
Effect of using different ingredients on the flavor of american pancakes

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Abstract— There are different ways to prepare american pancakes, and one of those changes that can be made is related to the ingredients used. Pancakes were made with 2 types of fat and 2 types of flour in the experiment and their flavors were tested on a scale from 0 to 10. The experiment was carried out in 2 blocks with 6 repetitions each. After the analysis, it was found that at a 5% significance level, only the flour chosen was significant, with the white flour performing better than the wholemeal in relation to flavor.

I. INTRODUCTION

In the preparation of any food, any changes that is made may modify the flavor of the meal, the substitution of ingredients is one of the most common changes, whether due to health issues, lack of access to any ingredient or just a desire to experiment.

The american pancake is a very tasty food, appreciated by many and easy to make, needing only a few ingredients to be made. Although simple, its recipe can be modified in several ways, considering that its ingredients have a wide variety. In the experiment in question, the objective is to analyze the effect that the substitution of two elements can have on the final flavor of the meal: the fat and flour used.

The fat [1] used to prepare the pancake can be in the form of butter that has an animal origin, or in the form of margarine that has a vegetable origin. There is a consensus in the culinary world that recipes using margarine are necessarily less flavorful than those with butter. This is due to the fact that a good butter has a rich, citrus flavor especially in the case of recipes like this that depend on emulsification. In addition, butter is richer in saturated fat while margarine is mostly composed of unsaturated fat that poses a risk for heart attacks. Due to their animal origin, butter contains a lot of cholesterol, something that is not present in margarine, so there is an importance in alternating the consumption of butter and margarine.

There are flours from different origins, as this food is basically some ground and dehydrated cereal. In the experiment in question, white and wholemeal flour will be tested. The difference between the two is due to the

refinement process that is used in white flour but not in the wholemeal type. The latter has a different taste and texture than what people are usually used to in their day-to-day lives, but it is nutritionally speaking, more suitable.

II. MATERIALS & METHODOLOGY

Due to the current situation of COVID-19, some decisions were taken in order to avoid contagion. The randomization of people who would be asked about pancakes was not possible at any level, so two blocks were created where three people tried each recipe six times. This was decided because even taking the greatest care when preparing the pancakes there is still the possibility of contamination.

The purpose of the experiment is to determine whether there is a relation between the ingredients and people's preference.

The experiment carried out was a Generalized Complete Blocks Design (GCBD) with 2 blocks and 6 repetitions. Two treatments were tested with 2 levels each:

- **Fat:** Butter x Margarine
- **Flour:** White x Wholemeal

a. Material

The experiment was carried out in the respective houses of each author, so each location is considered a different block. The same recipe [2] of american pancake was used to carry out the experiment and the same brands were also used when possible to minimize any effect:



Figure 1: Production process and resulting pancakes pieces

- 1 cup of flour
- 1 cup of milk
- 2 spoon of butter/margarine
- 2 spoon of sugar
- 1 spoon of yeast
- 1 egg
- 1 teaspoon of salt

The ingredients were all mixed together and taken to a frying pan until cooked through. For experimenting the pancakes, pieces of approximately 4cm x 4cm of each flavor were cut, as can be seen in Figure ???. The order in which the different pieces of food were tried was randomized within each block and the response harvested was their taste on a scale from 0 to 10; 0 being considered bad and 10 being very good; given by the residents of the respective homes and then an average of these responses was calculated which was used as the final answer of the experiment.

b. Methodology

To check if there is a difference in the taste of the pancakes in relation to the different treatments used, an Analysis of Variance (ANOVA) was performed with the collected data, but beforehand the necessary premises were tested to implement this technique. The data distribution can be seen in Figure 2. The homogeneity of the data variance was tested using the Lavene [3] test, and the null hypotheses that the data show the same variability were not rejected. The exploratory analyzes of the data carried out in this experiment and subsequent elaboration of the ANOVA model were made in software R.

III. RESULTS

The generated ANOVA model took into account the treatments used, the block and all the interactions that

TABLE 1: ANOVA TABLE

	DF	SQ	MS	F-value	p-value
Fat	1	2.684	2.684	3.606	0.064809
Flour	1	11.184	11.184	15.027	0.000385
Fat:Flour	1	0.125	0.125	0.168	0.684072
Block	1	0.043	0.043		
Fat:Block	1	3.882	3.882		
Flour:Block	1	1.277	1.277		
Fat:Flour:Block	1	0.135	0.135		
Residuals	40	29.772	0.744		

they could have and can be seen in Table 1. Adopting a significance level of 10%, the Fat and Flour treatments are considered significant, if the level of significance adopted is more rigid at 5%, only the Flour treatment has significant values. The interaction between treatments showed a high p-value, thus being non-significant.

To quantify the difference found between the tested treatments, Tukey [4] tests were performed, finding a difference of 0.96 for white flour in relation to the wholemeal, that is, the flavor note of pancakes made with white flour was on average 0.96 greater than that of wholemeal flour. Regarding Fat, margarine had an average grade 0.47 higher than butter.

To test the validity of the proposed model, the assumptions of normality of the residues of the model were tested. Initially, a graphical analysis was performed, as can be seen in Figure 3, as only the visual verification was not clear, a Shapiro-Wilk test was performed that proved the normality of the model's residues despite the fact that it has some outliers.

