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Educational Actions at School: Proposal to Increase Children's Contact with Vegetables

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Abstract

The objective of the research was to evaluate the effect of educational actions in the school environment on the level of food neophobia, knowledge, consumption, acceptance, frequency of intake, planting of vegetables and assistance in cooking preparations among children. In addition, to verify the impact of actions on the sensory acceptance of food products added with vegetables with low acceptability by this public. Eighty-six children aged 7 to 10 years participated. The research was organized in three stages: pre-intervention, with filling out questionnaires and sensory analysis of the products; intervention, with application of educational actions and; post-intervention, with reapplication of questionnaires and sensory analysis of products. Actions included the implementation of vegetable gardens, theoretical-practical activities and cooking workshops. The physicochemical composition of the products was carried out to ensure food safety. Educational actions reduced the degree of food neophobia and improved the acceptability of food products by children ($p < 0.05$). In general, the educational actions had a positive impact ($p < 0.05$) on the participants' knowledge, consumption, acceptance and frequency of vegetables intake However, there was little influence to increase the planting of vegetables at home, with no change in helping children with cooking preparations ($p > 0.05$). The food products presented a good nutritional profile. It is concluded that educational actions carried out at school are efficient to reduce food neophobia and increase knowledge, consumption, acceptance and frequency of intake among children. Also, they improve the acceptability of food products with the addition of vegetables with low acceptance by this public.

Keywords: child, food products, food and nutrition education

1. Introduction

Obesity affects more than 41 million children worldwide. In Brazil, overweight in children aged 5 to 9 years is 16.2% in girls and 14.4% in boys, while obesity reaches 9.2% and 9.0%, respectively (Guedes & Mello, 2021). As for the Brazilian regions, the Southeast (10.6%) and South (10.1%) have the highest obesity rates, while in the North (6.7%) and Northeast (6.4%) the prevalence is lower (Ferreira et al., 2021). Obesity is considered a risk factor for chronic non-communicable diseases (NCDs), such as diabetes mellitus, dyslipidemias, cardiovascular and metabolic diseases (Ferreira et al., 2020). These diseases can also start in childhood and can last in the next stages of life (Kumar & Kelly, 2017).

Different factors can contribute to the development of childhood obesity, such as socioeconomic, demographic, racial, cultural habits, eating habits, age range, sedentary lifestyle, among others. However, the high consumption of ultra-processed foods (Khandpur et al., 2020; Martins et al., 2020) with high rates of fat, sugar, sodium and calories are the main promoters of excess weight (Martí Del Moral et al., 2021). According to Wang et al. (2021), the intake of ultra-processed foods by children collaborates with more than two-thirds of the total calories consumed in one day. However, daily vegetable/fruit intake is 2 portions per day (Lim et al., 2020), which is well below the recommendation of 400 grams per day, equivalent to 5 portions (FAO, 2015).

The children public naturally has a preference for more caloric and sweet-tasting foods. Sweet foods promote a sense of pleasure and relaxation, as well as attenuating sensations of pain and bad tastes (Mennella & Bobowski,

2016). In this phase of life, greater sensitivity is also observed in the taste receptors, which intensifies these effects. Nevertheless, children tend to reject bitter foods as a protective mechanism, since this type of taste is interpreted as potentially toxic from a physiological point of view (Mennella & Bobowski, 2015). Sour and acid foods also have low acceptability to children, such as watercress, spinach, radish (Leuven et al., 2018), Swiss chard and eggplant (Castagnoli et al., 2021). Although these foods are highly nutritious, the presence of substances such as malic acid, phenolic acids, phytates, oxalates and high fiber content can be unpleasant for children's taste (Oz & Kafkas, 2017). Other conditions such as neophobia and food selectivity, which occur mainly in childhood, may exacerbate the child's reluctance to try new foods (Łoboś & Januszewicz, 2019). Considering this context, it is essential to use educational strategies that promote healthier eating, aiming at preventing childhood obesity and NCDs in the subsequent stages of life.

Educational interventions related to food and nutrition have already shown to be effective in increasing fruit and vegetable intake by children. School garden is an example of a methodology that allows the individual to contact directly with the cultivation of plants, as well as encouraging sustainability, the preservation of the environment and the knowledge about vegetables (Leuven et al., 2018). Another tool that improves the acceptability of children by fruit and vegetables is the cooking workshops (Allirot et al., 2016). This practice helps the development of cooking skills, improves the ability of students to work together and make new friendships, awakening the pleasure of cooking and experimenting with new preparations (Jacob et al., 2019).

The use of vegetables in cooking preparations has already been proven as a favorable technique to improve the nutritional profile of food products, in addition to increasing the consumption of these foods by children (Allirot et al., 2016; Crary et al., 2022). However, educational interventions carried out in a joint manner and inserted into the school environment can be even more effective, increasing the acceptability of vegetables, since they reinforce learning and interaction among children (Kim & Park, 2020). In this context, the objective of the research was to evaluate the effect of educational actions in the school environment on the level of food neophobia, knowledge, consumption, acceptance, frequency of ingestion, planting vegetables and aid in cooking preparations among children. In addition, to verify the impact of actions on the sensory acceptance of food products added with vegetables with low acceptability by this public.

2. Method

2.1 Type of Study and Target Audience

This is a cross-sectional study with the participation of 86 children aged 7 to 10 years, enrolled between the 2nd and 5th year of literacy in a public school in the urban area of Guarapuava, PR, Brazil.

2.2 Ethical Issues

The research was approved by the Committee on Ethics in Research involving Human beings of UNICENTRO, under opinion no. 3.787.067/2019. All ethical aspects of research with human beings have followed the recommendation of National Health Council Resolution 466/2012.

The inclusion criteria considered students from 7 to 10 years, enrolled in the 2nd, 3rd, 4th or 5th year of the participating school; signing of the Free and Informed Consent Term by legal guardians; signature on the Free and Clarified Consent Term by children, absence of food allergies or known diseases and; participation in all stages of the research. Children who did not meet these inclusion criteria did not participate in the study.

