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Brewer's Spent Grain Used in Fiber-Enriched Burgers—Influence of Sustainability Information on Consumer Responses

Ana Curutchet [1], Patricia Arcia [1,2], Fátima Prisco [1] and Amparo Tarrega [3,*]

[1] Department of Engineering, Catholic University of Uruguay, Montevideo 11600, Uruguay
[2] Latitud-LATU Foundation, Montevideo 11500, Uruguay
[3] Physical and Sensory Properties Laboratory, Instituto de Agroquímica y Tecnología de Alimentos, (IATA-CSIC), 46980 Paterna, Spain
* Correspondence: atarrega@iata.csic.es

Abstract: Brewer's spent grain (BSG) is the main brewery by-product, whose main use is animal feed but its incorporation into food can improve nutritional quality and sustainability. However, consumers base food preferences on packaging cues that assign meaning to food products. Furthermore, sustainability communication in food is poorly studied. Therefore, the objective of this work was to study the effect of communicating BSG enrichment in beef burgers on consumer responses. Three burger brands were considered and three labels were designed that included information about the addition of fiber. A total of 276 Uruguayans completed an online survey to measure their purchase intention. The way participants were informed about fiber addition did not influence their responses and the brand was the only factor that affected the results. Cluster analysis was applied, identifying four clusters. The brand was always the only significant variable and two of the clusters were highly interested in purchasing the fiber-enriched burgers. The results suggest consumers are interested in the inclusion of BSG in their products and expect information on the origin of the ingredient but not deep communication about the concept of 'by-products.'

Keywords: by-products; brand; purchase intention; BSG; label design; cluster analysis

Citation: Curutchet, A.; Arcia, P.; Prisco, F.; Tarrega, A. Brewer's Spent Grain Used in Fiber-Enriched Burgers—Influence of Sustainability Information on Consumer Responses. *Sustainability* **2023**, *15*, 3873. https://doi.org/10.3390/su15053873

Academic Editors: Julia Low, Qian Yang and Lisa Newman

Received: 23 December 2022
Revised: 14 February 2023
Accepted: 17 February 2023
Published: 21 February 2023

1. Introduction

Changes in human lifestyle and the food industry have caused a considerable impact on eating habits, leading the population to excessive consumption of refined sugars, salt, and high-caloric foods [1]. Current trends in the food industry and the constant search for healthier products suggest that the interest of consumers in natural and high-quality foods is increasing [2]. Consequently, the industry is committed to developing a new gastronomic offer, based on healthier products for consumers, without distancing them from fast and delicious food solutions [3]. Moreover, the worldwide health crisis created by COVID-19 redirected the current consumer attitude, perception, and behavioral patterns to the reduction of food waste and to the consumption of food products [4].

Therefore, there is an opportunity to improve the nutritional characteristics of foods with great consumption, such as meat products. Meat and meat products are important sources of protein in human diets and their consumption depends on socio-economic factors, ethics or religious beliefs, and social habits. Burgers, due to their sensory characteristics, convenience, and high content of biologically valuable proteins, have become widely consumed foods in numerous countries [5]. Therefore, burgers represent an interesting research matrix and a large variety of studies have worked in recent years to improve their nutritional profile [6–8].

Currently, plant derivatives, such as fruits, nuts, vegetables, herbs, and spices, are included in the formulation of healthier meat products, with their contribution of fiber and

antioxidants being the most valued components for the development of new products [9]. The consumption of foods with a high content of dietary fiber has been widely reported to reduce the risk of obesity, colon cancer, and cardiovascular disease, explaining the interest in its inclusion in various food products [10,11].

There is a great diversity of by-products from the food industry that are potential sources of nutrients (i.e., dietary fiber) and, if not reused, represent environmental problems and losses for industries, due to costs associated with the treatment and transport of waste [12].

During the last decade, the indiscriminate consumption of raw materials has reached a rate that compromises the planet's capacity if it is impossible to stop or change the current linear model of production and consumption [13]. The concept of circular economy seeks to respond to the challenges of current economic and productive growth, as it promotes a cyclical flow of transformation and recovery of products and services available in the market. Thus, the circular economy emphasizes the protection of the environment, and the efficient use of resources and their recycling [14]. Although this is not a new concept, the novelty lies in the growing interest in its implementation at the government, industry, and society levels, not only to respond to global challenges but also because it represents an opportunity to add value and develop sustainable products.

