Revista Virtual de Química

Article

http://dx.doi.org/10.21577/1984-6835.20220025

Evaluation of the Generation of Technofossils by Different Coffee Brewing Methods During COVID-19 Pandemic

Avaliação da Geração de Tecnofósseis por Diferentes Métodos de Preparo de Café Durante a Pandemia de COVID-19

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Recebido em: 29 de Março de 2021

Aceito em: 26 de Outubro de 2021

Publicado online: 22 de Fevereiro de 2022

Coffee is the second most consumed beverage in the world and an important international agricultural commodity, but the increasing use of single-serve coffee machines has led to major environmental concerns, as they produce non-biodegradable solid waste called technofossils, which are considered anthropogenic markers of the technosphere in the Anthropocene. Currently, Brazil is the world's largest coffee producer and the second largest consumer of this beverage. In this study, we evaluated the production of solid waste (biodegradable and technofossil) by the three most commonly used coffee preparation methods in Brazil during the COVID-19 pandemic: the "Brazilian coffee brewing method" (with cloth filter), electric coffee machine (with paper filter) and machines using single-serve Keurig Cups® (K-Cups). K-Cups produce a total waste mass 56% and 42% higher than those generated by the methods using the "Brazilian coffee brewing method" and the electric coffee machine, respectively. The K-Cups produce about 10 times more technofossil waste than the other two methods, but have a nearly equal distribution among all their generated waste (biodegradable: 50.5% and technofossil waste: 49.5%), with no statistically significant difference ($p < 0.05$). On the other hand, the "Brazilian coffee brewing method" and the one using an electric coffee machine, basically produce biodegradable solid waste, predominantly 93.5% for the "Brazilian coffee brewing method" and 84.0% for the one using an electric coffee machine, respectively. The technofossil residues generated mainly by the method that uses K-Cups are difficult to recycle, which poses increasing environmental risks if these solid residues are inadequately treated in the environment. This fact is worrisome, since during the COVID-19 pandemic a significant increase in the generation of municipal solid waste (>10%) was observed, as well as a significant increase in coffee consumption in Brazilian and worldwide households.

Keywords: Coffee; Anthropocene; Great Acceleration; waste; COVID-19

1. Introduction

Coffee is a commodity of large economic importance, considered as the second most consumed beverage in Brazil and,[1-4] following only the ingestion of potable water in more than 80 countries.[5,6] This drink is widely consumed due to cultural tradition, being the United States of America (USA) and Brazil the countries with the most important coffee consumption.[2,4,5,7-9] In 2020, the first year of the COVID-19 pandemic caused by the new Coronavirus SARS-CoV-2,[10,11] the Brazilian coffee crop was estimated as 63.08 million of 60 kg bags,[4] keeping the country as the major international "player" of this product, responsible for 36.7% of the global production.[4,8,12,13] In the same year, world coffee consumption it is estimated to rise by 0.3% to 168.39 million of 60 kg bags (2019), as result of panic-buying and stockpiling because COVID-19 pandemic.[4,14] Furthermore, even due to COVID-19 pandemic, the coffee still presence is mandatory in Brazilian food parcel, that take into account minimal groceries for a Brazilian family to survive at least for a month, including food, personal care and cleaning items.[15]

From 1950 to 2000, the consumption of coffee raised 200% around the world and, even with a severe economic global crisis started in 2008 and now with COVID-19 zoonotic crisis started in 2020, the production and consumption did not show any signs of decrease.[4,7,16,17] Coffee is still the second most commercialized commodity in the world, being only behind petroleum,[7,12,13] and a 25% increase of world coffee consumption is predicted for the next five years.[18] However, cultivation, roasting, packaging, transport, preparation, and final destination of residues imply significant negative environmental impacts,[16,17] which were increased by the COVID-19 pandemic, as people began to consume more products in their homes in response to full Lockdown and partial Lockdown (non-pharmacological containment measures to avoid the spread of the new Coronavirus SARS-CoV-2).[19-22] The mitigation of these environmental impacts can be complex, since coffee is one of the beverages with the most diversified preparation techniques, according to traditions of each country, even within the same geographic region.[1,16,18,23,24]

