

Research Article

Knowledge About Celiac Disease: Comparison Between Food Handlers and Culinary Arts and Gastronomy Undergraduate Students in Brazil

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Abstract

To evaluate the knowledge of food handlers and undergraduate students of the Gastronomy course about Celiac Disease (CD). A cross-sectional study was conducted with food handlers from restaurants and undergraduate students of Culinary Arts and Gastronomy courses located in the metropolitan area of Florianópolis, in the state of Santa Catarina, Brazil. Data collection was carried out between May and July 2019, using a questionnaire. Forty six food handlers and 99 undergraduates participated. When asked if they had heard of CD, 58.7% of food handlers and 76.8% of undergraduates answered 'Yes', however only 10.9% of food handlers and 30.9% of undergraduate students answered correctly the concept of the disease. Regarding gluten, 95.3% of food handlers and 99.0% of undergraduates replied that they had heard about it. However, only

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20.0% of food handlers and 45.4% of students were able to answer that gluten is a protein. Only 15.4% of food handlers and 37.4% of undergraduates correctly mentioned all gluten-containing cereals and 12.5% of food handlers and 28.6% of students correctly indicated all substitute options. When asked about conducting training on CD, only 7.1% of food handlers claimed to have received any training. The present study showed that the food handlers and undergraduate students in the sample presented unsatisfactory knowledge about celiac disease, gluten-free diet and culinary practices to avoid cross-contamination by gluten, which may interfere with the quality of services provided in restaurants and consequently with the quality of life of celiacs. The findings indicate the need for training of Brazilian food handlers on the subject and the inclusion of Nutrition subjects, with a focus on dietary restrictions in the Culinary Arts and Gastronomy courses in Brazil.

Keywords: Brazil; Celiac disease; Food handlers; Gastronomy; Gluten; Students; Training

Introduction

To Celiac disease is an autoimmune disease triggered by the consumption of gluten [1-3]. As a consequence of dietary exposure to gluten, which is found in wheat, barley and rye, genetically susceptible individuals develop autoimmune reactions characterized by duodenal villous atrophy, leading to malabsorption and gastrointestinal as well as extraintestinal symptoms [1].

A lifelong Gluten Free (GF) diet is the only available and accepted treatment for CD patients [4,5]. Strict adherence to a GF diet is necessary to normalize the mucous membrane of the small intestine and to improve the impaired absorption [2]. However, the GF diet is complex and difficult to follow [6] and could have negative effects on social life [7].

For patients with CD, this involves major lifestyle changes, especially in the dietary habits [2,8]. One of the most common difficulties for CD patients is the eating-out experience [2], due to the difficulty in accessing gluten-free meals or fear of gluten contamination [9]. In Brazil and the USA, although the indication of absence of gluten is mandatory on the food label [3,10,11], this requirement does not apply to preparations marketed in restaurants [11], which can generate anxiety for many celiacs [3]. In this sense, restaurants can be a particular barrier to complying with a GF diet [9].

A study conducted in the USA showed that 83% of patients with CD or non-celiac gluten sensitivity (n=790) found the GF diet could be a problem in restaurants and 63% avoided restaurants altogether [12]. A survey conducted in Brazil with 43 celiac patients showed that 39.5% of them usually eat in restaurants less than once a week, due to the lack of knowledge regarding CD on the part of cooks and the lack of care with gluten contamination [13]. In this sense, the worries of celiacs can be justifiable, since in the UK, for example, chefs' knowledge of CD is narrower than that of the general public [7]. Besides, study conducted in Brazil with 30 chefs, showed that 70% of the participants reported not knowing the meaning of CD [14].

Research on the knowledge about CD is not restricted to chefs and cooks, but also to Gastronomy undergraduates, since these will be the future professionals of the area. Research conducted with 90 chefs and 35 students from a Polytechnic Cooking and Culinary Arts Course in New Zealand, showed that students were more familiar with the care in preparing gluten-free foods when compared to chefs. The authors attributed this fact to the education received by the students, since only 50% of the chefs were qualified [15]. In addition, a study conducted with 430 chefs in the USA, showed that trained chefs had superior knowledge about CD when compared to untrained chefs [12].

Therefore, it appears that knowledge of CD may increase awareness of the disease and the preparation of gluten-free foods [15]. Reinforcing the assumptions that education and training positively impact knowledge about CD, a study that evaluated the perceptions of dietitians (n=6) and food handlers (n=6) regarding the supply of food to students with CD in two Brazilian municipalities, identified that dietitians had the perception that they performed an efficient training and food handlers perceived themselves as well oriented and trained in the pre-preparation, preparation, handling and storage of food and utensils, to avoid contamination with gluten [16].

