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RESEARCH ARTICLE

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FEASIBILITY STUDY FOR THE IMPLEMENTATION OF CLEANER PRODUCTION CONCEPTS IN A PIZZERIA

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ABSTRACT

Environmental degradation threatens the lives of all living beings on the planet. Amidst so many environmental impacts, we can highlight those arising from waste in production processes. These problems directly affect natural resources, causing damage to the environment and the quality of life of people living in cities. Thus, through Cleaner Production (C+P) methodologies, organizations can obtain economic benefits, in addition to minimizing or eliminating waste, preventing pollution and reducing environmental impacts. In this sense, this research was applied exploratory and aimed to present a proposal for the implementation of a C+P program in a pizzeria located in the city of Pelotas in the state of Rio Grande do Sul, Brazil. Data were monitored in relation to raw materials, consumption of water, gas, energy and monitoring of good manufacturing practices in the kitchen, as well as a study of the assembly process of pizzas and snacks was carried out and meetings were held on the subject with employees. With this work, it was concluded that the C+P concepts added to a better understanding of the pizzeria's internal environment, opening doors for several internal improvements that included better purchase planning, better production control and cost reduction.

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INTRODUCTION

Several environmental impacts generated by the largest consumer, the human being, led different communities to reflect on the damage caused by the production and consumption of products generated in an unconscious and unsustainable manner (PORTO *et al.*, 2009).

The Brazilian Federal Constitution of 1988 establishes in its article 225 that:

Art. 225 – Everyone has the right to an ecologically balanced environment, a good for common use by the people and essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for present and future generations (BRAZIL, 1988, p. 115).

Environmental degradation threatens not only the well-being of human society, but also the quality of life of all living beings on the planet and among the many environmental impacts in urban areas we can highlight floods, urban waste, air pollution, water, soil by

substances that alter its quality, problems that directly affect natural resources causing damage to the environment. (FONSECA *et al.*, 2013; MENDES *et al.*, 2021). Thus, waste is a nationwide problem since, according to data from the Brazilian Association of Public Cleaning and Special Waste Companies, in 2018, 79 million tons of solid waste were generated in Brazil, of which 6.3 million tons of waste were not collected from the generation sites and nearly 30 million tons were not properly disposed of, representing 40.5% of the total (ABRELPE, 2020). According to Neto *et al.* (2015) during its production process, the pizzeria industry works with several different inputs, consequently several residues are produced, which depending on their management can cause significant impacts to the environment, and many of these residues can be recycled or transformed into fertilizer, which is why the separation of the various types of waste generated is necessary, so that their mixing and contamination can be avoided to ensure their reuse. According to the cleaner production methodology, it is preferable that these residues are not generated, which contributes even more to the reduction of waste, and with it the reduction of costs for the company.

Also for Neto *et al.* (2015) spending on inputs or those related to the consumption of water and energy represent high costs for this sector, so the reduction of waste during the production process can bring benefits to the company, both economically and reduction of bills, as in obtaining greater visibility of the company as an environmentally responsible agent. For Mendes *et al.* (2021), although some Brazilian companies have been demonstrating a certain socio-environmental awareness for some time now, it is still necessary to find a middle ground between scientific or technological progress and environmental protection, with due environmental responsibility, as it is not wanted giving up the comfort and development of society. According to Mello (2002), Cleaner Production (C+P), which was developed by the United Nations (UN), is a complete tool for the prevention and reduction of waste, and has been implemented in several countries, including developing countries, enabling economic benefits for companies by minimizing or eliminating waste, preventing pollution and reducing environmental impacts.

For Batalha (2008), organizations that apply C+P technology in their production processes improve their business image and establish better relationships with customers, neighbors and society in general, in addition to ensuring compliance with current or foreseeable legislation in the near future and achieving obtain economic benefits and consequently an increase in competitiveness. In this sense, the present work applied the concepts of C+P, where its main objective was to eliminate or minimize the generation of environmental liabilities in a food industry company in the city of Pelotas. In order to establish and better understand the functioning of the company, the flowchart was prepared by filling in spreadsheets. As this is a small company and the business owners know deeply and even occasionally participate in the pizza production process, they will be the environmental agents of this work in the pizza parlor, making it unnecessary to form an eco-team. Through the elaboration of this work, it was possible to identify some improvements to be inserted in its production process, so that the company could choose to implement it or not.