2.3 Study Design

The research was organized in three stages: 1) Pre-intervention—the children filled out three questionnaires containing the following themes: a) knowledge, consumption, acceptance, frequency of ingestion and planting of vegetables, in addition to aid in cooking food recipes; and b) food neophobia. Also, performed the sensory acceptance of three foods with the inclusion of low acceptability vegetables, without participating in any educational activity; 2) Intervention—after 4 weeks, educational interventions of food and theoretical-practical nutrition were applied, which included: a) knowing the vegetables and importance of consumption; b) establishment and cultivation of vegetable gardens; c) healthy eating; and d) cooking workshops, in which children helped to develop the same three food products evaluated in the pre-intervention stage. These activities were carried out for 27 consecutive weeks; and 3) Post-intervention—the children filled in the same questionnaires applied in the pre-intervention, in addition to reassessing the acceptability of the food products.

2.4 Pre-Intervention Stage

Three different questionnaires were applied to the children: a) QA, Questionnaire A, referring to food neophobia; QB, Questionnaire B and QC, Questionnaire C, on consumption, knowledge, frequency, acceptance, planting of vegetables and cooking food recipes.

2.4.1 QA, Questionnaire A

In this form there were 8 questions (Q). Of these, four are considered neophilic and four neophobic, as described in the study of Laureati et al. (2015a). Responses were evaluated using a 5-point facial scale: very false for me—very true for me. Having the following classification: low neophobia, medium neophobia and high neophobia.

2.4.2 QB, Questionnaire B

The questionnaire was adapted from similar studies, consisting of eight questions (Jacob et al., 2019; Ratcliffe et al., 2011): "Do you have a vegetable garden in your school" (QB1); "Do you feel like planting vegetables in school?" (QB2); "Do you have a vegetable garden at home?" (QB3); "Do you feel like planting vegetables at home?" (QB4); "Do you feel like trying vegetables you don't know yet" (QB5); "Do you think eating vegetables is important?" (QB6); "Do you help prepare meals at home?" (QB7) and; "If you help prepare the meal at home, how many times do you do this?" (QB8).

The answers to the questions were as follows: in questions QB1, QB2, QB3, QB4, QB5, QB6 and QB7 alternatives were—I don't know, no and yes. Whereas the QB8 was made up of the alternatives: I do hot help (0 points), once a month (1 point), more than once a month (2 points), once a week (3 points), more than once in the week (4 points) and every day (5 points). Responses were single-marked, and were evaluated using frequency (%). For results analysis purposes, alternatives—I don't know, no and yes—have been joined together.

2.4.3 QC, Questionnaire C

The questionnaire consisted of 9 questions (Q) and was adapted from Ratcliffe et al. (2011): "Do you know this vegetable?" (QC1); "Have you tried this vegetable before?" (QC2); "Do you like this vegetable?" (QC3); "Did you eat this vegetable yesterday?" (QC4); "How many times do you eat this vegetable?" (QC5); "Do you eat this vegetable at home?" (QC6); "Do you eat this vegetable at school?" (QC7); "Have you ever planted that vegetable in the school vegetable garden?" (QC8) and; "Have you ever planted this vegetable in the vegetable garden at home?" (QC9).

The answers to the questions were as follows: in questions QC1, QC2, QC4, QC6, QC7, QC8 and QC9 alternatives were—I don't know, no and yes. In QC1 the child should write the name of the vegetable. The QC3 were evaluated using a 5-point facial scale (1, hated to 5, loved) (Brasil, 2017). Alternatives never/I don't know (0 points), once a month (1 point), more than once a month (2 points), once a week (3 points), more than once a week (4 points), every day (5 points), were used as QC5 answers. The answers to QC1 were classified according to the correctness of the name of the vegetable, using frequency (%). Responses were single-marked, and were evaluated using frequency (%). For results analysis purposes the alternatives—no and I don't know and never and I don't know have been united.

2.4.4 Elaboration and Sensory Analysis of Food Products

Three food products, pancake, pie and pizza were prepared for the research, with five vegetables containing low acceptability, being Swiss chard, watercress, eggplant, spinach and radish. In the pre-intervention stage, children performed sensory analysis of these products, without participating in any educational activity.

1) Elaboration of the products

The food products developed were pancake, pie and pizza. Each product contained the following vegetables as ingredients: Swiss chard, watercress, eggplant, spinach and radish. The formulations of food products are described in Table 1.

Preliminary sensory acceptability tests were applied to determine the amount of addition of each ingredient. All ingredients were acquired in the local commerce of the municipality.

Table 1. Added vegetables products evaluated by control and intervention groups

Product	Ingredients	Main steps of the recipe
Pancake 	Dough: whole milk (20.0%), wheat flour (14.8%), egg (5.5%), spinach (1.2%), watercress (0.6%), salt (0.4%). Filling: Chicken breast shredded (30.9%), Swiss chard (8.6%), eggplant (8.6%), onion (3.7%), tomato extract (2.5%), radish (1.2%), soybean oil (1.0%), garlic (0.6%), salt (0.4%).	Dough: blend all ingredients until homogenization. Add the small quantity (30g) dough to a frying pan (24 cm diameter) and cook for 2 minutes each side at a temperature of 160ºC. Repeat the cooking process until cooking the whole dough. Leave it aside. Filling: sauté the chicken in the oil for 10 minutes (180ºC). Shred the chicken and add the garlic, onion, eggplant, Swiss chard and radish chopped, tomato extract and salt and sauté for another 15 minutes (180ºC). Add 35 g of filling to each pancake.
Pie 	Dough: Whole milk (15.7%), egg (13.5%), wheat flour (11.6%), soybean oil (3.8%), corn starch (3.8%), spinach (1.4%), chemical yeast (1.4%), watercress (1.0%), salt (0.3%). Filling: Chicken breast shredded (24.1%), Swiss chard (6.8%), eggplant (6.8%), radish (3.4%), onion (2.9%), tomato extract (1.9%), soybean oil (0.8%), garlic (0.5%), salt (0.3%).	Dough: blend all ingredients until homogenization. Leave it aside. Filling: sauté the chicken in the oil for 10 minutes (180ºC). Shred the chicken and add the garlic, onion, eggplant, Swiss chard and radish chopped, tomato extract and salt and sauté for another 15 minutes (180ºC). Place 50% of the dough in a baking dish and distribute the filling. Cover with the rest of the dough. Bake in high oven (200°C), pre-heated for 30 minutes.
Pizza 	Dough: Wheat flour (24.3%), water (12.2%), sugar (1.8%), watercress (1.2%), spinach (1.2%), soybean oil (1.0%), biological yeast (0.6%), salt (0.1%). Filling: Chicken breast shredded (30.3%), Swiss chard (8.5%), eggplant (8.5%), onion (3.6%), tomato extract (2.4%), soy oil (1.0%), mozzarella cheese (1.0%), tomato sauce (0.6%), garlic (0.6%), radish (0.6%), salt (0.4%), oregano (0.1%).	Dough: mix the yeast, salt and sugar in 100 ml of warm water until the yeast is dissolved. Add wheat flour, oil, watercress, spinach and mix until homogenization. Cover until the dough is doubled in size, approximately 60 minutes. Open the dough with roll and cut into circles (9 cm in diameter). Bake in medium oven (180°C), pre-heated for 15 minutes. Leave it aside. Filling: sauté the chicken in the oil for 10 minutes (180ºC). Shred the chicken and add the garlic, onion, eggplant, Swiss chard and radish chopped, tomato extract and salt and sauté for another 15 minutes (180ºC). Brush the pizza with the tomato sauce. Add 15 g of filling to each pizza. Sprinkle cheese and oregano. Bake in medium oven (180°C), pre-heated for 15 minutes.

