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Cooking Workshops Increase the Sensory Acceptability of Watercress-Added Products Among Children

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Abstract

The objective of the research was to evaluate the knowledge, consumption and acceptance of children in relation to vegetables, especially the watercress, their participation in the preparation of meals and the degree of food neophobia of this public. Also, evaluate the effect of cooking workshops on the acceptability of watercress-added food products among children, in addition to analyzing the products physico-chemical composition. Twenty-three school-age children answered questionnaires and participated in cooking workshops for the preparation and sensory evaluation of cookie and cheese bread, added of watercress. The products were also evaluated in relation to the physico-chemical composition. Most children had low knowledge of vegetables and low acceptance of watercress. In general, the participation of children in the cooking workshops increased the products acceptability. The products presented a good nutritional profile and can be offered to school-age children, since they contain a better nutrient content than those traded without the addition of vegetables, especially for the contents of minerals and fibers. It was concluded that school-age children have low knowledge and acceptability of vegetables, among them the watercress. Cooking workshop is an effective educational strategy to improve the acceptability of food products added of watercress by this public. In addition, these products have a good nutritional profile, which promotes the supply of healthier foods, contributing to the reduction of the risk of future chronic non-communicable diseases.

Keywords: Products Development; Food and Nutritional Education; Vegetables.

1. Introduction

Childhood obesity is a public health problem of global concern (Skinner et al., 2018). Worldwide, it is estimated that 124 million children and adolescents between 5 and 19 years of age are obese and more than 40 million children under 5 years of age are overweight (FAO, 2019). In Brazil, in 2019, 16.33% of children

between 5 and 10 years of age presented overweight, 9.38% obesity and 5.22% severe obesity (IBGE, 2019). Thus, educational strategies are needed to change this scenario, with a view to improving child feeding.

Childhood is a period of life in which balanced nutrition is essential to promote healthy growth and reduce the risks of obesity and chronic non-communicable diseases in adulthood (Bass and Eneli, 2015). There are several types of unhealthy eating behaviors that are associated with childhood obesity (Dong et al., 2019), such as the consumption of industrialized foods, with high levels of salt, refined sugar and saturated fat (Sparrenberger et al., 2015). In addition, colleagues, friends, teachers, family members, the meal environment (D'Avila et al., 2015), the low frequency of physical activity practice, low availability of food, cultural practices and marketing strategies can also influence the choice of food (Al-Dalaeen and Al-Domi, 2017).

Children who like to try new foods present a food intake with a better nutritional profile when compared to those with food neophobia, a situation characterized by rejection of new foods (Armstrong et al., 2019; Spill et al., 2019). Generally, children have low daily intake of fruits and vegetables, 230 g for boys and 259 g for girls (Lynch et al., 2014), and the recommendation is 400 g (WHO, 2003). This is due to the presence of phytochemicals (carotenoids, flavonoids and glucosinolates) and organic acids (acetic acid, lactic acid, pyruvic acid, oxalic acid, malic acid, tartaric acid, fumaric acid, succinic acid and citric acid) that promote bitter, sour and acid flavors to food (Stokkom et al., 2019; Nor et al., 2021). In addition, fruits and vegetables have a more fibrous texture, which can also reduce acceptability (Stokkom et al., 2019; Nor et al., 2021). It is noteworthy that insufficient intake of fruits and vegetables can increase the risk of developing diseases since childhood. In the general population, this type of food habit accounts for about 14% of deaths due to gastrointestinal cancer, 11% of deaths due to ischemic heart diseases and 9% of deaths due to stroke worldwide (WHO, 2009). Thus, educational interventions are needed that can promote a healthier diet since childhood.

The implementation of actions that promote changes in food behavior in the early stages of life are fundamental to ensuring long-term results (WHO, 2009). There are several food and nutritional education programs that can be used with children, such as repeated exposure, culinary workshops, gardening, vegetable gardens and tasting workshops. Specifically, the cooking workshops, have demonstrated effectiveness in increasing fruit and vegetable consumption, improvement in food preferences and positive changes in anthropometric assessment (Muzaffar et al., 2018). In addition, children have a greater interest in preparing their own meals, generating greater skill and autonomy (Jarpe-Ratner et al., 2016).