In view of this, the unpreparedness of food handlers and Culinary Arts and Gastronomy undergraduates regarding service and preparation of meals for celiac individuals can be a reality. In this sense, it is important to assess the knowledge about DC on the part of food handlers and undergraduate students, since the knowledge of current and future professionals in the food service will have an impact on adherence to a safe gluten-free diet, contributing to the provision of life quality for celiacs. Therefore, the aim of this study was to compare knowledge about CD between food handlers and Culinary Arts and Gastronomy undergraduate students in the metropolitan area of Florianópolis, in the state of Santa Catarina, Brazil.

Materials and Methods

Population and sample

This is a cross-sectional, quantitative and analytical study conducted with a convenience sample of food handlers from restaurants and undergraduate students of Culinary Arts and Gastronomy courses located in the metropolitan area of Florianópolis, in the state of Santa Catarina, Brazil.

For the recruitment of food handlers, the restaurants registered with the Brazilian Association of Bars and Restaurants (ABRASEL), Santa Catarina (SC) state, were invited to participate in the study. The inclusion criterion for the restaurants was to be located within a radius of 10 km from the downtown area of Florianópolis, Santa Catarina, Brazil. A total of 129 restaurants registered with ABRASEL were identified, but only 53 met the inclusion criteria. The invitation to participate in the research was made via e-mail and telephone contact. Of the restaurants contacted (n=53), only 06 agreed to participate in the survey. Among the reasons for refusing to participate in the study were: The non-return of the email by the restaurant; the person responsible for the restaurant was absent when the phone call was made and not having an interest in participating in the research, since the restaurant did not serve gluten-free foods or because the restaurant was assisted by a dietitian. In addition, some establishments did not justify the reason for not participating in the study. Among those

who agreed to participate, the identified categories of the surveyed restaurants were: 1 Mexican cuisine, 1 hamburger shop, 2 oriental cuisine, 1 Australian cuisine and 1 natural cuisine.

All food handlers who worked for the restaurants that agreed to take part in the study were invited to participate. The inclusion criterion for food handlers was to know how to read and write and to be present on the day the questionnaire was applied. According to Brazilian legislation, the food handler is anyone in the food service area who comes into direct or indirect contact with the food [17]. Thus, those who were assistants in general services were not invited to participate. Out of the 53 food handlers identified, 46 fit the inclusion requirements. All Higher Education Institutions in the region that offered the Culinary Arts and Gastronomy courses, in the modality of Technology were invited to participate in the study. Three universities were identified, whose degrees are 2 or 3 years long, with two private and one public university. All first-year undergraduates enrolled in the Culinary Arts and Gastronomy degree course were visited and invited to participate in this study. The first-year undergraduate students were chosen because they had not taken any discipline related to the area of Nutrition. The inclusion criterion for undergraduate students was to be present on the day the questionnaire was applied. Undergraduate students who had a degree in health sciences, had taken courses or improvement courses in the field of Nutrition were excluded.

Data collection took place between May and July 2019, on the premises of the restaurants and educational institutions.

The study was approved by the Ethics Committee of the Federal University of Santa Catarina (protocol number 12359419.6.0000.0121). All the study participants provided written informed consent before enrollment.

Data collection

This research was developed by applying a questionnaire, which was designed using information from other studies with similar subjects [7,14]. Before application, the questionnaire for Culinary Arts and Gastronomy undergraduates was tested with students from other courses in the field of food and beverages (vocational course in Cooking, Bread making and Cooking for Restaurants and Bars at the Federal Institute of Santa Catarina, Florianópolis-Continente campus). Questionnaires for food handlers were tested in a group of food handlers who worked in a restaurant within one of the Teaching Institutions. The tests were performed to check if the questions were clear and needed reformulation.

The self-administered questionnaire was completed under the supervision of an investigator. The questionnaire of food handlers, consisting of 33 open and closed questions, was organized into three main areas. The first area refers to the characterization of the respondent (date of birth, sex, level of education and ethnic background, time spent working in the food business, role in the restaurant, time working in the current role), while the second one refers to knowledge about CD, gluten-free diet and applicability in culinary preparations and the third one refers to training. The undergraduate students questionnaire, consisting of 27 open and closed questions, was organized into three main areas. The first area refers to the characterization of the respondent (date of birth, sex, level of education and ethnic background), the second one refers to knowledge of CD, gluten-free diet and applicability in culinary preparations and the third one refers to training.