Note. All vegetables were hygienized in running water and sanitized in sodium hypochlorite solution (250 ppm) for 10 minutes.

2) Sensory analysis

Specific attributes were used for sensory evaluation of the products (appearance, aroma, taste, texture and color). A structured facial adapted hedonic scale of 7 points (1, super bad to 7, super good) was used for evaluation (Resurreccion, 1998), while the overall acceptance that was analyzed using a structured facial hedonic scale of 5 points (1, hated to 5, loved) (Brasil, 2017). For Acceptability Index (AI) assessment the following formula was used: AI (%) = (A x 100)/(B) – A, average grade and B, maximum grade (Guimarães et al., 2013). Children were offered 15 g of each product so that the child could carry out sensory analysis, together with drinking water to

clean the palate. The samples were delivered to the children in a balanced, monadic and sequential manner.

2.5 Intervention Stage

In this stage, four educational activities were carried out: a) knowing the vegetables and importance of consumption; b) implantation and cultivation of vegetables; c) healthy eating; and d) cooking workshops. The actions were carried out in schools from 2 to 3 days a week for a period of 27 weeks.

2.5.1 Implantation and Cultivation of Vegetable Garden

The implantation of the vegetable garden followed adapted guidelines from the literature (Nury et al., 2017; Wells et al., 2018). In each vegetable garden, the seedlings of the 5 vegetables with low acceptability were planted: Swiss chard, watercress, eggplant, spinach and radish, which were acquired in the local commerce of the municipality. The average total size of each vegetable garden was 5 m x 1.1 m, with beds of 80 cm approximate width. Initially, the environment was clean and organized by the researchers. In the sequence, small groups of children (between 10 and 15) were invited to start the processes of soil preparation, planting, irrigation and subsequent maintenance. Soil preparation consisted of returning the soil with a hoe for oxygen drainage and supply. Then, vegetable seedlings were planted in holes with a mean depth of 4 cm and spacing of 15 cm. The sides of the holes have been covered with soil. In the irrigation stage, the seedlings were wet every 2 days by the children with a manual watering agent, supervised by the researchers. In addition, the vegetable garden was also maintained by removing possible weeds and dirt from the site. Finally, the participants helped to collect the vegetables that would be used later in the cooking workshops, and to remove those unfit for consumption, which were discarded in organic waste.

2.5.2 Theoretical-Practical Activities

Playful, theoretical and practical actions using figures and games were used as adapted learning methodologies by Mannocci et al. (2016). The topics covered were related to the questionnaires applied in the pre-intervention stage, being: a) healthy eating, emphasizing the importance of in natura food consumption, as well as the differences between processed and ultra-processed foods. In addition, children received information on the importance of adequate water consumption (Brasil, 2014), of consuming school food (Cohen et al., 2021) and of conducting meals at appropriate times (Irwin et al., 2020); b) benefit of vegetable intake; c) biodiversity and sustainability, in which subjects related to vegetable growing were emphasized, and the sustainable use of water (Brasil, 2014); d) neophobia and food selectivity (Łoboś & Januszewicz, 2019); and e) cooking practices (Brasil, 2014). Children could interact freely during activities. To finalize this action, folders were delivered containing information on the topics covered in the intervention so that children could fix the activities performed.

2.5.3 Cooking Workshops

The cooking workshops were held after the completion of the other educational actions in consecutive weeks. In total, three individual cooking workshops were applied, one for each product (pancake, pie and pizza), with an average duration of 1 hour/workshop. Each preparation contained as an ingredient the five vegetables harvested in the garden by the children, Swiss chard, watercress, eggplant, spinach and radish, already described in Table 1.

Small groups of children (10 and 15) prepared the products in the school kitchen. To start the activity, the researchers recalled the importance of consuming vegetables to be used in preparations. During the preparation of recipes, children were invited to participate in the activity, helping with the steps (adding, cutting, mixing the ingredients, peeling, weighing and chopping). After the end of the cooking workshop, the children were invited to carry out a sensory analysis of the products produced.

2.6 Post-Intervention Stage

In order to evaluate the children's learning related to educational actions (intervention stage), questionnaires (QA, QB and QC) were reapplied and post-intervention evaluations were considered.

2.7 Physicochemical Composition

The food products elaborated in the research were evaluated in relation to their physicochemical composition, aiming at knowing the nutritional content. The following analyzes were carried out in triplicate: Moisture: determined in an oven at 105 °C until constant weight (AOAC, 2011); Ash: Analyzed in muffle furnace (550 °C) (AOAC, 2011); Lipid: cold extraction method was used (Bligh & Dyer, 1959); Protein: evaluated by the total nitrogen content of the sample, by the Kjeldahl method, determined at the semi-micro level (AOAC, 2011); Dietary fiber: the theoretical calculation was used according to the literature (USDA, 2020); Carbohydrate: a theoretical calculation by difference was used (100 - (% moisture + % ash + % lipid + % protein + % dietary fiber)); Caloric value (kcal): Atwater & Woods factors (1896) were used to calculate (carbohydrate, 4 kcal g^{-1}; protein, 4 kcal g^{-1} and; lipid, 9 kcal g^{-1}).

2.8 Statistical Analysis

The results of each stage (pre-intervention and post-intervention) were evaluated by Pearson's non-parametric chi-square test, Wilcoxon test and McNemar test, and by the Student's t dependent and Tukey's t-parametric tests, with a 5% significance level, using software R version 4.3.1.