Brewer's spent grain [BSG] is the main brewery by-product. Its annual production is estimated at 30 million tons worldwide [15]. Its main use is for animal feed, compost, or as an alternative source of energy. Furthermore, the BSG not used is deposited in landfills, which helps to accumulate greenhouse gas emissions [16].

The use of BSG as a food ingredient represents an opportunity for the food industry in the reuse of by-products because it can be considered a functional ingredient due to its rich composition of fiber, protein, and minerals, as well as its low cost and its wide range availability. The incorporation of BSG into a wide variety of products has been reported to represent an economical source of dietary fiber and a reduction in waste from food production [17]. It has been used to prepare bread, pasta, and chocolate milk at levels up to 10% with similar acceptance by consumers to their counterparts without BSG [18]. In addition, its incorporation has been studied in meat products, such as frankfurters [19], chicken burgers [20], and beef burgers [21–28]. Consumers' response to new products depends not only on their sensory properties but also on the information they perceive from the packaging. The label of a food product contains information about features such as origin, manufacture, nutritional components and claims, brand, and ingredients. This information can influence the hedonic expectations of consumers (i.e., how much they would like it).

Therefore, in this study, we aimed to investigate how the information on the label affects the response of consumers to fiber-enriched burgers, with the addition of BSG as the source of fiber.

1.1. Literature Review

Information given through the label enables consumers to make associations with other aspects of the product, such as healthiness, sustainability, convenience, or naturalness, facts that can play a relevant role in consumers' decisions, always depending on their interests and attitudes.

Effective strategies for communicating information through labels may increase consumer acceptance of more convenient, healthier, and environmentally friendly products [22]. Numerous products use cool packaging colors such as green and blue. Through their association with nature [29], these colors can cause products to be perceived as healthy and sustainable. Previous studies have found that cool packaging colors can make food and drink products seem healthier. Claims are also frequently used to bias perceptions of the healthiness or sustainability of food and drinks. This is concerning given that products with a claim are not necessarily healthier or more sustainable than products without a claim [30]. In this context, brands can have a relevant role in consumers' choices, not only because

brands affect the expectations of product quality but they also affect consumers' trust in information related to other aspects, such as healthiness or sustainability. In [31], the authors studied the relationship between brand and healthiness perception. They reported those consumers perceived both high- and low-calorie foods from healthy brands to be healthier but less delicious than those from unhealthy brands. Similarly, the sustainability perception of products is linked to the brand. Marketing efforts featuring sustainability are very frequent, with 65% of sales coming from brands engaging in sustainability initiatives [32]. New brands have emerged with a primary focus on environmentalism, and dominant (i.e., large/big) brands are feeling pressure to engage in sustainability initiatives [32].

With fiber enrichment using BSG, multiple pieces of information can be displayed on the labels that may interest consumers, such as nutritional claims (source of fiber), sustainability (from a by-product), and the origin of the fiber (barley fiber). It is important to study how consumers understand and use that information, to define the best communication strategy. Furthermore, the effect of health, nutritional, or organic claims on the label of food products has been shown to depend on other characteristics of the product, such as the brand or type of product [23,24]. The brand of the product has been reported to significantly influence the perception of consumers of food products [25,26] representing an indicator of product quality when purchasing [27]. For example, trust in the quality of recognized brands can increase consumers´ purchase intention toward products with changes in their formulation compared to less-known brands [28].

1.2. The Present Research

In this study, we investigate the willingness of consumers to buy a sustainable burger. First, the effect of brand and fiber addition communication on purchase intention was studied, and second, the preferred way to communicate fiber origin was evaluated. To study the effect of fiber enrichment information on the response of consumers, a survey was designed in which different burger packages were shown, and participants had to answer questions related to the intention to purchase each product. After, participants completed a socio-demographic questionnaire. The hypotheses of this study were:

H1: *Consumer willingness to buy a fiber-enriched burger increases when packages indicate that fiber is from barley or from a by-product.*

H2: *The response of consumers to fiber-enriched burgers depends on the brand.*

2. Materials and Methods

2.1. Participants

This study was conducted with a convenient sample of 267 voluntary respondents using an online panel hosted on the Google Forms®website during February 2020. All participants lived in Uruguay and no compensation was provided for their participation. The characteristics of the participants in terms of their socio-demographic characteristics are shown in Table 1.

Table 1. Socio-demographic characteristics of the participants (N = 267).