The environment in which the child is inserted plays a key role in the formation of eating behaviors and interferes in the effectiveness of interventions. In this respect, the school is a favorable place for these actions, since the children spend most of the time, having the influence of teachers and colleagues, which can provide better results (Li et al., 2017). Lytle et al. (2006) demonstrated that educational interventions in feeding performed at school are more effective when compared to those applied in the family environment. Variables such as family preferences, cultural issues, times and food availability at home make this environment less conducive to actions. In this context, the objective of the research was to evaluate the knowledge, consumption and acceptance of children in relation to vegetables, especially the watercress, their participation in the preparation of meals and the degree of food neophobia of this public. Also, evaluate the effect of cooking workshops on the acceptability of watercress-added food products among children, in addition to analyzing

the products physico-chemical composition.

2. Materials and Methods

2.1 Participants and Ethical Issues

Twenty-three children aged between 7 and 10 years of age, of both sexes, enrolled in a properly selected school, located in the municipality of Guarapuava, PR, participated in the study. Initially, the school principal was contacted to verify the interest of participation in the study. Then, a Free and Informed Consent Form (FICF) was sent to the children's parents and/or guardians, which should be signed authorizing participation in the activities and also the Free and Clarified Consent Form signed by the child (FCCF). This work was approved by the Ethics and Research Committee under opinion number 3.089.447/2018.

2.2 Study Design

The survey was organized in two steps: Stage 1 - the children completed two questionnaires on: a) knowledge, consumption, acceptance, frequency and culinary preparations and b) food neophobia. They also carried out the sensory analysis of two food products added with watercress. This vegetable was chosen for evaluation in the present study, since it presents a high rejection among school-age children (78.8%) (Castagnoli et al., 2021). However, it is composed of high levels of nutrients, especially vitamins and minerals (September-Malaterre et al., 2018); Stage 2 - after 1 week, two cooking workshops were held, in which the children assisted in the preparation of the two foods of Stage 1, evaluating them sensually at the end of each activity.

2.3 Stage 1

The children answered two questionnaires simultaneously: a) Questionnaire A (QA), on knowledge, consumption, acceptance, frequency and culinary preparations, adapted by Ratcliffe et al. (2011) and Jacob et al. (2019) and; b) Questionnaire B (BQ), concerning food neophobia, as described by Laureati et al. (2015). Both questionnaires were applied as a general characterization of the children.

2.3.1 Questionnaire A (QA)

The participants received the printed questionnaire, which contained 11 questions (P), adapted from Ratcliffe et al. (2011) and Jacob et al. (2019): "Do you know this vegetable?" (P1); "Have you ever eaten this vegetable before?" (P2); "Do you like this vegetable?" (P3); "Did you eat this vegetable yesterday?" (P4) "How many times do you eat this vegetable?" (P5); "Do you eat this vegetable at home?" (P6); "Do you eat this vegetable at school?" (P7); "Do you feel like trying vegetables that you still don't know?" (P8); "Do you think eating vegetables is important?" (P9); "Do you help prepare meals at home?" (P10) and; "If you help prepare meal at home, how many times do you do that?" (P11). In order to answer the questions from P1 to P7, the researchers showed the watercress, *in natura* form, for the children, without any theoretical explanation. The other issues were related to vegetables in general.

The answers to questions P1, P2, P4, P6, P7, P8, P9, and P10 were "yes", "no", and "I don't know". In question P1 there was also a blank space for the child to describe the name of the vegetable if they knew. The P3 question was evaluated using a mixed structured facial Likert scale of 5 points (1 "I detest" to 5 "I adore") (Chen et al., 1996). The alternatives "every day", "once a week", "more than once a week", "once a month", "more than once a month" and "never" were used as answers to P5. Question 11, on the other hand, was made up of alternatives: "every day", "once a week", "more than once a week", "once a month", "more than once a month". The children should mark only one alternative in each issue.