The exposure variable was the food handlers or undergraduate students. The outcome variables were defined for knowledge regarding CD, gluten-free diet and applicability in culinary preparations, namely: Heard of CD, heard of gluten, concept of CD, concept of gluten, gluten-containing cereals, gluten-free cereal options and practices to prevent contamination in the production of gluten free products: Importance of careful handling of food preparations for celiac people; verification of the claim of presence or absence of gluten on the food label; shared use of frying oil between preparations with and without gluten and shared use of equipment and utensils between preparations with and without gluten.

Statistical analysis

The variable corresponding to the concept of CD was collected through open question. The concept of CD was considered to be correct when the food handlers and undergraduates mentioned permanent intolerance to gluten [18]. The other variables were collected through closed questions. When asked if they had ever heard of CD and gluten, the food handlers and undergraduates could choose between the 'Yes' and 'No' answer options. The concept of gluten was considered to be correct when they chose the protein option [19]. When asked if the gluten-free diet was the only treatment for CD, the food handlers and undergraduates could choose between the 'Yes', 'No' and 'Don't know' options. The answer was considered to be correct when they checked the 'Yes' option [4,5]. When asked if celiacs could not eat gluten-containing foods, the food handlers and undergraduates could choose between the 'Yes', 'No' and 'Don't know' options. The answer was considered to be correct when they checked the 'Yes' option [1-3].

The food handlers and undergraduates answered questions about the presence and absence of gluten in food. Among the options of gluten-containing cereals, they could choose between barley, rye, wheat, corn and rice. The answer was considered to be correct when they checked the following options: Barley, rye and wheat [18]. As for cereals that can be used as substitutes for gluten-containing ones, the food handlers and undergraduates could choose out of the options: Corn starch, potato starch, cassava starch, rye flour, cassava flour and rice flour. The answer was considered to be correct when they checked the options: Corn starch, potato starch, cassava starch, cassava flour and rice flour [18].

When asked if preparing food for celiacs needs careful handling, the food handlers and undergraduates could choose between the 'Yes', 'No' and 'Don't know' options. The answer was considered to be correct when they checked the 'Yes' option. For questions about the need to check labels, the possibility of sharing equipment and utensils and the possibility of using the same oil to prepare food with and without gluten, the food handlers and undergraduates could choose between the 'True', 'False' and 'Don't know' options. The answer was considered to be correct when they checked the 'True' option. Food handlers and undergraduates, who were working at the time of data collection, were asked whether the restaurant in which they worked were assisted by a dietitian. They could choose between the 'Yes', 'No' and 'Don't know' options. For the question of whether food handlers and undergraduates who were working at the time of data collection had already undergone training on the subject of CD, they could choose between 'Yes' and 'No'.

The questionnaire data were entered twice into an Excel® spreadsheet. Proportions, means and a chi-square test were calculated for heterogeneity, as appropriate. Statistical analyses were performed with the software STATA 11.0® (Stata Corp, Chicago, IL, USA). The significance level adopted was less than 5% (p<0.05).

Results

Forty six food handlers with a mean age of 31.0±7.1 years and 99 undergraduates of Culinary Arts and Gastronomy with a mean age of 25.4±7.2 years participated in the survey. The sociodemographic characteristics of the participants are shown in table 1. Most food handlers and undergraduates were male (56.4% and 54.5%, respectively). As far as race is concerned, most food handlers and undergraduates self-reported as white (55.6% and 72.4%, respectively). For level of education, the majority of food handlers had completed high school (40.4%), while most undergraduates had an incomplete undergraduate degree (87.9%). It is of interest to note that 24.5% of food handlers had incomplete high school education or a lower level of education. Among the food handlers who had incomplete or complete graduation, out of a total of 8 professionals who informed the undergraduate course, 3 (37.5%) reported having graduated in Culinary Arts and Gastronomy (Table 1).

Variables	Food Handlers (n=46)		Undergraduates (n=99)	
	N	%	N	%
Sex				
Females	20	43.5	45	45.5
Males	26	56.5	54	54.5
Race				
White	25	55.6	71	72.4
Brown	14	33.3	13	13.3
Asian	0	0	5	5.1
Black	5	11.1	9	9.2
Level of education				
Incomplete elementary education	3	6.7	0	0
Complete elementary education	3	6.7	0	0
Incomplete secondary education	5	11.1	0	0
Complete secondary education	18	40.0	0	0
Incomplete undergraduate degree	11	24.4	87	87.9
Complete undergraduate degree	4	8.9	8	8.1
Post-graduate degree	1	2.2	4	4.0

Table 1: Sociodemographic characteristics of food handlers and Culinary Arts and Gastronomy undergraduate students. Metropolitan area of Florianópolis, SC. Brazil (2019).

