CHAPTER
26

Gravimetric characterization of solid waste from selective collection in the city of Rio de Janeiro in 2019

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ABSTRACT
This research describes the types of plastic packaging consumed in Rio de Janeiro, through the selective collection of recyclables carried out by the Municipal Company of Urban Cleaning of the City of Rio de Janeiro (COMLURB). The quantities, types and manufacturing companies of the products contained in the packages in the neighborhoods of different Planning Area (PA) were surveyed. The residues were characterized according to their physical composition: paper, plastic, glass and metal. The Society of Plastics Industries (SPI) Classification was the parameter for classifying plastic materials. A total of 18 samples of plastic waste were analysed. The results point to higher mass percentages for the paper component, 39.82%; plastic, 28.89%; glass, 25.84% and metal 5.45%. It was observed that 27% of the plastics are Polyethylene Terephthalate (PET) Crystal and 1.71% are PET Waste (no known technology for recycling); Polyethylene (PE) film plastics are 4.23%. The research identified 503 brands and 3,525 products of these brands, including cleaning packaging, personal hygiene, and food. The brands Nestlé, Unilever, Coca Cola, Danone, Bombril, Arcor were observed with the highest rates of consumption of plastic packaging by the population.

Keywords: Plastic waste, Gravimetry, Reverse logistics, Recycling.

1 INTRODUCTION

According to the National Solid Waste Policy, recycling is no longer an option, but a must and one of the pillars of the circular economy. Structure a system that is able to receive the recyclable materials generated by consumers after their consumption activity, transform the natural resources of these recyclable materials into new products such as the activities that take place in the recycling industries, all this recycling mechanics requires the implementation, structuring and operationalization of a reverse logistics system, to improve the entire recycling chain (CEMPRE, 2017).

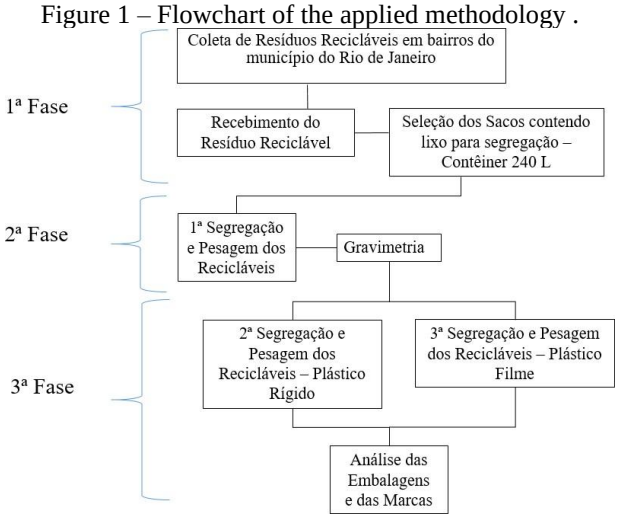
Recently, in Rio de Janeiro, according to the State Law8.151/2018, companies that produce, import or market packaging or packaged products, will be required to finance the reverse logistics system of packaging and packaging waste, with targets of selective collection increasing in at least 10% every two years from 2019, as a form of mechanism to encourage the entire process of increasing the logistics system and recycling (LERJ, 2018).

Therefore, the objective of the present study was to evaluate the types of plastic packaging and itsproducing brands after being discarded and consumed in Rio de Janeiro, collected through the selective collection of recyclables, carried out by the Municipal Company of Urban Cleaning in Rio de Janeiro (Comlurb), and to relate the brands of these products.

2 METODOLOGY

This research began on April 8, 2019 and was developed in three phases. Figure 1 shows, schematically, the stages of the research that will be detailed below.

Figure 1 – Flowchart of the applied methodology .



2.1 1ST PHASE - COLLECTION OF

Recyclable Waste in Neighborhoods in the Municipality of Rio de Janeiro The area selected for the study was the city of Rio de Janeiro, in the neighborhoods that have selective collection, organized according to the Planning Area (AP). The AP covered by this research were: AP 1, neighborhoods of Rio Comprido and Santa Teresa; AP 2.1, neighborhoods of Copacabana, Jardim Botânico, Gávea, São Conrado and Alto Leblon; AP 2.2, neighborhoods of Tijuca and Grajaú; AP 3.2, neighborhoods of Méier, Encantado, Todos os Santos, Engenho de Dentro and Piedade; AP 4.2, neighborhoods of Barra da Tijuca and Recreio; AP 5.2, Campo Grande and AP 5.3, Patience.

Comlurb's selective collection trucks performed the collection based on the scripts. At the end of each daily collection, the collected waste was sent to the Gravimetry laboratory of the Comlurb Research Center. The waste bags were stored in a 240 Liter container to be used as our sampling unit. Figure 2 illustrates the selective collection truck, the type of containers and the bags containing the waste for the analysis.

