

RECOMMENDATIONS FOR BARBECUE CHARCOAL CHOICE CRITERIA

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ABSTRACT: Brazil is the principal producer and consumer of charcoal in the world, where around 10% is used for cooking food on stoves, wood stoves, and barbecue grills. However, in the country, there are no official regulations to assess the quality of this product. The objective of this study was to investigate some of the main technical and qualitative aspects of charcoal used for barbecue, supporting the choice during product purchase. For this, a sampling of the product was conducted in commercial establishments in the city of Piracicaba (São Paulo, Brazil). The charcoal obtained was according to the places of acquisition: supermarket chain, independent supermarkets, slaughterhouses, gas stations, and one called "others". Samples of products from brands present at the time of visits were collected in two different years to verify the seasonality of the products. The frequency of brands, location of suppliers, prices, and informational aspects of packaging were analyzed in detail. It was verified the existence of several brands marketed in the studied categories. Most product suppliers are located in the State of São Paulo. Product prices showed significant variations between the two collections carried out, with a notable increase (18%) in charcoal sold by the supermarket chain category. The information standards available on product packaging have varied. The brands collected in the supermarket chain category presented the greatest amount of information and attributes on charcoal packaging, ensuring significant support for consumers to select it.

Keywords: charcoal, prices and packaging, seasonality, product characteristics

RECOMENDAÇÕES PARA CRITÉRIOS DE ESCOLHA DE CARVÃO PARA CHURRASCO

RESUMO: O Brasil é o principal produtor e consumidor de carvão vegetal no mundo, onde cerca de 10% é destinada a ao cozimento de alimentos em fogões, fogões a lenha e churrasqueiras. Porém, no país, não existem regulamentações oficiais para que avaliem a qualidade desse produto. O objetivo deste estudo foi investigar alguns dos principais aspectos técnicos e qualitativos do carvão vegetal utilizado para churrasco, subsidiando na escolha durante a aquisição do produto. Para isso, foi conduzida uma amostragem do produto em estabelecimentos comerciais da cidade de Piracicaba (São Paulo, Brasil). O carvão vegetal foi obtido de acordo com os locais de aquisição: rede de supermercados, supermercados independentes, frigoríficos, postos de gasolina e um denominado "outros". Foram coletadas amostras dos produtos de marcas presentes no momento das visitas em dois anos distintos para verificar a sazonalidade dos produtos. A frequência das marcas, localização dos fornecedores, preços e aspectos informativos das embalagens foram analisados detalhadamente. Verificou-se a existência de diversas marcas comercializadas nas categorias estudadas. A maioria dos fornecedores do produto estão localizados no Estado de São Paulo. Os preços dos produtos apresentaram variações significativas entre as duas coletas realizadas, com aumento significativo (18%) do carvão vegetal comercializado pela categoria rede de supermercados. Os padrões de

informações disponíveis nas embalagens dos produtos foram diversificados. As marcas coletadas na categoria rede de supermercados apresentaram a maior quantidade de informações e atributos nas embalagens do carvão vegetal, garantindo maior subsídio para que os consumidores o selecionem.

Palavras-chaves: carvão vegetal, preços e embalagens, sazonalidade, características dos produtos.

1 INTRODUCTION

For centuries, charcoal, one of the oldest man-made preparations, has been considered essential for humanity, and even today, in the 21st century, it remains a primary source of energy in many developing countries (AKOWUAH et al., 2012; VICENTE et al., 2017; JELONEK et al., 2020). Globally, the production of charcoal has tripled in the last 50 years from 17.3 million tons in 1964 to 58 million tons in 2018 (FAO, 2018; RODRIGUES et al., 2019). Its use is in the chemical and pharmaceutical industry as raw material, in Brazil, for example, it is in steel and metallurgy that its use is widely and strongly disseminated, resulting in annual consumption of about 5.3 million tons (DUFOURNY et al., 2019; IBA, 2020). For the retail consumer, its most well-known use is in cooking food, being considered one of the oldest practices used by humanity (VIKSNA et al., 2008; WARNES, 2008; LEDESMA et al., 2015). Used worldwide, charcoal is popular for preparing grilled meats, enhancing the flavor of the food (IQBAL e KIM, 2016). Even with widespread use, especially in underdeveloped countries, charcoal production has shown that it is still a practice characterized by the low valuation of the sector, often related to discrimination, marginalization, and the existence of little economic, environmental and social value (RUEDA et al., 2015).

Despite the wide application, there are few measures to control the quality of charcoal characteristics. In 2005, the European Standards Council (EN) approved the EN 1860-2 (2005) standard, which indicates limit values for certain parameters that characterize the quality of charcoal, from a consumer health and safety perspective, being considered one of the few quality guidelines for domestic charcoal. Even in countries that are considered major charcoal producers, such as Brazil, measures that can be taken to control the quality of

charcoal for domestic use in a barbecue are not known (DIAS JÚNIOR et al., 2015). In Brazil, the São Paulo State is the only one to have a formal mechanism for quality control guidelines for charcoal for barbecue and can provide subsidies for control in other regions of the country. This normative decision is Resolution nº 40 (SÃO PAULO, 2003; SÃO PAULO, 2015) quality seal is voluntary and aims to determine a minimum quality standard, including reference values for moisture content, fixed carbon content, volatile material content, ash content, and size of parts.