3. Results

3.1 Food Neophobia

Table 2 and Figure 1 describe the results related to the level of neophobia of the target audience, referring to QA. Sex did not have an influence on the level of children's food neophobia ($p > 0.05$). However, most of them were evaluated with a high degree of neophobia (medium/high) in the pre-intervention (82.6%) and post-intervention (79.1%) stages. Educational actions were efficient to reduce children's food neophobia ($p < 0.05$), as it can be seen in Figure 1.

Table 2. Sex prevalence over the level of neophobia of children, referring to QA, Questionnaire A, considering the pre- and post-intervention stages

Sex	Low n (%)	Medium n (%)	High n (%)	p*
Pre-intervention				
Boys	6 (40.0)	21 (47.7)	15 (55.6)	0.613
Girls	9 (60.0)	23 (52.3)	12 (44.4)	
General	15 (17.4)	44 (51.2)	27 (31.4)	
Post-intervention				
Boys	10 (55.6)	18 (47.4)	14 (46.7)	
Girls	8 (44.4)	20 (52.6)	16 (53.3)	0.813
General	18 (20.9)	38 (44.2)	30 (34.9)	

Note. n = 86; n: boys: 42; n: girls: 44. *Pearson's chi-square test, considering significant $p < 0.05$.

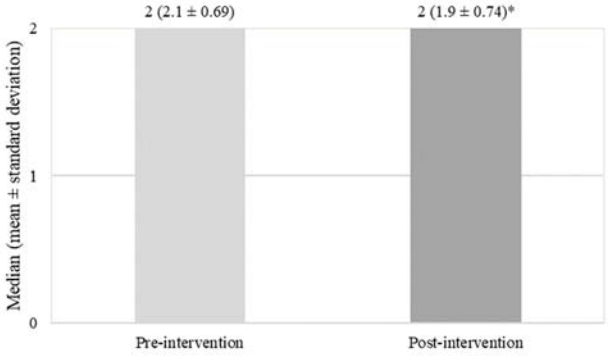

Figure 1. Effect of educational actions on the degree of children's food neophobia (Questionnaire A, QA), considering the pre- and post-intervention stages

Note. n = 86; *Wilcoxon test, Z = -2.549; p = *0.011*; Classification of scores for neophobia: 1 = low; 2 = medium; 3 = high.

3.2 Sensory Analysis

The results of sensory analysis of added vegetables products evaluated in the pre- and post-intervention stage are presented in Table 3. In general, educational action has improved the acceptability of food products. Positive effects were specifically verified for color and overall acceptance (pizza); taste, texture and overall acceptance (pancake) and; aroma, taste, texture and overall acceptance (pie). Pizza had the least influence on acceptance after the application of the educational intervention. This is because children have already presented high acceptability for this food before intervention. All preparations obtained acceptance rates above 70%, indicating good acceptance.

Table 3. Sensory scores (average ± standard deviation) of products, considering the pre- and post-intervention stages

Parameter	Pancake		Pie		Pizza	
	Pre	Post	Pre	Post	Pre	Post
Appearance	5.8 ± 1.56[a]	6.1 ± 1.35[a]	5.8 ± 1.70[a]	5.9 ± 1.47[a]	6.1 ± 1.42[a]	6.1 ± 1.38[a]
Aroma	5.8 ± 1.47[a]	6.1 ± 1.46[a]	5.7 ± 1.63[b]	6.2 ± 1.33[a]	6.0 ± 1.41[a]	6.3 ± 1.36[a]
Taste	5.9 ± 1.81[b]	6.7 ± 0.86[a]	6.0 ± 1.81[b]	6.5 ± 1.13[a]	6.3 ± 1.48[a]	6.7 ± 0.89[a]
Texture	5.9 ± 1.59[b]	6.3 ± 1.20[a]	5.9 ± 1.61[b]	6.3 ± 1.20[a]	6.0 ± 1.42[a]	6.2 ± 1.27[a]
Color	5.7 ± 1.62[a]	5.8 ± 1.67[a]	5.7 ± 1.72[a]	5.9 ± 1.61[a]	5.6 ± 1.50[b]	6.1 ± 1.34[a]
Overall acceptance	4.1 ± 1.25[b]	4.7 ± 0.68[a]	4.2 ± 1.32[b]	4.9 ± 0.79[a]	4.5 ± 1.00[b]	4.8 ± 0.68[a]
Acceptability index (%)	82[b]	94[a]	84[b]	98[a]	90[b]	96[a]

Note. Distinct letters in the line between the same product indicate a significant difference between pre- and post-intervention groups (dependent Student's t test, $p < 0.05$); hedonic scale for attributes - 7 points (1, super bad to 7, super good); hedonic scale for overall acceptance - 5 points (1, hated to 5, loved).

3.3 Effect of Educational Actions on Questionnaires B and C

The effect of educational action on children's answers to questions from QB is presented in Table 4. Educational actions increased ($p < 0.05$) children's desire to grow vegetables in the school environment (QB2). In addition, 100% of the participants indicated that there was vegetable garden in the school (QB1) after the intervention. It should be noted that there was a significant reduction in the number of children who reported having vegetable garden at home (QB3) after the actions were applied. In this case, it can be concluded that the interventions were effective to improve the knowledge of children about vegetable gardens, since before they did not know how to differentiate a vegetable garden from a garden, for example.

There was no significant difference ($p > 0.05$) between the pre- and post-intervention periods for QB4, QB5, QB6 and QB7. Similar effect was verified for question QB8 (data not shown, pre-intervention (4.50 points, 3.2 ± 2.15), post-intervention (4.00 points, 3.0 ± 2.08), Wilcoxon test, $Z = -0.616$; $p = 0.538$), which questioned the children about the number of times they helped prepare meals at home. Despite these results, it is worth stressing that the number of positive responses to these questions was already high before the interventions were implemented.

The form in which the question and answer are presented to children directly influence the judgment. Table 2 shows that children presented a high level of food neophobia, both in the pre- and post-intervention stages. In this case, the questionnaire used was more playful, with responses in the form of emojis. In question QB5, the answers were presented directly (yes, no, and I don't know), and most children reported having the will to try unknown vegetables. Thus, although the questions are convergent in both cases, the answers were discrepant. In question 6 (QB6), it is verified that children know that it is important to consume vegetables.

Table 5 and Figures 2 and 3 show the effects of educational actions on questions of QC. The educational intervention was effective ($p < 0.05$) to improve the answers of most questions of QC, with the exception of QC6 (Swiss chard) that reduced the consumption of vegetables at home (Table 5), which may have occurred due to the lack of knowledge about vegetables in the pre-intervention stage. Nevertheless, no significant effect was observed for some vegetables ($p > 0.05$) in questions 4 (Swiss chard, watercress and spinach), 6 (eggplant, spinach and radish) and 9 (Swiss chard, eggplant, spinach and radish).