In Brazil, the most common preparation methods still are "*café à brasileira*" ("Brazilian coffee brewing method" with fabric filter), electric coffee machine (paper filter), capsule coffee (K-cup), boiled coffee or Scandinavian style (no filtered dust), and express coffee, in addition to the use of soluble/ instantaneous coffee.[1,4,15] Coffee preparation always involves technological innovations to improve popularization and consumption.[3,5,16,18] Until the XIX century, the most common preparation way was filtering coffee powder with the application of boiled water.[15] In the 1950's, the medicine progress, agriculture "Green Revolution", urbanization raises and improvements in life quality, promoted growth acceleration of the world population (increase from 3.3 to 7.9 billion of inhabitants in 2021), impacting consumption, industrialization, and use of energy from fossil fuels.[25] This historical period is informally known as "the Great Acceleration" of Anthropocene, in which unprecedented growing of demand for food, potable water, energy, minerals, and commodities, and accelerated technological development started.[25-28] The consumption and agribusiness of coffee were not left out of these changes. To cope with modern life needs, the electric coffee machines were created in the 1950s, while in 1976 the capsules for "single-dose coffee" machines that make a single cup of coffee by Keurig Cup® method appear in Switzerland.[5,15,16]

With the large growth in sales of single-dose coffee machines, global environmental concerns have arisen about the production and final disposition of urban solid waste (USW), because polymerics resins (plastics) and aluminum that compose the capsules take longer timescales to degrade under natural conditions, requesting suitable recycling to mitigate this environmental impact of waste generation.[5,16] Although exist different "life cycle assessments" (LCA) of the coffee production chain and associated negative impacts (water and energy consumption, greenhouse gas emission, among others), few emphases is given to a qualitative and quantitative evaluation of USWs generated by different coffee brewing methods.[16-18,29,30] The comprehension of the worldwide generation and synchronic distribution of coffee USW has large relevance, serving as a sign of human capacity to produce artifacts of rare nature (elementary aluminum) and modern plastics.[27,28,31]

The Technosphere is an environmental compartment comprising the interconnected technological systems that support the modern stage of Mankind, and it is a phenomenon that now has sufficient scale to disrupt the Earth System's natural biogeochemical cycles.[31] Anthropogenic materials incorporated by rocks and sediments are piece of evidence of the Technosphere, called technofossils, and it is distinguish from natural fossils because, in general, are originated from rare or artificial materials, serving as a base for technostratigraphy. They are possible markers of Anthropocene, proposed to be a new Geologic Epoch that differs from Holocene since Mankind was converted into a geological force that change Earth System balance.[27,28] Consequently, wastes of massive use of coffee can ben, if preserved on Sanitary landfill (SL), be used in the future as possible geologic fossils (Technofossils) registers of the Anthropocene.[31] Even considering that a radioactive marker from nuclear fallout detonations from XX century will likely be chosen as the geological evidence that marks the beginning of the Anthropocene,[10,32,33] technofossils can be excellent auxiliary stratigraphic markers.[28,31] There are two main USW produced in association with coffee production: biodegradable waste (soggy coffee grounds and varied paper), and technofossils (aluminum and plastics). Coffee grounds are essentially composed of moist lignocellulosic, originated from different types of vegetal fibers.[6,34] On the other hand, the technofossils are shown as a composite of elementary aluminum and plastics (combined or isolated), such as, the biaxially oriented polypropylene film (BOPP).[34]

Multiple factors have affected the coffee consumption patterns, such as cultural traits, costs, and marketing strategies, while the comprehension of the environmental impacts of different coffee preparation systems is dependent on understanding these patterns and on the associated quality and quantity of USW generation. To improve our comprehension of the role of coffee brewing methods as a potential technofossil source, this study evaluates systematically the USW (biodegradable and technofossils) provided by the three coffee brewing methods most utilized in Brazil during COVID-19 pandemic.

2. Material and Methods

2.1. Place of experiments and evaluation methodologies

The estimates on USW production derived from different coffee preparation methods were performed using Biology Laboratory of Veiga de Almeida University (UVA) facilities. The three studied coffee brewing methods were chosen considering the Brazilian Association of Coffee Roasting and Milling Industry (Portuguese acronym: ABIC)[4,35] report that the main coffee preparation methods are the "Brazilian coffee brewing method" (cloth filter), coffee made in the electric coffee maker (paper filter), and coffee in capsules (K-cups).[8] The adopted operational unity used as a basis for comparison between the three preparation modes was the USW mass (g) production *per* "cup of coffee (50 mL) ready for consumption". A schematic representation of frontiers and boundaries from different ways of preparing coffee is showed in Figure 1.

