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Food Education Seminars for the Successful Introduction of Bread With Ora-Pro-Nóbis (*Pereskia aculeata* Miller) Flour Added to Public School Meals. An Approach Using Product-Specific Emoji List, Facial Hedonic Scale, and Word Association

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Keywords: children | emoji | facial hedonic scale | food literacy | healthy food | word association

ABSTRACT

The objective of the study was to evaluate the effect of food education seminars on the introduction of bread with OPN flour added to public school meals in Brazil. A product-specific emoji list, facial hedonic scale, and word association (WA) were used. To evaluate the effects of the food education intervention, seminars were applied at only one of the schools. One school was selected as an intervention group (IG) ($n = 398$) and the other one as a control group (CG) ($n = 441$). The food education seminar revealed itself to be an essential strategy for willingness to try and acceptance of the bread. The product-specific emoji scale helped to understand children's emotions regarding the new food. The WA task brought a holistic insight into the evaluation of bread by children, confirming the hedonic data. The introduction of new food in school meals is positively influenced by food literacy, and all sensory evaluations corroborate this.

1 | Introduction

Children and adolescents from various parts of the world benefit from school meals. Offering healthy food in schools is a way of supporting child development through adequate nutrition and improving students' cognitive skills, in addition to helping to reduce school dropout rates. At the beginning of 2022, 418 million students globally received school meals daily. Despite the interruption of almost every school meal program all over the world due to the closure of schools as a consequence of the COVID-19 pandemic in 2020, school food is again one of the biggest and most widespread safety networks around the world (World Food Programme 2022).

School meal programs are social policies that operate within the perspective of promoting Food and Nutritional Security

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Summary

- School meals in Brazil are of great importance for children's development.
- The inclusion of ora-pro-nóbis (OPN) flour in bread emerges as an important strategy to increase the nutritional value of this food.
- The results of this work revealed practical implications for sensory studies with children, the school food sector, the public policy sector, and the food industry.
- Food education seminars for children proved to be essential in introducing the healthy new product.
- Applying a quick food education program can help develop a food culture, promoting healthy and sustainable consumption.

(FNS). These programs provide nutritionally balanced meals that contribute to the development of healthy eating behaviors among students (Global Child Nutrition Foundation (GCNF) 2022).

The concept of FNS in Brazil is very broad. It is defined as the right of everyone to access quality food, in sufficient quantities, without compromising access to other essential needs, based on health-promoting dietary practices that meet cultural, economic, and socially sustainable diversity (Food and Agriculture Organization of the United State (FAO) 2014).

School meals in Brazil are of great importance for the development of children and adolescents. The National School Food Program (PNAE) is a Brazilian public policy initiative that aims to guarantee access to healthy and adequate food for all students in public schools. It has contributed to combating hunger and malnutrition, especially among the poorest families. It is also an opportunity to introduce new foods and food education, contributing to the formation of healthy eating habits beginning in childhood (Brasil 2017).

The introduction of non-conventional edible plants (NCEP) can be an interesting option to improve the nutritional quality of school meals. Among the NCEPs, *Pereskia aculeata* Miller stands out. Popularly known as ora-pro-nóbis (OPN), it is characterized by its high content of protein, fibers, and minerals in its leaves (Ferreira et al. 2024). OPN can be consumed fresh, as green leaves added to salads, stews, or juices. Furthermore, it can be transformed into flour, which can be used to prepare bread, cakes, and pasta, among other foods. OPN flour is made from dehydrated leaves, which increases the plant's shelf life and versatility of use. The potential use of the OPN leaves in the preparation of food products has been highlighted in scientific literature (Porto et al. 2022). Its great mucilage content highlights it as an important ingredient with emulsifying properties (Lise et al. 2021; Silva et al. 2021) and good acceptance (Lise et al. 2021; Mazon et al. 2020).

In the context of school meals, enriching bread with OPN flour benefits school children by improving health and nutrition. Bread is one of the most popular snacks with children and is part of the menu in public schools in Brazil. However, its main composition is carbohydrates. Therefore, OPN flour is an important vehicle to be enriched with nutrients.

One aspect that can influence the consumption of NCEPs is the degree of food neophobia, defined as the fear of trying new or unfamiliar foods (Barbosa et al. 2021). Food neophobia arises from the unknown, and therefore, introducing this new food through conversations and lectures seems to be a promising strategy for accepting the new food (Ares et al. 2024; Dahmani et al. 2024).

The recognition and importance of scientific literacy for children's education and self-regulatory abilities are highlighted in the literature (Doshi et al. 2024). Scientific literacy for food has a specific name called food literacy. Food literacy refers to the understanding of nutritious food concepts, eating habits, and attitudes focused on balanced diets (Horikawa et al. 2023). Schools are a favorable environment for the application of this type of communication (Dahmani et al. 2024). There are several types of approaches and methodologies for applying food literacy. The potential of food education to motivate8–12-year-s old children to try new foods is highlighted Mustonen and Tuorila (2010).

In Brazil, this type of strategy has become very important since for a new food to be part of the routine menu of a public school, it must be well accepted due to the public resources spent on purchasing foodstuffs. For this reason, the application of hedonic tests is the minimum required (Brasil 2017). The classic method for evaluating food acceptance with children is facial hedonic scales, as they are easy for children to understand, and the images are fun and inspire more attention to the task (Latorres et al. 2016; Mitterer-Daltoé et al. 2013a). Although only acceptability tests are required by the PNAE, other methodologies can be applied in order to achieve a better understanding of the perception of the new food offered.

