Sensory Evaluation of Bakery and Confectionery Products Prepared through Semi-Industrial and Artisanal Processes

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Abstract The consumption of bakery and confectionery products grows every day and consumers are becoming increasingly demanding. The search for quality makes this sector a very competitive niche market. Among the bakery products, the most consumed is bread, which is prepared with wheat flour, yeast, water and salt and sugar confectionery products such as cakes and biscuits which are also greatly appreciated. The objective of this study was to carry out a sensory evaluation of assorted breads, cakes and cookies prepared by semi-industrial and artisanal process, evaluating the attributes aroma, color, texture, flavor and overall acceptance using the affective test with a hedonic scale of 9 points and purchase intent with a 5-point scale. The results obtained in acceptance testing and overall impression were assessed using analysis of variance, ANOVA and Tukey test at 10% probability. From the results obtained, it can be observed that all products evaluated resulted in acceptance rates greater than 80%, indicating that all were well accepted. However, it was observed that when comparing the percentage of acceptance of bakery and confectionery products, the second group obtained the highest results. Among the products evaluated, the star bread stood out in the "breads" category, while in the "confectionery" the coconut cake, carrot cake and apple vanoka were highlighted. This result is due to the fact that Brazilian customs tend to consumption of more elaborate, stuffed and accented flavor products.

Keywords: *baking, sensory analysis, acceptance*

1. Introduction

Among the bakery products, bread stands out most, it is a food of daily consumption and greatly appreciated by consumers. According to [1] the difference in consumption of artisan and industrialized breads in Brazil, indicates that 86% of consumption corresponds to artisan breads (of these, 58% corresponds to French bread) and only 14% of the consumption is of processed breads such as sliced or sandwich loaf, hamburger bun, hot dog bread, garlic bread, herb bread, corn and honey bread.

Products designed by industrial processes differ from the artisanal process and confer different characteristics, both in color, firmness, aroma and flavor, as well as in appearance. The mechanical process requires experience and certain technical knowledge, because there is a combination of time / temperature and care in the elaboration of the dough.

Besides the quality of the ingredients, the bread preparing process is of fundamental importance and goes through the following steps: mixing or kneading, fermentation and cooking. Kneading is the main operation in the process, a step where the formation of the dough structure occurs. This structure is formed by the development of the gluten network which is responsible for the retention of CO_2 (carbon dioxide) released from the microorganisms participating in the fermentation, which together with water vapor is expanded with increasing temperature, acting as insulation, thereby preventing excessive increase in temperature and evaporation of moisture [2].

In the cooking step, some modifications that define the sensory aspects in the product occur: vaporization of moisture, temperature rise, volume increase [3], transformation of the dough viscosity to the elasticity of the bread crumb and sponge character of the dough [4].

Sensory analysis combines some techniques and methods in order to understand the reaction of the senses and the sensory properties, such as color, aroma, taste and texture of food. It allows for quality control, consumer tests, making correlation between the chemical and physical analysis, development of new products, among others [5,6]. This analysis is done taking into consideration the function of the responses submitted by

individuals to the various sensations that originate from physiological reactions that result from some stimulus, which leads to the interpretation of the intrinsic properties of products [7].

The objective of this study was to evaluate the sensory acceptability and purchase intent of different bakery and confectionery products prepared by semi-industrial and artisanal process.

2. Material and Methods

The products were developed and evaluated during an extension course in baking, held at the Laboratory of Bakery and Sensory Analysis of Araguaia University Campus - AUC, Federal University of Mato Grosso - UFMT in Barra do Garças, in the period from October to November 2014. The raw materials were purchased in local shops and sent to the laboratory.

2.1. Preparation of Products

For bread preparation, the ingredients were separated, weighed in a semi-analytical balance and subjected to semi-industrial process using a kneading trough (G-Paniz DV-30), dough divider (G-Paniz MPS-250), modeler (G-Paniz MPC-15) and turbo electric oven (G-Paniz FTE-120). The breads were prepared based on a conventional formulation (Table 1), previously tested, and the mixing process is basically the same for all breads, comprising of first adding yeast to the flour, mixing for two minutes, followed by addition of the remaining dry ingredients and finally water. Part of this water used was in the form of ice so that the mass temperature does not exceed 26℃. The fat was added after complete absorption of water so that there was no interference of the fat in water absorption by the flour.