Figure 2 – Selective Collection Truck, 240 L containers and bags containing garbage.

A weekly sample was collected, equivalent to 240 liters of recyclable MSW and over the course of a year, a total of 18 samples were collected. There was no collection in the holidays, Carnival, Easter, and weekends to avoid the influence of these periods on the quantity and quality of the sample components. The samples were sent to the Gravimetric Characterization Laboratory of the Applied Research Center of the Municipal Company, where they were separated into different components.

2.2 2ND PHASE - 1ST SEGREGATION AND WEIGHING OF RECYCLABLES

The first segregation of the sample amount of recyclable materials is as to the physical composition: paper, plastic, glass and metal. On the sorting table the waste bags were opened and scattered for separation. Figure 3 represents the 2nd phase.

Figure 3 – Separation of waste according to the components.

Then, the components were weighed (Figure 4), emphasizing that only the plastic component was studied with a more detailed segregation based on the composition materials, as well as the identification of brands and manufacturers.

Figure 4 – Portionsec watered metal , paper, plastic and glass.

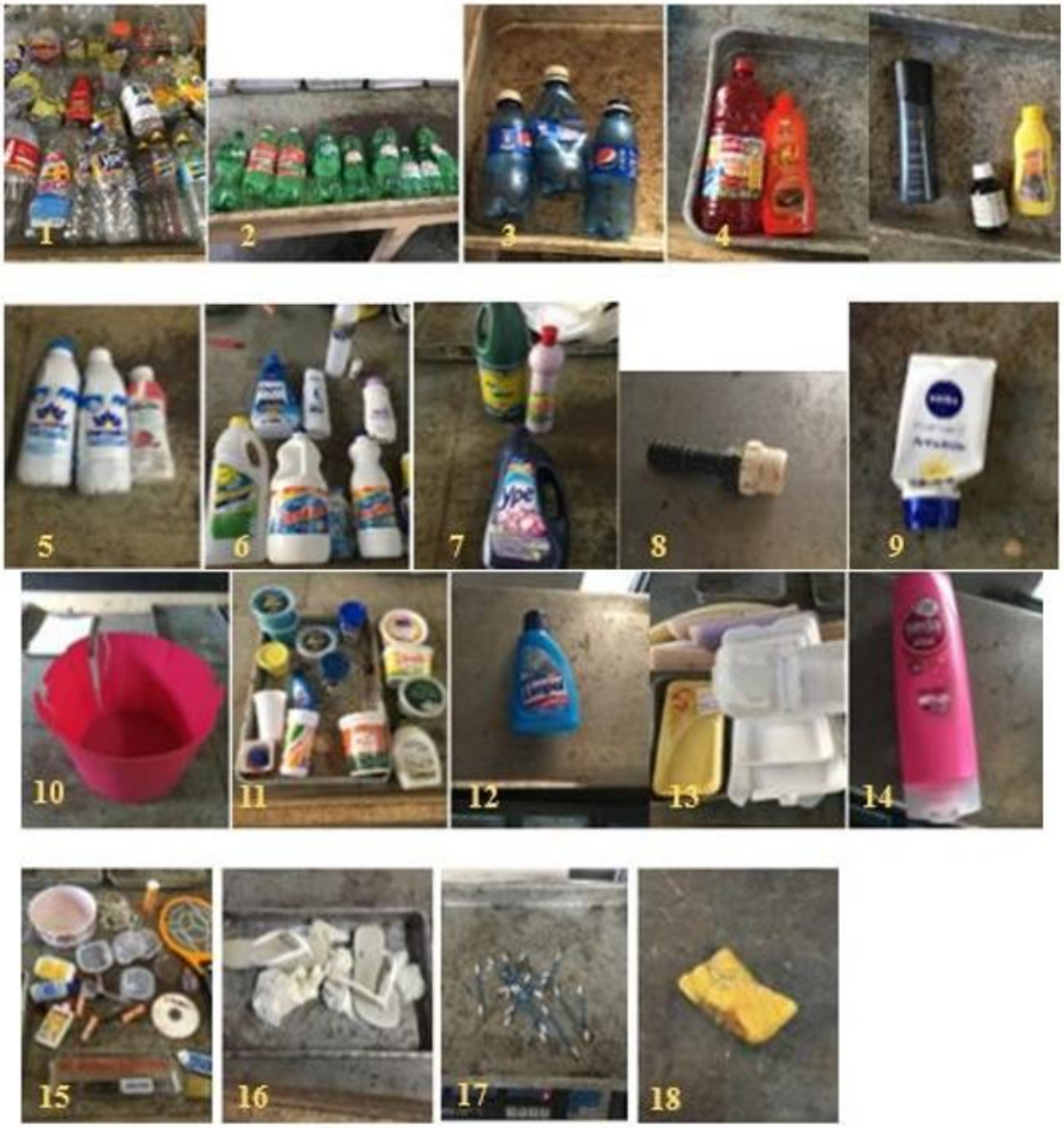
Some neighborhoods presented organic waste together with recyclable dry waste, and as a standard procedure for the present work, organic waste was separated from the samples to be analyzed and discarded.