Sensory analysis with emojis can be an innovative way to evaluate children's perception of food (da Cruz et al. 2021; Sick et al. 2022). Emojis are graphic symbols that represent not only facial expressions, but also concepts and ideas. These symbols have become popular around the world with the advancement of digital communication technologies and have the advantage of being language-independent indicators of emotions (Jaeger and Ares 2017).

Another promising methodology for studying the introduction of new foods to school meals is the Word Association. Latorres et al. (2016) and Mitterer Daltoé et al. (2017) found that Word Association can be used effectively for cognitive assessment of food for children. In this method, participants are asked to respond with the first word or phrase that comes to their mind when experiencing the sensory stimulus. Their responses are then analyzed to identify patterns, trends, and insights into the perception of the product or stimulus (Bordim et al. 2023a).

The purpose of this research was to evaluate the effect of food education seminars on the introduction of bread with OPN flour added to public school meals in Brazil. Emojis, the facial hedonic scale, and Word Association were used as approaches.

2 | Material and Methods

2.1 | Participants

A total of 839 public school children from two schools in the city of Pato Branco, Paraná, Brazil, aged 4 to 11 years, were invited to participate in the study. The two schools were similar in terms of the sociodemographic profile of the students.

The city is located in southern Brazil where computers, electronics, and agriculture industries dominate its economy. The exclusion criterion adopted was the dietary restriction on any of the ingredients that make up the bread. Parents or legal guardians authorized their children's participation. Students were provided with an informed consent form at the beginning of the sensory tests. The study was approved by the research ethics committee of the Federal Technological University of Paraná (UTFPR) under number CAAE: 63883422.8.0000.0177.

2.2 | Food Education Seminars

One seminar about healthy, diversified eating, plant consumption, and non-conventional edible plants (NCEP), specifically OPN, was given for each school class. Topics such as the nutritional aspects of OPN and the introduction of NCEPs into food were covered, aiming to familiarize children with different cultures and promote understanding of biodiversity. The objective was to encourage experimentation and interest in new foods, encourage the adoption of more diverse eating habits, and the appreciation of new and different flavors.

To prepare for the seminars, literary reviews, and discussions were carried out with the research group. The course was designed and presented on PowerPoint with attractive images to capture the interest of children from 4 to 11 years old. The seminar was presented by the researchers of the study and was conducted the day before sensory tests. It lasted 20 min and was presented to each school class in their respective classrooms during regular class hours (morning or afternoon). With the aim of evaluating the effects of food education intervention on the introduction of bread with OPN flour added, the seminars were applied to only one of the schools. One school was selected as an intervention group (IG) ($n = 398$) and the other as a control group (CG) ($n = 441$).

2.3 | Sample Preparation

The bread samples with OPN flour added for both schools were made the day before sensory tests in the municipal bakery of schools in Pato Branco, PR, Brazil, by the same bakers to ensure the standardization of the samples. Except for OPN flour, all ingredients used to make the bread were those used daily by the bakery. The ingredients used and their corresponding quantities are described in Table 1. The bread formulation was based on guidance from the OPN flour supplier and on previous tests in the bakery. It is worth noting that the original formulation is well accepted, frequently consumed by students, and is milk and egg free. The OPN flour used was produced by the company Proteios from Ribeirão Branco, SP, Brazil, without the use of pesticides, and produced with fresh, dehydrated, and micronized OPN leaves.

TABLE 1 | Bread formulation with OPN added.

Ingredients	%
Wheat flour enriched with iron, folic acid, refined salt, stabilizers, and flour improvers (mixture for preparing multi-bread)	60.75
Sugar	2.05
Biological yeast	1.03
Oil	0.94
Water	30.85
OPN flour	4.38
Total	100

First, all dry ingredients were mixed in a sheeter to ensure homogenization. Then, the rest of the ingredients were added until a homogeneous dough was obtained. Afterward, the dough was passed through a molding machine and then sized into small, rounded pieces (70 g). Next, following the fermentation period (3 h), the breads were baked in electric ovens (180°C). Figure 1 shows the French bread with OPN flour added.

2.4 | Sensory Tests

All sensory tests were carried out during school lunches in the cafeterias. Each school class ($n \approx 20$ students) was released at 15-min intervals to allow sufficient time for the test administration. In total, 40 sessions were conducted across both schools.

The breads, in the form most commonly consumed in schools in the city, were served with ground meat.

Students were interviewed by seven monitors experienced in the sensory tests applied. Tests were administered by monitors, answered by children, and recorded by monitors.

The first question was "Do you want to eat bread with OPN flour?"

2.4.1 | Emotional Evaluation of the Bread With OPN Added

Before evaluating the emotional reactions to bread with OPN added, a product-specific emoji list for these breads was developed.

The development of the emoji list followed the methodology proposed by (da Cruz et al. 2021). First, to create a specific list for the bread, a list of 33 (Figure 2) previously defined descriptor emojis to classify food products (Jaeger and Ares 2017) was presented to a group of 23 children (14 boys and 9 girls). This step was applied to students in a fifth-grade class (ages 10–11)



FIGURE 1 | French bread with OPN flour added.