When asked about received training on CD, only 7.1% of food handlers said they had already received some training. In addition, 41.5% of the handlers stated that the restaurant where they worked, had dietitian assistance and another 41.5% said they did not know this information. Among undergraduates, 40.4% stated that they were working in the food service at the time of data collection and, of these, only 5 (12.5%) had already received training on CD.

The sample of food handlers was composed of cooks (23.9%), waiters (23.9%), kitchen assistants (15.2%), owners (4.3%), managers (2.2%), salad making assistants (2.2%) and other positions (28.3%). Among the other positions were cited: Cashier, bartender and

attendant. Most food handlers had been working in the area between 2 and 5 years (42.9%), followed by those who had been working for more than 11 years (21.4%), up to 1 year (19.0%) and between 6 and 10 years (16.7%).

When asked if they had heard of CD, 58.7% of food handlers and 76.8% of undergraduates answered ‘Yes’ (p=0.026). Regarding gluten, 95.3% of food handlers and 99.0% of undergraduates replied that they had heard of this nutrient (p=0.169). However, only 20.0% of food handlers and 45.4% of undergraduates were able to answer that gluten is a protein (p=0.005). When asked about the definition of CD, only 10.9% of food handlers and 30.9% of undergraduates answered correctly (p=0.033) (Table 2).

Variables	Food Handlers (n=46)		Undergraduates (n=99)		p-Value *
	N	%	N	%	
Heard of celiac disease					
Yes	27	58.7	76	76.8	0.026
No	19	41.3	23	23.2	
Concept of CD					
Correct answer	5	10.9	30	30.9	0.033
Incorrect answer	25	54.4	42	43.3	
Don't know	16	34.8	25	25.8	
Heard of gluten					
Yes	41	95.3	97	99	0.169
No	2	4.6	1	1	
Concept of gluten					
Correct answer	8	20	44	45.4	0.005
Incorrect answer	32	80	53	54.6	

Table 2: Comparison of knowledge of celiac disease, gluten-containing and gluten free diets among food handlers and Culinary Arts and Gastronomy undergraduate students. Metropolitan area of Florianópolis, SC. Brazil (2019).

Note: * Chi-square test.

When asked about the gluten-free diet being the only treatment for CD, 41.9% of handlers and 46.5% of undergraduate students said they did not know how to answer this question. When asked if the celiac could not consume gluten, 72.1% of the handlers and 68.7% of the students responded assertively. These differences were not statistically significant (Table 3).

Variables	Food Handlers (n=46)		Undergraduates (n=99)		p-Value *
	N	%	N	%	
Gluten-free diet is the only treatment for CD					
Yes	36	36.4	20	46.5	0.468
None	17	17.2	5	11.6	
Don't know	46	46.5	18	41.9	
Celiacs can't consume gluten					
Yes	68	68.7	31	72.1	0.408
None	27	27.3	12	27.9	
Don't know	4	4	0	0	

Table 3: Comparison of knowledge of symptoms and treatment of CD among food handlers and Culinary Arts and Gastronomy undergraduate students. Metropolitan area of Florianópolis, SC. Brazil (2019).

Note: * Chi-square test.

Although most of the food handlers and the undergraduates indicated wheat as a gluten-containing cereal (82.6% and 89.9%, respectively), only 15.4% of food handlers and 37.4% of undergraduate students correctly marked the three gluten-containing cereals. On the other hand, 5.1% and 7.7% of food handlers and 13.2% and 7.7% of the undergraduates incorrectly answered that corn and rice, respectively, are food sources of gluten.

Only 12.5% of food handlers and 28.6% of undergraduate students correctly marked all gluten-free cereal options. The foods least recognized as substitute for gluten-containing cereals were cassava flour (40.6%) by food handlers and corn starch and cassava flour (both 53.2%) by undergraduates.

The participants' knowledge of careful handling of gluten-free food preparations for celiacs was also investigated, where 85.7% of food handlers and 93.9% of undergraduates considered that the production of food for celiacs requires specific procedures. When asked about the need to check labels for the presence or absence of gluten in the food, 88.4% of the food handlers and 95.0% of the undergraduates considered this information to be necessary, being this difference not statistically significant (Table 4).