2.3 3RD PHASE - 2ND SEGREGATION AND WEIGHING OF RECYCLABLES – RIGID PLASTIC

The third phase was the stage of separation and weighing of the plastic materials according to the type of constituent material in its composition. The identification criterion for separation is that of the Classification System of the Society of Plastics Industries (SPI). The rigid plastics were separated by type, and then by the type of coloring of plastic production, such as: Rigid – 1- PET Crystal, 2- PET Green, 3- PET Blue, 4- PET Other Colors, 5- PET Waste (type of non-recyclable PET); 6- HDPE White, 7- HDPE Other Colors; 8- PVC; 9- LDPE White, 10- LDPE Other Colors; 11- PP Branco, 12- PP Other Colors; 13- PS; 14- Other; 15- "Unidentified" (such packaging does not contained printed

SPI classification of the type of plastic they were manufactured); 16- rubber; 17- ear cleaning rod; and 18- sponge (Figure 5).

Figure 5 – Segregated portions of rigid plastic.



2.4 4TH PHASE - 3RD SEGREGATION AND WEIGHING OF RECYCLABLES – PLASTIC FILM

The third phase consisted of individually weighing each type of plastic according to its plastic film characteristics, also using the SPI as an identification system. 1- PE Film (code 2 or 4), 2- PP Film, 3- Other Film, 4- Colorless/White "Not Identified" Film (the packages did not contain the printed SPI classification of the plastic type), 5- "Unidentified" Black, 6- " Unidentified" Other Colors, and BOPP Film (Figure 6).

Figure 6 – Segregated portion of plastic film.

2.5 5TH PHASE - ANALYSIS OF PACKAGING AND BRANDS

At this stage, the evaluations were made through the type of plastic and the company that produced and marketed the segregated packaging that arrived from each neighborhood of the researched scripts. Brands and products were catalogued in quantities by each manufacturer who produced them.

3 RESULTS AND DISCUSSION

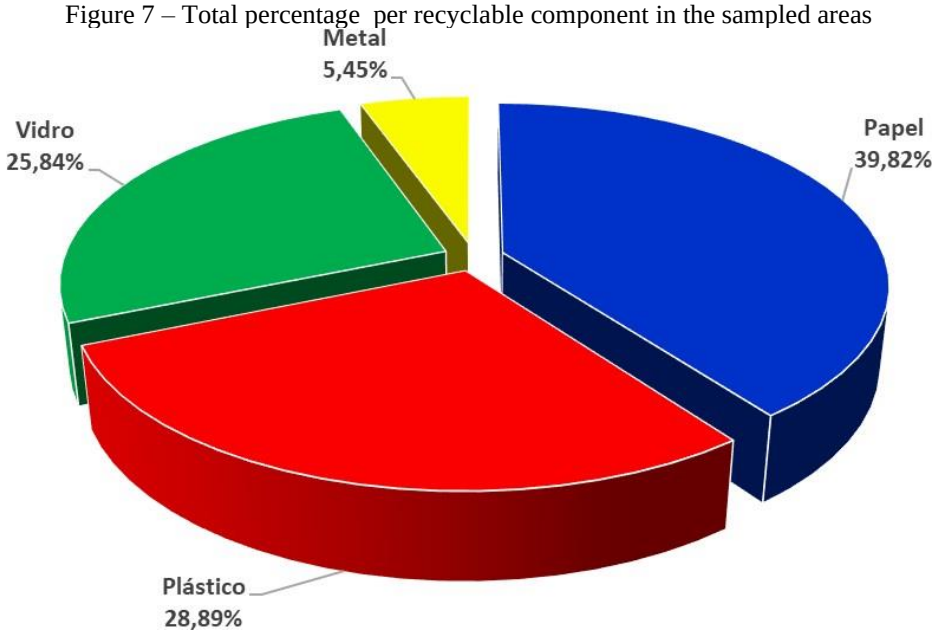
A total of 373.09 kg of waste from selective collection was collected in 18 scripts and analyzed during 2019.

The results point to higher mass percentages for the paper component, 39.82%; plastic, 28.89%; glass, 25.84% and metal 5.45%. These values are compatible with data from the Municipal Department of Environment (SMAC, 2015) and CEMPRE (2018). For the first, the averages of recyclables are described as: Paper, 40.7%; Plastics 16.0%, Glass 26.2% and Metal 3.8% (SMAC, 2015). For CEMPRE (2018),

The particularities of composition of recyclables can vary from city to city. In Rio de Janeiro, the mean values were Paper, 45.9%; Plastic ,22.0%; Glass, 11.3% and Metal, 4.4%, in 2018.

