Cooking Workshops as Strategy to Improve the Acceptability of Vegetables for Elementary School Children

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Abstract

The research aim was to develop cooking workshops using five health foods least accepted by elementary school children and assess their sensory acceptability and physicochemical composition. Three hundred and thirty two elementary school children aged between 7 and 10 years participated in the research. Food acceptability was evaluated in order to verify the nutritious foods less accepted by children, for use in

preparations prepared in cooking workshops. Five products were prepared in cooking workshops: eggplant cookie, chard muffin, cress bread, radish pancake and chayote esfiha. All preparations showed high Acceptability Indexes (> 85%). Higher lipid, calorie and fiber contents and lower ash and moisture contents were found in eggplant cookie. Lower contents of carbohydrate and calories were found in radish pancake, while higher contents of protein and ash were observed in chayote esfiha and chard muffin, respectively. The products with the highest carbohydrate contents were eggplant cookie and cress bread, while chard muffin had the lowest fiber content. It is concluded that cooking workshop is an effective educational strategy to improve the acceptability of vegetables with low acceptability for elementary school children.

Keywords: Healthy eating; Food and nutrition education; School.

1. Introduction

Obesity is a chronic disease that persists as a public health problem in worldwide and specially in several European countries, United States of America, Mexico (HRUBY; HU, 2015), Korea (YOON et al., 2017) and Brazil (CASAGRANDE et al., 2017). The childhood is considered a critical period to developing obesity. In this phase, eating habits are constantly forming and are influenced by several social, environmental, cognitive factors (LAFRAIRE et al., 2016), family (VOLLMER; BAIETTO, 2017), school and living together (MORENO-BLACK; STOCKARD, 2018). In addition, the restricted physical activity practice and high fat foods consumption, sugar and sodium content and, with a low concentration of nutrients (AL-DALAEEN et al., 2017; LÓPEZ-OLMEDO et al., 2018; AL- DOMI et al., 2019) collaborate to increase the risk of developing chronic non-communicable diseases (NCDs). Examples are diabetes mellitus (CUI et al., 2018), hypertension (WEBSTER et al., 2018), dyslipidemias (KAVEY, 2015), cardiovascular diseases (RAUBER et al., 2014), liver diseases (DOWLA et al., 2018) and obesity (WU et al., 2019). Excess weight also has negative effects on psychological and social aspects, as it is related to cases of depression, body dissatisfaction, eating disorders, stress (GURNANI et al., 2015; CHU et al., 2019; KOSTEV et al., 2019) and bullying (GURNANI et al., 2015; CHU et al., 2019).

The elementary school phase is a period that includes children aged 7 to 10 years (GAJDA, 2016). Research has already shown that there are differences between boys and girls food preferences in the time. Girls are more likely to consume fruits, vegetables and soups, while boys prefer foods with a higher content of sugar and fast foods (JOHNSON et al., 2015; MORENO-BLACK; STOCKARD, 2018). Despite this, both girls and boys generally have a low intake of fruits and vegetables, which contain higher amounts of fibers, vitamins, minerals and antioxidants (SEPTEMBRE-MALATERRE et al., 2018; KONING-BACKUS et al., 2019). Some fruits and vegetables have a bitter and sour flavor due to the presence of phytochemicals (CHADWICK et al., 2016; STOKKOM et al., 2019) and organic acids (MARTIN; ISSANCHOU, 2019), which are generally rejected by children. The daily recommendation for fruits and vegetables is 5 servings daily, equivalent to 400 g (WHO, 2003). However, only 9% of children reach this recommendation, since the average consumption among boys is 3 portions/day and 2.7 portions/day among girls (PUBLIC HEALTH ENGLAND, 2017).

