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Comparing the Antimicrobial Properties of the Food Additives in Processed Bread to Homemade Bread Without Additives

Abstract:

In order to discern the necessity of food additives in processed foods this study will look into the % microorganism growth over a three week time span on both processed bread and homemade bread. The processed bread contains added antimicrobial additives such as, calcium propionate to specifically slow spoilage (Weston Foods, 2020) (Sancho- Madriz, 2003). The homemade bread will only have four ingredients with no added preservatives. Two of each type of bread was sliced into quarters and were either control or treated by being rubbed on the refrigerator handle before being placed into plastic bags. This study was done in three replicates. Observations of the % coverage and qualitative information were taken at a weeks time over the span of three weeks. A Two way ANOVA with replication was conducted and the F-crit was 5.317655063, the F value was 1.021097046 and the P value was 0.3418417645. The interaction F-crit was larger than the F value and the P value was less than the alpha value, therefore the null hypothesis could not be rejected. This signifies that there was no difference found between the processed bread and the homemade bread. This study suggests that the additives do not give the food products any advantage in retarding the spoilage.

Introduction:

The world's population is growing quickly and there are already difficulties in ensuring that there is an adequate quantity of food to sustain this population. Even with quickly advancing agricultural technology to increase crop yields, the amount produced still falls flat of the amount needed to sustain the growing population (Wilson, 2014). While producing sufficient amounts of food is a problem, the amount of food wasted is an unnecessarily high number contributing to the world food shortage problem. It is estimated that about 1.3 billion tonnes of edible food has been wasted globally (FAO, 2020). Food additives were added to food in hopes of lengthening their shelflife so that there will be an overall decrease in waste and an increase in available foods. Today, most foods are processed through the addition of antimicrobial, preservatives and

nutrients. These additives will allows for the safety and lessen the quality loss from different reactions. (Garcia et al., 2016). These additives have been a partial solution to the world food shortage problem but there are studies that have found them to be potentially dangerous to human health such as formaldehyde (Hamburg 2009) . With this being said, the benefits of these additives outweigh the potential risks if the additives are necessary. This study was conducted to test the antimicrobial properties or processed bread in comparison to homemade bread. If the antimircobial additives are working effectively in the processed bread, then there will be a statistical difference in the microorganism % coverage between the processed and homemade bread.

Methods:

Homemade Bread was made from a recipe from Better from Scratch (Allen, 2020). This recipe consisted of 4.5 cups of flour, 500 mL of warm water, 1 Tblsp of active yeast, ¼ cup of sugar, 2 tsp salt and 2 Tbsp of oil. Two slices of the processed bread and the homemade bread were then sliced into quarters on a clean surface and 12 plastic bags were prepared. Three of each quarter pieces of each type of bread was placed into separate plastic bags and were labelled appropriately. A piece of the processed bread was rubbed on the refrigerator handle and placed in another plastic bag and labelled appropriately with the date, treatment and initials. This was done with the homemade bread as well and done so there was a total of three replicates for each type of bread rubbed on the fridge. The plastic bags were stored in a dark cabinet and were observed every week for three weeks. Observation of the % microorganism coverage and qualitative information such as the colour, the texture, the precentof the area grown on the bread were recorded. After the three week observation period, a two-way ANOVA statistical analysis on google sheets was conducted with the total percent coverage of the bread.

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Figure 1: Figure 1 displays the set up of the labelled homemade control and the homemade treated samples properly labelled.

Results:

Most of the samples did not grow any mold on them although it appeared that the same type of mold grew on the pieces that obtained mold. The mold was a greyish blue and texturally fuzzy and seemed to grow mostly on the left side of the bread but also in the center. The mold in all the samples that grew mold grew relatively slowly in the beginning with there only being traces of it in the second week of observations and then exponentially in the third week. On the processed control sample no mold grew on any of the replicates. On the treated processed bread one of the replicates grew mold on to cover 50% of the bread sample. The control homemade bread grew mold on one replicate with it covering 25 % of the sample. On the treated homemade bread two replicates grew mold with 100% mold coverage and 85% mold coverage. A two- way ANOVA statistical analysis was conducted on the total % mold coverage. The F-crit value is 5.317655063 and the F value is 1.021097046. The P-value is 0.3418417645 wich is greater than the 005 alpha value. Graph 1 described the procession of the mold growth percent coverage over the three week observation period.