Variables	Food Handlers (n=46)		Undergraduates (n=99)		p-value *
	N	%	N	%	
Need for careful handling when preparing food for celiacs					
Yes	36	85.7	93	93.9	0.109
Don't know	6	14.3	6	6.1	
Need to check labels					
Yes	38	88.4	94	95	0.085
None	5	11.6	3	3	
Don't know	0	0	2	2	
Possibility of using the same oil					
Yes	4	9.3	5	5	0.633
None	32	74.4	77	77.8	
Don't know	7	16.3	17	17.2	
Possibility of sharing equipment and utensils					
Yes	8	18.6	10	10.1	0.375
None	30	69.8	76	76.8	
Don't know	5	11.6	13	13.1	

Table 4: Comparison of knowledge of careful handling of gluten-free food preparations for celiacs among food handlers and Culinary Arts and Gastronomy undergraduate students. Metropolitan area of Florianópolis, SC. Brazil (2019).

Note: * Chi-square test.

Knowledge of precautions to avoid cross-contamination with gluten pointed out that 74.4% of food handlers and 77.8% of undergraduate students considered that the same oil cannot be used to fry foods with and without gluten. Moreover, 69.8% of food handlers and 76.8% of undergraduates thought that one should not share the same utensils and equipment to prepare food with and without gluten. Importantly, despite this percentage, 30.2% of food handlers and 23.2% of undergraduates answered that they did not know or made a mistake regarding the possibility of sharing equipment and utensils and 25.6% of food handlers and 22.2% of undergraduates replied that they did not know or were wrong about the possibility of sharing oil between preparations with and without gluten. This difference is not statistically significant (Table 4).

Discussion

This is the first study that compares knowledge about celiac disease between food handlers and Culinary Arts and Gastronomy undergraduate students in Brazil.

The sample analyzed in this study was of convenience and showed similarity in the sociodemographic profile with samples from other Brazilian studies [20-22]. A study carried out with food handlers from popular restaurants in Rio de Janeiro/Brazil, found that the profile of handlers was composed mostly of men (67.0%) [20]. As for age, the findings of the present study corroborate with two Brazilian studies that found that most food handlers were between 30 and 49 years old [20] and between 21 and 30 years old [21]. Corroborating with the present study, 55.0% food handlers of study conducted in São Paulo/Brazil [21] and 52.0% food handlers of study conducted in Espírito Santo/Brazil [22] had completed high school.

Although most of the food handlers who answered the questionnaire were cooks, other functions, such as waiters, attendants, managers and owners who do not deal directly with food preparation, also comprised the sample. These professionals are fundamental in food service, as they are responsible for direct contact with the customers, disseminating information about the culinary preparations served in the restaurants [23]. It is of interest to note how important it is that all food handlers know how to prepare the meals, especially their ingredients, as well as to know how to explain it to customers with CD, so that they feel safe when ordering. With regard to working time in the food service, the results of this study were similar to those found by another Brazilian study, where 57.0% of the handlers had worked between 1 and 9 years [24].

As for the sociodemographic profile of the convenience sample of Culinary Arts and Gastronomy undergraduates students the same was found in a survey conducted in Brazil, where most undergraduates (65.2%) were aged between 18 and 24 years [25]. In addition, a research carried out with 184 students from a Culinary Arts school of a private university in Costa Rica, showed that 55.4% were male and were between 19 and 21 years old [26].

The present study showed that knowledge of celiac disease, gluten-free diet and applicability in culinary preparations is unsatisfactory between food handlers and the first-year Culinary Arts and Gastronomy undergraduate students who composed the sample. The comparison between these participants and the results obtained can be justified by the fact that food handlers and undergraduate students did not have training and education in the area of Nutrition. It is believed that the knowledge about CD presented by the participants is the knowledge acquired from the media and social media [27].

Both food handlers and undergraduates claimed to have heard about CD, however the undergraduate students are more familiar with the disease than the food handlers. Studies have found unsatisfactory knowledge about CD among chefs [7,14]. A study carried out with 30 chefs of self-service restaurants in Brazil, showed that 30% of them had already heard of DC [14]. A study conducted in the United Kingdom, with 322 chefs, showed that only 17.1% of professionals had heard of DC [7].

The knowledge that Culinary Arts and Gastronomy undergraduate students have about CD has been previously investigated [15,25].