The kneading process took place for 4 minutes at a speed of 380 rpm, the time required for optimal gluten formation. The mass was then taken to a divider and shaped in the specific format of each type of bread and allowed to stand for 15 to 40 minutes depending on the mass of each fermentation process. After this time, the fermented products were taken to the oven at a temperature of 180℃ to 220℃ for an average time of 10 to 45 minutes. The confectionery products such as cakes and biscuits were also developed during the course through artisanal process using a household mixer (Power Chef planetary model, PHILCO), and manual cookie modelers of various shapes. The formulations of the cakes and cookies were also conventional (Table 2). The finished products were subjected to sensory evaluation by acceptance test and purchase intent.

2.2. Sensory Evaluation

Samples were offered to 50 judges aged 16-40 years of both sexes, who evaluated the attributes aroma, color, texture, taste, and overall acceptance of the products, using a hedonic scale of 9 points, and purchase intent using a 5-point scale. The results of the acceptance test were evaluated by ANOVA statistical analysis and Tukey test at 10% probability using an appropriate software.

3. Results and Discussion

3.1. Acceptance Testing

According to the results shown in Table 3, it can be seen that in the flavor attribute, acceptance values ranged from 7.5 for the sliced loaf of bread to 8.6 for the star bread, which differed from the others at p<0.10, with no significant difference between the products that had lower averages, i.e the sliced bread, milk bread, whole wheat bread, corn bread, panettone, colonial bread, Italian bread, French bread, hamburger bun, hot dog bread, pita bread and brioche bread. However, all products were very well accepted in all evaluated attributes, since to be considered accepted by their sensory characteristics, a product needs to present a minimum acceptance rate of 70% and the results of percentage of acceptance found ranged from 80.9% for the sliced bread texture and 97.7% for Star bread flavor, a result that is in agreement with Esteller and Lannes [8], who stated that the taste is the most appreciated attribute of a food.

Table 1. Bread formulations (grams)

Ingredients	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Wheat Flour	100	100	100	100	100	100	1200	500	100	1300	1000	1000	100	100	100	600	1000	840
Whole-Wheat Flour	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Corn Flour	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dry yeast	0.5	1.2	1.5	1.0	2.0	2.5	30	30	0.5	15	20	10	0.5	0.5	0.5	20	30	15
Sugar	3.5	7.0	4.0	6.0	25	12	84	50	5	10	180	12	6	0.5	5	25	50	90
Salt	2.0	2.0	4.0	2.5	1.5	2.0	30	10	2.0	05	10	20	2.0	2.0	2.0	10	10	10
Flour enhancer	1.0	1.0	1.0	1.5	1.0	1.0	-	-	1.0	-	-	-	1.0	1.0	1.0	-	-	-
Water	55	45	120	62	40	40	375	200	50	-	400	240	55	56	55	-	-	-
Fat	4	6.0	4.0	8.0	8.0	6.0	-	-	8.0	-	-	-	4	0.5	4	-	-	-
Powdered milk	1.0	4.0	-	-	-	-	60	20	2.0	-	-	-	2	-	-	-	-	-
Anti-mold	0.2	0.2	0.4	0.25	-	0.2	-	-	0.2	-	-	-	-	-	-	-	-	-
Glucose	2.0	1.0	-	-	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-
Eggs	-	5.0	-	-	10	4.0	150	50	6.0	150	-	100	-	-	-	100	-	100
Panettone flavor	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Raisin	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
Comfits	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
Margarine	-	-	-	-	-	-	100	30	-	-	-	30	-	-	-	-	-	100
Milk	-	-	-	-	-	-	-	-	-	500	-	200	-	-	-	200	480	240
Coconut milk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200
Oil	-	-	-	-	-	-	-	-	-	100	-	-	--	-	-	240	60	-

1= Sliced loaf of bread, 2= Milk bread, 3= Whole wheat bread, 4= Corn bread, 5= Panettone, 6= Sweet bread, 7= *Kuchen* bread, 8= Pizza bread, 9= Colonial bread, 10= Pita bread, 11= Brioche bread, 12= Italian bread, 13= Hamburguer bun, 14= French bread, 15= Hot dog bread, 16= Herb bread , 17= Star bread, 18= Coconut bread.