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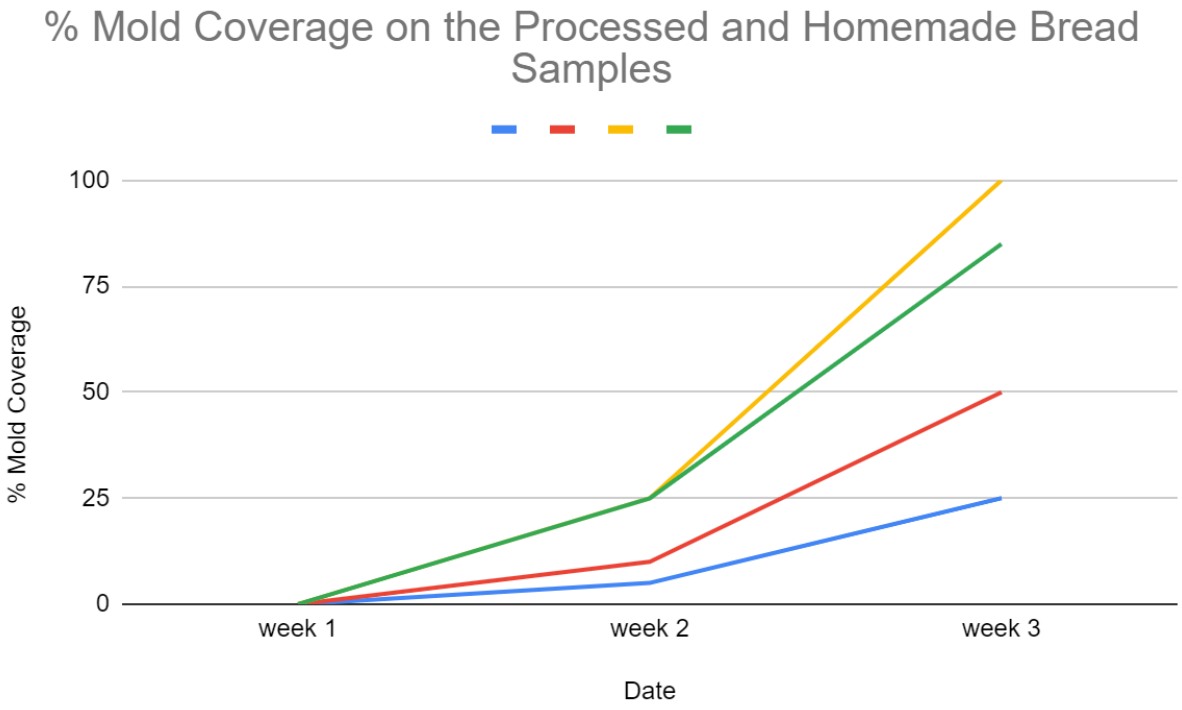

Graph 1: Graph 1 described the trend of the % mold growth in the homemade control (blue) which grew to 25% sample coverage, the processed treated (red) which grew to 50% sample coverage , the homemade treated bag 1 (yellow) which grew to 100% sample coverage, the homemade treated bag 3 (green) which grew to 85% sample coverage.

ANOVA

Source of Variatio	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	2133.333333	1	2133.333333	2.160337553	0.1798117077	5.317655063
Columns	3675	1	3675	3.721518987	0.08984204222	5.317655063
Interaction	1008.333333	1	1008.333333	1.021097046	0.3418417645	5.317655063
Within	7900	8	987.5			
Total	14716.66667	11				

Figure 2: Figure 2 displays the data obtained from performang the Two-Way ANOVA on google sheets. The F value is 1.021097046, the F-crit value is 5.317655063 and the P value is 0.3418417645. The F value is smaller than the F-crit value which suggests that we cannot reject the null hypothesis and there is no statistical difference. The p value greater than the 0.05 alpha value which also supports to reject the null hypothesis.

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Discussion:

A two- way ANOVA statistical analysis was conducted on the total % mold coverage. The F- value was less than the F-crit value and the P- values is less than the alpha 0.05 value. This signifies that the null hypothesis cannot be rejected and that there is no statistical difference between the processed bread and the homemade bread in the deceleration of mold growth. These results may suggest that all the extra food additives are not working efficiently enough to lengthen the shelf life of the product and deter the growth of microorganisms. This might suggest that there needs to be a new approach to the preservation of food or the additives used are not the optimal ones.

