished, light-colored, and free of cracks and rust. For the walls, angles between the ceiling and floor are required. Maintaining these conditions increases employee safety and positively reflects on the quality of the food prepared.¹⁶

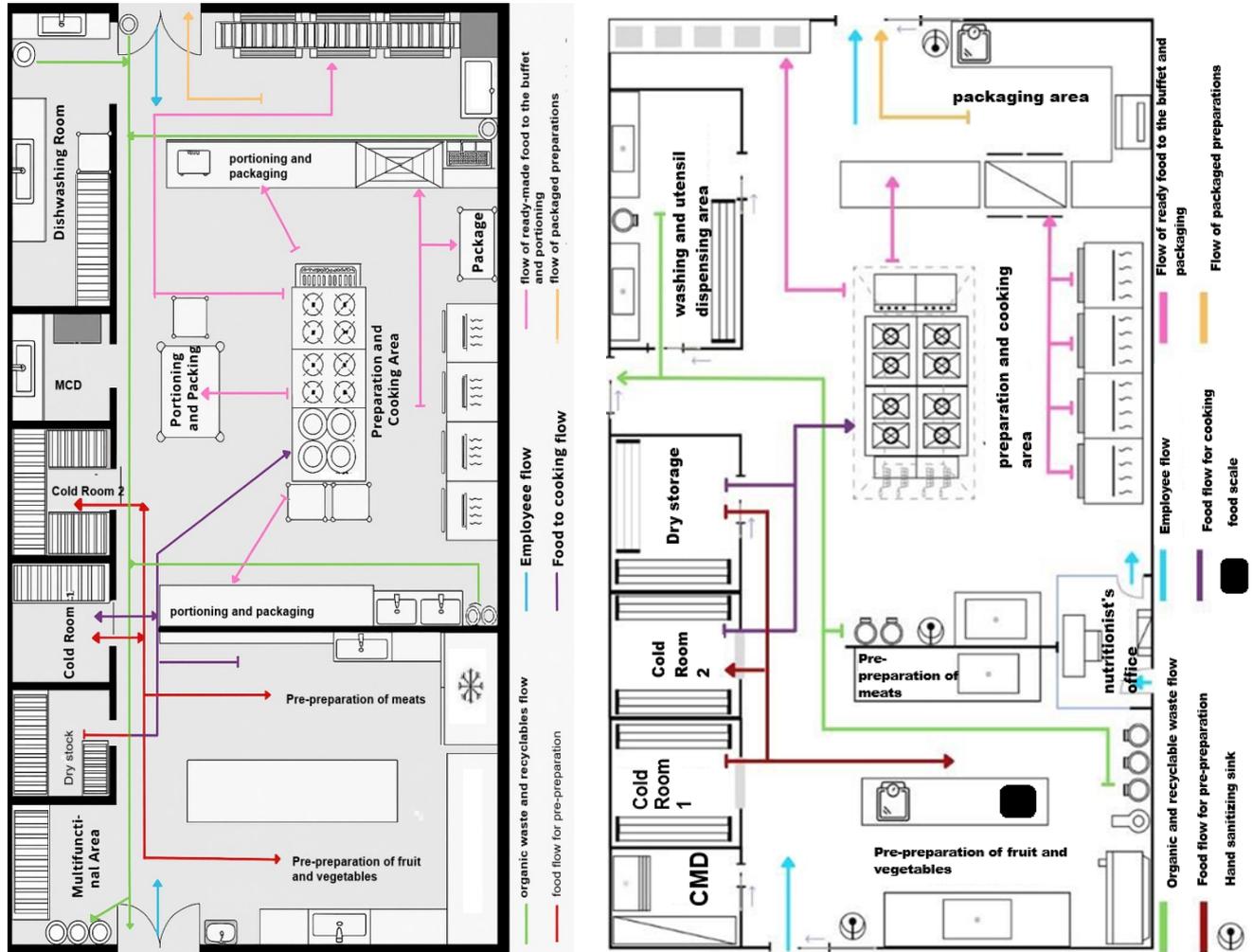
Concerning air circulation, inadequacies were noted due to the lack of windows and an insufficient exhaust system, resulting in a stuffy environment. Similar findings in an FNU were reported by Braga et al. ¹⁸ who also identified high temperature issues due to insufficient air renewal and very high windows, which hindered kitchen ventilation. Both the lack of ventilation and exposure to heat have a direct impact on worker health and productivity, impairing concentration and intellectual performance.²