A study carried out in Brazil, with 46 Culinary Arts and Gastronomy undergraduates, found that 70.7% said they knew what DC is [25]. Additionally, a study carried out in New Zealand, with 35 students from the first year from a Polytechnic Cooking and Culinary Arts Course, found that 94.3% of the interviewees reported having heard of CD [15]. The access and exchange of experiences and information in relation to food consumption and dietary restrictions, which happens within Higher Education Institutions on a frequent basis, can provide Culinary Arts and Gastronomy undergraduates a greater proximity to the term CD. For food handlers, however, there is a distance from the theme, since they often start working in the food service area without prior qualification (in this study, only 3 professionals had a higher education degree in Gastronomy) or experience in the function [20,28]. In addition, the exhaustive work routine makes it difficult for these professionals to seek qualification after being hired by the restaurant. The lack of demand for professional qualification is also influenced by the low salaries received by food handlers from different segments of the food service in Brazil, which favors the high turnover of labor and makes the search for qualification difficult [20]. In Brazil, 92% of the Culinary Arts and Gastronomy college degrees are of a private nature [29], making it difficult for food handlers to access the courses, due to their high cost. In public Higher Education Institutions, which offer free courses, there is great demand in relation to the number of places offered.

As for the knowledge of CD and the gluten-free diet, almost all of the food handlers and undergraduates of this study had already heard of gluten. This hypothesis probably stems from the mass media of the food industries that appropriate the term as a nutritional marketing strategy [30]. This can be seen when observed that although most food handlers and undergraduates had heard of CD and gluten, many of them had difficulties defining it correctly as permanent intolerance to gluten [18] and to explain that gluten is a protein [19]. Corroborating the findings of this study, research conducted in the United Kingdom identified that 82.9% of food handlers did not know the concept of CD [7]. Regarding the undergraduate students of Culinary Arts and Gastronomy, a study carried out in Brazil found that none of the interviewees presented the complete definition of the disease [25]. A study carried out in New Zealand found that the majority of students from a Polytechnic Cooking and Culinary Arts Course did not know how to answer or incorrectly answered the concept of CD [15]. Some food handlers and undergraduates have stated that celiacs cannot eat gluten, but responded that they did not know whether the gluten-free diet is the only treatment for CD. These results suggest that it is difficult for them to understand the concept of CD. Although the food handlers and undergraduates have heard of the terms “celiac disease” and “gluten”, they do not make a correct connection between the terms. These findings may indicate that the dissemination of knowledge about the concept of CD, the concept of gluten and the relationship between them is not happening and could be stimulated due to the importance of this knowledge in the safe care of celiacs.

The correct association between the terms CD and gluten could reach food handlers through training carried out by restaurants. Reinforcing this premise, a study that evaluated the knowledge that 430 chefs had about CD, sensitivity to gluten and peanut allergy, identified that chefs who received training, had superior knowledge about the three conditions when compared to untrained chefs [12].

In Brazil, however, the training of food handlers is only mandatory for matters related to food safety, where the objective is to guarantee

the hygienic and sanitary conditions of the prepared food [17]. National [21,31-35] and international studies [36,37], pointed out the effectiveness of training related to good manufacturing practices for food handlers. In this sense, it could be suggested that the training on the careful preparation of food for celiacs can positively affect the professional practice of food handlers. However, care must be taken to select the best technique for conducting training so that those who handle the food understand the importance of information and put it into daily practice [20,38-40]. It is necessary to establish a training program, permanent training and daily monitoring of the actions developed by food handlers [20,34,35,39]. In this context, it is important to note the role of the restaurant manager in enabling these trainings to be carried out. The manager needs to be sensitized and make time available to carry out this activity with the food handlers and guarantee that the dietitian will participate in it. For the training to be successful in practice, it is necessary that the dietitian is present daily in restaurants and acts in the guidelines regarding the safe production of food for celiac individuals, as well as in their supervision.

Research conducted with chefs and students from a Polytechnic Cooking and Culinary Arts Course showed that students were more familiar with the terms CD and gluten when compared to chefs. The authors attributed this fact to the education received by students [15]. Therefore, undergraduates in Culinary Arts and Gastronomy could acquire knowledge about CD throughout their academic education, where disciplines related to the area of Nutrition, specifically about dietary restrictions, could be integrated into the curriculum. Culinary Arts and Gastronomy courses in Brazil do not have an established Curriculum Guideline, which is why college syllabi may differ between institutions. Thus, a study carried out in Brazil already proposes the creation of specific curricular guidelines for these courses, including making it mandatory to offer topics related to dietary restrictions [41].