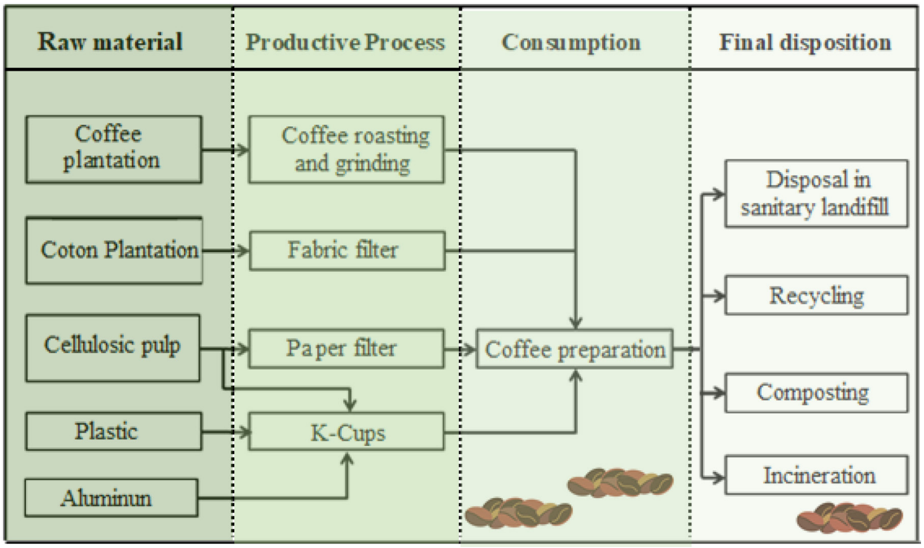

Figure 1. Frontiers and boundaries of the coffee life cycle sharing in three methods of preparation according to a Brazilian Solid Waste Policy [36]

2.1.1. Preparation method #1: "Brazilian coffee brewing method"

It was followed up the suggestion of preparation contained in the coffee maker's Pilão® pack: it was added 250 mL filtered water (measured in glass beaker) in a metal teapot and started to warm up on a Consul® stove, Erva Doce Model, until it is close to the boiling point of the water. Posteriorly, a cloth filter placed on plastic support above a thermos bottle containing about 20 g of Pilão® Coffee, received all the water volume and had his filter transferred to a thermos bottle branded Alladin® (Figure 2).

2.1.2 Preparation method #2: Electric coffee machine

As oriented by the manufacturer electric coffee machine Mondial® manufacturer Bello Aroma 2.6 model (Electric Power: 800 W), it was used 250 mL of filtered and heated water (measured in a glass beaker) (Figure 2); Adding 20 g of Pilão® Coffee; it was filtered through the Pimpinela® paper filter, model Nº 102, and the coffee was reserved in the coffee pot.

2.1.3 Preparation method #3: Capsuled coffee

It was followed wholly the orientation from the Nespresso® electric coffee manufacturer, Vermelho Rubi Model C40 (Electric Power: 1260 W): it was added a coffee capsule of Caffé Vergnano Espresso® brand on the coffee machine that contains previously 100 mL of filtered water (measured in a glass beaker), expected to be ready and transferred the liquid to a plastic cup Copobras® manufacturer, model polypropylene cup CF-180 of 50 mL (Figure 2).

2.2. Estimates of generated residues

For all methods, the obtained samples were weighed in nine replicates using an analytical balance (Mettler Toledo® brand, AL 200C model), including all the waste generated (packaging wasted, used capsules, coffee grounds, used paper filter, etc.). Each weighing estimate refers to nine replicates (N = 9) for each preparation method as an attempt to minimize possible systematic and/or random errors, attending to Central Value Limit Theory (CVLT) in statistical analysis.

2.3. Statistical analysis

Descriptive statistics included averages and standard deviation, and are presenting in the form of box plots. A Shapiro-Wilk normality test was used to evaluate if the

Figure 2. The three coffee brewing methods used in this study

results have a normal distribution. Finally, a one-way analysis of variance (ANOVA), followed by a Tukey HSD test, was used to evaluate possible statistical differences between averages, performed in entirely randomized blocks. A 95% confidence interval ($p < 0.05$) was chosen for all tests because it is considered a default in statistical analysis. Every statistic evaluation and treatment of the results were realized using codes in R language.[37]