Figure 7 illustrates the mass percentage of each component identified in the recyclable waste collected throughout 2019 in the city of Rio de Janeiro.

Figure 7 – Total percentage per recyclable component in the sampled areas



Among the neighborhoods of the city of Rio de Janeiro, there are some that represent the neighborhoods of the South Zone, West Zone, North Zone. In Table 1, we present the Planning areas surveyed, with the values obtained according to the identified component. It is possible to note that AP 4.2 generated the highest percentage of recyclable components.

Table 1 – Overall result of the samples collected in % by neighborhoods sampled in Rio de Janeiro 2019.

PLANNING AREAS	**PAPER**	**PLASTIC**	**GLASS**	**METAL**	**TOTAL**
AP 1.0	28,78	12,16	6,66	0,63	**48,23**
AP 2.1	22,69	15,48	29,03	4,10	**71,30**
AP 2.2	15,70	19,32	15,40	2,96	**53,38**
AP 3.2	10,32	9,98	3,42	0,38	**24,10**
AP 4.2	41,63	29,81	28,18	7,39	**107,01**
AP 5.2	11,21	12,75	6,28	1,89	**32,13**
AP 5.3	14,39	5,48	4,92	2,46	**27,25**
TOTAL:	**144,72**	**104,98**	**93,89**	**19,81**	**363,40**
PERCENTAGE:	**39,82%**	**28,89%**	**25,84%**	**5,45%**	**100,00%**

The perceived increase in the values of plastic recyclables achieved in this research confirms that the consumption of plastic packaging is increasing significantly in the lives of populations around the world and the city of Rio de Janeiro has not behaved differently from the rest of the world.

4 SAMPLES OF RECYCLABLES BY NEIGHBORHOODS

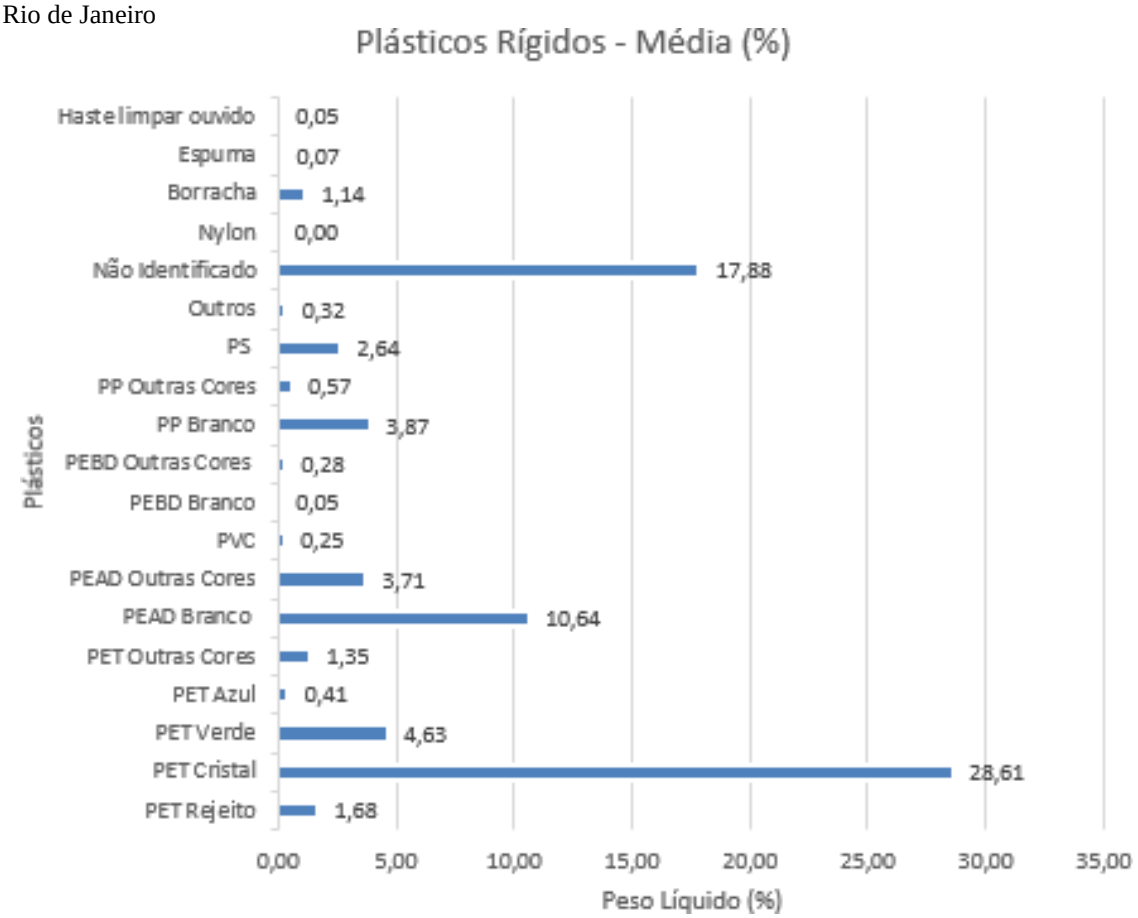
In this item will be presented the detailed values of each neighborhood surveyed, within the official script of recyclable waste of Comlurb, in the period of the research. Table 2 shows the Planning Area of the city and its bairrthe corresponding collections, whose samples were analyzed by types of plastics.