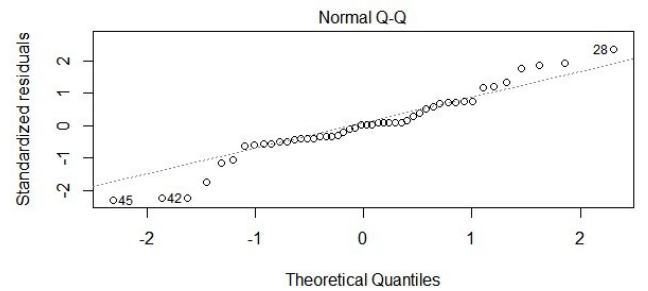


Figure 3: QQ-plot of residuals

Regarding the effect of the block, it is not possible to test hypotheses because it cannot be guaranteed that this effect has a chi-square distribution. However, it can be seen through Table 1 that the block has a mean of squares below the mean of the square of errors, thus indicating that only its effect may not be significant.

To analyze possible interactions between Block x Treatments, visual analyzes of the data were made through interaction graphs. In Figure 4 there is the

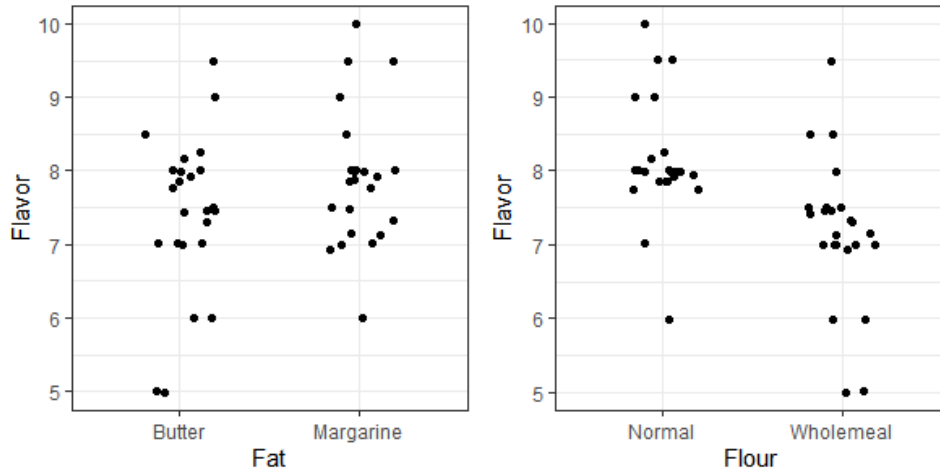


Figure 2: Dot chat of the collected data

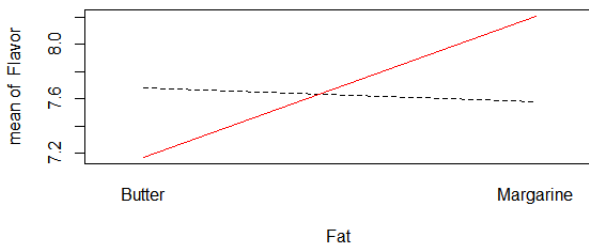


Figure 4: Interaction plot Block x Fat

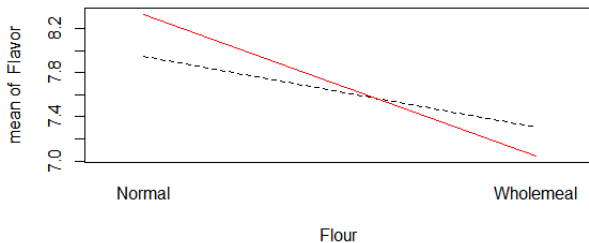


Figure 5: Interaction plot Block x Flour

Block x Fat interaction and in Figure 5 Block x Flour interaction, the data seem to show an interaction between Block x Treatments in relation to both treatments. Although it is not possible to perform statistical tests in relation to these interactions, the mean of the squares of the same can be used for some comparison to be made. It can be said according to Table 1 that the mean square of the Block-Fat interaction is 5.2 greater than the mean square of the errors, and the Block-Flour interaction is 1.71 greater.

IV. CONCLUSION

Based on the ANOVA model found, it is concluded that the flour chosen to make american pancakes has a

significant effect on their final flavor, with white flour having a better average flavor than whole. To a lesser extent, one can also perceive an influence of the type of fat used to prepare the food, with margarine showing a better performance, contrary to what was expected at the beginning of the experiment. No effect was identified on the interaction between the type of flour and fat used.

It is very important, however, that it should be noted that an interaction effect between the blocks and the treatments was found, this may mean that the results found in this particular experiment do not apply in the general context, that is, depending on the people who try the pancakes the displayed result may be different.

Considering the results found in the analysis of variance and the context on nutritional issues of the different ingredients presented, it is seen that although healthier, wholemeal flour changes the final flavor of pancakes, being considered not as tasty as the one made using normal flour. Regarding the fat used in the preparation, margarine offers a slightly better flavor, but as it has some health hazards, it is up to the consumer to consider which source will be used for the preparation of american pancakes.

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