3. Results and Discussion

3.1. Characterization of waste generated on coffee brewing methods

Firstly, the *Shapiro-Wilk* normality test demonstrated that there were no needs of normalizing the data set to use parametric analyses. The comparison of total average masses of USW obtained by different methods (Table 1; Figure 3) showed that K-cup preparation generated 56% and 42% more waste than "Brazilian coffee brewing method" and electric coffee machine procedures, respectively (ANOVA: $F = 45.3521$ and p-value = 0.00024; followed by Tukey HSD test, $p < 0.05$ with Variation Coefficient = 5.420347 %). However, there were no significant statistical differences between "Brazilian coffee brewing method" and electric coffee machine method (ANOVA, followed by Tukey HSD test, $p < 0.05$). The amount of coffee ground generated by the preparation method that uses K-cups capsules was on average 18% smaller than the others ($p < 0.05$), being the same fact observed in the previous international studies.[16,18]

The paper filter mass used in the electrical coffee machine method was 54% higher than that obtained by Hicks,[16] when comparing wastes generated by different methods: an electric coffee machine, a French press, and a capsule coffee machine. Furthermore, the masses generated by Pilão® coffee pack, just as polypropylene cups used and useless, did not show significant statistical differences ($p < 0.05$) between preparation methods. Finally, the other residues were inherent and exclusive to each preparation method (Table 1).

Coffee consumption generates a variety of residues and wastes, as observed in Table 1. As expected, the "Brazilian coffee brewing method" was that generated a fewer numbers of different types of USW *per* coffee dose produced (three), when compared USW generated on the other two methods (five), that require a bigger technological sophistication because they are "convenience products of modern life".[18] Must be highlighted that this study was ignored the contribution regarding cloth filters utilized in the "Brazilian coffee brewing method", have seen that they can be reused hundreds, or even thousands of times before they be discarded as waste in SL or USW incinerators.[15] According to the schematic conceptual model on Figure 1, the coffee ground (soggy coffee powder) obtained in every method of preparation, just as the paper filter used and useless are biodegradable waste that can be reutilized in composting to generate organic compost for ornamental plants or edible,[13,15] or forwarded to SL or USW incinerators.[18,29,30] Moreover, the different package boxes of Kraft paper for being made based on cellulosic pulp too show properties that characterize them as biodegradable waste being liable of being recycled because they are a "clean waste" and have a "carbon footprint" smaller than a plastic package or of glass.[38,39]

Although they are not necessarily inherent to the consumption of coffee in Brazil, the typical plastic cups, as presented in this study, are frequently produced from polypropylene or polyethylene and show potential to be recycled, if they are clean, but very often frequently, they are treated as rejects highly stable and inert in natural conditions and forwarded to SL and incinerators,[16] becoming

Table 1. Residues generated after the use of different methods of coffee preparing (masses proportional to a single dose of 50 mL of coffee obtained) (N = 9)

Method	Residues	Composition	Mass (g)	Total Mass (g)
#1 (Brazilian brewing) [1]	Coffee ground	Soggy Coffee Grounds	12.467±0.996	13.330±1.008
	Used cup (50 mL)	Polypropylene	0.686±0.004	
	Pilão® Coffee Pack	Polypropylene metalized[A]	0.137±0.001	
#2 (Electric coffee machine) [1]	Coffee ground	Soggy Coffee Grounds	12.297±0.473	14.636±0.502
	Paperbox of Pimpinela® paper filters	*Kraft* paper	0.143±0.001	
	Used Cup (50 mL)	Polypropylene	0.684±0.004	
	Pilão® Coffee Pack	Polypropylene metallized[A]	0.137±0.001	
	Used Paper Filter	Pulp cellulosic humid	1.375±0.023	
#3 (Capsuled coffee) [2]	Coffee ground (without capsule)	Soggy Coffee Grounds	10.507±0.537	20.805±0.797
	Used capsule of coffee (without coffee ground)	Polypropylene e aluminum	4.507±0.239	
	Used cup (50 mL)	Polypropylene	0.762±0.004	
	Package of capsule box *Caffé Vergnano* Espresso®	*Kraft* paper	3.628±0.007	
	Personal Pack's capsule	Polypropylene metallized[A]	1.408±0.010	

[A]Biaxially oriented polypropylene film (BOPP). [1]Related to initial 4g dry weight coffee, calculated as 1/5 of 20 g dry weight used for preparing 250mL. [2]Related to initial 5g dry weight coffee, as informed by the manufacturer (N = 9).