It was detected that, although the doors are correctly fitted to the frames, they are manually closed rather than automatically, in disagreement with RDC N° 216/2004.¹⁶ In addition, the absence of doors in the dishwashing area and in the CMS, located in front of the production area, may pose risks of chemical contamination of food due to exposure to cleaning products.

During the site visit for observations, live insects were identified in the dry storage area, which lacks a door to prevent the entry of vectors and pests. Given these circumstances, a study conducted by Alves & Oliveira¹⁹ in nine food service units that implemented monthly control of protective measures concluded that such measures reduce the proliferation of vectors and pests. The study highlighted that the use of physical barriers, such as drain covers, doors, curtains, and plastic screens, can reduce the need for chemical disinsectization.

Based on the analysis of incorrect workflows, a new proposal for the delicatessen layout of the supermarket (Figure 2) was developed, adapting the physical-functional structure of the environment, improving flows, and redistributing and adding new areas. The floor plan includes explanatory legends for a more precise and detailed understanding. For better visualization and comparison between the current layout and the one proposed in this study, Figure 3 shows the changes made simultaneously.

Figure 3. Current layout and proposed design side-by-side for visual comparison.



Source: The authors (2024)

As a starting point, it was identified that automatic doors should be installed in all preparation and storage areas. In addition, a lack of planning was observed in the multifunctional area. Therefore, this area was replaced by the CMS, which was relocated away from the food preparation area to reduce the risk of chemical contamination.^{12,16}

Noting that handlers in the preparation area used the dry storage more frequently than the pre-preparation area, the storage was relocated closer, ensuring accessibility for both central regions. The cold chambers were also shared by both handling teams - the pre-preparation and preparation teams - resulting in high traffic in the corridor. According to Rosa et al.,⁸ resizing the layout can reduce the number of accidents by minimizing backtracking and random pathways in the kitchen, promoting a linear production flow. This also corroborates the findings of Maia et al.,¹⁵ who identified similar workflow problems, as the dry storage and cold chambers were far from the meat pre-preparation area, requiring handlers to cross the kitchen to access these locations. To address this, the dry storage and cold chambers were relocated to align with the food production flow.

To ensure a continuous workflow, Cold Chamber 1 was moved near the pre-preparation area, which will be exclusive for raw foods delivered by the stock handler and accessible only to pre-preparation handlers. Cold Chamber 2 will receive minimally processed foods from the pre-preparation area, which will remain stored until used by the preparation handlers. A study conducted by Braga et al.¹⁸ also required relocation of the cold chamber to improve flow in their layout proposal.

It was observed that, in the original floor plan, Cold Chamber 2 was positioned in front of the industrial stove in the cooking area, which is the primary source of heat in the kitchen. This location required frequent adjustments to the internal temperature regulation of the chamber and caused thermal discomfort for handlers whenever they accessed it. Consequently, Cold Chamber 2 was relocated outside the heat zone, which can prolong the equipment's lifespan, preventing damage and maintenance costs. Furthermore, this change will minimize thermal shock, contributing to the prevention of health issues and excessive fatigue among handlers.²⁰

Figure 1 shows the absence of waste bins near the fruit and vegetable area, which generates the majority of waste. In response, bins equipped with lids and pedals were installed near the vegetable peeler, in accordance with RDC No. 216/2004. In the packaging area, it was necessary to add a bin for recyclable materials below the counter. Waste disposal will occur at times separate from production, through a corridor created exclusively for this purpose, as presented in Figure 2, minimizing flow crossovers present in the original layout.²⁰