MATERIALS AND METHODS

This study was carried out in the second half of 2019 in a food business located in the frigate district, near Avenida Duque de Caxias, in the city of Pelotas/RS, serving the general population from Tuesday to Sunday including holidays from 7:00 pm to 23:00. At the end of the day, that is, from 11:00 pm to 12:00 am, the company performed the general cleaning. The technical construction of all phases counted on the collaboration of the owner partners and all the employees involved in the preparation of pizzas and snacks.

For the development of the research, the need for a predominantly qualitative approach was evidenced. The research was carried out

through a case study. In qualitative research, the researcher's concern is not with the numerical representation of the researched group, but, according to Goldenberg (1997) with the deepening of the understanding of a social group, an organization, an institution. At first, a brief meeting was held with those already mentioned, where they were asked about the raw materials, quantities and expenses, water, gas and energy consumption that served as the basis for starting and measuring the perspectives of each stage. Later, accompaniments were made in the kitchen, studying the process of assembling pizzas and snacks, which take place at night, when the pizzeria opens to the clientele. The raw material and waste flow was evaluated, in order to observe all the processes that make up the company and thus be able to identify opportunities for improvement that could be introduced. In the elaboration of the flowchart, we count on the support of the owners. The input and output diagnostic worksheets were also filled with the support of the partners. Data analysis and proposals for improvements were carried out by the working group, and the proposals were made available to the company's management in order to assess the implementation. The elaboration of the proposals took into account aspects of prevention, minimization and recycling, with the proper disposal of waste if the other options were not possible. The solutions indicated were designed to be technically and economically viable. The execution of this project took 24 days to complete, including bibliographic and field research, meetings with company members and also the analysis and writing of the report, which originated this publication. Accepting the proactive stance of environmental responsibility is vital for the company, which is aware that it will only remain active if it is meeting a demand from society (PORTO *et al.*, 2009; SEVERO *et al.*, 2015). Cleaner production techniques are used as fundamental tools to achieve the necessary improvements to the system (CNTL, 2002).

About the Eco team: The eco team is the team responsible for passing on the methodology to the other employees of the company, promoting changes and C+P. The identification of its members is, therefore, of great importance, and those who know the company more deeply or are responsible for important areas within it should be included in the eco-team. This is formed by company professionals, who are employees engaged in various activities and key positions. The activities can be: organization, production, technique, materials department, purchasing, reception, sales, maintenance, quality control, personnel department, administrative council, planning, development, environment, safety, energy (CNTL, 2002). As it is a small company and the business owners know it deeply and even occasionally participate in the pizza production process, the idea of forming an eco-team was unnecessary for this situation.

Flowchart: A flowchart was developed that graphically represents the production processes of pizzas and snacks ordered (Figure 1) and manufacturing (Figure 2).

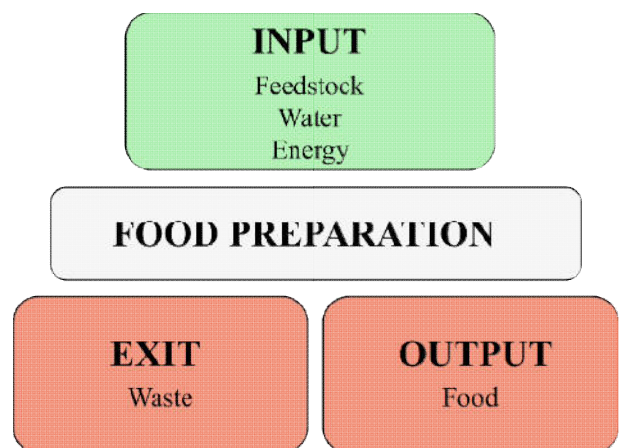


Figure 1. Food preparation flowchart.