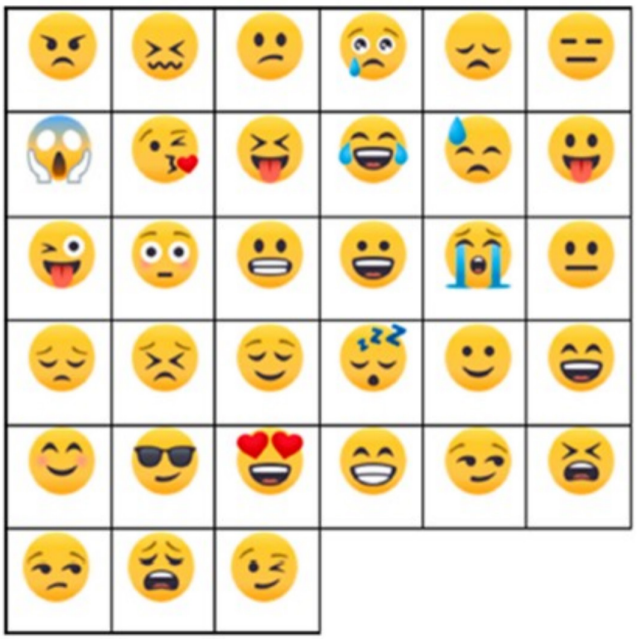


FIGURE 2 | Table of emoji that were used in the development of the product-specific emoji list (da Cruz et al. 2021; Jaeger and Ares 2017).

from the school called the control group. The specific list was prepared the day before the tests. A batch of bread was produced for this group to taste, after which they completed a questionnaire to select specific emojis. Participants were asked to "Select all emoji you believe that are related to what you have felt once you tasted the bread with OPN flour added". Children involved in this scale development phase also participated in the sensory tests the following day, however, their data were excluded to prevent bias in scale validation.

The students were instructed to select all emojis that describe their emotional experience while consuming the bread with OPN added using the *check-all-that-apply* (CATA) method. The emoji that had an overall frequency equal to or greater than 10% in the development phase was included in the product-specific list.

The list of emojis selected was applied to the emotional evaluation of bread with OPN added in both schools. Children who were interested in tasting the bread with OPN added were instructed to select all the emojis from the list that corresponded with their reactions to the bread they were tasting in the school lunch.

The emojis were randomly presented, with the generation of four sheet forms in order to avoid any bias related to the order.

The validation of the emoji list occurred by the correspondence analysis between the frequency of points marked on the facial hedonic scale and the frequency of emojis marked for evaluating the bread with OPN added, as further detailed in the sections described below.

2.4.2 | Acceptance of Bread With OPN Added

The bread with OPN added was submitted to an acceptance evaluation through a nine-point facial hedonic scale, ranging from 9, "liked extremely," to 1, "disliked extremely" (da Cruz et al. 2021). Students were asked to indicate the facial expression that best symbolized how much they liked or disliked the bread (Figure 3).

2.4.3 | Word Association (WA)

To evaluate children's holistic perception of bread, the Word Association technique was applied according to Latorres et al. (2016). WA was carried out after the completion of the emoji list and hedonic scale with the same students. The following stimulus was read to the students: "Please tell me the first four words, sensations, or feelings that came to your mind when you tasted the bread with OPN added." From their responses, monitors wrote the words or sentences on an identified sheet.

2.5 | Data Analysis

Mc Nemar test was carried out to compare the frequency of each emoji used between schools. Cochran's Q test was performed to evaluate the differences in the choices of emojis for both schools with all of the students (da Cruz et al. 2021).

The bread acceptance index was calculated based on the average obtained from the test (where the maximum value of the scale is equal to 9, representing 100%). Multinomial logistic regression



FIGURE 3 | 9-point facial hedonic scale applied to the bread with OPN flour added.

was used to identify the variables (age, school, and sex) that had the greatest effect on the acceptance of the product in school meals (Latorres et al. 2016).

Analysis of Word Association data was based on Latorres et al. (2016). All associations were included, and words with similar meanings were grouped into the same category. The researchers independently created the groupings, and the final categories were discussed and defined. Furthermore, only categories composed of words mentioned by more than 5% of participants were included in the frequency analysis. To better understand and visualize the results, a word cloud map was also generated using the Orange 3.23 software program.

Correspondence Analysis (CA) was performed to validate the product-specific emoji list by combining the emojis selected and hedonic scores, and to describe the feelings of the students who tried the bread with OPN flour added. The contingency table was constructed with nine rows (facial hedonic scale points) and thirteen columns (frequency of each emoji).

Data were analyzed using XLSTAT software (Addinsoft) and Statistica 12.7.

3 | Results

3.1 | Participants

Of the 839 students, 562 (67%) were willing to try the bread with OPN flour added. The participants included 260 boys (46.26%) and 302 girls (53.73%) within the following age groups: 4 and 5 years ($n = 41\%–7.3\%$); 6 and 7 years ($n = 173\%–30.8\%$); 8 and 9 years ($n = 214\%–38.1\%$) and 10 and 11 years ($n = 134\%–23.8\%$).

Of the 398 students at the IG school, 322 tried the bread (80.9%). Of the 441 students at the CG school, 240 tried the bread (54.4%). These results show the positive effect of a Food Education intervention in schools on children's willingness to try new food.

3.2 | Emotional Evaluation of the Bread With OPN Added

3.2.1 | Selection of Emojis for the Product-Specific Emoji List

The results of the selection of emojis that will be part of the product-specific emoji list are shown in Table 2. Of the 33 emojis presented, 13 had a frequency equal to or greater than 10% and were selected. The number of emojis selected in the present study is next to that of da Cruz et al. (2021) and Sick et al. (2022) who included 15 and 17 in the emoji scale, and lower than the report by Schouteten et al. (2019), who included 20.

The selection included 10 positive emojis (😍), 😀, 🙂, 😁, 😜, 😎, 😀, 😊, 😌, (😁),1 neutral (😐) and 2 negative (😖), (😕) according to the classifications presented by Schouteten et al. (2018). Nine of the 13 emojis listed in this study overlap with those reported by da Cruz et al. (2021).