Despite the search for improvements in the production, logistics, and distribution of charcoal for cooking, there is still a lack of standardization of processes and products. Thus, it is very common for a trademark to use charcoal from different producers or distributors, in the same way, that a same producer or distributor can supply to different brands (MEIRA et al., 2005; DIAS JÚNIOR et al., 2018). It is noted that widespread brands of barbecue charcoal in Brazil are packaged and marketed by distributors who do not produce charcoal, intermediating the production chain and who often take most of the profit. This arrangement of the charcoal chain involves the aggregation and mixing of charcoal from various sources, from different processes and, consequently, of dubious quality for food preparation, since it is proven that unsuitable products contribute to increase the content of carbon monoxide and carbon dioxide and increased particle emissions, which can cause several problems to the environment and human health, (VIKSNA et al., 2008; LEDESMA, et al., 2015; DUEDAHL-OLESEN et al., 2015; JELONEK, et al., 2020).

Even though charcoal is a popular choice of fuel for barbecue, almost no data specifying its properties are available to consumers (JELONEK et al., 2020). In addition to technical attributes to qualify the use of charcoal, the issues inherent to product

packaging, such as size, type (paper or plastic), fuel lighters, handle presence and present information, are important attributes to be observed in the acquisition of product (DIAS JÚNIOR et al., 2015). This information may provide indications that the product addresses environmental and social issues (MEIRA et al., 2005), allow the traceability of the product from the output of the production unit to the consumer shelf (BRAND et al., 2015), and, over time, ensure the seasonality, maintenance, and availability of the product. These actions would collaborate for decisions and strategies to improve the quality of the charcoal, also adapting to the needs of the consumer (OKELLO et al., 2013).

Due to the difficulties of a more precise definition of charcoal quality for food preparation, the search for information that can broaden the range of references about the issue is extremely important, aiming for a higher valuation of the product. The quality of barbecue charcoal may vary depending on the brands sold and the commercial categories that distribute the product. An exploratory analysis is required to obtain results and indicatives, considering that seasonality may interfere with the qualitative charcoal characteristics available to the retail consumer. This research work aimed to investigate some of the main technical and qualitative aspects of charcoal used for barbecue, providing clues to future actions aimed at attracting consumer's attention to product selection.

2 MATERIAL AND METHODS

2.1 Sampling of charcoal

The products were obtained from the commerce of the municipality of Piracicaba, state of São Paulo, southeastern Brazil, located at an altitude of 524 meters, Piracicaba has the following geographical coordinates: Latitude: 22 ° 43 '30' South, Longitude: 47 ° 38' 51 " West. The city was chosen due to its relevance to the consumption of the product (PRÓCARVÃO, 2002; SGARBI, 2013). A sampling process was carried out dividing the commercial establishments into five categories: Supermarket chains (S), supermarket chains

with branches distributed in different parts of Brazil; Independent supermarkets (I), supermarkets of medium and large size, but with a unique location in the city of Piracicaba; Meat houses (M), food trade of beef, pork, chickens and processed meat of animal origin; Gas stations (G), trade-in car fuels that also sell charcoal in your convenience store; Category of commercial establishments known as "others" (O), consisting of grocery stores, mini-markets, bakeries, greengrocers and retailers that sell charcoal.

This categorization was carried out to analyze the hypothesis of the existence of more specific quality control in commercial categories of larger commercial size, more organized, thus providing superior products to consumers. Ten commercial establishments by category were selected randomly, located under the reference area of the 63 districts that make up the city of Piracicaba, SP, Brazil. The list of commercial establishments used for the selection was obtained from the Commercial and Industrial Association of Piracicaba. Sampling was conducted in two phases, the first in December 2014 and the second in December 2015. The same establishments were visited again in the second sampling.

The products were purchased in their original packaging, collecting two packages (3 and 5 kg) of each brand, according to availability at the time of the visit to the selected commercial establishment. This quantity guaranteed the randomness of the samples. For comparison, only brands present during the first sampling were acquired in the second sampling. When not more offered the mark was named as "absent".

2.2 Data collection

A questionnaire was designed and applied to owners and employees of commercial establishments, seeking to understand economic and technical aspects for qualifying the use of charcoal. The following criteria were evaluated: the price of charcoal, information present on the packaging, type of packaging, consumer preference for a product and option to change brands.

2.3 Data analysis

The data were evaluated through descriptive statistics. For product prices, mass and marketed value were considered, testing for normality (Kolmogorov) and homoscedasticity of variances (Levene). Then, the analysis of variance was conducted and for multiple differentiation of means, the Scott-Knott test was applied, at 95% probability. Histograms were developed to observe the distributions of product prices for both sampling phases.