The application of educational interventions increased ($p < 0.05$) the favorable answers to QC3 ("Do you like this plant?") for most children, except for Swiss chard that did not present significant modification (Figure 2). It also increased the number of times in the week/day ($p < 0.05$) that children ate watercress and eggplant (QC5, Figure 3). No significant effect was observed for other vegetables ($p > 0.05$).

Table 4. Effect of educational actions on children's answers to questions in QB, Questionnaire B regarding knowledge, consumption, acceptance, frequency, planting of vegetables and cooking preparations, considering the pre- and post-intervention stages

Question	Pre-intervention				Post-intervention				p*
	Yes		No/I don't know		Yes		No/I don't know		
	n	%	n	%	n	%	n	%	
QB1	31	36.0	55	64	86	100.0	0	0.0	**
QB2	60	69.8	26	30.2	77	89.5	9	10.5	*0.001*
QB3	61	70.9	25	29.1	42	48.8	44	51.2	*0.002*
QB4	65	75.6	21	24.4	67	77.9	19	22.1	0.845
QB5	56	65.1	30	34.9	62	72.1	24	27.9	0.327
QB6	76	88.4	10	11.6	80	93.0	6	7.0	0.388
QB7	59	68.6	27	31.4	64	74.4	22	25.6	0.383

Note. n = 86; Question (Q): QB1. "Do you have a vegetable garden in your school?"; QB2. "Do you feel like planting vegetables in school?"; QB3. "Do you have a vegetable garden at home?"; QB4. "Do you feel like planting vegetables at home?"; QB5. "Do you feel like trying vegetables you don't know yet?"; QB6. "Do you think eating vegetables is important?"; QB7. "Do you help prepare meals at home?"; *McNemar test, considering significant $p < 0.05$; **p value not calculated due to data invariability.

Table 5. Effect of educational actions on children's responses to questions of QC, Questionnaire C regarding knowledge, consumption, acceptance, frequency and planting of vegetables, considering the pre- and post-intervention stages

Question	Pre-intervention				Post-intervention				p*
	Yes		No/I don't know		Yes		No/I don't know		
	n	%	n	%	n	%	n	%	
Swiss chard									
QC1	2	2.3	84	97.7	81	94.2	5	5.8	*0.001*
QC2	60	69.8	26	30.2	79	91.9	7	8.1	*0.001*
QC4	26	30.2	60	69.8	19	22.1	67	77.9	0.265
QC6	54	62.8	32	37.2	33	38.4	53	61.6	*0.001*
QC7	28	32.6	58	67.4	77	89.5	9	10.5	*0.001*
QC8	6	7.0	80	93.0	73	84.9	13	15.1	*0.001*
QC9	35	40.7	51	59.3	25	29.1	61	70.9	0.099
Watercress									
QC1	0	0.0	86	100.0	81	94.2	5	5.8	**
QC2	18	20.9	68	79.1	80	93.0	6	7.0	*0.001*
QC4	12	14.0	74	86.0	18	20.9	68	79.1	0.327
QC6	14	16.3	72	83.7	30	34.9	56	65.1	*0.007*
QC7	9	10.5	77	89.5	70	81.4	16	18.6	*0.001*
QC8	3	3.5	83	96.5	80	93.0	6	7.0	*0.001*
QC9	9	10.5	77	89.5	23	26.7	63	73.3	*0.009*
Eggplant									
QC1	46	53.5	40	46.5	81	94.2	5	5.8	*0.001*
QC2	36	41.9	50	58.1	80	93.0	6	7.0	*0.001*
QC4	13	15.1	73	84.9	27	31.4	59	68.6	*0.016*
QC6	26	30.2	60	69.8	22	25.6	64	74.4	0.572
QC7	9	10.5	77	89.5	19	22.1	67	77.9	*0.001*
QC8	3	3.5	83	96.5	76	88.4	10	11.6	*0.001*
QC9	12	14.0	74	86.0	18	20.9	68	79.1	0.210
Spinach									
QC1	9	10.5	77	89.5	78	90.7	8	9.3	*0.001*
QC2	34	39.5	52	60.5	77	89.5	9	10.5	*0.001*
QC4	14	16.3	72	83.7	15	17.4	71	82.6	1.000
QC6	30	34.9	56	65.1	28	32.6	58	67.4	0.860
QC7	13	15.1	73	84.9	76	88.4	10	11.6	*0.001*
QC8	1	1.2	85	98.8	76	88.4	10	11.6	*0.001*
QC9	21	24.4	65	75.6	29	33.7	57	66.3	0.243
Radish									
QC1	9	10.5	77	89.5	81	94.2	5	5.8	*0.001*
QC2	57	66.3	29	33.7	79	91.9	7	8.1	*0.001*

QC4	12	14.0	74	86.0	24	27.9	62	72.1	*0.036*
QC6	49	57.0	37	43.0	37	43.0	49	57.0	0.065
QC7	39	45.3	47	54.7	72	83.7	14	16.3	*0.001*
QC8	6	7.0	80	93.0	77	89.5	9	10.5	*0.001*
QC9	20	23.3	66	76.7	26	30.2	60	69.8	0.286

Note. n = 86; Question (Q): QC1. "Do you know this vegetable?"; QC2. "Have you tasted this vegetable before?"; QC4. "Did you eat this vegetable yesterday?"; QC6. "Do you eat this vegetable at home?"; QC7. "Do you eat this vegetable at school?"; QC8. "Have you ever planted this vegetable in the school vegetable garden?"; QC9. "Have you ever planted this vegetable in the vegetable garden at home?". *McNemar test, considering significant $p < 0.05$; **p value not calculated due to data invariability.