With that being said, this study was limited to a suboptimal size of a data set. For further investigation and accurate analysis this study would have required at least 100 or so replicates and more levels of the tested samples. This size of the data set could have affected the results as there was not much growth in the samples overall. Additionally it is uncertain whether or not the mold actually came from the microorganisms on the fridge or from preexisting microorganisms from the baking process. From baking the bread at home there were many instances where bacteria could have come in contact with the bread after it was baked. For example, during any step of the baking as a home kitchen is not always completely sanitized. Although this factor of uncertainty might have affected the data, it is not a concern because the study was testing for homemade versus the processed bread which would imply that it was not made in a completely sterilized lab. Additionally the same type of mold grew on the four samples that obtained microorganism growth even after being treated and separated. This suggests that the either the same microoragnism were already preexisting in both types of bread or that the microorganisms grown came from rubbing the samples on the fridge handle.

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With food spoilage being a huge contributor to the food shortage problem, the addition of substances that can delay the growth of microorganisms are a necessity. There are countless of different additives that can do this but some pose risk to human health and can act as carcinogens (National Research Council, 1983). The food additive, calcium propionate was the main additive added into the processed bread and was found to not have any significant difference in preventing microorganism growth. Calcium propionate is not the only food additive used in processed food to lengthen the shelf time. (Sanchoz-Madriz, 2003) For further studies, a comparison of different food additives added in processed bread would be useful to determine the best additives to use. This study can extend into any category of processed foods as the additives added depend on the original properties of the food such as, water content, nutrient loss or antioxidant properties.

Conclusion:

In this study, there was found to be no difference in the deterrence of microorganism growth between processed bread and homemade bread and the null hypothesis was failed to be rejected. With the food shortage problem continuing to be an imminent threat to the human race, the lengthening of shelf life and deterrance of microorganisms are vital to the food shortage solution.

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Appendix:

Observations:

Date	**% Coverage**	**Observations**
Nov 4 2020	1 all three bags 0% 2 all three bags 0% 3 all three bags 0% 4 all three bags 0%	Nothing has grown on the pieces of bread
Nov 11 2020	1 1) nothing 0% 2) nothing 0% 3) nothing 0% 2 1) 5 % 2) nothing 0% 3) nothing 0% 3 1) noting 0% 2) 10% 3) nothing 0% 4 1)25 % 2) nothing 0% 3) 25%	1 nothing has appeared on the bread 2 only on one sample a fuzzy greyish mold appears in the top left corner 3 only on one sample a bluish grey mold appears on the left side, does not appear fuzzy 4 1) sample 1 has fuzzy bluish grey mold in the center 3) sample 3 has fuzzy bluish grey mold in the center and left corner
Nov 17 2020	1 1) nothing 0% 2) nothing 0% 3) nothing 0% 2 1) 25% 2)nothing 0% 3)nothing 0% 3 1)nothing 0% 2)50% 3)nothing 0% 4 1) 100% 2) nothing 0% 3) 85%	1 Nothing have grown on these samples 2 on the same sample the same bluish grey mold spread to the corner and down the left side - none in the middle 3 on the same sample the same bluish grey mold darkened on the left side and spread toward the center 4 1) the whole piece of bread is now covered in the bluish grey fuzzy mold, it is present on the bag as well 3) the same bluish grey mold has bread throughout the mold but in patches around the bread.

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Table 1: Table 1 describes the observation taken on the Processed Control (1), the Homemade Control (2), the Tested processed bread (3) and the tested Homemade bread (4). There were three replications done of each of the four possible treatments above. The obseravations were taken weekly and the % coverage plus the colour, the texture and the area the mold grew were recorded above.