The acceptance for foods with high fat and sugar contents is predominant among children

(FILGUEIRAS et al., 2019; MORAN et al., 2019). These products have high palatability, in addition to attractive sensory features, which can lead to food dependence (ONAOLAPO; ONAOLAPO, 2018). Furthermore, the addition of food additives and flavor enhancers trigger off changes in brain synapses connected to reward, pleasure and addiction (BROWN et al., 2017). A survey carried out in Canada described the patterns of food consumption according to types of processing (MOUBARAC et al., 2017). It was found that 55.1% of daily energy consumption comes from ultra-processed products, among children and adolescents. In Brazil, the average consumption of added sugar by children is around 11% (FILGUEIRAS et al., 2019), exceeding the average recommendation of 5% by the World Health Organization (WHO, 2015). In countries like the United States, sugar intake can be even higher, reaching 16% of total daily energy (REICHELT et al., 2018). This dietary pattern, which started in childhood, can last in the next stages of life, contributing to the development of NCDs, especially obesity. Knowing this, actions that promote the consumption of healthy foods among children are recommended to modify behavior and food choices, in order to combat childhood obesity.

Programs focused on food and nutrition education have already been shown to improve culinary habits, in addition to encouraging choices for more nutritious foods. They also promote the food consumption with low acceptability such as vegetables, in addition to influencing healthy eating practices, including family involvement (JARPE-RATNER et al., 2016). Due to current social changes, which include an increase in eating away from home, many studies have evaluated the effectiveness of cooking workshop activities as a way to modifying children's preferences, attitudes and behavior (MUZAFFAR et al., 2018), adolescents (LAVELLE et al., 2016) and adults (REICKS et al., 2014) regarding food. Among children, results demonstrated that cooking workshops can improve skills for food preparation. It also helps to modify children's food preferences and behaviors (HERSCH et al., 2014). With this, there is an increase in the consumption of fruits and vegetables and willingness to try new foods, reduction of cases of overweight and obesity (HERSCH et al., 2014; MUZAFFAR et al., 2018), in addition to promoting a greater frequency of meals with the family at home (MUZAFFAR et al., 2018).

The environment in which the activity takes place can directly interfere with the success of the educational action. In this aspect, the school is a very favorable place, since children remain in this place for a long period of time (MORENO-BLACK; STOCKARD, 2018). Furthermore, the school aims to offer new knowledge and skills that promote adaptation in adult life (GAJDA, 2016). Thus, school interventions that include learning activities such as nutritional education, for example, collaborate to increase the fruits and vegetables consumption (MORENO-BLACK; STOCKARD, 2018) and reduce cases of obesity, in addition to being inexpensive, considering its favorable results (GRAZIOSE et al., 2017). In this context, the research aim was to develop cooking workshops using foods least accepted by elementary school children, and to evaluate their sensory acceptability and physicochemical composition.

2. Materials and Methods

2.1 Participants

Were enrolled in the research 332 elementary school children (7-10 years old), between the 2nd and 5th grades in 18 urban public schools in Guarapuava, PR, Brazil. Forty-seven percent of children (156) were

male and 53% (176) were female.

2.2 Food acceptability

To assess the food acceptability a previous survey was carried out with the students, in order to verify the most accepted and least accepted foods. For this, a questionnaire was prepared containing drawings of food belonging to all food groups: cereals; fruits and vegetables; dairy products; meat and eggs; beans and oilseeds; oils and fats and; sugars and sweets, adapted from the USDA (2017). Foods included in this questionnaire were sold in the municipality region, of low cost and accessible to children, in addition to being usually offered in school meals. Children received printed instrument and were asked to mark it with an "x" if they liked the food or not. The five most nutritious and healthy foods that had the lowest acceptance by children were used in recipes prepared at cooking workshops. The purpose of this intervention was to promote the direct participation of children in the recipe's preparation, which could improve the final product acceptability.

2.3 Cooking workshop

Five cooking workshops was made with different products (Frame 1) were applied in each of the participating schools, for 3 months. The average duration of each workshop was 1 hour. At the beginning of the workshop, an educative intervention dynamic was applied to children, in order to explain nutritional importance of the consumption the less accepted food, which was used in the preparation. The products were prepared and cooked at the school kitchen and/or cafeteria by small groups of students (between 25 and 30). All children participated individually in some of the peeling, cutting, chopping, weighing, adding and mixing the ingredients. Verbal instructions were provided during the workshop, aiming to increase the participant's understanding at each stage of elaboration. All ingredients were purchased at the local supermarkets and groceries in Guarapuava, PR.