Knowledge is not restricted to the concept of CD and gluten, but also permeates the foods used in the development of preparations for these individuals. Regarding the knowledge of which foods are sources of gluten, the present study found that few food handlers and undergraduates mentioned all the correct options. Although the majority of participants indicated wheat as a cereal that contains gluten, not half of the handlers indicated barley and not half of the handlers and undergraduates indicated rye as gluten-containing cereals. Similar results have been found in the literature in research carried out with food handlers and Culinary students [15,25]. Among food handlers, a study conducted with 36 Brazilian cooks, showed that 66.1% of respondents reported wheat as the cause of symptoms in celiacs, but none of the respondents got all four imported food options right [42]. Another study conducted in Brazil, with undergraduates, found that the majority (84%) indicates wheat as a source of gluten, however less than half indicates barley and rye (45% and 47.8%, respectively) [25]. A study that evaluated the knowledge about which foods have gluten through a quiz, among Culinary students and chefs, identified that the students obtained higher scores, suggesting that the education received at the university on the subject was being effective and should continue [15]. In this perspective, this study reinforces the importance/need for knowledge related to Nutrition to be available/accessible to Culinary Arts and Gastronomy undergraduate students at Higher Education Institutions in Brazil.

In this sense, a study conducted with 18 employees of gluten free restaurants in Brazil deserves to be highlighted, as it was found that 17% of the employees evaluated wrongly chose the option that contained barley as an option free of this nutrient [43]. This fact is relevant, since the restaurant was specialized in gluten-free production and, even so, food handlers were still not sure which cereals contain gluten. Thus, it is perceived the need for the dietitian's supervision in food production, so that the training, monitoring and sharing of correct information is constant. In addition, food handlers need to understand the importance of this information so that they seek knowledge and, from understanding, want to put it into practice. Education should be used as a form of awareness and instruction, preventing or minimizing the impacts of the food handlers' misconduct [44].

The recognition of gluten-free substitutes for food preparation is also indispensable for the proper care of celiacs. Brazilian study that evaluated the nutritional table of 162 gluten-free foods such as bread, cake mix, snacks, biscuits, energy bars, granola, chocolate, pasta and cake, found that the raw materials used as ingredients of gluten-free products were limited to five varieties: Rice, cassava, corn, soy, and potato [45]. Among the limited number of inputs that can be used to replace flours that contain gluten, in this study, a low percentage of participants correctly marked all options exempt from this nutrient and there was an erroneous indication of the presence of gluten in rice and corn. These findings are worrisome, because this lack of knowledge can have an impact on limiting the variability of gluten-free preparations offered in restaurants. The least recognized food as gluten-free and that could be used as a substitute was cassava flour. This data is relevant, since cassava is a popular food in Brazil [46] and is also one of the most used ingredients to replace wheat flour [45,47].

The development of gluten-free products can be stimulated during the education of undergraduate students in Culinary Arts and Gastronomy. The relationship between Gastronomy and Nutrition occurs at the moment when teachers from both areas work together providing the undergraduate students with an understanding of the importance of developing recipes for specific individuals. The role of the Nutrition teacher in Gastronomy courses promotes the discussion of content related to dietary restrictions with teachers in this area, and provides undergraduates with a broader view of CD. For food handlers, information on recipe modification often does not happen, due to the training carried out throughout their professional lives being related to good manufacturing practices. In order for the food handler to approach these issues, it would be recommended that they approach the dietitian [43]. The daily and mandatory performance of the dietitian in restaurants could supply this demand, however, in Brazil, there is no such requirement.

The follow-up of the gluten-free diet found barriers in the consumption of food outside the home [12,13]. A study that evaluated the challenges associated with the management of CD, pointed out that following the gluten-free diet is considered very or moderately difficult, particularly when eating out [48]. This fact can be explained by the concern regarding gluten contamination during food preparation. Cross-contamination of GF diet means that a gluten-free foodstuff acquires gluten; this can occur:

- a. In the production line, when gluten-free products share the same facilities and/or equipment with gluten containing products;
- b. At the time of cooking gluten-free foods, when eating out or when consuming ready-to-eat foods; avoiding this requires special care

separating gluten-free from gluten-containing kitchen gadgets and utensils, also food ingredients (such as jam, margarine, mayonnaise) and any potential source of gluten present in kitchens [49].

Following GF diet must include eliminating gluten as ingredient as well as hidden component and potential cross contamination in foods [49].

The knowledge about the need for care when preparing food for celiacs in order to avoid cross-contamination, as well as the need for observation of the food label was something pointed out by most food handlers and undergraduate students in this study. Labeling the presence of gluten in industrialized food packaging is mandatory under Brazilian law [50], but for food production in food services this requirement does not apply. A systematic review carried out by Falcomer and collaborators in 2018, which assessed gluten contamination between industrialized and non-industrialized foods, pointed out that industrialized products labeled as gluten-free had a lower percentage of gluten contamination than non-industrialized ones, suggesting the occurrence of contamination in food services.