Hand washing sinks were installed in the cooking and ready-to-eat packaging areas, located near the employees' entry doors. Previously, it was observed that the delicatessen lacked sufficient sinks to serve the number of handlers, hindering hand hygiene during production. Nascimento & Quintão²¹ evaluated three community kitchens in the municipality of Leopoldina/MG, and none had sinks in the preparation areas. RDC 216/2004 emphasizes the need for an adequate number of sinks and their strategic placement relative to the preparation flow.¹⁶

In response to the growing demand for ready-to-eat packaged products, a packaging area was added to the new layout, which had previously been nonexistent in the kitchen. Consequently, the food packaging process used to co-occur with cooking activities, compromising workflow and exposing ready-to-eat foods to potential contamination. To prevent interruptions in the FNU workflow and unnecessary crossovers, proper physical planning is essential. This ensures operational efficiency, prevents future issues, and guarantees that the new packaging process does not interfere with cooking activities.²²

CFN Resolution N°. 600, of February 25, 2018,²³ highlights that the presence of a nutritionist is essential for supervising the activities of employees. Therefore, the need for the nutritionist's role in the delicatessen was observed to ensure compliance with hygiene and food safety standards. Accordingly, a new office was allocated for the nutritionist within the FNU, featuring independent entrances and exits and glass walls, allowing a full view of the pre-preparation, preparation, and packaging areas. Currently, the office is located on the first floor of the supermarket, making it extremely distant from the food production sectors situated on the ground floor.

CONCLUSION

In light of the above, the present research aimed to demonstrate the importance of an appropriate layout in an FNU, optimizing space to facilitate employee mobility and reorganizing operational workflows,

consequently promoting operational quality improvement. Accordingly, a proposal for a new design for the supermarket rotisserie was presented.

The field research allowed the observation of complex variations and dynamic interactions, contributing to the validation and refinement of existing knowledge. Specific needs were identified by engaging directly with the investigated environment, enhancing the empirical data's social relevance, and encouraging interdisciplinary collaboration. In this way, the study contributes to enriching the theoretical foundation of the topic, offering practical and sustainable solutions to challenges faced by the scientific community.

It is advisable to install additional exhaust units in the delicatessen, as this equipment helps maintain an adequate ambient temperature, minimizing the risks of overheating. Furthermore, these additional installations are crucial in removing excess heat, vapors, and grease particles, promoting a safer and more efficient work environment.

A limitation identified in the study concerns the sanitary facilities and changing rooms, which are shared by all supermarket employees rather than being exclusive to food handlers. However, the overall supermarket layout does not allow the construction of exclusive restrooms. Therefore, it is suggested that the bathrooms be relocated to an area where food handlers do not need to cross the space intended for supermarket customers to access the changing rooms and restrooms, avoiding the exposure of work attire to external contamination.

It is recommended that this project be implemented in the future with the collaboration of a multidisciplinary team, including professionals from architecture, civil engineering, and nutrition. These specialists would be responsible for adopting the corrective measures outlined in this research and adapting the physical-functional structure of the establishment to comply with current regulations.

The study contributed significantly to adapting the delicatessen layout, proposing improvements to the physical-functional structure to optimize space, increase operational efficiency, and reduce cross-contamination risks, thereby ensuring greater hygienic-sanitary safety. The research followed regulations such as RDC N° 275/2002 and RDC N° 216/2004, suggesting the reorganization of workflows, relocation of strategic areas, and implementation of additional handwashing sinks, automatic doors, and a more efficient exhaust system. In addition to enriching the theoretical foundation on physical-functional planning in FNUs, the study presents practical and sustainable solutions to common challenges in commercial FNUs.

However, some limitations were identified, such as the impossibility of implementing exclusive restrooms for food handlers due to structural constraints of the supermarket, the lack of practical execution of the proposed changes, and the need for collaboration among different professionals to enable project implementation. Furthermore, the study was based on a point-in-time analysis of the delicatessen routine, without longitudinal follow-up, and some suggestions may require substantial investments, which could limit their application. Despite these limitations, the research emphasizes the importance of adequate planning to ensure a safer and more efficient work environment, benefiting employees and consumers.

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Contributors

Batista GGS and Eidam TB contributed to developing the research proposal, data collection, manuscript writing, and floor plan design. Milane NC and Banhos AG contributed to the final version's correction, review, and approval.

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