To evaluate the responses in P1, the frequency (%) of correct identification of the vegetable (watercress) was considered. The other questions were evaluated in relation to the frequency (%) of marking for each alternative presented, since there were no correct or wrong answers.

2.3.2 Questionnaire B (QB)

The instrument consisted of 8 questions (P), four of them neophylics and the other four neophobes (Laureati et al., 2015): "I eat almost every day new and unusual foods" (P1); "I don't trust new foods" (P2); "If a food is new, I don't try it" (P3); "I like to try weird tastes and foods, which are unusual and coming from different countries" (P4); "When I am at a friend's party, I like to try new foods" (P5); "I am afraid to eat food I have never had before" (P6); "I am very fussy when it's a matter of food" (P7) and; "I really eat everything!" (P8).

The answer to each question was presented on a five-point facial scale: "very false for me", "false for me", "so-so", "true for me", and "very true for me", the child should mark a "x" in just one of the alternatives. The evaluation was based in three groups: "low neophobia" (scores ≤ 17), "medium neophobia" (scores between ≥ 18 and ≤ 24) and "high neophobia" (scores ≥ 25).

2.3.3 Products Development

Two products have been made adding watercress, cookie and cheese bread. The formulations are described in Frame 1. The percentages of addition of ingredients were defined by means of preliminary sensory tests performed with the products.

Frame 1. Added products of watercress studied in the research.

Products	Ingredients	Main steps of the recipe
Cookie 	Watercress (25.0%), rice flour (22.7%), oat flour (20.5%), eggs (12,5%), unsalted butter (10.2%), brown sugar (6.4%), cocoa powder 100% (2.3%) and chemical yeast powder (0.5%).	Cook the watercress in boiling water (100ºC) for 20 minutes, drain and chop. Beat the butter and brown sugar until it forms a homogeneous dough, place the eggs and beat again. In a container, add the dough and add the watercress, the flour, the cocoa and the yeast. Mix by hand until homogenization. Shape the dough in cookie format. Bake in a pre-heated oven at 180ºC for 20 minutes.

Cheese bread 	Tapioca (35.5%), watercress (23.0%), ricotta cream (20.9%), grated parmesan cheese (19.4%), salt (0.6%) and oregano (0.6%).	Cook the watercress in boiling water (100ºC) for 20 minutes and drain. Mix all ingredients and knead until a homogeneous dough is formed. Roll the dough into small spheres, place them in aluminum molds and bake (180ºC) for 30 minutes.

Before starting the recipes, all the vegetables were hygienized in running water and sanitized in sodium hypochlorite solution for 10 minutes. Source: the authors (2021).

2.3.4 Sensory Analysis

The affective sensory analysis of the products was performed with the children in the Stage 1 and Stage 2 at the end of each cooking workshop. The following attributes were evaluated: appearance, aroma, taste, texture and color, using a 7-points mixed hedonic facial scale ranging from 1 ("Super bad") to 7 ("Super good"), adapted from Resurreccion (1998). There was also a question on the overall acceptance of the preparation, which was analyzed using a mixed structured hedonic facial scale of 5-points (1 "I disliked a lot" to 5 "I liked a lot") (Brasil, 2017). The Acceptability Index (AI) of the recipes was evaluated according to the formula: AI (%) = A x 100/B (A = average grade obtained for the product; B = maximum grade given to the product) (Brasil, 2017; Kemp et al., 2018).

Prior to the products sensory evaluation, the children were given simple instructions on how to answer the questionnaire. Then, each child was taken to an organized place with a voting booth cabin type, so that she could carry out the product evaluation. At this time, a portion of each sample (approximately 15 g) was handed out in a white disposable container, always with the help of the executing team.