Despite identifying the need for care when preparing food for celiacs, when asked about care in relation to cross-contamination, there still were food handlers and undergraduates who considered the sharing of oil and equipment and utensils between preparations with and without gluten to be correct or did not know how to answer the questions. The findings of this study corroborate another Brazilian study that evaluated the risks of gluten contamination in a university restaurant that served preparations for celiacs. In it, among the most frequent doubts raised by food handlers, was the possibility of cross contamination by the sharing of oil between foods with and without gluten [51]. The correct dissemination of information regarding care to avoid cross-contamination must be known by everyone who works or will work in food services.

For the adequate and safe supply of gluten-free foods for celiacs in restaurants, there is a need for policies of training on the requirements for the GF diet to be addressed to employees at food services to reduce the chance of gluten-cross-contamination. It is essential to design viable and effective strategies to prevent contamination in food services, including training food handlers, respective legislation, control measurement and supervision by dietitians and competent agencies [6]. These trainings must not only aim at the multiplication of knowledge, but mainly at changing behavior and attitudes [52].

From training and constant qualifications of food handlers and from the dissemination of knowledge related to Nutrition and CD to Culinary Arts and Gastronomy undergraduate students, it will be possible to start a modification of the current scenario of disinformation and unpreparedness of these current and future workers. To this end, a joint effort by Brazilian Higher Education Institutions is necessary. In the sense that there is a greater concern in inserting disciplines related to the area of Nutrition, with a focus on dietary restrictions in the curricula; Nutrition professionals, in order to become more active in restaurants; and from the celiac public, in order to demand from supervisory organs and restaurants accurate information about the ingredients and the way of preparing the foods on the menus.

Although the sample of the present study is of convenience and not representative of food handlers and Culinary Arts and Gastronomy undergraduate students in Brazil, we sought to deepen the

identification of a gap in the literature and the understanding of the phenomenon investigated, since few studies investigating the theme were identified in the literature, both nationally and internationally. During the conduct of this study, no research was carried out to compare the knowledge about CD between these current and future food handlers in Brazil.

Thus, it is important, as a strong point of this study, to start reflections on the importance of two topics:

1. Training of food handlers regarding the safe preparation of meals for celiacs, since it has already been identified in the literature that the habit of eating out is a worrying factor for the celiac population, mainly due to the misinformation of the food handlers regarding cross-contamination;
2. Inclusion of Nutrition disciplines in Higher Education at Culinary Arts and Gastronomy courses in Brazil with a focus on dietary restrictions, such as CD, since it is during education that students will have contact with different dietary restrictions and understand the importance of preparing food for these individuals.

A possible limitation may arise from the responses of the participants, which may not correspond exactly to the knowledge and behavior of the individuals, due to the bias of social desirability. The tendency to transmit a culturally acceptable image and according to social norms, avoiding criticism in test situations, can impair the quality of the information obtained in research [53].

It is suggested that studies be carried out with a representative sample of food handlers and undergraduate students in Culinary Arts and Gastronomy courses in Brazil to verify whether the results found in this study are also a reality in the country. In addition to studies with the objective of comparing the knowledge of undergraduate students at the beginning and at the end of the Culinary Arts and Gastronomy courses, identifying whether the course curriculum contains or not discipline (s) related to dietary restrictions and, seeking to verify whether the offer this (these) discipline (s) is being sufficient to understand the knowledge about CD.

Access to secure information about products and services available on the market must be provided by food companies, including restaurants. Thus, the relevance of the study is to investigate whether this information is known to current and future food workers, especially for serving the celiac individuals. In addition, it reinforces the relevance of professionals in this area, having autonomy and confidence to safely produce food for consumers with some type of food restriction.

Conclusion

The knowledge of food handlers and Culinary Arts and Gastronomy undergraduate students about celiac disease in the present study was unsatisfactory. Access to correct information about the disease, food and care in preparation was insufficient. Conducting training can help in sharing knowledge about CD for food handlers. These activities must be carried out with the choice of methodologies that allow participants to understand the content and the importance of using it in daily practice. The standardization of these trainings, as well as a frequent monitoring of the food handlers' routine can help in the effective implementation of safe practices in handling food for celiacs. In restaurants, dietitians can act, not only in relation to good manufacturing practices, but also to ensure the safe care of celiac individuals.

According to the results of the present study, it is important that the Culinary Arts and Gastronomy courses in Brazil consider the inclusion of disciplines in the area of Nutrition with a focus on dietary restrictions, such as CD, providing undergraduates with the interrelationship of preparation of foods with specific care for individuals with the disease. Therefore, the performance of the dietitian in the training of food handlers and in the education of gastronomes can contribute to the adequate care of celiac individuals when they eat out, positively impacting on the quality of life of these individuals.

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