Variable	%
Gender	
Male	52.9
Female	47.1
Age group	
17–29	45.5
30–44	29.9
45–60	18.3
61 years or older	6.3

Table 1. *Cont.*

Variable	%
Education level	
Primary completed	1.3
High school uncompleted	10.7
High school completed	29.8
Undergraduate	44.4
Postgraduate	13.8
Number of children	
None	60.7
1	17.0
2 or more	22.3
Household income	
Low/Average [less than UYU 50,000]	26.3
Average/High [more than UYU 50,000]	73.7

2.2. Stimuli and Experimental Design

To study the effect of fiber enrichment information on the response of consumers, nine burger packages were designed using a 3 × 3 experimental design with the product brand and the label information included as the variables. For the brand variable, three brands from the Uruguayan marketplace were chosen: the market leader brand (the brand with the biggest share of the market), a low-cost brand (brand with the lowest price), and an artisanal brand (brand commercialized as a handmaid product). For each brand, three versions of the label were designed using their original packaging, obtained from the market, as a reference; thus, the only change made was the inclusion of the fiber addition information. Figure 1 shows an example of the labels designed for the artisanal brand.

(**a**) (**b**) (**c**)

Figure 1. Examples of labels designed for the artisanal brand, shown varying the way the fiber source is mentioned: (**a**) "with barley fiber"; (**b**) with no mention; and (**c**) "with natural fiber from a by-product" and the logo.

The nine labels designed presented the claim "source of fiber." For each brand, two packages also included information about the origin of the fiber, one with the affirmation "with barley fiber" and the remaining displaying "with natural fiber from a by-product." These two labels also included a self-created logo that shows a connection between the product and a circular economy. The third label for each brand did not mention the source of the fiber (Table 2). A summary of the information on the labels for each brand is shown in Table 2.

Table 2. Label design: experimental design considering the brand and the mention of the fiber source as variables.

Brand	Messages Included on the Label (Besides Source of Fiber)
Leader	"With barley fiber" "With natural fiber from a by-product" and logo No additional information
Low-cost	"With barley fiber" "With natural fiber from a by-product" and logo No additional information
Artisanal	"With barley fiber" "With natural fiber from a by-product" and logo No additional information

All participants received the nine designed packages and were asked to complete a questionnaire. During the questionnaire, the frequency of beef burger consumption was asked on a 4-point scale from 1 ("never or almost never") to 4 ("more than once a week"). Then, participants were asked to complete a questionnaire about the fiber-enriched burger labels. The order of presentation of the images was randomly varied among the respondents. For each label, consumers were asked to indicate their purchase intention using a 7-point scale from 1 ("I would definitely not buy") to 7 ("I would buy"). Subsequently, participants were informed about the origin of the by-product, its nutritional benefits, and its impact on sustainability, followed by a 7-point scale question asking if they found the fiber enrichment of products using BSG interesting (from 1, "I don't find it interesting" to 7, "I find it very interesting").

Finally, respondents were asked to indicate how they would prefer the information, fiber comes from this by-product, displayed on the product label. Eight options were presented to the participants (Table 3) and they were asked to check all those that applied.

Table 3. Question about the preference for fiber-origin communication.

How Would You Prefer It to Be Stated on the Food Label That Fiber Comes from This By-Product?
"With barley fiber"
"With natural fiber from a by-product"
"With natural fiber from a brewery by-product"
"Reducing waste"
"Environmentally friendly"
"Toward a circular economy"
(Logo 1)
(Logo 2)

After finishing the previous survey, the participants completed a socio-demographic questionnaire.

2.3. Data Analysis

To study purchase intention, an analysis of variance (ANOVA) of two factors, brand and mention of the fiber source, was performed. When the effects were significant, the differences were calculated using Tukey's test ($\alpha = 0.05$). To identify consumer groups with different patterns, hierarchical cluster analysis was performed, considering Euclidean distances and Ward's aggregation method. For each consumer group, an ANOVA of

two factors, brand and mention of the fiber source, was performed. The composition of each group, according to consumers' purchase intentions and corresponding to the nine labels presented, was compared using the chi-squared test. Significant differences among proportions were determined using the Marascuilo procedure [33]. Data analyses were performed using the software XLSTAT 2020.3.1 Version (Addinsoft, Paris, France).