2.4 Stage 2

2.4.1 Cooking Workshops

The cooking workshops were individually designed with the two products added with watercress, already described in Frame 1. Each workshop lasted, on average, approximately 1 hour. At the beginning of the activity, a dynamic educational intervention was applied in order to explain the nutritional importance of the watercress intake. The products were elaborated in the kitchen and/or cafeteria of the schools by small groups of students (between 3 and 5). All the children assisted in all stages of product preparation, such as peeling, cutting, chopping, weighing, adding and mixing the ingredients. The researchers provided verbal instructions during the workshop, aiming to increase the participant's understanding during the recipe preparation.

At the end of each cooking workshop, the children underwent sensory evaluation of the products, as described in Stage 1 - Sensory Analysis.

2.5 Physico-Chemical Composition

The following product assessments were carried out (in triplicate): Moisture: determined in an oven at 105 °C up to constant weight (AOAC, 2011); Ash: analyzed in muffle furnace (550 °C) (AOAC, 2011); Lipid: the cold extraction method (Bligh and Dyer, 1959) was used; Protein: evaluated by the total nitrogen content

of the sample, by the Kjeldahl method determined at the semi-micro level, using a conversion factor of 6.25 (AOAC, 2011); Dietary Fiber: measured by theoretical calculation (USDA, 2020); Carbohydrate: evaluation by theoretical calculation (by difference), according to the formula: % Carbohydrate = 100 - (% moisture + % protein + % lipid + % ash + % dietary fiber); total caloric value (kcal): The calculation was theoretical using the factors of Atwater and Woods (1896) for lipid (9 kcal g^{-1}), protein (4 kcal g^{-1}) and carbohydrate (4 kcal g^{-1}).

2.6 Statistical Analysis

The data were analyzed using R Software version 3.6.1, by analysis of variance (ANOVA). The comparison of means of sensory analysis of Stages 1 and 2 was performed by the dependent Student's t-test. The influence of the level of food neophobia between the sexes was assessed by the Chi-square test. All the evaluations were analyzed with a level of 5% significance ($p \leq 0.05$).

3. Results and Discussion

Twenty-three school-age children (47.8% boys and 52.1% girls) participated in the study. The mean age was 8.0±0.95 years. Table 1 describes the children's answers to Questionnaire A, applied in Stage 1.

Table 1. Children's answers to questions (P) 1, 2, 4, 6, 7, 8, 9 and 10, from Questionnaire A (QA), Stage 1

Variable	Yes n (%)	No n (%)	I don't know n (%)
QAP1 - "Do you know this vegetable?"	2 (8.7)	21 (91.3)	0 (0)
QAP2 - "Have you ever eaten this vegetable before?"	2 (8.7)	19 (82.6)	2 (8.7)
QAP4 - "Did you eat this vegetable yesterday?"	0 (0)	23 (100)	0 (0)
QAP6 - "Do you eat this vegetable at home?"	1 (4.4)	17 (73.9)	5 (21.7)
QAP7 - "Do you eat this vegetable at school?"	0 (0)	18 (78.3)	5 (21.7)
QAP8 - "Do you feel like trying vegetables that you still don't know?"	3 (13.1)	9 (39.1)	11 (47.8)
QAP9 - "Do you think eating vegetables is important?"	1 (4.4)	5 (21.7)	17 (73.9)
QAP10 - "Do you help prepare meals at home?"	14 (60.9)	8 (34.7)	1 (4.4)