The principal components analysis (PCA) was also carried out to inform the proximity between the products collected (charcoal brands), depending on the characteristics of the packages. For this purpose, the binary logic was used for each item

and/or aspects observed on the packaging of the products (MANLY e JAN, 2008). Thus, each observed aspect was susceptible to two values: 1 (observed in the packages) and 0 (absent). Standardized mean values with mean zero and variance equal to one were considered for each analyzed variable. The data correlation matrix was used for the PCA. Linear combinations were interpreted by normalized eigenvectors and correlations between the original variables and the main components. The analyzes were performed using Minitab software 16.0®.

3 RESULTS AND DISCUSSION

Table 1 presents the results of the occurrence and inconstancy of the products collected in the first and second sampling.

Tabela 1. Products collected during in phase I (2014) and phase II (2015) of sampling

Brand and category	Presence in Phase		Absolute Frequency in Phase		Relative Frequency (%) in Phase		Producer or Distributor Location in Phase	
	I	II	I	II	I	II	I	II
	S1	✓	✓	2	2	1.9	3.1	Nova Ponte (MG)
S2	✓	✓	2	2	1.9	3.1	Cândido Mota (SP)	Cândido Mota (SP)
S3	✓	✓	2	2	1.9	3.1	Maringá (PR)	Maringá (PR)
S4	✓	✓	2	2	1.9	3.1	Lavras (MG)	Lavras (MG)
S5	✓	✓	2	2	1.9	3.1	Maringá (PR)	Maringá (PR)
S6	✓	✓	2	2	1.9	3.1	Bariri (SP)	Bariri (SP)
S7	✓	×	2	-	1.9	-	Paranapanema (SP)	-
S8	✓	✓	4	4	3.7	6.3	Salto de Pirapora (MG)	Atibaia (SP)
S9	✓	×	2	-	1.9	-	Jacupiranga (SP)	-
S10	✓	✓	2	2	1.9	3.1	Americana (SP)	São Paulo (SP)
I10	✓	✓	2	2	1.9	3.1	Americana (SP)	São Paulo (SP)
I11	✓	✓	4	4	3.7	6.3	Piracicaba (SP)	Piracicaba (SP)
I12	✓	✓	2	2	1.9	3.1	Abaeté (MG)	Abaeté (MG)
I13	✓	✓	4	2	3.7	3.1	Rio Claro (SP)	Rio Claro (SP)
I14	✓	✓	4	4	3.7	6.3	Anhembi (SP)	Anhembi (SP)
I15	✓	×	2	-	1.9	-	Descalvado (SP)	-
I16	✓	✓	2	2	1.9	3.1	Piracicaba (SP)	Piracicaba (SP)
I17	✓	✓	2	2	1.9	3.1	Torrinha (SP)	Torrinha (SP)
M13	✓	✓	14	6	13.0	9.4	Araras (SP)	Rio Claro (SP)
M16	✓	✓	4	4	3.7	6.3	Piracicaba (SP)	Piracicaba (SP)
M18	✓	×	2	-	1.9	-	S ^{ta} Maria da Serra (SP)	-
G13	✓	✓	8	2	7.4	3.1	Rio Claro (SP)	Rio Claro (SP)
G16	✓	✓	14	10	13.0	15.6	Piracicaba (SP)	Piracicaba (SP)
O6	✓	×	2	-	1.9	-	Bariri (SP)	-
O7	✓	✓	4	2	3.7	3.1	Paranapanema (SP)	Paranapanema (SP)
O11	✓	×	2	-	1.9	-	Piracicaba (SP)	-
O12	✓	✓	2	2	1.9	3.1	Abaeté (MG)	Abaeté (MG)
O15	✓	×	2	-	1.9	-	Descalvado (SP)	-
O16	✓	✓	6	2	5.6	3.1	Piracicaba (SP)	Piracicaba (SP)
O19	✓	×	2	-	1.9	-	Rio de Janeiro (RJ)	-
O20	✓	×	2	-	1.9	-	São Manuel (SP)	-
:	31	22	108	64	100	100	-	-

Where: Numbers indicate how product brands; S = Supermarket chain; I = Independent supermarkets; C = Meat house; G = gas stations; O = others. The symbols: ✓ = presence; × = absent. The abbreviations in brackets are relative to the states of the Brazilian federation: MG = Minas Gerais, SP = São Paulo, PR = Paraná. RJ = Rio de Janeiro. **Source:** The authors (2022)

In the first sampling, ten brands were detected in the category of supermarket chains (S), eight brands in the category independent supermarkets (I), three brands in the category of meat house (M), two brands in the gas stations (G) and eight brands in the category called "others" (O). In the second sampling, one year after the first one, it was observed that the number of brands decreased considerably (29% reduction), demonstrating the inconstancy of products on the market. The category that most reduced the availability of brands was the "Others" category, with a reduction of 62.5%, within a year. The other categories had the loss of one or two trademarks. According to the results obtained by the application of the questionnaire, commercial categories of smaller commercial sizes do not have a standard for the selection of suppliers or even fixed vendors for charcoal. In this case, the choice of products for commercialization is made based solely on the price, giving preference to those of lower cost. Often these products are sold to final consumers at a lower price than the other categories, however, probably increases the possibility that charcoal is inappropriate for barbecue use.