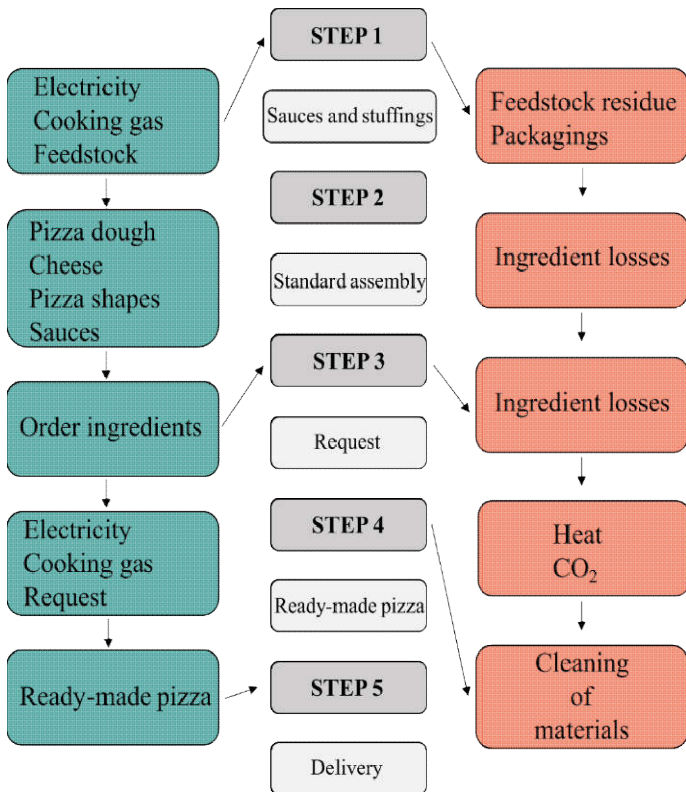


Figure 2. Pizza preparation network.

Diagnosis: Prepared through the flowchart (Figure 3) of inputs of raw materials, inputs and auxiliaries, water and energy. Outlets of liquid effluents, solid and atmospheric waste.

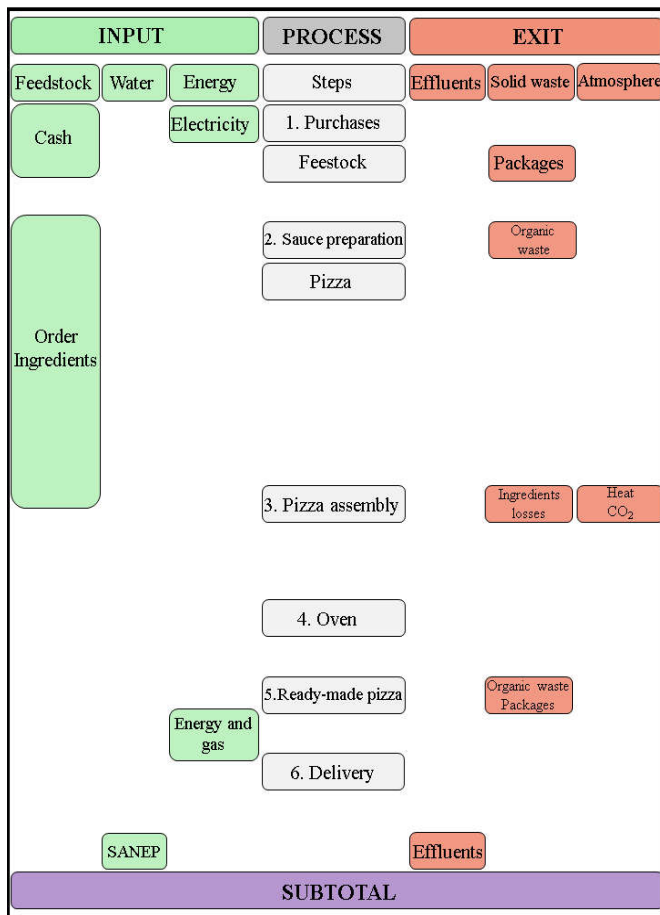


Figure 3. Input and output analysis of the production process

Table 1 was prepared using the input and output flowchart above, containing the raw materials, their weekly quantity, unit cost and total cost.