Table 2 – Results of the Samples of Plastics

PLANNING AREAS	HARD PLASTIC																			PLASTIC FILM					
	PET Waste	PET	Green	PET	PET Other Colors	HDPE White	HDPE Other Colors	PVC	LDPE White	LDPE other sColors	PP White	PP Other Colors	PS	Other	Unidentified	Rubber	Foam	Ear Cleaning Rod	PE	PP	Other Films	Unidentified colorless White	Unidentified Black	Not identified Other Colors
AP 1.0	0.20	3.91	2.13	0.00	0.00	0.91	0.11	0.01	0.00	0.00	0.25	0.14	0.26	0.00	1.57	0.09	0.00	0.00	0.46	0.12	0.50	1.67	0.01	0.25						
AP 2.1	0.23	4.35	0.26	0.08	0.00	2.62	0.39	0.23	0.01	0.00	0.37	0.07	0.36	0.11	3.19	0.11	0.00	0.01	1.12	1.11	1.07	2.08	0.98	1.10						
AP 2.2	0.26	6.43	0.74	0.00	0.41	1.74	1.04	0.00	0.00	0.00	0.99	0.06	0.41	0.05	3.89	0.03	0.03	0.00	0.20	0.19	0.13	1.22	0.03	0.78						
AP 3.2	0.10	2.72	0.33	0.03	0.04	1.03	0.30	0.00	0.00	0.00	0.43	0.13	0.14	0.00	1.30	0.47	0.00	0.00	0.19	0.04	0.07	1.89	0.00	0.78						
AP 4.2	0.77	10.08	0.98	0.28	0.69	2.46	1.66	0.05	0.02	0.41	1.66	0.16	1.47	0.10	6.74	0.39	0.00	0.03	0.62	0.26	0.46	4.56	0.39	1.85						
AP 5.2	0.15	2.20	0.32	0.06	0.24	1.43	0.59	0.00	0.02	0.00	1.10	0.00	0.24	0.11	3.20	0.56	0.00	0.00	0.26	0.08	0.12	0.75	0.30	1.04						
AP 5.3	0.00	0.75	0.25	0.06	0.10	0.99	0.00	0.00	0.00	0.00	0.09	0.08	0.03	0.00	1.50	0.00	0.03	0.00	0.07	0.03	0.06	0.61	0.02	0.83						

Figure 8 shows the result of the means of rigid plastic collected in all samples of this research.

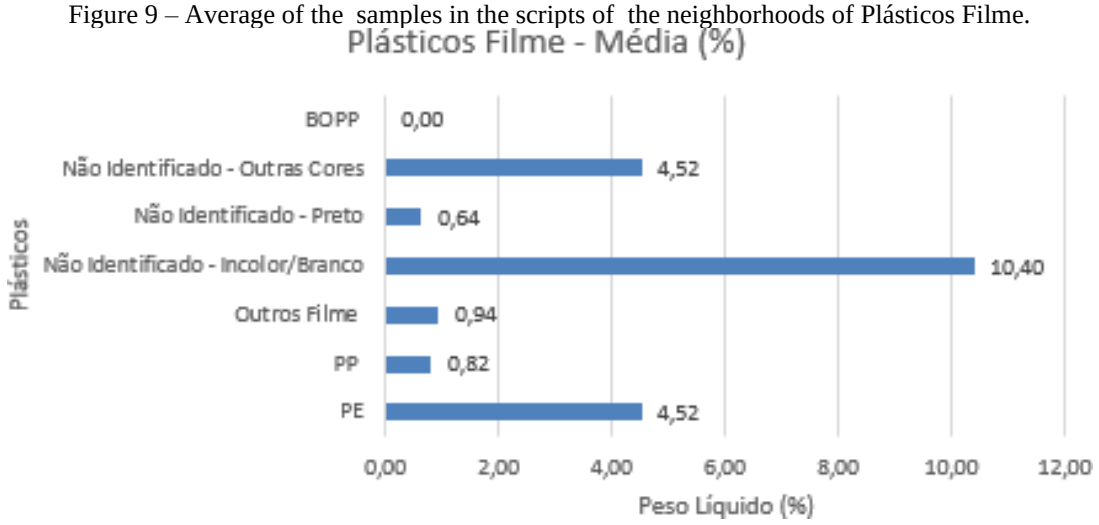
Figure 8 – Mass percentage of the types of rigid plastics, collected by Comlurb in the selective collection routes of the city of Rio de Janeiro