2.4 Sensory analysis

The products sensory acceptability was assessed at the end of each cooking workshop. Following sensory attributes were analyzed: appearance, aroma, flavor, texture and color, using a 7-points mixed hedonic facial scale ranging from 1 ("Super bad") to 7 ("Super good"), adapted from Resurreccion (1998). The question of overall acceptance was analyzed by a mixed structured hedonic facial scale of 5-points (1 "I disliked a lot" to 5 "I liked a lot") (CECANE, 2010; MINIM, 2013). Children received a portion of each sample (approximately 15 g) in a white, disposable container. 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) (TEIXEIRA et al., 1987). The AI was also analyzed according to the methodology described in the manual for applying acceptability tests of the National School Feeding Program (CECANE, 2010), so that the preparation could be considered in future studies of inclusion in regional school lunch.

Frame 1 - Preparations elaborated in cooking workshops.

Preparation	Ingredients	Main steps of recipe	Preparation photo
Eggplant cookie	Wheat flour (43%), eggs (16.55%), butter (13.79%), dark chocolate drops (11.03%), brown sugar (9.66%), eggplant flour (5%), vanilla essence (0.55%), baking powder (0.41%).	Sanitize the whole eggplants and cut them in 0.5mm slices. Dry in an oven with forced air circulation at 64° C for 24 hours. Grind in a domestic blender and pass through a sieve to obtain the eggplant flour. Beat the butter, vanilla essence and brown sugar until a dough is formed. Add the eggs and beat again. Add the baking powder and the wheat and eggplant flours and beat again. Add the chocolate drops and mix well. Stretch the dough with a rolling pin and shape. Bake in a preheated oven at 180°C, for 15 minutes.	
Chard muffin	Wheat flour (27%), whole milk (23.4%), eggs (19.3%), chard (14%), oil (12%), grated parmesan cheese (5.9%), parmesan cheese in cubes (2.9%), baking powder (0.6%), black pepper (0.1%), salt (0.1%).	Cut the chard leaves into small pieces. Cook in boiling water for 20 minutes, then drain. Add eggs, oil, milk, flour, cheese, baking powder, salt and pepper. Mix manually to form homogeneous dough. Add the dough into paper molds for baking. Stuff with the diced cheese. Bake at medium temperature (200°C) for 30 minutes.	
Watercress bread	Wheat flour (48.57%), watercress (14.06%), whole milk (10.12%), eggs (10.12%), unsalted margarine (5.57%), brush eggs (5.46%), crystal sugar (5.06%), organic yeast (1.01%), salt (0.03%).	Leave the cress for 2 minutes in hot water (approx. 80°C), after cooling it in ice water. Mix the yeast with half the warm milk, a little sugar, salt and wheat flour. The other half of the milk mix with the crushed cress. In a container, place the margarine, eggs and the rest of the sugar and flour. Add the liquids. Knead the dough until homogenized, let it stand at room temperature until it doubles in volume. Shape the loaves, arrange in rectangular pan cake and let stand until doubled in volume. Then brush the bread with the eggs and bake at 180ºC for 20 minutes until golden brown.	
Radish pancake	Dough: radish (29.9%), whole milk (20.6%), eggs (11.8%), wheat flour (11.4%), whole wheat flour (5.8%), oil (3.0%), salt (0.7%). Filling: ham (8.9%), mozzarella cheese (7.8%), oregano (0.1%).	Immerse the radish for 2 minutes in hot water (approx. 80°C), after cooling it in ice water, until room temperature. Grind the radish with the other ingredients. Add the dough in small amounts in a skillet over medium heat for 3 minutes. Stuff with ham and cheese and sprinkle with oregano. Roll the dough into a pancake pans and bake (180°C) for 20 minutes until the cheese melts.	