Table 2. Formulations of the cakes and cookies (grams)

Ingredients	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Wheat flour	960	120	480	200	-	480	240	240	240	360	150	240	1000	240
Dry yeast	15	-	-	-	-	-	-	-	-	-	-	-	30	-
Baking powder		10	10	-	-	10	10	10	10	10	10	10	-	10
Sugar	170	160	160	-	50	640	320	320	320	320	300	320	40	320
Water	600	-	-	-	-	100	120	-	-	-	-	-	-	200
Eggs	50	100	50	50	-	400	200	200	150	200	300	200	300	300
Vegetable fat	100	-	-	-	-	-	-	-	-	-	-	-	-	-
Salt	10	-	05	-	05	-	05	-	-	-	-	-	05	-
Margarine		200	200	250	500	-	-	-	100		150	150	120	-
Apple	240	-	-	-	-	-	-	-	-	-	-	-	-	-
Raisin	120	-	-	-	-	-	-	-	-	-	-	-	-	-
Cinnamon	07	-	-	-	-	-	-	-	05	-	-	-	-	-
Clove	05	-	-	-	-	-	-	-	-	-	-	-	-	-
Nutmeg	05	-	-	-	-	-	-	-	-	-	-	-	-	-
Anise	-	-	-	-	-	-	-	-	-	-	10	-	-	-
Sour starch	-	150	-	-	-	-	-	-	-	-	-	-	-	-
Maize starch	-	150	-	375	1000	-	-	-	-	-	-	-	120	-
Vanilla flavour	-	-	10	10	10	-	-	-	-	-	-	-	10	-
Milk	-	-	-	-	--	-	-	-	-	-	-	120	250	-
Chocolate	-	-	15	-	-	-	90	-	-	-	-	-	-	-
Condensed milk	-	-	-	-	395	-	-	-	-	-	-	395	395	-
Egg-Yolk	-	-	-	-	20	-	-	-	-	-	-	-	80	-
Oil	-	-	-	-	-	-	250	250	-	240	-	-	-	-
Orange juice	-	--	-	-	-	-	-	200	-	-	360	-	-	-
Banana	-	-	-	-	-	-	-	-	200	-	-	-	-	-
Carrot	-	-	-	-	-	-	-	-	-	300	-	-	-	-
Corn flour	-	-	-	-	-	-	-	-	-	-	250	-	--	-
Coconut milk	-	-	-	-	-	-	-	-	-	-	-	100	-	-
Icing sugar	-	-	-	80	-	-	-	-	-	-	-	-	-	-
Grated coconut	-	-	-	-	-	-	-	-	-	-	-	100	-	-

1= Apple Vanoka, 2= Nair cookie, 3= Passatempo ccokie, 4=Casadinho cookie, 5=Sequilho cookie, 6=Swiss roll, 7=Chocolate cupcake, 8= Orange cake, 9=Banana cake, 10=Carrot cake, 11= Corn cake, 12=Coconut cake, 13=Berliner, 14=Sponge cake

Table 3. Evaluated attributes and global acceptance of bakery products in the "bread" category