The Cristal PET, presenting 28.61% of the total samples, was the type of plastic most found in the recyclable waste of Rio de Janeiro within the neighborhoods analyzed by this research, followed by "Unidentified" plastics 17.88%. This type of material was classified as "Unidentified" because it presents on its packaging the identification of its class. The White HDPE, presenting 10.64% in relation to the total mass of plastics, appears as the third type of plastic most found in the analyzed samples.

Figure 9 shows the mass percentage of the types of plastic film identified in the waste from the selective collection of the city of Rio de Janeiro. The type of plastic film with the highest representativeness was the colorless "Unidentified" with 10.40% of the samples, "Unidentified" other colors with 4.52%, with a value equal to the PE plastic.

Figure 9 – Average of the samples in the scripts of the neighborhoods of Plásticos Filme.



5 THE SITUATION OF PACKAGING AND ITS BRANDS

Table 3 shows the results of the survey of the brands found in this study. The first in the ranking is Coca Cola with 15.51% of the total samples, followed by Nestlé with 7.78%, and third by Unilever with 3.72% of the total samples. Minalba, mbev, Arcor, Ypê and Pepsico, complete the ranking of the 10 largest companies with post-consumer plastic packaging waste.

According to Break Free From Plastic (BFFP, 2018), much of the packaging collected in its study off the coast of 42 countries belongs to producers of major brands such as Coca-Cola, Pepsico and Nestlé, and the study also states that most of this waste is plastics that are difficult to recycle. The results of this research are consistent with those found by the Greenpeace report, since the same major brands configure the first places in the ranking of packaging arranged in the environment and cataloged by this research.

Plastic packaging is associated with the companies producing the brands found. The research identified 33 brands/companies with different products in a total of 2418 packaging units or packaging fragments, among them: cleaning packaging, personal hygiene, beverages, pharmaceuticals, food, etc.

Table 3 – Ranking of brands in each Planning Area

PLANNING AREAS	AP 1.0	AP 2.1	AP 2.2	AP 3.2	AP 4.2	AP 5.2	AP 5.3	TOTAL	RANKING	%
SM (Unmarked)	58	34	186	69	301	181	39	**868**	**1**	**37,51%**
Coca Cola	42	52	87	22	118	25	13	**359**	**2**	**15,51%**
Nestle	25	30	7	10	84	20	4	**180**	**3**	**7,78%**
Unilever	4	10	16	8	31	15	2	**86**	**4**	**3,72%**
Minalba	13	18	10	16	23	0	0	**80**	**5**	**3,46%**
AMBEV	12	9	18	4	21	9	6	**79**	**6**	**3,41%**
Arcor	0	14	0	0	32	2	19	**67**	**7**	**2,90%**

Ype	3	7	9	5	21	9	5	**59**	**8**	**2,55%**
Pepsico	6	10	13	7	15	3	0	**54**	**9**	**2,33%**
Good Bril	3	8	13	1	17	3	4	**49**	**10**	**2,12%**
RB Goup (Reckitt Benckiser)	2	9	11	5	14	6	0	**47**	**11**	**2,03%**
Danone	5	4	2	1	25	2	2	**41**	**12**	**1,77%**
Colgate Palmolive	2	0	12	4	16	3	3	**40**	**13**	**1,73%**
M Days White	2	4	5	1	13	7	4	**36**	**14**	**1,56%**
BRF	2	3	4	3	16	2	3	**33**	**15**	**1,43%**
Pandurata	0	2	9	1	16	1	0	**29**	**16**	**1,25%**
Horti Fruti	3	2	8	1	14	0	0	**28**	**17**	**1,21%**
Lactalis	3	3	5	4	3	8	0	**26**	**18**	**1,12%**
Mondelez	1	3	1	0	11	2	5	**23**	**19**	**0,99%**
Johnson & Johnson	0	4	4	3	8	1	1	**21**	**20**	**0,91%**
Proctor & Glamber	2	2	2	3	6	5	0	**20**	**21**	**0,86%**
Camil	0	1	3	1	10	4	0	**19**	**22**	**0,82%**
Flora	1	2	4	1	1	7	1	**17**	**23**	**0,73%**
HP	0	11	3	0	4	0	0	**18**	**24**	**0,78%**
Kimberly Clark	0	3	3	1	10	1	0	**18**	**25**	**0,78%**
Wickbold	2	2	1	1	3	7	1	**17**	**26**	**0,73%**
Yakult	0	0	3	0	3	0	11	**17**	**27**	**0,73%**
Cargill	1	3	1	0	3	3	5	**16**	**28**	**0,69%**
Bimbo Group	0	2	1	4	9	0	0	**16**	**29**	**0,69%**
Gathered Raymundo da Fonte	1	5	0	1	7	1	0	**15**	**30**	**0,65%**
L'Oréal	0	8	2	2	2	0	0	**14**	**31**	**0,61%**
Legal Coconut	1	11	1	0	0	0	0	**13**	**32**	**0,56%**
Guaracampi	0	1	1	2	2	4	3	**13**	**33**	**0,56%**