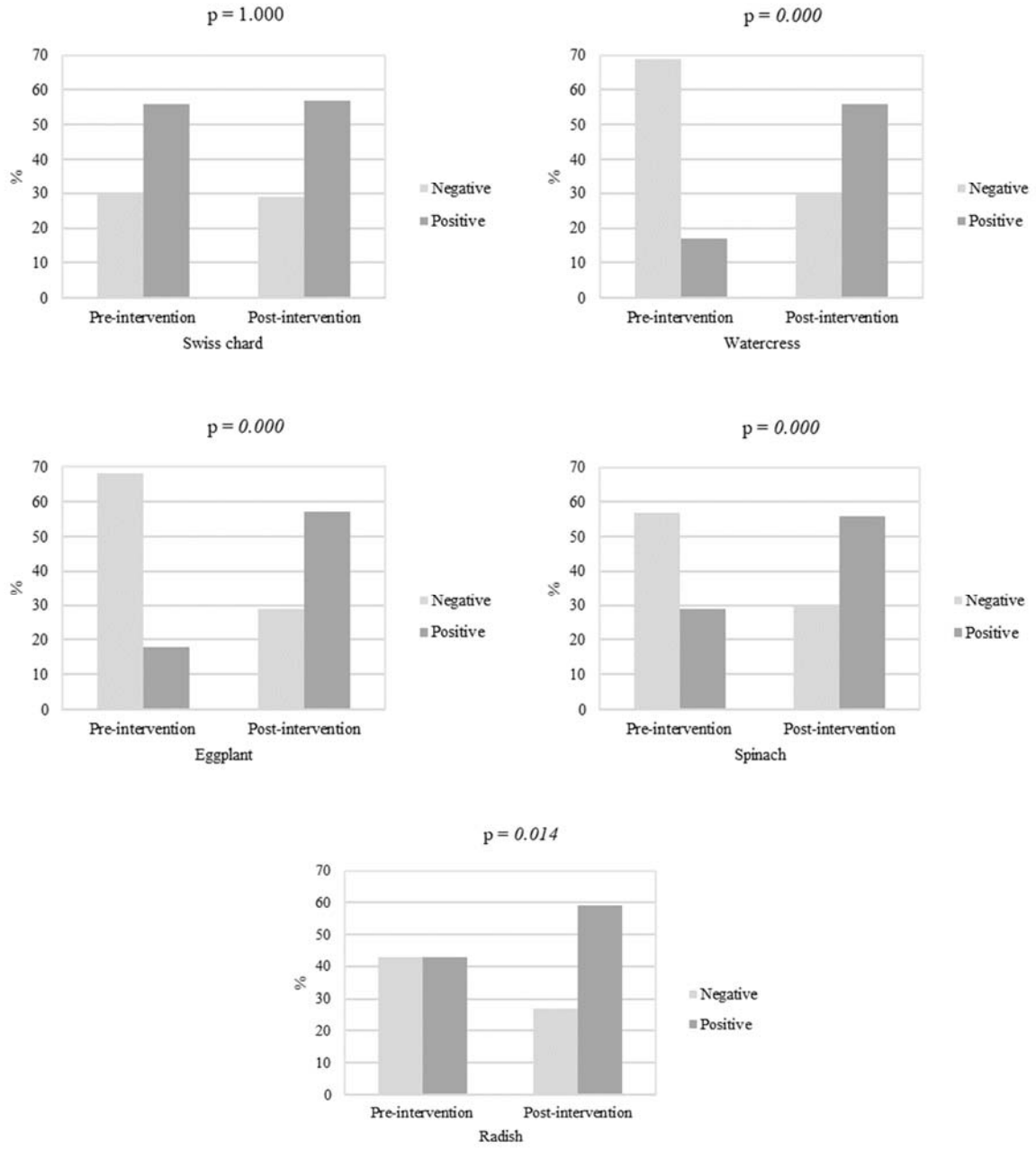

Figure 2. Effect of educational actions on children's answers to question 3 ("Do you like this vegetable?") from QC, Questionnaire C concerning the vegetables Swiss chard, watercress, eggplant, spinach and radish, considering the pre- and post-intervention stages

Note. n = 86; McNemar test, considering significant $p < 0.05$; Answer rating: Negative = I don't know, hated, didn't like or indifferent; positive = liked and loved.

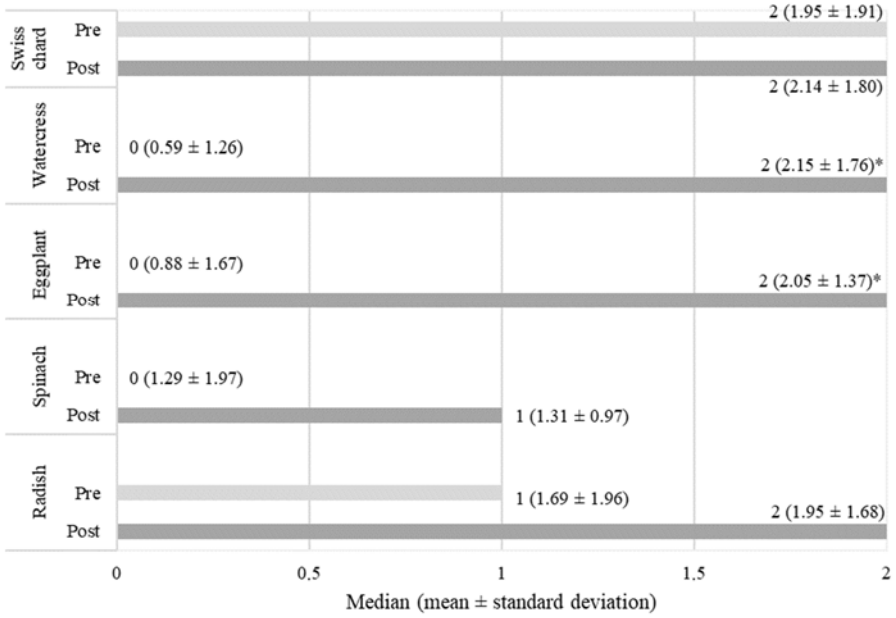

Figure 3. Effect of educational actions on children's answers to question 5 ("How many times do you eat this vegetable?") from QC, Questionnaire C, referring to vegetables Swiss chard, watercress, eggplant, spinach and radish, considering the pre- and post-intervention stages

Note. n = 86; *Wilcoxon test, considering significant $p < 0.05$; Answers rating: 0 = never/I don't know; 1 = once/month; 2 = more than once/month; 3 = once/week; 4 = more than once/week; 5 = every day.

3.4 Physicochemical Composition

Table 6 describes the results of the physicochemical composition of the added products of Swiss chard, watercress, eggplant, spinach and radish and elaborated in the cooking workshops.