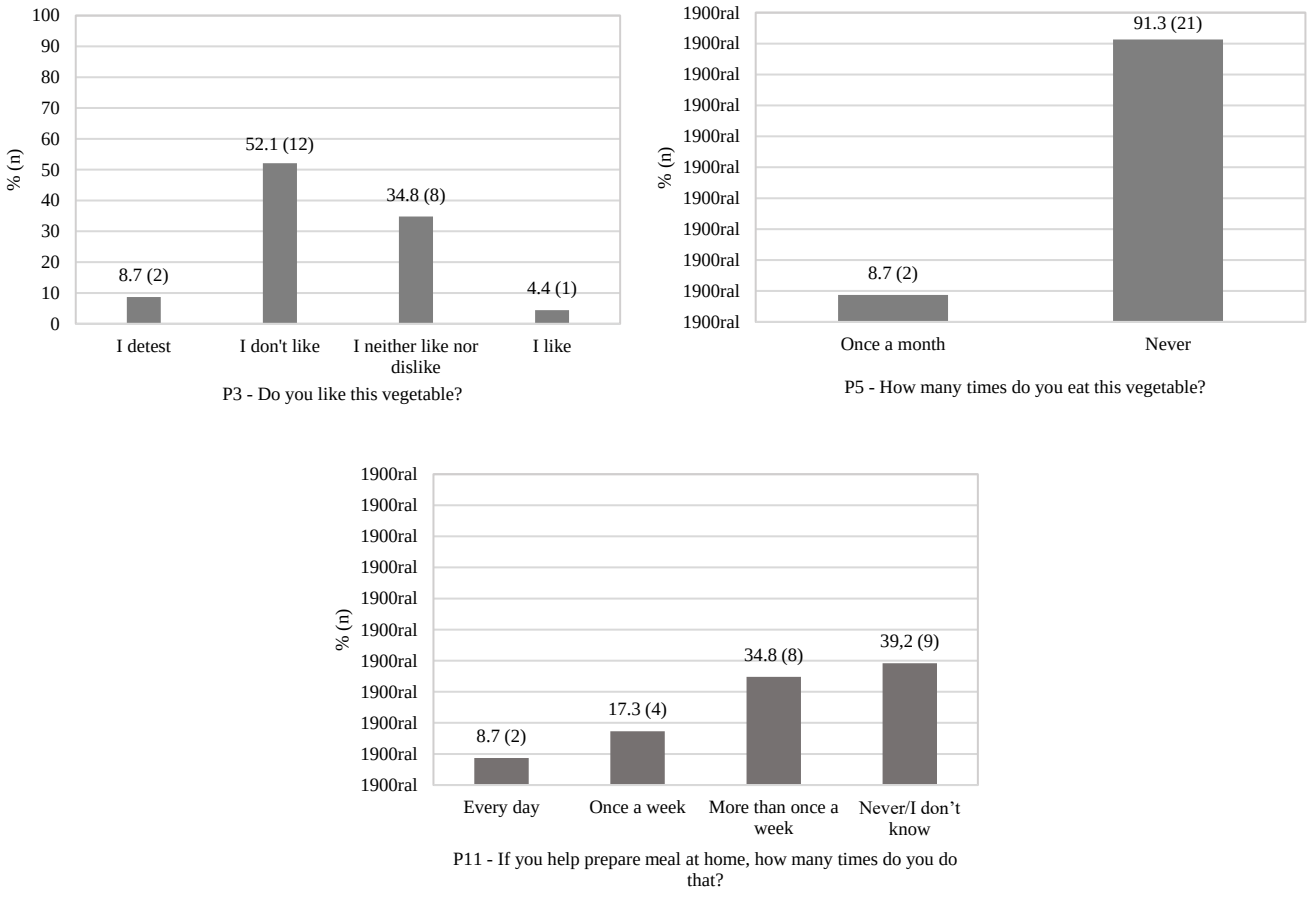
n: 23 children. Source: the authors (2021).

Most children did not know watercress. Only 2 participants knew the vegetable's name when questioned, corroborating the research by Leuven et al. (2018). However, the authors demonstrated that educational actions improve children's learning in relation to this vegetable. Other studies have also shown that the use of educational techniques with the children public contributes to improving diet quality, body mass index and motivation for vegetable consumption (Lee et al., 2020).

Regarding the watercress consumption (P2, P4, P6 and P7), there was a prevalence for the answers "no" and "I do not know". This shows that children have a low acceptance of this vegetable, corroborating with the

literature (Castagnoli et al., 2021). This effect occurs especially due to the bitter and sour tastes of some vegetables, which are promoted by the presence of substances such as phytochemicals and organic acids (Stokkom et al., 2019). In question P8, the participants demonstrated a high degree of neophobia for vegetables in general, and 86.9% of them reported not being willing or not to know about the desire to try them. Other studies have also reported that children have high levels of food neophobia related to vegetables (Cooke et al., 2003; Guzek et al., 2018). In this respect, the implementation of continuous interdisciplinary interventions may promote an increase in vegetables consumption (Anzman-Frasca et al., 2012; Hoppu et al., 2015).