3.2.2 | Emotional Evaluation of the Bread With OPN Added With the Product-Specific Emoji List

The frequency of emoji use from the product-specific emoji list for the bread is shown in Table 3. Children from both schools together used, on average, 1.95 emojis (15%) to evaluate the sample. This number of emojis used by each student is in line with previous studies, which highlight the use of 1–2 emojis by consumers to express their feelings. In regard to the average usage frequency (15%), this value was higher than those recorded in other surveys with children. da Cruz et al. (2021) reported 8.24%, Schouteten et al. (2018) reported 10%, and Schouteten et al. (2019) reported 7.5%. This higher frequency may be a consequence of the smaller number of emojis selected to make up the product-emoji scale.

The average use of emojis by children from both schools revealed the emojis most chosen to express their feelings about the bread by all students who wanted to try this new lunch. The emoji most used was (😍), followed by (😁). The least used was the emoji (😜) chosen by only 5.52% of all children.

Regarding the comparison of the frequency of use between the two schools, with the exception of the emoji (😍), all other emojis showed a difference in the frequency of use between the two schools. It is worth noting that the CG school, the one that did not receive the food education seminars, had the highest frequency of use for the two emojis classified as negative (😖) and (😕). The positive emojis were mostly used by the IG school, the one that had received the food education seminars.

3.3 | Acceptance of Bread With OPN Added

The results of the acceptance index of the bread with OPN flour added and the statistical significance of age, sex, and school in the acceptance are shown in Table 4.

With an acceptance index of 78.52% in CG school and 80.16% in IG school, the bread with OPN flour added proved to be well accepted, with differences between schools, revealing the

TABLE 2 | Frequency of emoji usage in developing the product-specific emoji list.

Emoji	Definition	Frequency (%)
	Angry face	4.35
	Confounded face	13.04
	Confused face	17.39
	Crying face	4.35
	Disappointed face	4.35
	Expressionless face	0
	Face screaming in fear	8.70
	Kissing face with closed eyes	8.70
	Face with stuck-out tongue	8.70
	Face with tears of joy	0
	Face with cold sweat	4.35
	Face with tongue sticking out	21.74
	Face with tongue sticking out and winking eyes	21.74
	Flushed face	0
	Grimacing face	0
	Grinning face	30.43
	Loudly crying face	4.35
	Neutral face	26.09

(Continues)

TABLE 2 | (Continued)

Emoji	Definition	Frequency (%)
	Pensive face	4.35
	Tired face	8.70
	Smiling face	17.39
	Sleeping face	4.35
	Slightly smiling face	39.13
	Smiling face with open mouth and tightly closed	39.13
	Smiling face with smiling eyes	21.74
	Smiling face with sunglasses	17.39
	Smiling face with heart-shaped eyes	43.48
	Grinning face with smiling eyes	43.48
	Smirking face	4.35
	Weary face	8.70
	Unamused face	4.35
	Tired face	8.70
	Winking face	4.35

positive effect of the food education seminars on the acceptance of bread by students. The acceptance index of the present study was similar to studies on the introduction of new foods in public schools in Brazil. Latorres et al. (2016) and Breda et al. (2017) recorded acceptance indexes of 87% for meatballs and fish burgers. Mitterer-Daltoé et al. (2013a) showed an acceptance index of 80% to 84% for fish nuggets.

The results revealed that only the sex of the participants did not have an effect on the students' acceptance of the bread evaluated by multinomial logistic regression. Regarding

TABLE 3 | Frequency (%) at which each emoji was used to validate the list of product-specific emojis and average for both schools.

	Emoji	Definition	CG school	IG school	Both schools
Emoji 1		Face with tongue sticking out	6.25a	5.28b	5.69E
Emoji 2		Confounded face	14.58a	12.11b	13.17CD
Emoji 3		Grinning face with smiling eyes	11.25b	18.32a	15.13CD
Emoji 4		Face with tongue sticking out and winking eyes	4.58b	6.21a	5.52E
Emoji 5		Smiling face with sunglasses	11.67b	13.35a	12.63CDE
Emoji 6		Smiling face with smiling eyes	16.25b	21.12a	19.04C
Emoji 7		Smiling face with open mouth and tightly closed	24.58b	27.95a	26.51B
Emoji 8		Slightly smiling face	15.00b	22.98a	19.57BC
Emoji 9		Smiling face with heart-shaped eyes	42.92a	40.68a	41.64A
Emoji 10		Confused face	9.17a	8.07b	8.54DE
Emoji 11		Neutral face	8.33b	8.70a	8.54DE
Emoji 12		Grinning face	7.92b	12.11a	10.32DE
Emoji 13		Smiling face	6.67b	9.32a	8.19DE

Note: ab Different lowercase letters on the same line indicate significant difference at 5% by McNemar test. ABCDE Different capital letters on the column indicate significant difference at 5% by Cochram's Q test.
Abbreviations: CG School: Control group, IG School: Intervention group.

demographic variables, these results were in agreement with those reported by Latorres et al. (2016) and Mitterer-Daltoé et al. (2013b). For both studies, sex was not a variable that had a significant effect on food acceptance by children, while age was.

For the purposes of better understanding the effect of age on acceptance, a linear regression was applied (x: age; y: acceptance index) to the results of the two schools (Figure 4). Inverse behavior was recorded in both schools.