The frequency of the marks presented variation between the two sampling phases. For example, the M13 brand and the G16 brand have achieved high frequencies (meat houses and gas station categories, respectively), that is, the consumer is more likely to find those brands on the shelves of the trades in those categories. This is justified because of the small number of brands available at the time of sampling for the categories and because the supplier or distributor is located in the municipality itself or nearby cities (from 40 to 60 km from Piracicaba) (BRAND et al. 2015). There was an increase in the relative frequency from the first to the second sampling due to the decrease of the products in that time interval (31 to 22) since the methodology of this research was to collect in the second sampling only the marks present in the first sampling.

The most structured commercial categories are intended to control the quality of the products and the maintenance of a brand and price to the retail consumer. For example, it has been detected that some supermarket chains

have routines of visits and inspection of the productive processes of charcoal, requiring aspects that relate to raw material, carbonization, regularization of workers, environmental requirements, packaging, transport, besides the physical characteristics, chemical and mechanical properties of charcoal. Although the smaller commercial size, independent supermarkets also seek fixed suppliers, systems or inspection approaches have not been reported. Categories such as meat houses, gas stations, and "others", reported that the acquisition of the products for resale is made considering mainly the price and the proximity of the suppliers. In these categories, the frequency of charcoal volatility may be even higher since quality is the least observed aspect for consumers to purchase the products (DIAS JÚNIOR et al., 2015).

It was also observed that some brands were exclusive of certain categories studied (Table 1). In supermarket chains, this exclusivity was due to its brand, given that some commercial groups in Brazil have their brands spread and even recognized for their high quality and price. This is a result of a continuous quality inspection that accompanies steps from the acquisition of the raw material to the final product. There are product brands that have been identified in more than one commercial category, a fact also observed by Rosa et al., (2012) and Brand et al. (2015) when studying charcoal in different stores in the states of Espírito Santo and Paraná, respectively. For example, brands 6 and 7 appeared in the supermarket chains and the category "others"; brand 10, in chains and independent supermarkets; brands 13 and 16, which are unique in the gas stations category, have also been identified in the independent supermarket and the "others". These results support the hypothesis that a supplier results in the distribution of different brands of charcoal or the same brand, which can be met by several suppliers of the product when considering mainly availability and price.

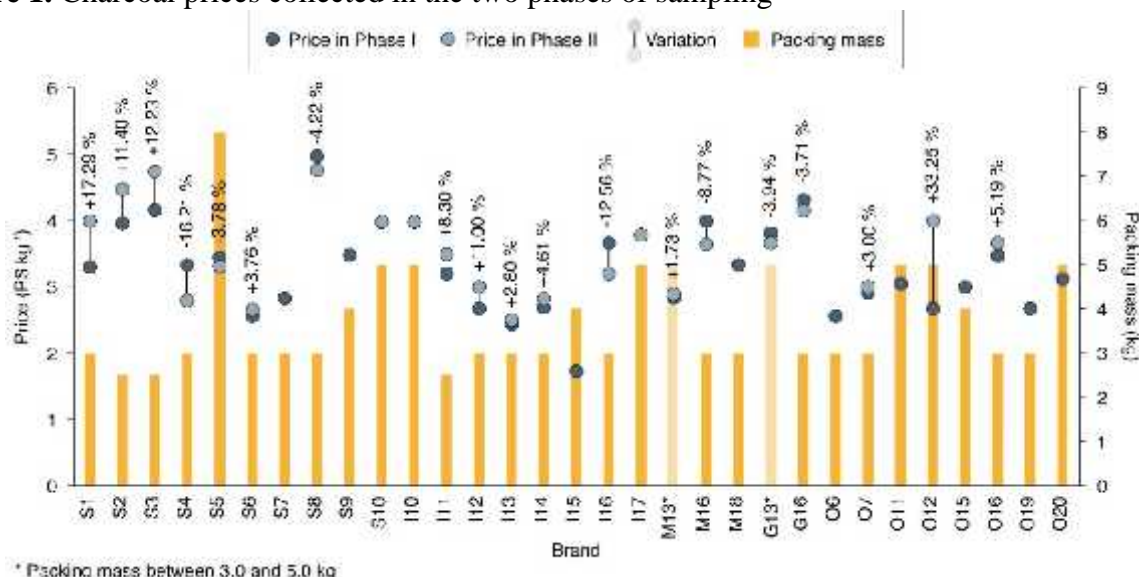
In both samples, the majority of producers and, or distributors (> 70%) are in the state of São Paulo, followed by Minas Gerais, which contributes with 16.1% of the brands identified in the first sampling and 18.2% in the