Most children (95.6%) stated that they do not think or know if it is important to consume vegetables (P9), similar to that observed by Cambraia et al. (2012). Whereas an expressive number of participants reported helping in the preparation of meals at home (P10) (Table 1), more than once a week (Figure 1). In this sense, the involvement of children in the preparation of family meals helps to improve the quality of the diet, in addition to increasing the interaction between parents and children (Gross et al., 2010; Ranjit et al., 2015). According to Fisher and Birch (2001), children consider this attitude to be fun, which contributes to the increase in vegetable consumption (Leuvein et al., 2018). Figure 1 describes the children's answers to the questions, P3, P5 and P11 to Questionnaire A, applied in Stage 1.



Source: the authors (2021).

Figure 1. Children's answers to the questions, P3, P5 and P11 to Questionnaire A, Stage 1.

When the children were questioned regarding the watercress acceptability, 95.6% of them marked as I detest/do not like/do not like or dislike, and none reported adoring it. It should be considered that these responses were indicated, even, by children who did not know the watercress, considering that the expressive majority of them reported never consuming it (P5). This demonstrates that there is an individual denial in enjoying food that has not been consumed yet. Furthermore, children with a high degree of food neophobia have a higher olfactory sensitivity (Monnery-Patris et al., 2015), which may also increase the refusal for new foods, since they can be interpreted as unsafe for consumption (Dovey et al., 2008). Characteristic sensory aspects of some foods, such as taste, texture and appearance, may also explain the greater or lesser consumption of vegetables among children and adults (Wardle, 1995; Drewnowski et al., 1999). Table 2 describes the influence of sex on the degree of neophobia of school-age children.

Table 2. Sex influence on the degree of neophobia of children evaluated in the research

Sex	Low neophobia % (n)	Medium neophobia % (n)	High neophobia % (n)	p*
Boys	18.2 (2)	45.4 (5)	36.4 (4)	0.681
Girls	33.3 (4)	41.7 (5)	25.0 (3)	
General	26.1 (6)	43.5 (10)	30.4 (7)	

n: 23 children; n boys: 11; n girls: 12. *Chi-square test, considering significant the value of $p \leq 0.05$. Source: the authors (2021).

Sex did not influence the children's level of neophobia ($p \geq 0.05$), which corroborates the literature (Pliner et al., 1997; Cooke et al., 2003; Russel et al., 2008). However, some studies have shown that there is a prevalence of neophobia among girls. Generally, female individuals have a greater concern with the body since childhood, being more exposed to food and cooking themes (Pliner et al., 1993; Wardle et al., 2004), which increases the acceptance of different foods, especially vegetables (Johnson et al., 2015). It should be noted that most of the children evaluated in the present study presented a classification of medium/high dietary neophobia (73.9%), which was also observed in countries such as Italy (Laureati et al., 2015) and China (Xi et al., 2022). Table 3 describes the results obtained in the sensory analysis of food products evaluated in Stages 1 and 2.

Table 3. Average sensory scores (± standard deviation) and Acceptability Index (AI) (%) of products with added watercress evaluated by children in Stages 1 and 2

	Cookie		Cheese bread	
Parameter	Stage 1	Stage 2	Stage 1	Stage 2
Appearance	5.2±1.64[a]	5.4±1.61[a]	4.6±2.16[b]	5.3±2.16[a]
Aroma	4.4±1.95[b]	5.4±1.76[a]	4.7±2.27[b]	5.6±2.06[a]
Taste	4.2±2.06[b]	5.2±1.59[a]	4.5±2.20[b]	5.3±2.09[a]