Product	Aroma	Color	Texture	Flavor	Overall Acceptance
Sliced bread	7.5 ± 1.0^{e}	7.9 ± 1.2^{c}	7.3 ± 1.2^{c}	7.50 ± 1.2^{d}	8.0 ± 0.7^{d}
Milk bread	7.8 ± 1.3^{e}	7.6 ± 1.2^{c}	7.7 ± 1.1^{c}	7.80 ± 1.4^{d}	8.2 ± 0.7^{d}
Whole wheat bread	7.7 ± 0.9^{e}	8.3 ± 0.8^{c}	8.0 ± 0.9^{c}	7.83 ± 1.3^{d}	8.1 ± 0.8^{d}
Corn bread	7.9 ± 1.1^{e}	8.3 ± 0.9^{c}	8.3 ± 0.8^{b}	8.10 ± 1.1^{d}	8.4 ± 0.6^{b}
Panettone	7.9 ± 1.2^{e}	8.5 ± 0.7^{a}	8.2 ± 0.9^{c}	8.20 ± 1.1^{d}	8.4 ± 0.9^{b}
Sweet bread	8.3 ± 0.8^{d}	7.9 ± 0.9^{c}	8.2 ± 0.9^{c}	8.36 ± 0.7^{d}	8.3 ± 0.6^{d}
Kuchen bread	8.4 ± 0.6^{c}	8.2 ± 0.9^{c}	8.0 ± 1.1^{c}	8.50 ± 0.6^{c}	8.4 ± 0.8^{b}
Pizza bread	8.6 ± 0.7^{b}	8.3 ± 0.9^{c}	8.9 ± 0.8^{b}	8.65 ± 0.7^{b}	8.6 ± 0.6^{b}
Colonial bread	7.5 ± 1.2^{e}	7.8 ± 1.1^{c}	7.9 ± 0.9^{c}	7.72 ± 1.1^{d}	7.9 ± 0.8^{d}
Italian bread	7.9 ± 0.9^{e}	8.4 ± 0.6^{b}	8.0 ± 1.0^{c}	7.91 ± 0.9^{d}	8.1 ± 0.6^{d}
Star bread	8.6 ± 0.5^{a}	8.4 ± 0.9^{a}	8.5 ± 0.7^{a}	8.79 ± 0.5^{a}	8.7 ± 0.4^{a}
Herb bread	8.5 ± 0.5^{d}	8.3 ± 0.7^{c}	8.4 ± 0.6^{b}	8.50 ± 0.7^{d}	8.5 ± 0.5^{b}
French bread	8.2 ± 0.8^{e}	8.4 ± 0.6^{b}	8.2 ± 0.7^{b}	8.50 ± 0.5^{c}	8.5 ± 0.6^{b}
Hamburguer bun	8.2 ± 0.9^{e}	8.2 ± 0.6^{c}	8.4 ± 0.5^{c}	8.50 ± 0.5^{d}	8.6 ± 0.5^{b}
Hot dog bread	8.3 ± 0.5^{e}	8.2 ± 0.6^{c}	7.9 ± 0.7^{c}	8.50 ± 0.5^{d}	8.5 ± 0.5^{c}
Coconut bread	8.7 ± 0.4^{b}	8.3 ± 0.8^{c}	8.7 ± 0.4^{a}	8.66 ± 0.5^{d}	8.7 ± 0.5^{b}
Pita bread	7.9 ± 0.6^{e}	7.9 ± 0.7^{c}	8.2 ± 0.6^{c}	8.20 ± 0.8^{d}	8.4 ± 0.5^{b}
Brioche bread	7.9 ± 0.7^{e}	7.9 ± 0.9^{c}	8.4 ± 0.7^{b}	8.20 ± 0.7^{d}	8.4 ± 0.5^{b}

Regarding the texture attribute, the Star and coconut breads obtained the highest average, not differing statistically at p <0.10, followed by corn bread, pizza bread, herb bread, French bread and brioche bread which also did not differ. And for flavor attribute, as already mentioned, the star bread had the highest acceptance percentage found, obtaining the highest average of 8.79, a fact observed in all evaluated sensory attributes. The acceptance percentages for the flavor attribute were higher, with most results being above 90%, a fact that is in accordance with [8] who state that the popularity of bread is attributed, among other things, to its taste.

As for the color attribute, the sliced bread, milk bread, whole wheat bread, sweet bread, *kuchen* bread, pizza bread, colonial bread, herb bread, hamburger bun, hot dog bread, coconut bread, pita bread, and brioche breads did not differ significantly at p <0.10, obtaining the lowest average in this analysis. The highest averages were assigned to panettone and star breads. According to [9] in a study of the development of a fiber source bread from malt bagasse, the color attribute was the one that had the highest acceptability index reaching 88.88%, followed by overall impression, texture and aroma attributes with 86.11%, 83.05% and 80% respectively.

In agreement with the other attributes, the global acceptance had the highest average for the star bread, differing from the others at p<0.10, thus it can be considered that among the bakery products of the "bread" category, the star bread was the most accepted by consumers.