In the control group, CG school, as age increased, acceptance decreased. Children aged 4 and 5 had an acceptance rate of 83.8%. This rate dropped to 69.7% for children aged 10 and 11. This is a behavior already known in sensory acceptance tests for unusual foods offered to children (Latorres et al. 2016; Mitterer-Daltoé et al. 2013b; Pagliarini et al. 2005). Mitterer-Daltoé et al. (2013a) and Latorres et al. (2016) evaluated the acceptance of fish products by students from public schools in Brazil. Pagliarini et al. (2005) evaluated the acceptance of lunches offered in schools in Milan, Italy. In all research, an inverse relation between acceptance and age was reported.

With the intervention group (IG school), the result was different. As age increased, acceptance also increased. Acceptance started at 75.8% for children aged 4 and 5 and reached 82.4% for children aged 10 and 11. It was suggested that this opposite behavior was a consequence of the food education seminars.

3.4 | Correspondence Analysis (CA)

Correspondence analysis was applied with two intentions: to validate the product-specific emoji list by combining the emojis selected and hedonic scores, and to describe the feelings of the students who tried the bread with OPN flour added. CA is an interdependence technique, the main benefit of which is the ability to represent lines and columns in a perceptual map (Bordim et al. 2021).

The validation can be visualized by two groups of correspondences: emoji and hedonic scores by schools (Figure 5) and by groups of ages (Figure 6). The product-specific emoji list for the bread with OPN flour added was validated. For all biplots, the same pattern of relationships between emojis and acceptance scores was followed, which means reproducibility. CA reveals a clear separation between emojis with positive, neutral, and negative feelings and their strong relationship with the acceptance scores of the like group, neither like nor dislike, and dislike group, respectively.

Children who stated dislike moderately, dislike very much, and dislike extremely represented the feeling for 😖. Children who stated dislike slightly and neither like nor dislike represented the feeling for 😕 and 😐. Children who stated like slightly and like moderately represented the feeling for 🙂. Children who stated like very much and like extremely represented the feeling for 😍, 😛, 😁, 😜, 😎, 😀, 😊, 😌, 😄.

The first two dimensions of the biplots described from 75.85% to 88.45% the correspondence between the emojis and acceptance scores. Most of the explanation was observed for the first dimension. We can infer that the first dimension separates the emojis based on valence, as negative emojis are on the right side and positive emojis are on the left side.

The second dimension separates emojis based on expressiveness and emotional intensity, discriminating between those that show more intense emotions (located at the bottom) and those that show less intense emotions (located at the top). This second dimension helps to understand how different emojis are perceived in terms of emotional intensity, complementing the separation by valence already observed in the first dimension.

TABLE 4 | Acceptance index and statistical difference of the variables of age, sex, and school.

	Acceptance (%)	
CG school	78.52	
IG school	80.16	
	Statistical significance of variables	
	Wald	*p*
Age	30.24	0.00019
Sex	14.75	0.06419
School	19.40	0.01288

Note: $p \leq 0.05$ indicates a significant effect of the independent variable on acceptance.

3.5 | Word Association

Table 5 shows the categories obtained by applying the word association technique. Participants spontaneously mentioned 655 terms in response to the stimulus used (bread). Six categories were established by consensus among the researchers who participated in the data analysis. In the same category, words with similar meanings were grouped. The categories were: Different, Like, Happiness, Disliked, Color, and Neither like nor dislike.

The most cited categories for both schools were "Like" and "Dislike", followed by the "Color" category. In the WA task, the most cited terms can be considered the most relevant and most remembered by participants.

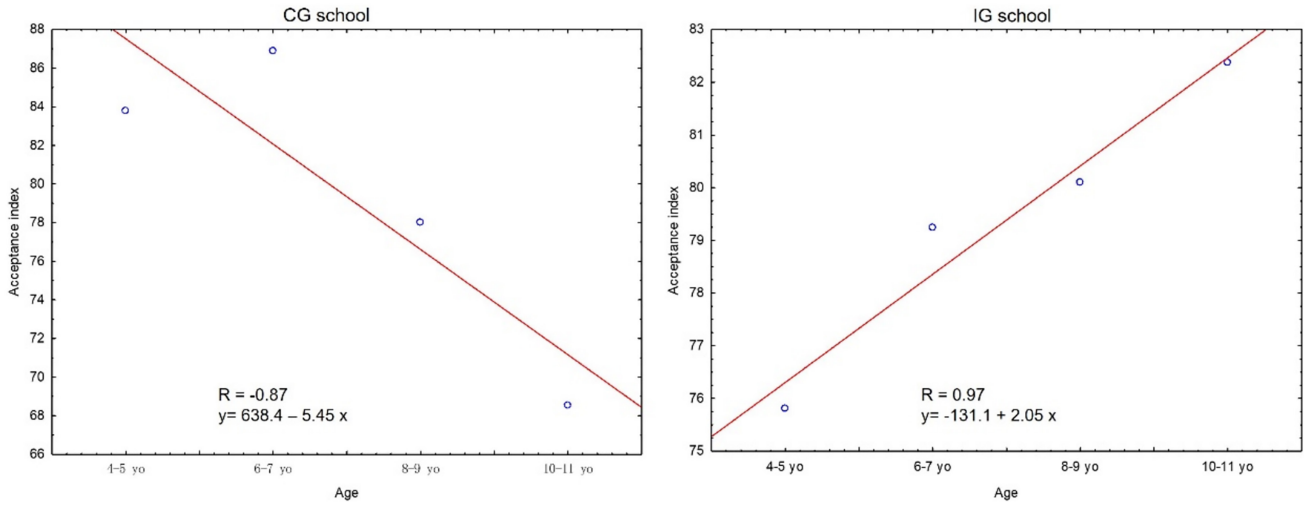


FIGURE 4 | Linear model for predicting the acceptance index as a function of age. Group 1: 4–5 yo, Group 2: 6–7 yo, Group 3: 8–9 yo, Group 4: 10–11 yo.