second sampling. The other states with smaller proportions were Paraná and Rio de Janeiro. Traders reported that they negotiate mostly with distributors and producers in the Minas Gerais State, but that despite the low cost, charcoal is considered "light", low density, and the acceptance by consumers would be lower, even if cheaper. The needs of charcoal consumers through the QFD (Quality Function Deployment) tool (DIAS JÚNIOR, et al., 2015; DIAS JÚNIOR, et al., 2018). The author's report that among consumers' needs is that the product "provides heat for longer" and that they would not care about the price. This observation

emphasizes the need for dense charcoal with a high heat capacity to allow cooking during the barbecue (DIAS JÚNIOR, et al., 2020).

Figure 1 shows the average prices (R\$ kg⁻¹) of the products sampled in the two phases of the study. The highest price between the two samplings was product S8 (R\$ 4,97), while the lowest observed value was product I15 (R\$1,73), collected during the first sampling of the study. Between the two sampling intervals, there was an increase of up to 33.25% for the O12 brand and a decrease of up to -16.21% for the S4 product.

Figure 1. Charcoal prices collected in the two phases of sampling



* Packing mass between 3.0 and 5.0 kg

Where: S = supermarket chain; I = independent supermarkets; M = house of meat; G = gas stations; O = other commercial establishments. Values in brackets correspond to the coefficient of variation. **Source:** The authors (2022)

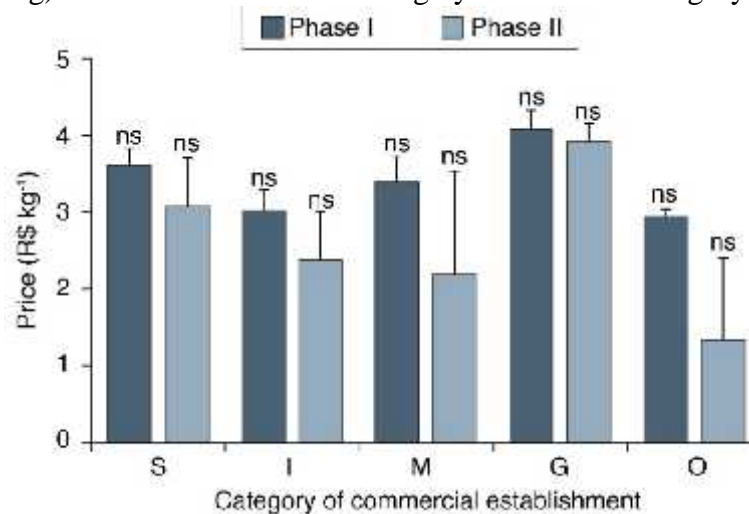
According to Riegelhaupt and Pareyn (2010), transportation is one of the factors contributing to the increase in the price of charcoal. Periods of high commercialization values encourage charcoal production activity and the consequent decrease in price due to the high supply provided (CASTRO et al., 2007; TIPPAYAWONG et al., 2020). However, this offer is considered unstable, due to seasonal and random fluctuations, during the year (COELHO JÚNIOR et al., 2006; DOGGART et al., 2020). Another aspect to be considered is the price variability in the charcoal market, due in part to a large number of producers, distributors, and suppliers of the product (COELHO JÚNIOR et al., 2006; BRAND et al., 2015).

Brands that have production units close to the municipality can lower the final value of charcoal to the retail consumer (BRAND et al., 2015), due to the lower cost of transport. This may justify the fact that the S8 product presents a higher price for the first sampling when compared to the second one since there was a change of supplier from a more distant municipality (Salto de Pirapora, MG) to a nearby one (Atibaia, SP). The product with the lowest observed price (I15) has the supplier unit located in a municipality near the sampling site of this study, only 125 km.

Based on Figure 1, which shows the average values of the two samplings by commercial category, there were no differences between prices, however, in absolute form, the

highest value of charcoal was for the category of fuel stations and the lowest value for the category called "others".