In the research for the PET Reject, 14 brands and 18 different products were found, considering the samples collected in all the scripts. The situation of products and packaging made of PET Waste should be given special attention to a replacement of this material at the time of its manufacture, demonstrating the need to change this type of plastic compound that represented 1.68% of the samples collected in the present study. This attitude of rethinking the material would facilitate the recycling of these packages, and avoid increasing the volume of waste sent to destination final in landfills for example, because we know that this type of plastic is thus classified as PET Waste, because currently in the market of recyclables there is no known technology for recycling them.

The companies included in this profile of PET Waste generators were: Pão de Açúcar (Qualitá bleach); Benasse (Benasse tray); HP (HP cartridge); Danone (Activia yogurt and Danone yogurt); Nestlé (Greco yogurt and Nestlé yogurt); Green Milk (very lethal milk); Laep Investments (Parmalat milk); Equate (Saline Solution Equate); Da matina (morning yogurt); Verde Campo (yogurt, lacbacillus and sour cream); Lactalis (Elegê milk); EVLution Nutrition (EVL supplement); and Johnson & Johnson (oil control Roc)

The production of packaging with this type of plastic that does not allow recycling is not consistent with the current situation of plastic in a global vision. Another measure would be to advise consumers not to encourage the manufacture of these packages, avoiding the consumption of these products until the changes in the raw material of the packaging produced are replaced by plastic with recycling potential.

About PET Cristal, 98 different brands were found among the 152 segregated products. PET Cristal is the type of plastic that has the highest marketing value and, in this research, represents 27.85% of the samples collected , a situation that can be taken into account to increase the recycling potential of this type of plastic in the national market and in Rio de Janeiro.

For PET Green, PET Blue and PET Other colors, several different companies with different products were surveyed, and the representativeness of these types of materials did not exceed the mark of 4.65% of the total samples collected. Here it is important to mention that the recyclable market increasingly prioritizes processing PET waste with the lowest possible pigmentation, factors that favor the commercialization within this market.

We found 79 different brands of HDPE plastic packaging among 137 products, with significant representativeness in this research of 10.78% of the samples analyzed for the plastic type HDPE White, and 3.71% for the plastic type HDPE type of other colors. The vast majority of this type of plastic packaging found, are cleaning products according to what was revealed by this research.

For PP-type plastic, 60 different companies with 85 different products were found , with 3.90% of representativeness in the samples surveyed in the White coloration, and 0.57% of PP of other colors. The greatest representativeness is for the products of the food genre , where this type of plastic is used for packaging. For the PS type plastic, 10 companies and 14 products were found, with representativeness in this research of 2.66% in average of the samples collected. Usually trays and compartments for food were the products found in this research.

For the "Unidentified" Plastics, 78 companies and 111 products were found. Several companies produce packaging of "Unidentified" Plastics, without the numbering referring to the material of their composition, a situation that hinders the segregation and extraction of this type of packaging by consumers and the recycling market. In this profile, we identified the following brands: Too, Arcolor, Avon, Ayurveda, Bayer, Beba Saúde, BIC, Bio Instinto, Bioleve, Bolo de Bolo, Boticário, Britânia, Casbri, CDC, Chá Dao, Colgate Polmolive, Danone, Delta, Divina Dama, Duracell, Embelleze, Everest, Fabrica de Bolo, Farmax, Fin'Arte, Flor da Serra, Flora, Glaxo, Granja Yabuta, Greci, Grupo Puranata, Harman, Hemafarma, Higi Marcas, HortFruti, HP, Hypera Pharma, INCOTERM, Indipel, Johnson&Johnson, K-Patette, Laboratório Daudt Oliveira, Lactalis, Leite de Rosas, Lightex, Limppano, L'Oreal, Lorenzetti, Medihealth, Mel Guarapari, Melitta, Mercur, Merheje, Mineração

Água Padre Manoel, Neo Química, Nestlé, Orbi Química, Orgânico Brasil, Pepsico, Polenghi, Premisse, Pritt, Proctor&Glamber, Pura Vida, R&M cosmetics, Reckitt Benckiser RB Group, Risque, Sanifill, Santa Massa, Sany do Brasil, Servier, Soin, Tirolez, União Quimica, World Comexx, Yakulty, are examples of companies that do not identify the type of plastic packaging composition, a system that would facilitate and increase recyclability of their brands and products.