Texture	3.9±1.69[b]	4.7±1.67[a]	4.3±1.97[b]	5.3±2.11[a]
Color	4.8±1.47[b]	5.7±1.37[a]	3.1±1.51[b]	4.7±2.21[a]
Overall Acceptance	3.5±1.21[b]	4.3±0.76[a]	3.4±1.55[b]	4.1±1.30[a]
AI[1]	70.0	86.0	68.0	82.0
AI[2]	56.0	82.6	56.0	73.9

Distinct letters in the column of the same product indicate a significant difference among the groups by the dependent Student's t-test ($p \leq 0.05$); AI: Acceptability Index for overall acceptance ([1]Kemp et al., 2018; [2]Brasil, 2017); Hedonic scale for attributes: 7-points: 1 ("Super bad") to 7 ("Super good"); Hedonic scale for overall acceptance: 5-points: 1 ("I disliked a lot") to 5 ("I liked a lot"). Source: the authors (2021).

In general, the children's participation in cooking workshops increased the scores ($p < 0,05$) in all the parameters for cookie and for cheese bread. Exception was verified for the appearance attribute, in cookie, which did not show significant difference between steps 1 and 2 ($p > 0.05$). Thus, it was possible to demonstrate the effectiveness of the cooking workshop to improve the acceptability of watercress added products (Figure 1 – QAP3). Similar results were observed by Maiz et al. (2021), who held cooking workshops with products added with broccoli and spinach. This technique promotes the child's involvement in the preparation of recipes, increasing the desire to experience and consume new foods and self-efficiency in the preparation of meals, promoting new experiences. In addition, it favors the interest of this public in consuming new foods (Maiz et al., 2019), reducing food neophobia.

The products acceptability indices increased after the children's participation in the cooking workshops. Cookie can be classified as a product of good acceptance, since it presented an AI ≥ 70% (Kemp et al., 2018), both in Stage 1 and Stage 2. The cheese bread, on the other hand, only obtained this classification after the cooking workshop was held. Despite this, none of the products can be offered in the Brazilian school meals, since AI was less than 85% (Brasil, 2017).

3.1 Physico-Chemical Composition

Table 4 shows the mean values of the physico-chemical composition of the products elaborated in the cooking workshops.

Table 4. Mean physico-chemical composition of the products added with watercress, elaborated in the cooking workshops

Parameter	Cookie	Cheese bread
Moisture (g 100 g^{-1})	11.6±0.04	53.2±0.07
Ash (g 100 g^{-1})	1.7±0.09	2.2±0.05
Protein (g 100 g^{-1})	9.4±0.04	7.2±0.10
Lipid (g 100 g^{-1})	17.5±0.09	7.9±0.05
Carbohydrate (g 100 g^{-1})	59.8±0.57	29.4±0.38

Total energy value (kcal 100 g^{-1})	433.84±0.92	217.8±0.81
Dietary Fiber (g 100 g^{-1})$^{\alpha}$	3.7	0.8

Values calculated on a wet basis; $^{\alpha}$Theoretical calculation: USDA (2020). Source: the authors (2021).

The products presented a good nutritional profile and can be offered to school-age children, since they contain a more favorable nutrients content than those traded without the addition of vegetables, especially for the contents of minerals and fibers (USDA, 2020). Cookie had a dietary content higher than 3% in its composition, classifying it as a source of fibers (Brasil, 2012). Cheese bread had value lower than 1%. The addition of oat flour to the cookie was the main responsible for the high content of fiber (7.6 g 100 g^{-1}) (USDA, 2020). In addition, cookie is the product with the highest amount of watercress added to the recipe, which contains high concentration of fiber (1.1 g 100 g^{-1}) (USDA, 2020). Thus, the products can contribute to a healthier diet, provided that the daily nutritional recommendations for nutrient consumption are respected (IOM, 2005).

4. Conclusion

School-age children have low knowledge and acceptability of vegetables, among them the watercress. Cooking workshop is an effective educational strategy to improve the acceptability of food products added of watercress by this public. In addition, these products have a good nutritional profile, which promotes the supply of healthier foods, contributing to the reduction of the risk of future chronic non-communicable diseases.

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