Figure 2. Prices (R\$.kg) of charcoal for food cooking by commercial category

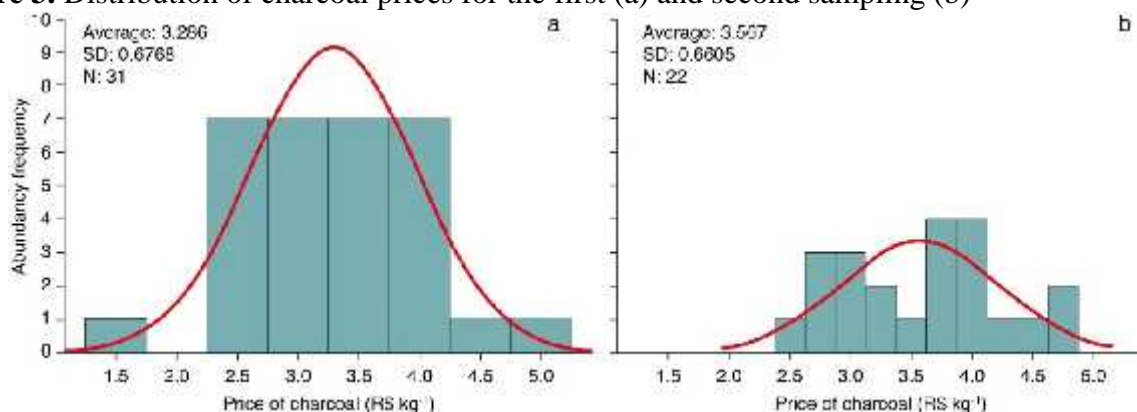


Where: S = supermarket chain; I = independent supermarkets; M = house of meat; G = fuel stations; O = other establishments. Dispersion values correspond to the standard error of the mean. ns = not significant at 95% probability. **Source:** The authors (2022)

In general, the results support the idea that supermarket and fuel stations chains commercialize charcoal at a higher cost than the other categories. Average prices were higher for the first phase of the study in the five categories studied. It is also observed that the corresponding deviations were greater for the second sampling. 2014 in Brazil was a year of several events. The country hosted the Football

World Cup; there were political representation elections; water crisis in the State of São Paulo, among other factors that may have influenced the price of wood and charcoal. The highest concentration of the distribution was found between R\$ kg⁻¹ 2.50 to R\$ kg⁻¹ 4.00 for the first phase (Figure 3a) and a little more variable (from R\$ kg⁻¹ 3.00 to R\$ kg⁻¹ 4.00) in the second phase (Figure 3b).

Figure 3. Distribution of charcoal prices for the first (a) and second sampling (b)



Source: The authors (2022)

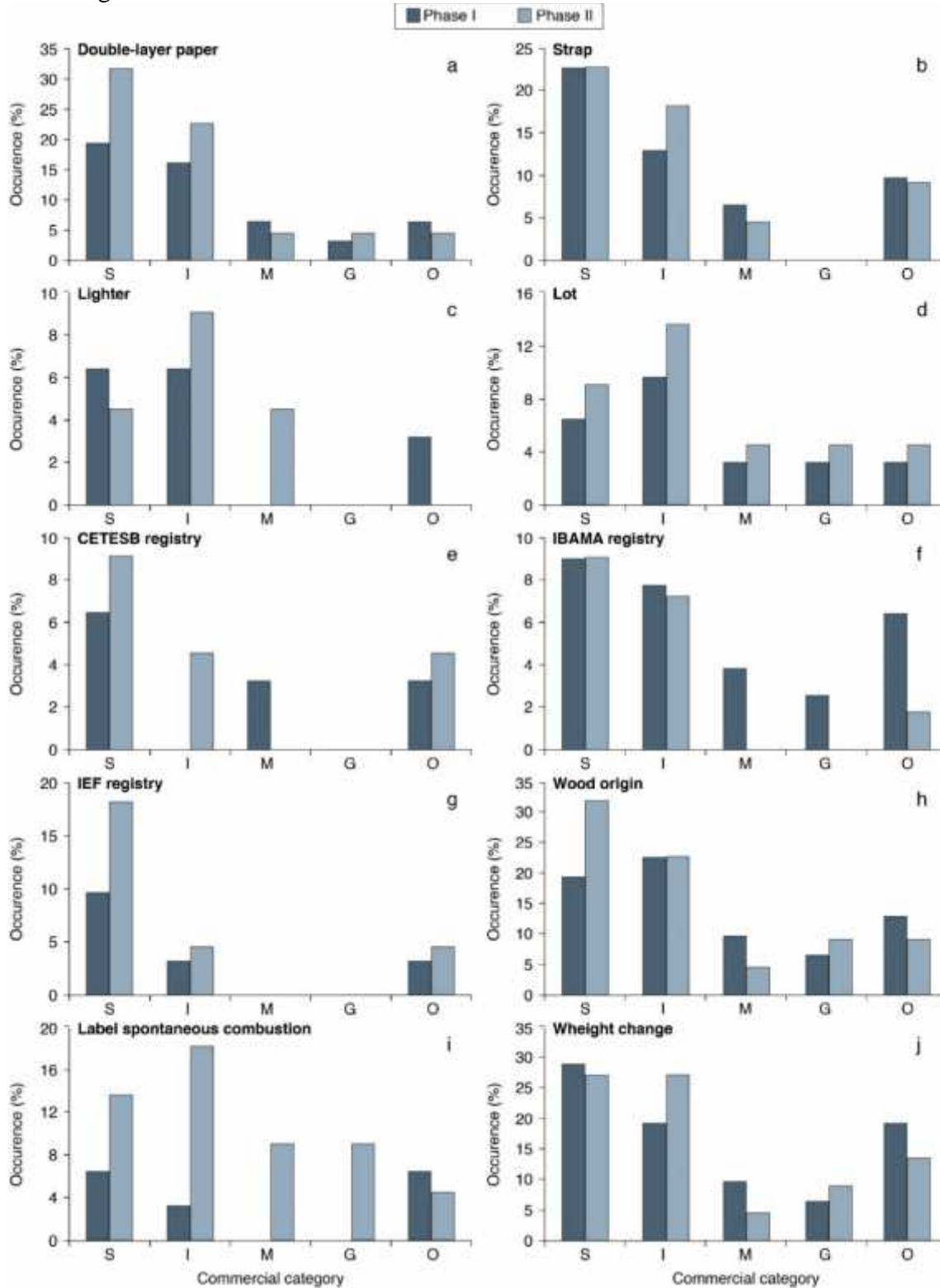
Charcoal packs are important in product protection and storage, facilitating transportation to the final consumer when they have handles or supports. There are also fuel lighters for ignition aid and important