Chayote esfiha	Dough: wheat flour (29.97%), chayote (12.43%), eggs (2.75%), sugar (1.95%), water (1.50%), oil (1.50%), biological yeast (0.50%), salt (0.15%). Filling: chayote (13.19%), shredded chicken (9.99%), carrot (9.99%), tomato (9.99%), onion (5.00%), salt (0.50%), oil (0.40%) and garlic (0.20%).	Peel and cook the chayote in boiling water (100°C) for 20 minutes. Crush the chayote with water. Mix all the ingredients and knead until you get homogeneous dough. Form balls with a small amount of the dough and let it rest until it doubles in size. To make the filling, cut the cooked chayote into small pieces. In a pan, fry the garlic and onion with the oil. Add the tomato and carrot and sauté. Add shredded chicken and chayote, season with salt. Sauté until all the released water is dry. Allow to cool and top the esfihas. Bake in a preheated oven at 200°C for 20 minutes.	

*Before starting the recipes, all vegetables were cleaned in running water and sanitized in sodium hypochlorite solution for 10 minutes; Source: elaborated by the authors.

2.5 Physicochemical composition

Following evaluations were carried out on the products (in triplicate): Moisture: determined in an oven at 105°C until constant weight (AOAC, 2011); Ash: analyzed in a muffle furnace (550°C) (AOAC, 2011); Lipid: the cold extraction method was used (BLIGH; DYER, 1959); Protein: evaluated through the total nitrogen content of the sample, using the Kjeldahl method, determined at the semi-micro level (AOAC, 2011); Dietary fiber: measured by theoretical calculation (PADALINO et al., 2013; USDA, 2018); Carbohydrate: evaluation by means of theoretical calculation (by difference), according to the formula: % Carbohydrate = 100 - (% moisture + % protein + % lipid + % ash + % dietary fiber); Total energy value (kcal): 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 with the aid of software R version 3.6.1, through analysis of variance (ANOVA). The comparison of means was performed by the Tukey's test, with a level of significance of 5%.

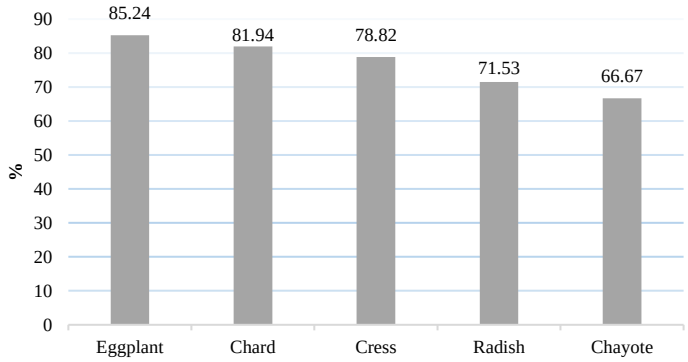
2.7 Ethical issues

This work was approved by the Research Ethics Committee of UNICENTRO, opinion number 3.089.447/2018.

3. Results and Discussion

3.1 Food acceptability

Figure 1 shows the most nutritious and healthy foods that had the lowest acceptance by children.



Source: elaborated by the authors.

Figure 1 - Nutritious and healthy foods less accepted by elementary school children.

The percentage of foods rejection evaluated by the children ranged between 85.24% for eggplant and 66.67% for chayote. Among the five least accepted foods, 40% were from the fruit group (eggplant and chayote), 40% from the leafy group (chard and cress) and 20% belonged to the group of roots and tubers (radish). Similar results were found in other surveys conducted with children living in Argentina (ROSSI et al., 2018) and in the United States (HANSON et al., 2019). Children generally have food