Table 1. Quantity and costs of inputs

Feedstock	Weekly quantity	Unit	Unit cost (R\$)	Total cost (R\$)
Tomato sauce	14	Tin (4 kg)	13.60	190.40
Mozzarella	34	kg	25.90	880.60
Ham	26	kg	18.00	468.60
Pepperoni	16	kg	8.00	128.00
Olive	10	2 kg	16.00	160.00
Onion	2	20 kg	40.00	80.00
Corn	5	Tin	4.80	24.00
Catupiry	10	kg	21.20	212.00
Bacon	15	kg	12.00	180.00
Provolone	1	kg	28.00	28.00
Chicken	25	kg	6.90	172.50
Ground beef	6	kg	18.00	108.00
Egg	3	30	12.00	36.00
Dried tomato	3	20 kg	35.00	105.00
Banana	8	kg	2.49	19.92
Chocolate	1	kg	18.00	18.00
Cooking gas	55	kg	5.53	304.15

In the pre-assessment, it was possible to identify the main waste generated in the pizzeria (Figure 4). These data were confirmed by the table of waste generated in the pizzeria.

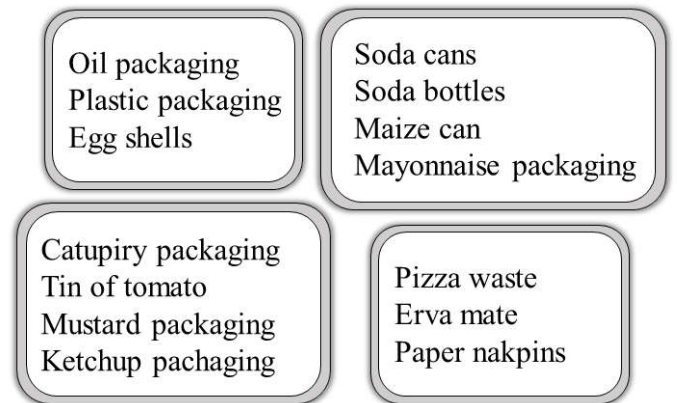


Figure 4. Waste generated in the pizzeria.

Awareness and training are necessary, as this is the first step in the C+Pprocess and to ensure the success of the work. Plastic materials such as ketchup bags, plastic bags among others, due to their decomposition taking around 200 years, cause a significant environmental impact. Oil bottles that still had a few drops left in the package can contaminate the water, making it impossible to use or requiring a specific treatment system. The pizzeria collected the caps of the bottles and the seals of the aluminum cans of the drinks consumed by the customers. These materials were donated to a local institution that rescues abandoned animals and this donation was made by the mother of some owner partners. Bacon oil (Figure 5a) was collected and donated to employees. The same happens with raw leftovers from the removal of fat from the meat (Figure 5b). The pizzeria does not selectively collect their waste, for this reason they do not have bins for the proper separation and disposal of each waste. Thus, during the assembly of pizzas and snacks, food leftovers (Figure 5c) are discarded along with plastics and other materials that could be recycled. The processes for assembling the pizzas were fixed, changing only where the ingredients came from, coming from a cooled shelf on the kitchen counter. After its assembly (Figure 6a), the pizzas went to the electric ovens (Figure 6b), then could follow two destinations: to the salon to be consumed or packaged for delivery, which was made by a courier. If they were for delivery, the boxes were placed on top of the ovens so they could stay warm until the delivery person took them. It should be noted that the place where the pizzas were prepared was different from the place where the snacks were prepared and they also had different employees (Figure 6c).

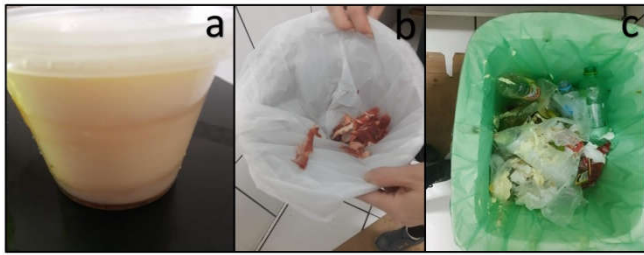


Figure 5: (a) Bacon oil; (b) Raw meat fats; (c) Kitchen trash



Figure 6. Kitchen layout. (a) Place of assembly of snacks; (b) Electric ovens; (c) Snack preparation location