3. Results and Discussion

3.1. Purchase Intention and Interest in BSG

Consumers´ purchase intentions varied among the burger packages that included different information. The results of the ANOVA showed that the way the fiber addition was communicated to consumers did not influence their response to the purchase intention ($P = 0.648$). This may be due to the lack of fixation by participants on the label information. Remembering that consumers spend on average 22 seconds choosing a product while grocery shopping [34], not all consumers read the complete information displayed on food packages. We also must consider that burgers with health benefits (i.e., fiber enriched) are not promoted locally and there is no previous conception about the product or its consumption impact on health. There is also the possibility that the addition of fiber to burgers did not generate expectations from consumers, just because they are not interested in that product, and therefore the different messages provided did not generate changes in their purchase intention.

Stancu et al. [35] studied consumers' understanding of health claims and the potential link between understanding and intention to buy. They reported consumers caught some beneficial features of a product with health claims in its package, even though those benefits were not explicitly mentioned in the claim.

In this study, the results indicate the brand has a significant impact on the purchase intention of enriched burgers ($P < 0.0001$). The market leader brand was preferred with a purchase intention average of 4.7, followed by artisanal with 4.3, and finally, low-cost, which scored an average of 2.7. Fiber addition communication did not have a significant effect on purchase intention, and only the brand influenced consumer interest. Thus, adding fiber from a by-product may not be considered for the low-cost brand because the purchase intention remained negative. This result can be explained by the brand loyalty of consumers and the tendency to choose habitual brands, inducing consumers to maintain the purchase of their usual brand, even when changes are made to the formulation and, therefore, the label [36]. For example, Sekhar et al. [24] reported the influence of brands on the purchase intention of organic food. Their findings indicate that brand credibility is positively related to purchase intention. Ares et al. [37] studied consumers' perception of product reformulation in the implementation of nutritional warnings and found that the brand was significant in this context. Preference for reformulated products without nutritional warnings was more pronounced for non-market leaders. The low purchase intention obtained for the low-cost brand may be explained by consumers buying cheaper food products who probably do not expect an added value from the product (i.e., healthy or sustainable characteristics). Therefore, the effect of including sustainability information on food labels is varied, depending on the product category and its producer.

Cluster analysis was applied to determine segments of consumers with different patterns of eating burgers and to identify those groups of consumers willing to purchase BSG-enriched burgers with fiber from BSG. Four clusters were identified; the brand had a significant effect on the purchase intention, whereas the message about the fiber enrichment displayed on the label had no significant effect (Table 4).

Table 4. Influence of brand and type of mention about fiber source on the purchase intention of burgers. Results of analysis of variance F ratio and probability (P) values. C1–C4 are groups of consumer clusters with different purchase intentions.

Source	C1 (63%)		C2 (22%)		C3 (7%)		C4 (8%)	
	F	***P***	**F**	***P***	**F**	***P***	**F**	***P***
Brand	94.8	<0.0001	393,2	<0.0001	53.8	<0.0001	97.7	<0.0001
Mention of fiber source	2.3	0.10	0.07	0.93	1.6	0.21	0.43	0.65
Brand x Mention of fiber source	1.1	0.37	0.12	0.97	0.8	0.51	0.26	0.91

Consumers in Cluster 1 (C1) (63%) do not show a difference in preference between the leader and the artisanal brand but would not buy the low-cost brand. This cluster includes mostly young consumers with high incomes, who are medium-frequency consumers of burgers. Consumers in Cluster 2 (C2) (22%) were only willing to buy a fiber-enriched burger when it is from an artisan brand and would not buy the low-cost brand burger. This group includes high-income young people who eat burgers regularly. Cluster 3 (C3) (7%) was composed of medium-age and high-frequency consumers who leaned toward the artisanal burger brand, although all brands were slightly accepted. Cluster 4 (C4) (8%) was determined by respondents who would only buy the leader brand. These participants were mostly medium-age women with low income (Table 5). In this study, it was observed that in general young people (mostly in C2) were people who consume burgers more than once a week. Some studies have found that older consumers are less likely to decrease their meat consumption [38]. In de Gavelle et al. [39], the authors reported that younger consumers were more likely to adopt a vegetarian diet or to increase their plant protein consumption than middle-aged or older consumers. Nevalainen et al. [40], examined consumers' reported changes in their meat and plant protein consumption in Finland. They identified four consumer clusters based on self-reported past changes in meat and plant protein consumption. The clusters differed in their sociodemographic characteristics: gender, age, level of education, and area of residence. They found differences between the clusters in food neophobia, natural concerns, health, and pleasure motives.