neophobia and refuse to try new foods, especially vegetables. This is because substances belonging to groups of phytochemicals and flavonoids, present in these foods, cause a bitter and astringent flavor (SEPTEMBRE-MALATERRE et al., 2018). Generally, children have a greater preference for sweet flavor, caused by experiences with food during the first year of life (MENNELLA, 2014). In addition, foods with little crunchiness and juiciness may be less acceptable for children (STOKKOM et al., 2019). Appearance is a factor that also interferes with children's food acceptance. The more colorful the food the greater the interest in consumption (BRUNK; MOLLER, 2019). Consumers believe that foods with more vibrant colors tend to have a more intense and tastier flavor (SPENCE, 2015). Another aspect related to low consumption of vegetables is the parents' lack of confidence in the preparation of meals, since they have little familiarity with some foods and practical cooking skills (ROBSON et al., 2016; OVERCASH et al., 2018).

3.2. Sensory analysis of cooking workshop

Table 1 describes the results of sensory test applied to products prepared in the cooking workshops.

Table 1 - Mean notes (± standard deviation) obtained in affective sensory test and of acceptability index (AI) (%) of preparations elaborated in cooking workshops

Preparation	Appearance	Aroma	Flavor	Texture	Color	Overall acceptance	AI[1]	AI[2]
Eggplant cookie	6.08±1.22^{b}	6.19±1.30^{b}	6.23±1.16^{b}	5.90±1.35^{b}	5.50±1.42^{d}	4.51±0.81^{bc}	90.3	90.1
Chard muffin	6.14±1.08^{b}	6.26±1.12^{b}	6.40±1.04^{b}	6.06±1.16^{b}	6.05±1.11^{ab}	4.65±0.65^{b}	93.0	93.6
Cress bread	5.52±1.43^{c}	6.32±1.04^{b}	6.22±1.35^{b}	6.11±1.21^{ab}	5.54±1.42^{cd}	4.49±0.84^{c}	89.8	87.6
Radish pancake	5.96±1.29^{b}	5.77±1.59^{c}	6.26±1.25^{b}	6.04±1.30^{b}	5.81±1.37^{bc}	4.61±0.80^{bc}	92.1	91.3
Chayote esfiha	6.40±1.08^{a}	6.72±0.74^{a}	6.72±0.72^{a}	6.37±1.12^{a}	6.12±1.21^{a}	4.86±0.47^{a}	97.1	97.0

*Distinct letters in column indicate significant differences by Tukey's test ($p < 0.05$); [1]Teixeira et al. (1987); [2]Cecane (2010).

All recipes had average grades above 5 (good) for the attributes and 4 (liked) for overall acceptance. The chayote esfiha received the highest sensory acceptability ($p < 0.05$). In texture and color features, cress bread and chard muffin, respectively, presented notes similar to esfiha chayote. However, lower acceptance was verified for cress bread (appearance and overall acceptance), radish pancake (aroma) and eggplant cookie (color).

The products prepare in the cooking workshops showed high AI's (> 70%), which shows that they were well accepted by children (TEIXEIRA et al., 1987). In addition, they can be inserted as an option in school lunch menu, since they presented an AI > 85% (CECANE, 2010). Similar results have been reported in other studies that used different strategies to improve children's food consumption (HORST et al., 2014; CUNNINGHAM-SABO; LOHSE, 2014; CARNEY et al., 2018, ZEINSTRA et al., 2018). Horst et al. (2014) found an increase in consumption of cauliflower, pasta, chicken and mixed salad among children aged 6 to 10 years in Switzerland, after they are having helped with the preparation of the recipes together with the parents. Cunningham-Sabo & Lohse (2014) concluded that it is possible to increase vegetables consumption among children aged 8 to 12 years in the United States, after the application of a cooking

workshop for snacks made with vegetables. In another study, it was shown that the intake of carrots and broccoli by children is higher when foods are added with herbs and spices, compared to conventional cooking (salt and oil) (CARNEY et al., 2018). Another method that demonstrated a positive effect on vegetable consumption among children up to 5 years old was repeated exposure to food for 5 months (ZEINSTRA et al., 2018). Thus, it appears that changes in food preparation and processing have a positive influence on children's food consumption, which can increase intake of vegetables and collaborate to determine appropriate eating habits in the future.