information about the production, the origin of the raw material, registration in environmental agencies, a lot of production among others, guaranteeing to the consumer that charcoal was produced in compliance with legal

environmental conditions, social and occupational health (MEIRA, et al., 2005; DIAS JÚNIOR et al., 2015). Figure 4 shows the

results of the technical attributes analyzed in the packaging of the products collected in the five commercial categories studied.

Figure 4. The information present on the packages of charcoal collected in the five commercial categories



Where: S = supermarket chain; I = independent supermarkets; M = meat houses; G = fuel stations; O = others commercial establishments. Registry CETESB = registration of licensing in the Environmental Company of the State of São Paulo; Registry IBAMA = registration of licensing in the Brazilian Institute of Environment and Renewable Resources; Registry IEF = registry at the State Forestry Institute of Minas Gerais. **Source:** The authors (2022)

It can be noticed that the products presented paper packaging, with the minority in the paper of double layer, more present in the brands found in the category supermarket chain. This type of packaging confers greater resistance to tears in falls or impacts, hindering perforations and exposing the charcoal to the environment, which can compromise its quality.

Support straps and lighters to aid in the ignition of charcoal are items that provide comfort to consumers. These items were observed in some products (eg S1, S4, S6, S8, S10, I10) of the commercial categories investigated, in higher percentages (9%) in supermarket chains and independent supermarkets. That there is no relation between these items and the price, also they can be considered differential attributes in the quality of the products (BRAND et al., 2015). Present in most of the brands found the production batch allows the traceability of the production, facilitating the quality control from the exit of the carbonization kiln to the shelf of the consumer (BRAND et al., 2015). Similar aspects to the other items analyzed above were observed in higher percentages in the categories of supermarkets and independent supermarkets.

Thus, based on Figure 3, it can be observed that the products collected in the supermarket chain category presented the highest percentage of adherence to the necessary regulatory attributes (CETESB, IBAMA, IEF, and timber origin records) for the commercialization of charcoal. Information regarding registration in environmental agencies was identified, with the Environmental Company of the State of São Paulo being the organ in which the products were least adhered to. Only S7, S8, I10 (phase II), M18 and O7 products have this number on their packaging. The registration with Brazilian Institute for the Environment and Renewable Natural Resources was the one that mostly consisted of the products collected since it is an environmental requirement for the commercialization of charcoal. Also, the State Forestry Institute registry was observed in products originating in the States of Minas Gerais and Paraná (Table 1). The importance of

these records is related to the guarantee that the wood used to produce charcoal has been legally harvested. Information about the origin of wood used in the production of charcoal is a very relevant aspect due to the increased environmental awareness in recent years. Most of the products collected inform this characteristic, however, specific laboratory analyzes must be carried out to prove such information. In addition to the environmental aspects, knowledge about the wood used in the process can serve as an indication of the potential of the charcoal that will be consumed.

The impossibility of spontaneous combustion as a characteristic of charcoal (ROHD, 2005) is a subject discussed by the production chain due to the validity of Resolution 420 of the National Agency for Land Transport (BRASIL, 2004). According to the government agency (ANTT), charcoal is classified as hazardous, belonging to Class "4.2 - Spontaneous Combustion". Despite this, a study carried out by the Science and Technology Foundation of the state of Rio Grande do Sul (CIENTEC) indicates that charcoal does not present this characteristic, conferring the decoupling of the state to the Resolution (ROHD, 2005). Because of Resolution 420, the cost of transport increases by up to 30% due to the security measures imposed for the other states. Most of the products collected did not present the spontaneous combustion label (Figure 3) but were nevertheless identified in some of them (ex: S2, S4, S6, I11, O6).

Few brands had stamps of provenance and quality. Only at the first sampling was observed the products S1, S5, S8, I12, and O12. These are seals relating to a quality inspection of the distributor (S8 and S5) or the environmental agency supervising the state of origin as a guarantee of product quality (S1, I12, and O12). It was also observed that most of the products inform that charcoal can have its mass changed due to its high hygroscopicity (BERGERON, et al., 2013; DIAS JÚNIOR, et al., 2016; SILVA, et al., 2018).