Table 5. Distribution of consumers (%) on clusters according to gender, age, number of children, and income. Difference among proportions test, $\chi 2$, and probability (P) values. C1–C4 are groups of consumer clusters with different purchase intentions.

		C1	C2	C3	C4	χ^2	*P*
Gender	M	53 ^{a}	59 ^{a}	58 ^{a}	29 ^{b}	24.8	<0.0001
	F	47 ^{b}	41 ^{b}	42 ^{b}	71 ^{a}	24.8	<0.0001
Age	17 to 29	50 ^{a}	43 ^{a}	33 ^{a,b}	21 ^{b}	19.4	<0.0001
	30 to 44	28 ^{a,b}	37 ^{a}	17 ^{b}	36 ^{a}	12.4	0.006
	45 to 60	17 ^{a,b}	16 ^{b}	33 ^{a}	21 ^{a,b}	10.5	0.015
	More than 60	5 ^{b,c}	4 ^{c}	17 ^{a,b}	21^{a}	21.9	<0.0001
Frequency of consumption	More than once a week	3 ^{a}	44 ^{b}	28 ^{b}	0 ^{a}	84.6	<0.0001
	At least once a week	19 ^{a}	13 ^{a}	48 ^{b}	48 ^{b}	47.8	<0.0001
	At least once a month	51 ^{c}	29 ^{b}	4 ^{a}	33 ^{b,c}	54.2	<0.0001
	Less than once a month	27	14	20	19	5.1	0.161
Income	Low income	22 ^{c}	28 ^{c}	67 ^{b}	100 ^{a}	160	<0.0001
	High income	78 ^{a}	72 ^{a}	33 ^{b}	0 ^{c}	160	<0.0001

The percentage values in the rows followed by different letters are significantly different ($P \leq 0.05$).

As shown in Figure 2, all clusters are interested in purchasing fiber-enriched burgers (purchase intention value above 3.5 on the seven-point scale) if they are from a leader brand. C1 and C2 are also interested in the artisanal brand, and C3 is the only group that presents purchase intention from a low-cost brand. C2 and C4 are the most interested in purchasing fiber-enriched burgers, presenting values over five on the seven-point scale.

These two clusters represent 30% of all consumers participating. The C2 is composed principally of young people, high users of the product, and with high income, who prefer the enrichment in the artisanal brand. The C4 cluster is composed mostly of consumers with low income, women, and medium frequent consumers who would buy the market leader brand enriched burger.

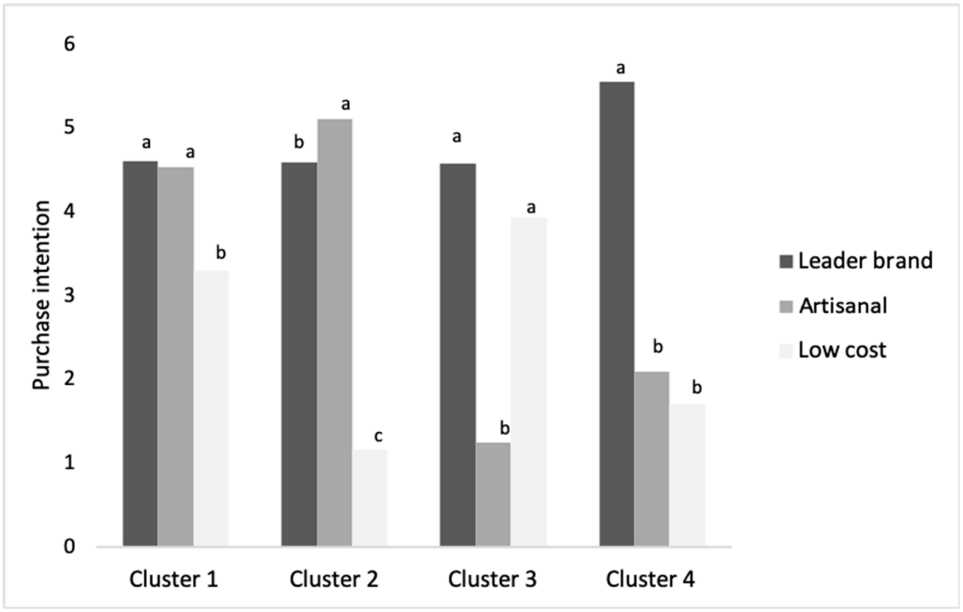

Figure 2. Average values of the purchase intention of fiber-enriched burgers of different brand types for the four consumer clusters. C1–C4 are groups of consumer clusters with different purchase intentions. For each cluster, a different letter means significant differences between brands.