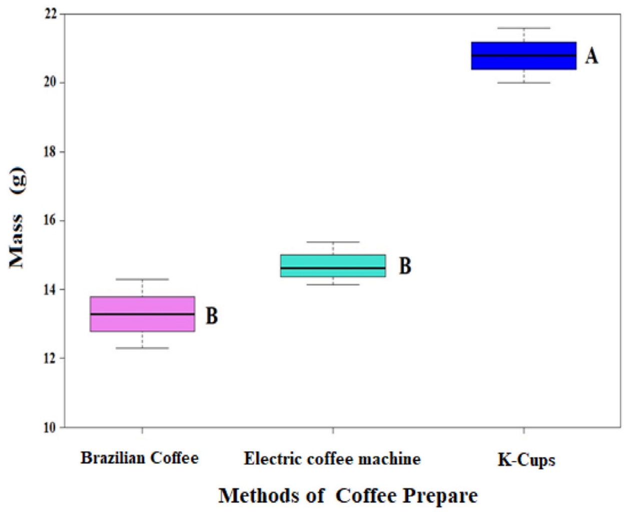

Figure 3. *Box-plots* with total masses of waste generated by different methods of preparing a single coffee dose of 50 mL. Different capital letters indicate significant statistical differences, following *Tukey* Test HSD ($p < 0.05$). (N = 9)

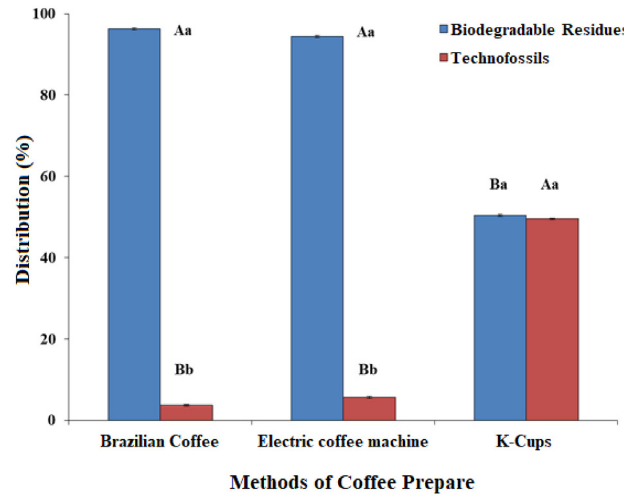

Figure 4. Percentual distribution (averages and standard deviations) between biodegradable and technofossils products from different coffee preparation methods. Capital letters different mean significant statistical difference (Tukey HSD test $p < 0.05$) between methods. Different lowercase letters indicate significant statistical difference (Tukey HSD test $p < 0.05$) between biodegradable residues and technofossils for the same method. (N = 9)

too eligible to potential technofossils from Anthropocene. On another hand, as viewed previously, the packages that present BOPP pellicle in his composition, as presented in this study, just as the plastic capsules K-Cups that are mostly constituted by polypropylene and metallic aluminum that are not biodegradable residues and although exist technologies that allow his recycling, in practice are considered too as waste that has an environmental friendly destination (SL and USW incinerators),[18] becoming too strong candidates to technofossils from Anthropocene. The BOPP pellicles are composites made by elemental aluminum and polymeric material based in polyamide, polycarbonates, and a huge variety of plastic resins, which turn extremely costly and technological complex his recycling.[40] In its turn, the K-Cup's also have a metallic variety (metallic capsules) in which 77% of the product is coated by elementary aluminum, and the other compounds are: iron, copper, manganese and compounds of ink applied to the capsules.[40]

3.2. Biodegradable residues and technofossils generated by coffee preparation

As can be seen in Figure 4, the two first methods of preparation generate a medium quantity of biodegradable residues more than 17 times above ($p < 0.05$) the amount of quantity of technofossils, already the method #3 (K-Cups) that use a "convenience product of modern life" technologically more sophisticated doesn't show significant statistic difference ($p < 0.05$) between the biodegradable residues and technofossils generated. Although the "Brazilian coffee brewing method" and electric coffee machine doesn't show significant statistic difference ($p < 0.05$) each other, the same doesn't can be said about the capsuled coffee method that shows a quantity 10 times bigger than the technofossils generated ($p < 0.05$) and a quantity 54% smaller of biodegradable residues ($p < 0.05$), respectively.