Table 6. Average physicochemical composition (± standard deviation) of added preparations of vegetables prepared in the cooking workshops

Parameter	Pancake	Pie	Pizza
Moisture (g 100 g^{-1})	62.5 ± 0.07^{a}	59.9 ± 0.07^{b}	54.2 ± 0.07^{c}
Ash (g 100 g^{-1})	2.4 ± 0.08^{ab}	2.5 ± 0.08^{a}	2.3 ± 0.06^{b}
Protein (g 100 g^{-1})	11.5 ± 0.09^{b}	8.5 ± 0.07^{c}	12.4 ± 0.08^{a}
Lipid (g 100 g^{-1})	4.5 ± 0.06^{c}	8.2 ± 0.09^{a}	7.1 ± 0.09^{b}
Carbohydrate (g 100 g^{-1})	19.1 ± 0.32^{c}	20.9 ± 0.66^{b}	23.9 ± 0.45^{a}
Total caloric value (kcal 100 g^{-1})	162.6 ± 1.10^{c}	191.6 ± 0.81^{b}	209.3 ± 0.98^{a}
Dietary fiber (g 100 g^{-1})$^{\alpha}$	1.0	0.8	1.3

Note. Distinct letters in the line indicate a significant difference by Tukey's test ($p < 0.05$); Wet-based calculated values; $^{\alpha}$Theoretical calculation (USDA, 2022).

The pancake showed the highest moisture content ($p < 0.05$) and lower lipid, carbohydrate and calorie contents. Pizza was the product with the lowest amount of moisture, however it had the highest concentration of protein, carbohydrate and calories. Also, it obtained lower amounts of ash compared to pie. Higher lipid and lower protein content were observed in the pie ($p < 0.05$). None of the formulations can be considered as a source of fibers, since they have contents lower than 10% of the Daily Reference value per portion of the food (80 g pancake; 100 g, pie; and 90 g pizza).

4. Discussion

Generally, sex does not influence the level of children's food neophobia, which has been proven in the present study (Table 2) and other studies (Cole et al., 2017; Hazley et al., 2022). However, some authors suggest that boys may present higher levels of neophobia (Moding & Stiflter, 2013; Siegrist et al., 2013; Laureati et al., 2015b), since they have a higher preference for foods such as meat, referring to strength and masculinity (Çinar et al.,

2021). Girls, however, tend to eat foods with a more favorable nutritional profile, such as fruits and vegetables, due to their concern with weight control since childhood. In general, the female sex is more prone to develop an excessive concern with body image, due to pressure exerted by the family, society and the media, which encourages her in the search for a lean body, which may cause personal dissatisfaction (Frederick et al., 2022).

Neophobic behavior is prevalent in childhood, since children reject food due to lack of external stimuli, such as contact with unknown foods, with different textures and tastes (Torres et al., 2020). According to Łoboś (2019), this stage of life is marked by the development of eating habits, so the choice of certain foods can minimize the risks of eating those that harm health. Nevertheless, this type of food can lead to harmful effects, such as food monotony and, consequently, nutritional deficiencies. This effect was also observed in the target audience of this study, since most children presented a high level of neophobia (medium/high), both in the pre- and post-intervention stage (Table 2), similar to that reported in the literature (Laureati et al., 2015b). In addition, the influence of parents on eating habits, children's inherent preferences for sweet taste, sensory aspects of food, lack of incentive and affectivity at the time of meal, anxiety and diets with low nutritional content (Torres et al., 2020) is highlighted. In the study of Rotman et al. (2020), it has been demonstrated that families that stimulate the practice of healthy habits have a better food quality, especially when it comes to vegetable consumption.

All preparations evaluated in this study presented an acceptability index higher than 70% (Table 3), which indicates good sensory acceptance (Passos & Ribeiro, 2009). Nevertheless, the type of product offered to the child is a factor that can influence the sensory evaluation (Allirot et al., 2016). This effect was verified for pizza, which had the least influence on the notes after the application of the educational intervention. In this case, children already presented high acceptability for this food before interventions, similarly to that observed by Gonçalves et al. (2014), where pizza was accepted by 85% of the children evaluated. It is common for this public to have a higher preference for ultra-processed foods which have high of sodium, fat and sugar levels, corroborating with Wang et al. (2021), who observed that most of the energy consumed by school-age children was from fast foods. This type of food is considered to be hyperpalatable due to the addition of dyes, flavorings, emulsifiers, sweeteners, gelling agents and other additives, which improve the appearance and taste of the final product (Monteiro et al., 2019).

Educational actions can help reduce food neophobia and increase children's willingness to try new foods, expand children's consumption and learning and attitudes toward vegetables (Allirot et al., 2016; Leuven et al., 2018; Kim & Park, 2020; Schreinemachers et al., 2020; Zeng & Gallarza, 2022), as confirmed in the present study (Figures 1 and 3 and Table 4). It is worth noting that there has been an increase in the number of times children eat watercress and eggplant at home (Figure 3). This result may be explained, possibly, because they are vegetables that presented higher availability and supply both in school and in the family environment, during the period in which the study was conducted. Thus, it is suggested that new research can evaluate the consumption of vegetables in different periods of the year, since the supply of vegetables is influenced by seasonality (Abizari et al., 2017). However, it is also possible that the greatest contact of children with vegetables through interventions may have stimulated the desire to prove these specific foods (Allirot et al., 2016). It should be noted that there was a reduction in the number of children who reported having vegetable garden at home (QB3) after the actions were applied (Table 4). In this sense, it is concluded that the teaching methodologies were effective in improving children's learning about the concept of vegetable gardens, since before the intervention they did not know how to differentiate a vegetable garden, for example, as also observed by Amiri et al. (2021).

Theoretical-practical methodologies that unite the study and the direct involvement of the child from planting to preparing meals, such as school gardens and cooking workshops, help to build positive experiences in relation to food. This effect is more relevant, especially when it comes to vegetables that are not present in the food routine, which encourages the child to try them in different preparations (Van Der Horst et al., 2014; Allirot et al., 2016; Nury et al., 2017). In the case of school gardens, this technique allows the target public to have greater contact with nature, awakening the interest in preserving the environment through sustainable cultivation practices, with the restricted use of pesticides (Davis et al., 2015). Another important factor to be considered is the application of this methodology in the school environment, which can be used as a pedagogical misuse, since group and outdoor activities provide students with interaction with the environment and society (Kim & Park, 2020). The cooking workshop, on the other hand, has the capacity to increase children's desire to prepare their own food early, stimulating the creativity associated with cultural practices. Moreover, it allows school children to have new opportunities to experience foods that are not common in their food routines, since the way of preparation, the company, the location and the situation in which the individual feeds can change the level of acceptance of the preparations (Schultz & Rosen, 2022). Allirot et al. (2016) and Kim and Park (2020) also concluded that this strategy increases the appreciation of the use of local food. Furthermore, the development of the activity in a collective manner combined with the sensory analysis of the product provides greater contact with food and the

exchange of experiences, contributing to increase food consumption with low acceptance.