3.2. Fiber Enrichment Communication

Once consumers were informed about the origin of BSG and its benefits, 71% found (scores six and seven of the seven-point scale question) the enrichment of food products with this by-product interesting. They also showed a strong preference for some messages used to communicate the enrichment over others. From the options presented, the claim "with barley fiber" was selected for almost half of the participants (46.8%) and Logo 2 was also frequently selected (26.2%) (Figure 3).

Figure 3. Frequency of mention of statements selected by the consumer to be included in the product label to communicate that fiber comes from this by-product.

Reported results indicate that when consumers receive previous information on the origin and benefits of BSG (i.e., nutritional and environmental features), most find the inclusion of the by-product in food products interesting. The indication "with barley fiber" was preferred among consumers to be included on the labels. Only a small number of consumers showed interest in including the term "by-product," and the concepts of "circular economy" or "reducing waste." This seems to agree with the findings of van Doorn et al. [41], who reported that consumers respond unfavorably to sustainable new products, which give negative quality associations. They conclude that sales of newly introduced products with a sustainability claim are lower than those of their conventional counterparts; however, this does not extend to all brands or product categories. They also reported that more innovative new sustainable products enjoy higher sales, and the same happens when the brand is associated with a company committed to ensuring societal and stakeholder well-being. Furthermore, Pretner et al. [42] studied the willingness of consumers to pay for a circular product, finding that when consumers are provided with information about the environmental virtues of the product, consumer willingness to purchase increases significantly, especially when that information is verified by a third party. For consumers, a BSG-enriched burger may be seen as an innovative product, which could influence a group of consumers to be interested in purchasing.

4. Conclusions

This investigation highlights how product information could influence consumer purchase intention and may drive food companies to develop innovative positioning strategies for introducing products made with by-products.

The brand has a strong effect on purchase intention, on consumers, and how fiber communication seems to not affect purchase patterns. Through the identification of the consumer clusters, some observed that willingness to buy fiber-enriched burgers with different information displayed on the labels was highly varied among consumers depending on the brand of the product. All consumers showed to be interested in purchasing BSG-enriched burgers if the product is from the market leader. Furthermore, 85% of the respondents (C1 and C2) would also buy the fiber-enriched burger if it is from an artisan brand.

Different messages explaining fiber enrichment to consumers on the product labels did not impact their willingness to purchase burgers. Giving detailed information on the source of fiber, nutritional composition, and sustainability to consumers increased their interest in BSG-enriched products, with the phrase "with barley fiber" selected the most to include on the labels. When including a by-product as an ingredient of other food products, consumers prefer its inclusion to be expressed on the package as the product it comes from (i.e., barley).

The main limitation of this work is the non-probabilistic nature of the sample, which does not permit the generalization of the results. Therefore, further studies with a higher random consumer sample and another product category are needed to reach deeper conclusions. However, this study shows that there is a group of consumers with a positive attitude toward a sustainable burger concept, which could be taken up by the food industry.

This study includes all fiber-enriched burgers; future studies should include a non-enriched product, which will allow us to evaluate whether fiber enrichment improves the purchase intention of burgers.

Seeking a more successful strategy to improve the purchase intention of both sustainable and healthy products, such as presenting other sources of information (i.e., videos or podcasts) with more detailed information, can be included on food labels and would be of interest.

Author Contributions: Conceptualization, A.C., P.A. and A.T.; methodology, A.C. and F.P.; validation, A.C., P.A. and A.T.; formal analysis, A.C. and A.T.; writing—original draft preparation, A.C. and F.P.; writing—review and editing, A.C., P.A. and A.T.; supervision, P.A. and A.T. All authors have read and agreed to the published version of the manuscript.

Funding: Spanish government MCIN/AEI to the Center of Excellence Accreditation Severo Ochoa (CEX2021-001189-S/MCIN/AEI/10.13039/501100011033).

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the ethical committee of the Catholic University of Uruguay (Code: 20 06 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets generated for this study are available on request to the corresponding author.

Acknowledgments: Special thanks to designer Jorge Garcia for the layout of the labels.

Conflicts of Interest: The authors declare no conflict of interest.

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