When we look at Table 4, we note that the confectionery products showed higher averages than those found for the breads in the five attributes evaluated (aroma, color, texture, flavor and overall acceptance), ranging from 7.7 for the aroma of Swiss roll, to 9.0 for the color of the coconut cake. Thus resulting in acceptance percentage values between 85.8% and 99.2%, respectively. The Vanoka apple, coconut cake and the carrot cake were the

products which obtained the best acceptance. This result is due to the fact that Brazilian customs entail the consumption of more elaborate, stuffed and accented flavor products.

Regarding the cakes, [10] consider the texture and color as the most important quality parameters, in these attributes the coconut and carrot cake had the highest averages, significantly differing from the others at p<0.10. However, these parameters may vary due to baking temperatures, oven structure, humidity and air velocity within the oven [11].

The analyzed cookies obtained lower averages than those found for the cakes. However, the values found were high, which can be attributed to the fact that cookies are well accepted and consumed by people of all ages [12]. The lowest value found corresponded to the color of *passatempo* cookie, 8.03, a value higher than the averages for all cookies in the work of [13].

Table 4. evaluated attributes and overall acceptance of the products in the category "confectionery".

Product	Aroma	Color	Texture	Flavor	Overall Acceptance
Apple Vanoka	8.7±0.5[a]	8.7±0.5[b]	8.7±0.6[c]	8.7±0.5[a]	8.9±0.3[a]
Coconut cake	8.6±0.6[b]	9.0±0.4[a]	8.8±0.3[a]	8.8±0.4[a]	8.92±0.3[a]
Carrot Cake	8.7±0.5[a]	8.7±0.5[a]	8.7±0.5[b]	8.7±0.5[a]	8.8±0.41[b]
Chocolate Cupcake	8.3±0.8[c]	8.5±0.6[c]	8.2±0.8[d]	8.4±0.7[b]	8.5±0.5[c]
Orange Cake	8.4±0.7[b]	8.5±0.6[c]	8.7±0.5[b]	8.7±0.6[a]	8.7±0.5[b]
Banana Cake	8.4±0.5[c]	8.1±0.8[c]	8.3±0.8[d]	8.3±0.6[b]	8.6±0.5[c]
Corn cake	8.3±0.6[c]	8.3±0.7[c]	8.4±0.6[d]	8.6±0.5[a]	8.7±0.5[c]
Passatempo cookie	8.0±0.8[c]	8.0±0.8[c]	8.2±0.7[d]	8.5±0.5[a]	8.4±0.5[c]
Nair cookie	8.3±0.5[b]	8.2±0.7[c]	8.3±0.6[d]	8.4±0.7[b]	8.5±0.5[c]
Casadinho cookie	8.4±0.7[b]	8.4±0.6[c]	8.4±0.8[d]	8.5±0.6[a]	8.6±0.5[c]
Sequilho cookie	8.5±0.6[b]	8.2±0.8[c]	8.5±0.6[c]	8.5±0.5[a]	8.7±0.5[b]
Swiss roll	7.7±0.9[c]	8.1±0.6[c]	7.9±0.7[d]	7.9±0.6[b]	8.2±0.4[c]
Berliner	8.5±0.5[b]	8.8±0.4[b]	8.7±0.5[c]	8.8±0.4[a]	8.8±0.4[b]
Sponge cake	8.4±0.7[c]	8.1±0.8[c]	8.2±0.6[d]	8.4±0.7[b]	8.5±0.5[c]

All coefficient of variation values were lower than 11.58%; mean ± standard deviation. Equal letters in the same column were not significantly different at p ≤ 0.10.
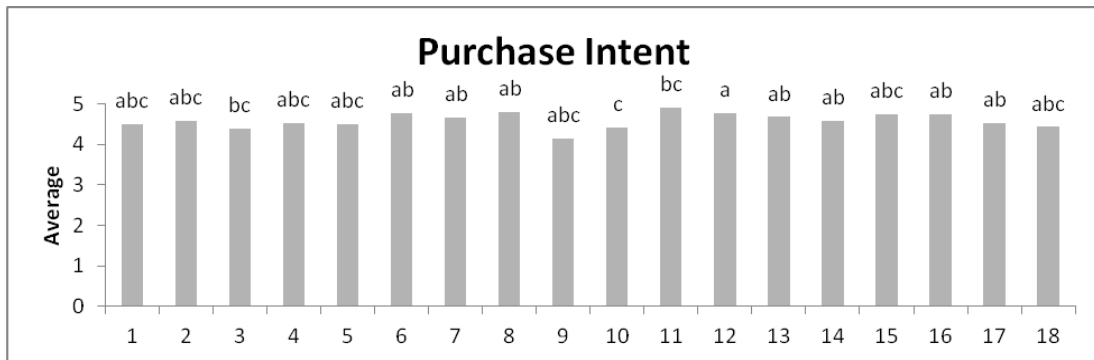