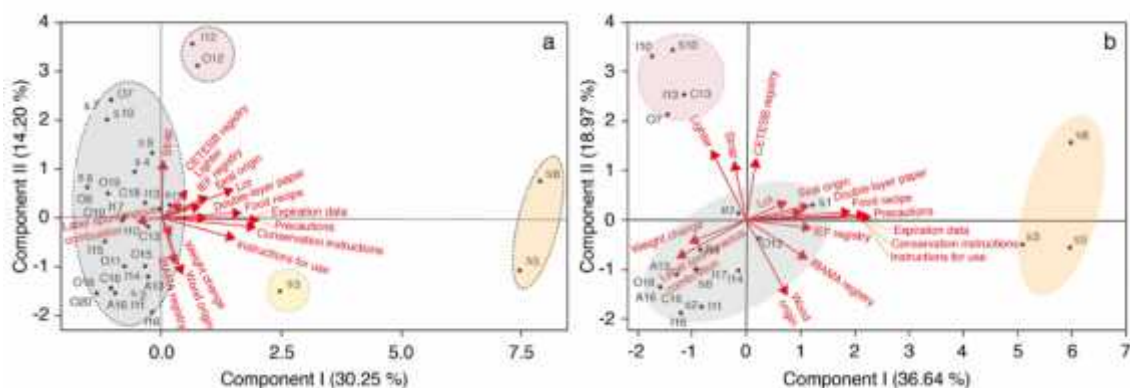
Some information on instructions for use, conservation, precautions, shelf life, and food recipes were not observed, detected only

in brands sold by the category of the supermarket chain (S5, S8, and S9). These actions indicate a differential of the category about the others studied. In general, the packaging did not present standardization about the information provided, a fact also observed by Brand et al., (2015) in charcoal brands sampled in cities of the state of Santa Catarina.

The importance of the information contained in the packages was observed by Dias Júnior, et al., (2015) as one of the main items desired by consumers of barbecue charcoal. The authors also pointed out that consumers would be willing to "pay a little more" for

higher quality products, which justifies the importance of these aspects in the choice of purchase. The characteristics that seek to select specific items of product quality are defined in the course of the work, thus maintaining the desired incorporations throughout the entire process, which could be applied to the targeting and suitability of the charcoal packages (SHEN et al., 2000; CHAN, 2002; DIAS JÚNIOR, et al., 2015). Figure 5 show the ordering diagrams of the variables (information and items observed on the packages) as a function of the first two main components.

Figure 5. Ordering diagram of the items and information collected on the packaging of the products collected in the first sample (a: 2014; b: 2015), considering the scores and eigenvectors of the main components I and II



Source: The authors (2022)

In the first sampling (Figure 5a) it is possible to differentiate four groups: the first-formed by-products S5 and S8; the second for products I12 and O12; the third with a single representative, S3; and a fourth group formed by the other products. However, one group appears more distant from the others (R5 and R8). This distancing was caused by the fact that these products presented most of the information and items analyzed on their packaging.

The formation of the group consisting of the trademark S3 occurred due to the absence of the handle, fuel lighter, and registration in the organ CETESB. Products I12 and O12 constitute the same trademark in different commercial categories (independent supermarket and "others"). For the formation of this group, the scores considered the fact that the packages do not have fuel lighters, besides

not informing the registration numbers in IBAMA and CETESB (opposite scores, Figure 5a), also contributing to the lack of information about an alteration of weight. The other brands of the products formed the fourth group, which did not present most of the information or items considered for the grouping (opposite scores). Thus, in the first phase of the research, the products S5 and S8 stand out for the attributes analyzed in the packages.

Already in the second sample of the study (Figure 5b), three groups were formed: a group formed by products S5 and S8 and S3. Products I10, R10, I13, M13, and O7 make up a second group and the third group encompass the other products. The product S3 presented increased information in the packages in the interval between the two collections and, thus, it was part of the group with most of the observed aspects. The second group relates to

similar brands marketed in different commercial categories and to a product of category "others" (O7). The incorporation of handles, lighters, and registration in CETESB allowed the composition of a grouping. This presented more diverse, with different observed items, however, the absence of handles and lighters was fundamental for the formed grouping.

In general, from the first to the second sample, changes in the aspects analyzed and studied in the commercialized charcoal packages were observed, and some of the information and items that were previously not present were incorporated into some of the products.

4 CONCLUSION

Some brands of charcoal grills were exclusive to the supermarket chain. Prices showed significant variations between the samples and time. The brands collected in the supermarket chain category presented the greatest amount of information and attributes in the charcoal packaging. The high variability of the studied variables did not allow for well-defined groupings of the products; however, the supermarket chain category stands out for having most of the attributes evaluated on the packaging, which generally provides better quality charcoal, due to a higher quality requirement from suppliers. Thus, it is noted that the most expensive product (category fuel stations) is not necessarily the one with the greatest attributes for the consumer to assess its quality.

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