The processes related to the assembly of snacks were fixed, varying only the ingredients that were arranged on the kitchen countertop. After assembly, they went to the press and then had two possible destinations: to the salon to be consumed or packaged for delivery. If they were for delivery, they were also placed on top of the ovens so that they could stay warm until the delivery person picked them up for delivery to the customer's home. There was an imminent risk of an accident in this location, being considered a danger zone due to the large flow of traffic in the access corridor to the ovens, which could cause accidents due to the slippery floor. This route was made by the couriers for external delivery and by employees at the time of delivery of orders to customers who were waiting to consume there in the restaurant.

RESULTS AND DISCUSSION

The manufacture of pizzas and snacks requires a large amount of some ingredients, so a considerable amount of packaging for such inputs has been discarded as they were purchased on a large scale. Thus, one of the proposals studied was the implementation of solid waste separation, with selective collection in the pizzeria, separating the different types of waste. It was important for the company to assess the performance of this collection to determine the level of achievement of its objectives and to detect deficient areas that needed attention (AHMED *et al.*, 2018). This segregation would promote a better assessment, as it would obtain specific data for each type of waste in order to promote the reduction of waste, identifying the most wasted items, as well as the forwarding for reuse/recycling of waste (SILVA *et al.*, 2007; VIEIRA, SERRA, MAXIMIANO, 2006). C+P is a complete tool in terms of an option for optimizing the production process and continuously improving it, as it encompasses the points that lead to this end, such as: prevention, minimization, quality, planning, safety, environment, design, occupational health, efficiency (ELIAS *et al.*, 2004; OLIVEIRA and PEREIRA, 2017). Organic waste can be sent to a vegetable garden in the city, for use as fertilizer, with or without the need for composting. Egg shells can be sent to institutions that use them as ingredients for the preparation of multimix flour because they are rich in calcium and others. In addition, the assembly of pizzas occurred manually and even with training could lead to variations in the product, depending on the employee who would be assembling the pizza. Therefore, the amounts of each ingredient contained in each pizza could not be quantified.

Pizza manufacturing processes in general do not cause drastic impacts on the environment. Even so, C+P practices together with selective collection and the use of solutions that minimize damage to the environment can bring cost reduction for the entrepreneur and greater visibility regarding the socially environmental practices practiced by the company, which are increasingly good, viewed by consumers. According to Motta (1995), when the implementation and adaptation to changes are recognized as a condition for competitiveness, it appears that one of the main objectives of organizational changes is the search for greater flexibility in management systems.

Some measures proposed for the issues raised are structured in:

- Raising awareness and training of employees and partners, through written material and lecture on C+P;
- Implementation of selective collection, taking into account that in the production process, several solid residues are discarded, which if properly separated, can be taken to the reuse/recycling process. This program does not have a high cost for its implementation, so it is characterized as a good alternative when considering the cost-benefit ratio. For this program to continue, it is only necessary to instruct employees in relation to recyclable, non-recyclable and organic waste;
- Possible measuring spoon that can be used in the handling of pizza preparation. This adjustment would allow standardization of portions of all ingredients, reducing waste and maintaining the quality standard as they are able to produce pizzas and snacks with the same flavor every time;
- Allocate organic waste to be used as fertilizer in a vegetable garden in the city, for example;
- Carry out the separation of eggshells from other waste, that is, use a separate collector only for this waste, so that it does not come into contact with other organic waste, thus, the eggshells could be donated to an institution or cooperative that use this input for the manufacture of multimix flour;
- Install non-slip tape in the kitchen hallway that gives access to the lounge.

CONCLUSION

This work contributes to a better understanding of the pizzeria's internal environment, opening doors for several internal improvements to an assessment of the necessary quantities of raw materials in the products, better planning, production control and cost reduction. It is recommended that spreadsheets of the production process of snacks be also made, as they were made only from pizzas, as our focus was directly on a single product, which was possible at the time the study was carried out. Despite this, the propositions of this study show the potential for economic and environmental benefits that C+P can provide. It signals to companies the real possibility of reducing their costs, often represented by the waste found in production processes.

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