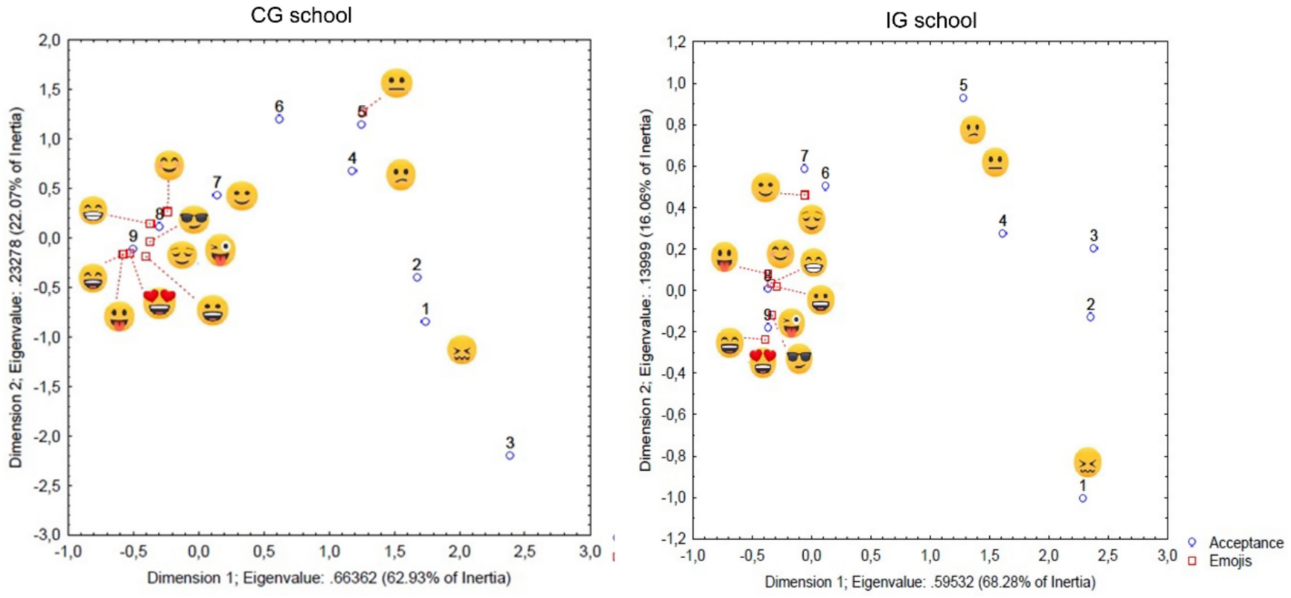


FIGURE 5 | Correspondence analysis of the distribution of acceptance indexes of schools and the emoji in the validation of the product-specific emoji list.