3.3 Physicochemical composition

The physicochemical composition results of the preparations are shown in Table 2. Higher moisture contents were found in the radish pancake ($p < 0.05$). The eggplant cookie had the lowest moisture content, since the high temperature of the oven when baking increases water evaporation (GARG et al., 2019). The chard muffin had the highest amount of ash among the preparations ($p < 0.05$), the cookie being the one with the least content, since the amount of eggplant added was small (5%), compared to the other vegetables. Higher protein content was found in chayote esfiha, since it contains ingredients with high protein contents such as chicken and eggs (USDA, 2018).

Table 2 - Physicochemical composition mean (± standard deviation) of preparations elaborated in cooking workshops

Preparation	**Moisture** (g 100 g^{-1})	**Ash** (g 100 g^{-1})	**Protein** (g 100 g^{-1})	**Lipid** (g 100 g^{-1})	**Carbohydrate** (g 100 g^{-1})	**Total energy value** (kcal 100 g^{-1})	**Dietary fiber** (g 100 g^{-1})
Eggplant cookie	9.53±0.02^{e}	0.91±0.01^{e}	2.96±0.08^{c}	18.56±0.08^{a}	68.03±0.25^{a}	451.05±0.90^{a}	3.57$^{\alpha}$
Chard muffin	45.30±0.03^{b}	3.94±0.01^{a}	2.80±0.08^{d}	15.05±0.02^{b}	32.91±0.19^{c}	278.29±0.85^{c}	0.91$^{\beta}$
Cress bread	20.71±0.02^{d}	1.09±0.01^{d}	4.17±0.07^{b}	4.94±0.03^{d}	69.09±0.12^{a}	337.48±0.46^{b}	1.40$^{\beta}$
Radish pancake	62.42±0.04^{a}	2.74±0.02^{b}	4.15±0.08^{b}	8.52±0.07^{c}	22.18±0.39^{d}	181.94±0.58^{e}	1.42$^{\beta}$
Chayote esfiha	39.41±0.05^{c}	1.36±0.02^{c}	4.23±0.09^{a}	2.50±0.09^{e}	52.50±0.42^{b}	249.42±0.98^{d}	1.52$^{\beta}$

Distinct letters in column indicate significant differences by Tukey's test ($p < 0.05$); Values calculated on wet base; Theoretical calculation: Adapted of Padalino et al. (2013); USDA (2018); $^{\beta}$USDA (2018); Source: elaborated by the authors.

Chard muffin was the preparation with the least amount of protein in its composition. Regarding the contents of lipid and calories, the eggplant cookie showed the highest results, which is due to the presence of ingredients such as butter and chocolate. Eggplant cookie and cress bread were the recipes with the highest carbohydrate content ($p < 0.05$). The esfiha chayote had the lowest lipid content, while the radish pancake had the lowest carbohydrate and energy value.

Higher content of dietary fiber was found for eggplant cookie, being considered a source of fibers since it has a minimum fibers content of 3% in its composition (BRASIL, 2012). This effect is mainly due to the high fiber content of eggplant flour (45.22 g 100 g^{-1}) (PADALINO et al., 2013), much higher than other fresh vegetables such as radish (1.6 g 100 g^{-1}), chard (1.6 g 100 g^{-1}), cress (1.1 g 100 g^{-1}) and chayote (1 g 100 g^{-1}) (USDA, 2018). Chard muffin was the preparation with the least amount of dietary fiber.

Despite the differences observed in the nutritional composition, all products can be offered to children, since they have a good nutritional profile, which contributes to a healthier diet.

4. Conclusion

The use of the cooking workshop is an effective educational strategy that guarantees a good acceptability of food products added with vegetables with a low acceptability for elementary school children. In addition, the added preparations of vegetables have a good nutritional profile, which helps in offering healthier foods to this audience, contributing to reducing the risk of chronic non-communicable diseases.

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