The understanding for the population is of vital importance in the mechanics of recycling, according to EMF (2017), we know that more than 40 years after the first launch of the first universal symbol of recycling, and even then only 14% of the plastic packaging is collected for global recycling.

Of these 78 companies that did not identify in their packaging the type of plastic material of their composition, both in rigid plastics and in plastic films. In rigid plastics, the samples represent 17.94% of the quantity surveyed. And in film-type plastics. Unidentified Colorless/White 10.40%, plus 0.64% of the Unidentified Black, and 4.52% of the Unidentified of Other Colors, representing a great loss for the market of recyclable materials, both at the time of segregation, both in the possible contaminations and mainly diversion to the environment.

For the plastics of the film type were found 244 manufacturers and 367 products, with 4.57% of plastic PE film, 0.83% of plastics PP film, and 0.94% of the samples of plastic film Other, the main type of packaging for these types of plastics were plastic bags and bags.

With regard to plastic film, the identification of which type of plastic was produced would be a great factor in improving the recycling systems and use of this type of plastic, since it was known that a significant part of the packaging found in the research is of the type "Not Identified."

It is worth mentioning that "SM" (No Brand), in reality is not a specific brand, or a single large producer, but a criterion used for cataloguing packaging that did not present a form of identification, proof that many plastic residues could not be identified at the time of research in the laboratory, or the actual responsible for the production of the packaging. In the present study, 868 units were counted, about 24.62% characterized by various packages, pieces of packaging, plastic fragments , which presented difficulty in identifying the brand or manufacturer. This corroborates and verifies the difficulty of identifying large volumes of small plastics remaining in the environment, and thus making it difficult to hold their producers accountable to carry out a final destination environmentally appropriate.

Thus, it is evident that the reverse logistics of post-consumption has to become more visible in order to equate the return and correct destination of products and materials, contributing to the circular economy and to the understanding of recyclability (LEITE, 2018), enabling the return of post-consumer products and packaging to the production cycle generated by manufacturers, importers,

distributors, traders and citizens (CEMPRE, 2017; BRASIL, 2016), no longer being a process that occurs in a reactive way so that in this way the strategic vision about the activity and the capacity of organizations to meet the demands of consumers does not become limited (VLACHOS, 2014)

6 CONCLUSION

The present research carried out the gravimetric characterization of post-consumer plastic waste in the city of Rio de Janeiro, through the selective collection system of Comlurb. The results point to higher mass percentages for the paper component, 39.82%; plastic, 28.89%; glass, 25.84% and metal 5.45%. About 77% of the plastic waste collected in the city belongs to hard plastic, followed by plastic film (21.85%).

Under the conditions evaluated, the company Coca Cola presented the highest percentage of plastic packaging discarded by the population of Rio de Janeiro (15.51%), followed by Nestlé with 7.78% and Unilever with 3.72% of the total samples.

According to the results of this research, the focus of Rio de Janeiro's reverse logistics should primarily direct efforts to Rigid Plastic of the type: PET Waste (1.68%), in order to replace this type of plastic compound in the production of packaging; PET Cristal (28.61%), because they represent the largest volume of material researched and have a market available for recycling; PET Green (4.63%), PET Blue (0.41%) and PET Other Colors (1.35%) ; HDPE White (10.64%) and PP White (3.87%), for presenting such a significant volume and having considerable acceptance in the markets of recyclables and plastics considered "Unidentified" (17.88%), being urgent the attention of companies to the standard identification for such packaging.

In the case of Plastic Film: PE (4.52%), because they present themselves in a relevant quantity within the neighborhoods; the plastics Not Identified Colorless/White (10.40%), "Unidentified" Black (0.64%), "Unidentified" Other Colors (4.52%), in order to change this context of difficulty at the time of identification, having presented considerable volume for reuse.

The generation of plastic films also reinforces the creation of alternatives to increase recycling. In addition, better identification should be established on the packaging , clearly informing the type of plastic that makes up the packaging and the possible forwarding to appropriate destination locations.

The mass values presented confirm the viability of certain types of plasticthat nowadays could count more effectively for the increase in the numbers of recycling in Rio.

This study may bring the discussion of the use of the reverse logistics instrument, provided for in the National Solid Waste Policy, with the andnajamento of producers/manufacturers in the replacement of these products in the production cycle, abandoning the linearity of commercialization and bringing the concept of circular economy.

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