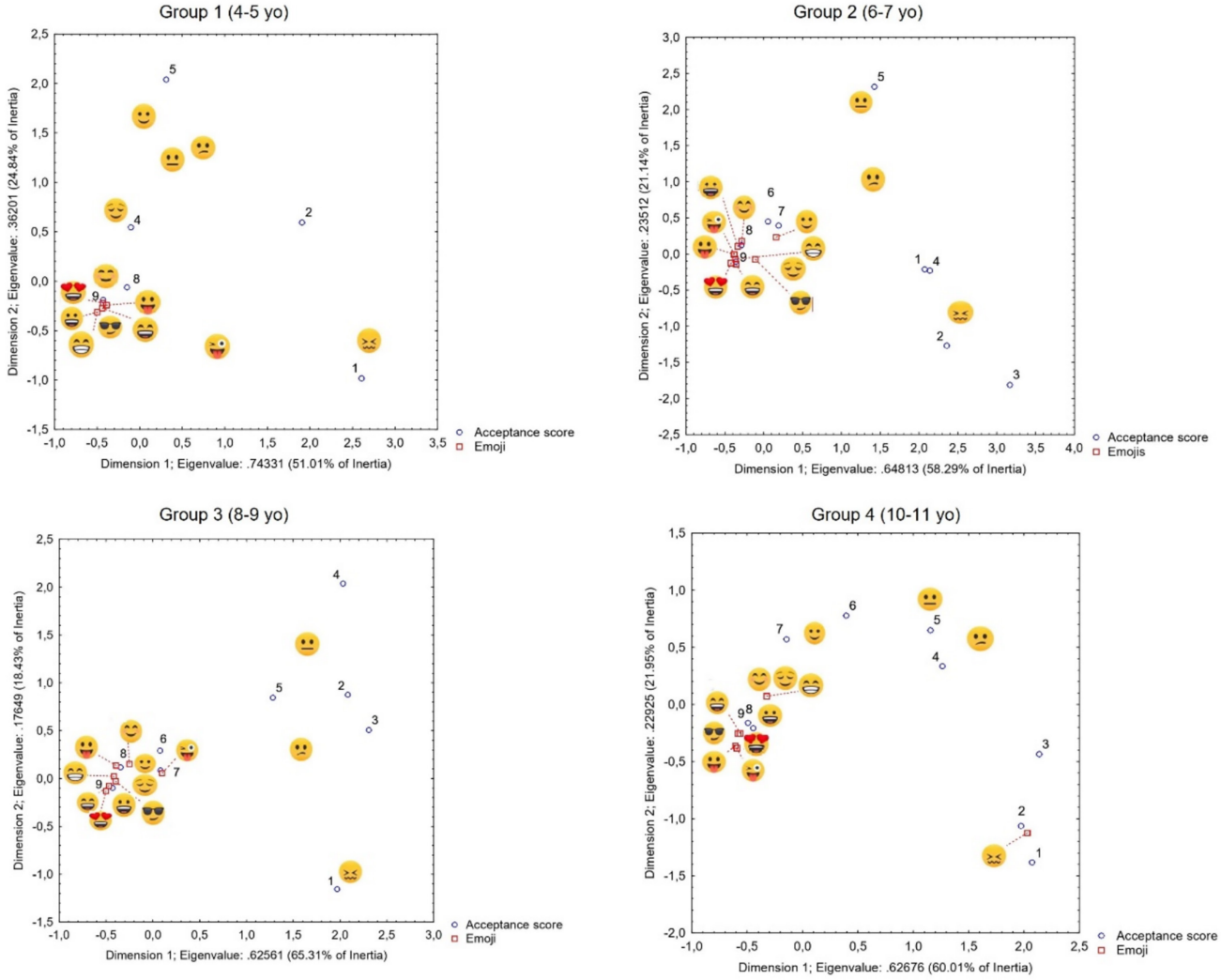


FIGURE 6 | Correspondence analysis of the distribution of acceptance indexes of groups of ages and the emoji in the validation of the product-specific emoji list.

TABLE 5 | Absolute frequency of category mentions for the bread with OPN added by school children.

Category	CG school	IG school	Total
Different (different, strange, confusing)	15[b]	18[a]	33
Like (Tasty, good, would eat, normal, try, interesting, new, prefer, recipe, repeat, delicious, loved, wonderful, incredible, flavorful, perfect, great)	195[b]	224[a]	419
Happiness (nice, happy)	18[a]	15[b]	33
Dislike (horrible, disgust, hated, chill, bad, vomit, disliked, unpleasant)	42[a]	28[b]	70
Color (colored, green, brown, rainbow, orange, Hulk)	19[b]	46[a]	65
Neither liked nor disliked	11[b]	24[a]	35

Note: ab Different lowercase letters on the same line indicate significant difference at 5% by McNemar test.

The significant number of citations for the "Like" category corroborated the results of good acceptance shown by the facial hedonic scale and positive emotions shown by the product-specific emoji scale. Terms such as "good," "tasty," "delicious," and "flavorful" indicate that many participants enjoyed the product and showed an interest in consuming it again.

Other categories, such as "Happiness" and "Neither likes nor disliked," also offer valuable insights. The "Happiness" category, with 33 mentions, includes terms such as "Happy" and "Nice," indicating that some participants associated bread consumption with positive emotions. The "Neither liked nor disliked," category, with 35 mentions, suggested a neutral or moderate hedonistic perception of the bread for some participants.

To better visualize the holistic perception of bread with OPN flour added by school children, a word cloud map was applied with all terms generated by the word association technique (Figure 7). Word clouds are graphical representations that display words according to their frequency of use (Jin 2017; Mitterer-Daltoé et al. 2021). As the font size represents the number of mentions by consumers, we can observe the bread with OPN added profile described as tasty, good, green, bad, and neither liked nor disliked. Other words were also mentioned when categorizing bread; however, they were mentioned less frequently.

Regarding the comparison between schools, the positive effect of the food education seminars was also seen on the WA task results. For all categories, differences were recorded. It is worth noting that the highest number of citations for the "Like" category and the lowest number for the "Dislike" category were from the IG school. These results were in line with the differences in acceptance between the two schools shown in the hedonic test. Mentions of terms related to the "Color" category were also higher for children from the IG school.



FIGURE 7 | Word cloud from the categories that appeared from the stimulus bread with OPN added. Nlnd: Neither liked nor disliked.

4 | Discussion

The present work sought to evaluate the effect of food education seminars on the introduction of bread with OPN flour added to public school meals in Brazil for children aged 4 to 11 years. Emojis, facial hedonic scale, and word association were used as approaches.

The effects of the food education seminars were evaluated using the strategy of applying the seminars to just one of the schools (Intervention group—IG school). The impact of the food education seminars can be seen in all the results explored.

The direct impact was seen in the number of schoolchildren with a willingness to try the new bread offered at school lunches. The difference was significant, with more students from IG school wanting to try the bread. This is already considered a big step for issues related to food neophobia and, therefore, for the introduction of new food into school meals. The willingness to try a new food is considered an important measure of food neophobia by children (Loewen and Pliner 1999).

Children are naturally "afraid" of trying new food. This is considered an evolutionary protective mechanism (Lafraire et al. 2016). Therefore, food education is crucial for building knowledge about the healthiness and safety of new food.

The importance of children understanding their emotions is widely known in academic, medical, and school circles (UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development 2019). It is known that understanding emotions leads to their regulation and that this regulation has broad implications for psychosocial well-being and socio-emotional skills, as well as positive academic results (Silkenbeumer et al. 2024). In parallel, in the last decade, sensory studies involving emotions with children have been increasingly frequent (da Cruz et al. 2021; Gallo et al. 2017; Jaeger et al. 2017; Schouteten et al. 2018, 2019, 2022; Sick et al. 2022).

Exploring the relationship between children and food through their emotions can be seen not only as a sensory tool, but also as

a tool to promote the importance of understanding and awareness of their emotions about their food. The use of emojis to obtain emotional profiling of the bread showed very valuable results with regard to the development and validation of a specific emoji scale for the product, as well as the emotional profile brought about by the use of the scale. Furthermore, the emoji results, when compared between the two schools, also indicated the positive effect of the food education seminars, since positive emojis were most used by the IG school.