The introduction of convenient products of more sophisticated technology to be preparing domestic coffee ("Brazilian coffee brewing method" and electric coffee machine) have a capacity of change and maximize hugely the environmental impact of a rushed and banal present in 98% of Brazilian homes.[8,16] Furthermore, although don't be a target of this study, should be pointed that increase of technological sophistication provided by the electric coffee machine and coffee machine that use K-*Cups* empowers that the generation of electro-electronic residues, that constitute themselves as eloquent symbols of Anthropocene.[41]

3.3. Environmental impacts of technofossils generated by different coffee preparation methods

Regarding the two Anthropocene's technofossils evaluated in this study, is pointed that the importance of polymers and thermoplastics have due to their high environmental impact and the possibility of physically degrading in smaller particles generating microplastics (< 5 mm) and nanoplastics (< 1 mm) that can come to negatively impact the different trophic levels from different living beings present in river, lakes, and oceans.[42-44] According to Bomfim *et al.*,[34] about of 8.3 billion metric tons (Bt) of plastic were produced by Mankind until the present moment, of this total, approximately 6.3 Bt of polymers were produced since "The Great Acceleration" (between 1950 and 2015), of which only 9% were recycled, 12% were incinerated and 79% were disposed of in SL or in discarded inappropriately disposed of in the environmental. Some author estimates point that 12 Bt of plastic will be waste, or better, potential technofossils of Anthropocene disposed of in SL until the year 2050.[38]

The panorama became alarming when it is known that in 2017 were consumed in Brazil approximately 1.1 million tons of coffee, where 0.9% represents the consumption of K-Cups capsules, which characterize approximately 10 thousand tons of this raw-material only in this modality of preparation, according to a survey preparation by EUROMONITOR.[45] Beyond that, the research predicts the increase of consumption of 1 thousand tons per year until 2021, because the Brazilian consumers are being attracted to price drops of machines that utilize K-Cups,[35,46,47] and a significant portion of the Brazilian workforce (schools,[10,11,19,20] universities,[21] etc.) has been working at home since the World Health Organization (WHO) declared, on March 11, 2020,[10,11] that the COVID-19 pandemic had become a serious global zoonotic crisis.[11,22] With the obtained results in this study, calculated that K-Cups could provide the generation of approximately 41 thousands of tons of residues (biodegradable + technofossils) *per* year, which will inevitably be disposed of either in SL (destination of 59.5% of UWSs generated in Brazil), or in controlled landfills (23%) or dumps (17.5%), according to ABRELPE.[47] Against this perspective become urgent the effectuation of initiatives of reduction of the environmental impact of food packaging, just as preconized by "3 Rs" theory: reduction, recycling, and reuse.[25,39]

3.4. Challenges and Alternatives for mitigating Technofossils generated by different coffee brewing methods

Some alternatives are recognized, still incipient, to mitigate environmental impacts due by K-Cups, in Brazil and in the world,[16] for example, in Italy the aluminum capsules are disassembled and recycled and the coffee grounds are only forwarded to composting through a partnership with an aluminum recycling company. In Brazil, a startup keeps a partnership with Nescafé® so that your capsules made in polypropylene are recycled and become new products to this company. However, although the startup has a monopoly on K-Cups recycling technology in the country, numerous obstacles were reported in the effectiveness of reverse logistics and the performance is restricted to the state of São Paulo.[34] In addition, international non-pharmacological control measures (full and partial Lockdown) to contain the spread of the new Coronavirus SARS-CoV-2 in Brazil and practically paralyzed the recycling activities of all types of waste during the COVID-19 pandemic.[10,22]

Although opportunities exist to a potential reduction in environmental impacts due to K-Cups, dissembling them into their individual and recycling them, the technological challenges and practical order indicate that could be practically impossible that such late scale achievement in a country with continental, like Brazil,[16,34] with the economy highly impacted by the COVID-19 pandemic.[10,22] Generally, K-Cups are externally a mixture of different polymeric resins and internally composed of a plastic filter and an aluminum sheet that seal the system,[16,34] as seen in the Figure 5. Moreover, the K-Cups polypropylene based have high resistance to weathering, even though they are constituted as a mixture of polymers and contaminated with 11 polyamides.[34]