Educational interventions improved the food product notes evaluated sensorially (Table 3). A similar effect was observed in the acceptability referred to by children (QC3, Figure 2), except for Swiss chard that did not present significant modification. These results corroborate similar studies with children (Allirot et al., 2016; Øvrebø et al., 2019; Crary et al., 2022). Despite the favorable results for most evaluations, some attributes are more difficult to experience changes in the sensory acceptance of children, such as appearance, aroma and color. Appearance is one of the main attributes observed in a food product, since it is the first impression the consumer has in relation to the food, so the better the presentation, the greater the acceptance of the product. Similarly, the aroma impacts directly into sensory acceptability. This attribute influences the taste of the food, since the aroma is characterized as a set of sensations of psychophysiological origin, which arise from contact with the nasal, tactile and stative sensory receptors (Lagerkvist et al., 2023). In addition, green-colored foods can reduce acceptance, as individuals interpret green color as potentially toxic, associating with sour taste (Spence, 2015). In this context, the use of interventions with methodologies focused on improving the acceptance of these specific attributes can increase vegetable consumption, as well as reduce food waste (Yuan et al., 2019)

Many studies have already proven the positive effect of educational interventions with children in the school environment (Van Der Horst et al., 2014; Allirot et al., 2016; Nury et al., 2017; Leuven et al., 2018; Kim & Park, 2020; Schreinemachers et al., 2020; Zeng & Gallarza, 2022). However, modifications may not be possible as observed in questions QB4, QB5, QB6, QB7 and QB8 (Table 4), QC4 (Swiss chard, watercress and spinach), QC6 (eggplant, spinach and radish), QC9 (Swiss chard, eggplant, spinach and radish) (Table 5) and QC5 (Swiss chard, spinach and radish) (Figure 3), which was also observed by Øvrebø et al. (2019). In the present study, it was possible to observe that children did not have knowledge of some vegetables. It should be considered that the target public of the study was low income, so it is possible that vegetable consumption occurs mainly at school, since family members may not have sufficient financial resources to acquire these foods and thus do not have the habit of eating. In addition, the fact that the population resides in the periphery of the municipality makes it difficult to acquire both ready-to-use vegetables and seedlings for planting (Carmo et al., 2016). Another aspect that can directly interfere in the development of children's eating habits is the family environment (González et al., 2021). Thus, the lack of incentive from parents and/or guardians is one of the main determinants for children's lack of will to know, plant vegetables and help in preparing meals at home, as already demonstrated by the literature (Metcalfe et al., 2018; Marlow & Forestell, 2022). Therefore, it is important to include family members in educational interventions for children, emphasizing the relevance of in natura vegetable intake and the involvement of children in cooking preparations (Lavelle et al., 2023).

The form in which the question and answer are presented to children influences directly in the trial (Sick et al., 2022), which was also observed in the present study. Table 2 shows that children had a high level of food neophobia in both the pre- and post-intervention periods. In this case, the questionnaire used was more playful, with responses in the form of emojis. In QB5, the answers were presented directly (yes, no, and I don't know), and most children reported having the will to try out unknown vegetables. Thus, although the questions are convergent in both cases, the answers were discrepant. In QB6 it was possible to observe that children know that it is important to consume vegetables, as also reported by Jacob et al. (2019). Despite this, the actual intake of these foods is influenced by a set of factors, such as the parents' eating habits, children's innate preference for sweet and savory tastes, sensory aspects of foods, lack of incentive and/or affectivity during meals, anxiety and diets that are not very varied (Torres et al., 2020).

In the present study, it has been demonstrated that children did not know the Swiss chard, as it can be seen in question QC6 in which there was a reduction of vegetables consumption at home (Table 5). Possibly, children confused the Swiss chard with another vegetable in the pre-intervention stage, since they reported high consumption at home. After the intervention, the number of markings indicated a lower frequency of home eating of the vegetable, since they became better acquainted with the vegetables. Other authors also observed similar effects, since educational actions promoted an increase in children's capacity to identify vegetables (Allirot et al., 2016; Nury et al., 2017; Leuven et al., 2018; Kim & Park, 2020).

The general results obtained in the research allow us to conclude that theoretical-practical educational activities, through playful actions, posters, figures and games, school vegetable gardens and cooking workshops are essential for the development of healthy eating habits in childhood (Allirot et al., 2016; Leuven et al., 2018; Fallvord & Laguna-Camancho, 2019; Jacob et al., 2019; Kim & Park, 2020; Crary et al., 2022). The insertion of food and nutritional education in the school environment allows the child to know the benefits and harmful effects of food, thus improving autonomy when making food choices (Pereira et al., 2017; Szczepańska et al., 2022).

The addition of vegetables in food products favors nutritional enrichment, in addition to promoting healthier consumption and eating choices by school-age children, increasing the daily intake of vegetables (Spill et al., 2011; Allirot et al., 2016), which was also observed in the products elaborated in this research (Table 6). It should be noted that the roasting process promotes greater evaporation of water from the products, reducing moisture content, as observed for pizza and pie (Blikra et al., 2019). This effect can also justify the highest contents of protein, carbohydrate and calories found in pizza. It should also be considered that the preparations are composed of different ingredients and quantities, which have a direct influence on the nutritional profile of the products, corroborating with the literature (Spill et al., 2011; Allirot et al., 2016). Although pancake, pie and pizza do not have a high dietary fiber content, are an option for consumption among children, as they have better nutritional content than those normally marketed.

5. Conclusion

Educational actions applied in the school environment are effective in reducing the degree of food neophobia and collaborate to increase sensory acceptance by the children's audience. Furthermore, they have a positive impact on the knowledge, consumption, acceptance and frequency of ingestion of vegetables. Despite these positive effects, they are little influential in increasing the planting of vegetables at home, as well as not modifying children's participation in cooking preparations. Food products prepared with the addition of vegetables that have low acceptability to children have a health-friendly nutritional profile and being a food option for the target audience. Thus, it is suggested that these and new types of school interventions are continually offered to children to promote a better quality of life, in addition to awareness of the importance of sustainability.

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