With a specific list containing 13 selected emojis, the emotional profile for both schools was represented mainly by the following emoji frequency order: (), , , , , , , . The creation of a specific list of emojis for the product is important, as it highlights those most strongly associated with those products, and with some that are not relevant being excluded, resulting in a shorter list, which reduces fatigue and boredom. A more concentrated selection avoids duplicate responses to emojis with similar meanings (Schouteten et al. 2019).

Previous research involving emojis and children links a higher percentage of positive emoji choices with greater hedonic acceptance (da Cruz et al. 2021). For this research, this relationship was no different. The product-specific emoji scale was validated by relating negative emojis to the lowest hedonic scores and positive emojis to the highest hedonic scores through correspondence analysis.

The bread with OPN added showed good acceptance for both schools, and this is a positive result within the context of food neophobia. It is known that food neophobia is reduced by exposure to new foods (Pliner et al. 1993); however, it is also known that exposure to new foods that are tasty is more effective in reducing food neophobia. Therefore, creating positive experiences with new flavors strengthens the desire for new flavors (Loewen and Pliner 1999).

With an acceptance of 78.52% for the CG school and 80.16% for the IG school, the acceptance test also revealed the significant effect of a food education seminar. The hedonic results by logistic regression also revealed the effect of age on different acceptances. An inverse relationship between age and acceptance was verified between the two schools, also indicating the effect of seminars. The CG school showed the expected behavior: the younger the age, the greater the acceptance. According to Tuorila et al. (2016) this behavior is a consequence of children being more critical in their food preferences as they get older, making it difficult to introduce a new food that is not part of their eating habits.

At IG school, this relationship was linearly inverse. As the children's age increased, acceptance for the bread increased. It is suggested that the way in which the course was presented was possibly more effective in their absorbing knowledge and transmitting the safety of the new food with older children.

From the methodological point of view, the Word Association technique proved to be an effective technique for holistic assessment with children, enabling the identification of the perception of school children about the bread and assessing the discrimination between schools.

WA results highlighted the positive perception of bread by children and also reiterated the positive effect brought about by the food education seminars. “Like” was the category most cited by both schools, but significantly more cited by the IG school. In contrast, the category “Dislike” was most cited by children from the CG school.

In addition to results related to hedonic issues, WA results brought the color of the bread as an important result of the stimulus. The color caught the children's attention. It is widely known that food appearance is of unquestionable importance to adult consumers (Bordim et al. 2023b) and for children it should not be different (Faralla et al. 2023). Color was a subject discussed at the food education seminars since studies have confirmed a relationship between colorful foods and healthy foods (Cömert et al. 2020; Faralla et al. 2023).

The green color of the bread brought about by OPN flour highlighted the significance of pigmentation brought on by the use of natural ingredients (Bordim et al. 2021; Bordim et al. 2023a; Ohtaki et al. 2023). While the main objective is an increase in the nutritional value of bread, the OPN flour can also be used as a natural colorant.

The results of this work revealed practical implications for sensory studies with children, the school food sector, the public policy sector, and the food industry. OPN, as a plant-based food, brings nutrients to the bread. It is also a traditional barrier to children's acceptance (Dahmani et al. 2024).

It is well known that food neophobia reduces nutritional variety (Apelman et al. 2025) and has shown that children need scientific information to feel safe trying and even accepting bread. Therefore, information for children is the difference in introducing healthy new products. Applying a quick food education program can help develop a food culture, promoting healthy and sustainable consumption.

This finding was so evident in the present study that other schools in the city received the food education seminars before having the opportunity to also taste the bread with OPN flour added.

Limitations of the study can be cited. First, the use of a single sample is mentioned. Other foods containing OPN flour should be tested for future introduction to school meals. Second, the level of food neophobia was not measured. The application and validation of a questionnaire such as the Food Situations Questionnaire by Loewen and Pliner (2000) could help to understand the acceptance, emotions, and willingness to try the bread. Third, although a holistic test (word association) was applied, with the exception of color, no sensory description information was noted by the children. Therefore, future work using descriptive methods such as Projective mapping (Mitterer Daltoé et al. 2017) may bring more understanding of children's perception of different foods with OPN flour added.

Another point to explore as future research is the time interval between the food education seminars and the sensory tests. It might be interesting to evaluate how the children perceive the product over a more extended period to validate the objective.

5 | Conclusion

Bread with OPN flour added has the potential to be included in school meals in public schools. Food education seminars were shown to be an essential strategy for the willingness to try and acceptance of the bread by children.

The use of a product-specific emoji list helped to understand children's emotions regarding the new food.

The use of the WA task brought a holistic insight into the evaluation of bread by children, corroborating the hedonic data and highlighting the importance given to the green color of bread to children.

Therefore, as food neophobia is a natural state in children, the introduction of a food education program in schools appears to be an essential procedure in the introduction of new food in school meals.

Author Contributions

Cássia Regina Eidelwein: conceptualization, methodology, investigation, writing. **Marcela Janning Dos Santos:** investigation, writing. **Ana Claudia Almeida Ferreira:** conceptualization, methodology, investigation, writing. **Bruna Rebonatto:** conceptualization, methodology, investigation, writing. **Marcos Rochinski:** methodology, funding acquisition, writing. **Tatiane Luiza Cadorin Oldoni:** investigation, writing. **Leticia Vidal:** methodology, writing. **Marina Leite Mitterer-Daltoé:** conceptualization, funding acquisition, methodology, investigation, supervision, writing.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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