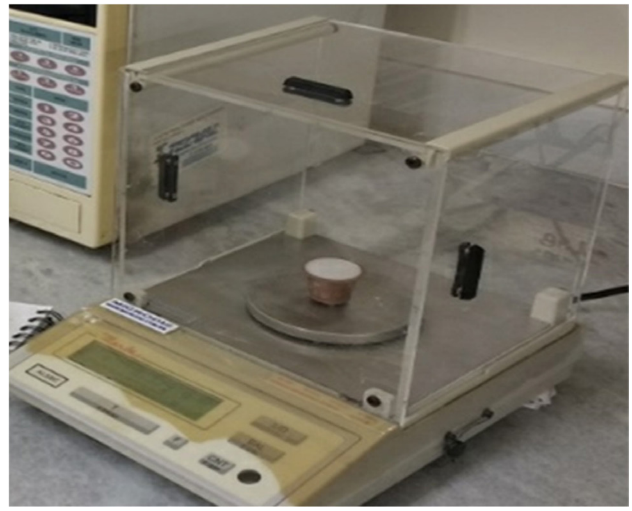

Figure 5. K-cup capsule being weighed used in this study

To mitigate the generation of Anthropocene technofossils, it was also suggested that materials made from aluminum and plastic from coffee machines that utilize capsules were covered with biodegradable plastics (bioplastics), as they are more environmentally friendly.[16] However, the transition of K-Cups that are composed of highly stable and inert (elemental aluminum and plastic) by biodegradable plastics would have a significant impact on the final disposal in SL, since, in the anaerobic condition found in these civil engineering facilities, organic matter would be preferably converted to methane (CH_4), a greenhouse gas (GHG) 25 times more powerful than CO_2 to increase global climate change.[16] An alternative would be the popularization of composting of these eventual capsules produced with bioplastics, but even more, carbon would be needed to produce them, which would make the process environmentally unsustainable.[16]

Without the effects of implementing a truly sustainable and circular economy in the next years, with the development of new management models based in reverse logistic of technofossils and without an effective understanding of the different usage flows, from the evaluation of the cycle of life of these materials, the environmental impact derived from consumption of coffee by world population, tends to become even more noticeable and harmful, especially in the public waste management system of residues, which will necessarily have to promote solutions for these new social habits, and consumption patterns.[25] In addition, the current Brazilian scenario due to the COVID-19 pandemic makes it even more difficult to recycle any type of waste, given that the recycling industry has been practically paralyzed for over a year, as it is not considered an essential activity for the country's economy.[10,22]

Alternatively, later studies could evaluate if different ways of preparing coffee that comes gaining increasing acceptance on Brazilian market, such as, an "Italian coffee machine" (*Moka pot*) and the "French press" could be considered eligible for processes inherent to a circular economy, in which raw material would constitute inputs for a new product cycle.[23,30]

Finally, as preconized by Brazilian Legislation the responsibility for promoting the utilization and/or reduction of residues,[36] just as the utilization of inputs with lower environmental impacts and that promote sustainable development are shared by the whole society. Therefore, in the absence of public policies to promote the reduction, reuse, and/or recycling residues (biodegradable or technofossils) generated different coffee brewing methods will be up to the consumer to play a key role and be directly responsible for a conscious choice of the most environmentally friendly coffee preparation method.[17]

4. Conclusion

International coffee consumption has been growing since the start of the "Great Acceleration" and, without any downward trend, even after the beginning of the crisis of the international capitalist system in 2008 and, now after the start of the serious global zoonotic crisis caused by the new Coronavirus SARS-CoV-2 in 2020.

The introduction of convenient products of modern life (such as the electric coffee machines, and capsule coffee machines) for domestic coffee preparation resulted in qualitative and quantitative changes in the generation of residues when compared to the traditional methods of use. However, a greater generation of residues *per* cup (50 mL) of coffee was obtained when using the K-Cups capsules preparation method compared to the two technologically less sophisticated preparation methods ("Brazilian coffee brewing method" and electric coffee machine). Therefore, capsules show a higher potential to produce Anthropocene's technofossils, about 10 times above that other preparation methods, this finding suggests more severe negative impacts, since these technofossils can be converted into smaller particles, generating microplastics and nanoplastics in different environmental matrices.

Although the trend is that the international consumption of coffee will continue to grow over the next few years, it is important to assess the changes in habits and consumption patterns of this beverage. Lockdowns in Brazil and the world could become an element of significant change in which workers at home, due to the COVID-19 pandemic, will preferentially adopt more technologically sophisticated methods of coffee preparation and with that significantly increasing the generation of technofossils that may be improperly disposed of in the environment.

Acknowledgements

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brasil (Finance Code 001).

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