Figure 1. Histogram of purchase intent test of the "bread" category; 1-Sliced bread; 2=Milk bread; 3=Whole wheat bread; 4=Corn bread; 5=Panettone; 6=Sweet bread; 7=Kuchen bread; 8=Pizza bread; 9=Colonial bread; 10=Italian bread; 11=Star bread; 12=Herb bread; 13=French bread; 14=Hamburguer bun; 15=Hot dog bread; 16=Coconut bread; 17=Pita bread; 18=Brioche bread
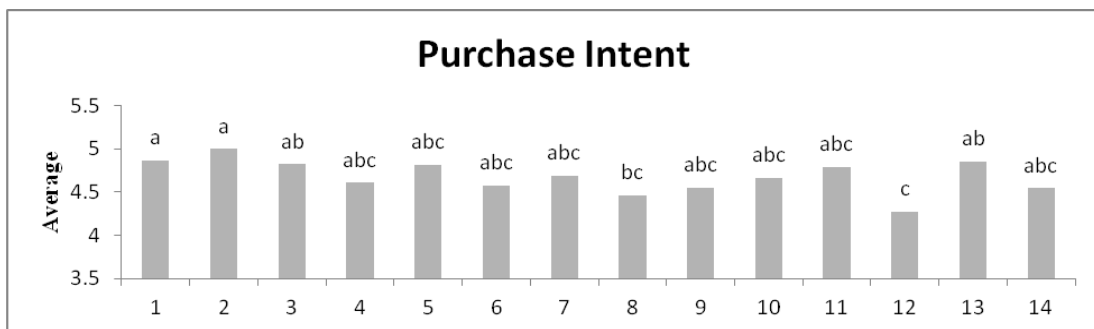

Figure 2. Histogram of purchase intent test of the "confectionery" category; 1= Apple Vanoka; 2= Coconut cake; 3= Carrot Cake; 4= Chocolate Cupcake; 5= Orange Cake; 6= Banana Cake; 7= Corn cake; 8= Passatempo cookie; 9= Nair cookie; 10= Casadinho cookie; 11= Sequilho cookie; 12= Swiss roll; 13= Berliner; 14= Sponge cake

3.2. Purchase Intent Test

According to Figure 1, the bread had a high rate of purchase intent, and the star bread was the one that stood out with an average of 4.91, statistically differing from the others at p <0.10. From this group the product which obtained the lowest average purchase intent was the colonial bread which scored 4.16, equivalent to "probably buy" in the five-point scale used.

The confectionery products (Figure 2) were evaluated and the following results obtained: average of coconut cake 5.0, followed by pastry averaging 4.89 and apple vanoka averaging 4.87 in purchase intent, and none of them differed statistically at p <0.10. The product with the lowest average for this group was the swiss roll with 4.28, though it can be considered that all confectionery products obtained high averages in purchase intent, showing that

they are well accepted in the market and are classified by the judges with scores ranging between "probably buy" and "definitely buy". Due to the high purchase intent values usually attributed to bakery and confectionery products, these are quite explored by researchers in the search for development of healthier foods.

4. Conclusion

All the products evaluated obtained acceptance rates greater than 80%, indicating that all were well accepted. However, it was observed that when comparing the percentage of acceptance of bakery products and confectionery products the second group obtained the highest results. Among the products evaluated the star bread stood out in the "bread" category, while the coconut cake, carrot cake and apple vanoka stood out in the "confectionery" group. This result is due to the fact that Brazilians tend to consume more elaborate, stuffed and accented flavor products. Regarding the analysis of purchase intent, all evaluated product obtained averages between "probably buy" and "definitely buy".

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