Figure 1: Figure 1 displays the processed treated bread after 3 weeks

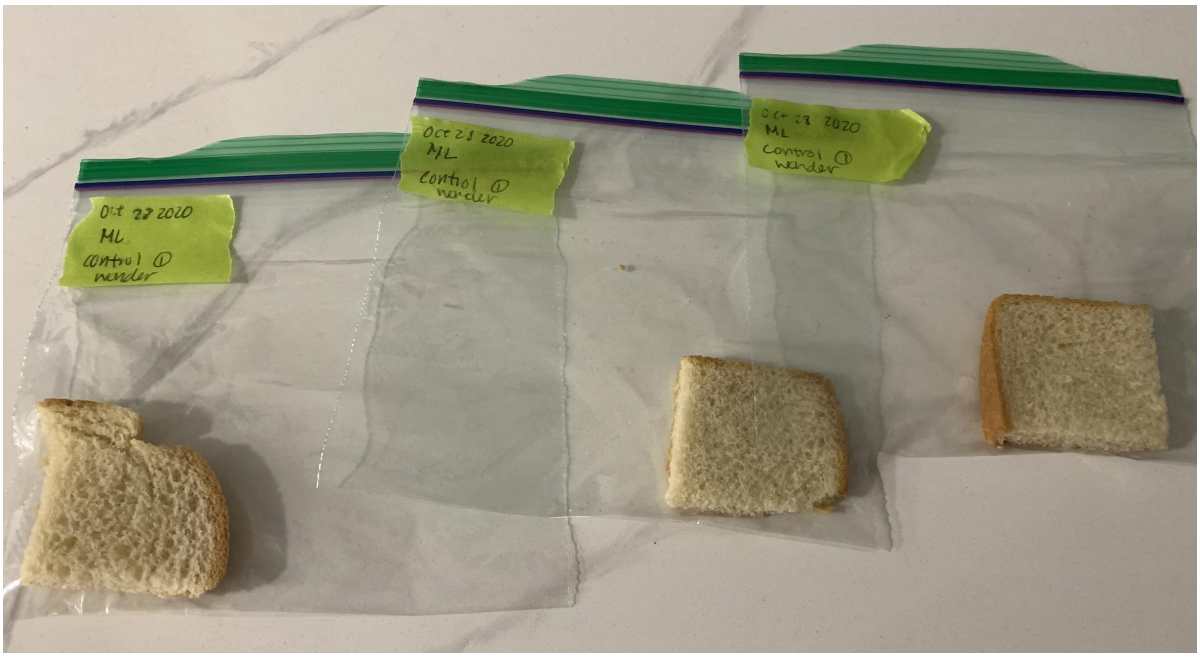

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Figure 2: Figure 2 displays the Processed Control after 3 weeks.

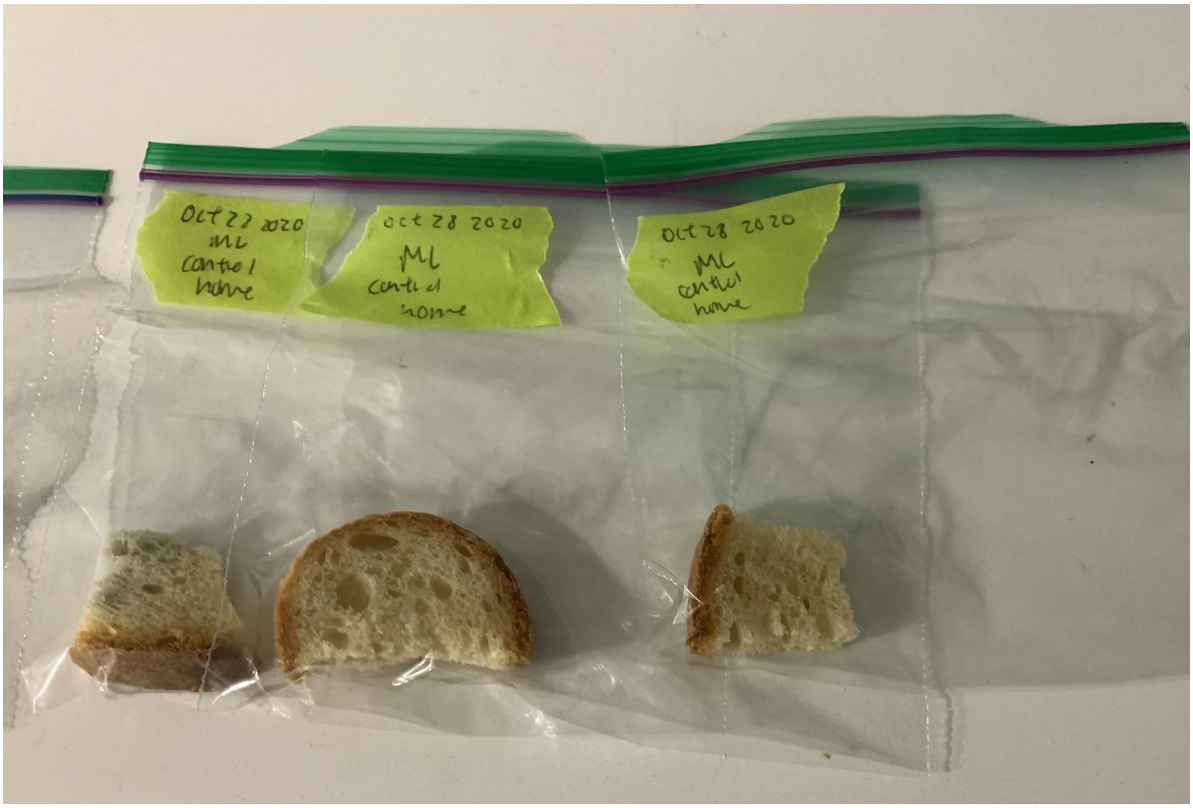

Figure 3: Figure 3 displays the Homemade bread control after 3 weeks.

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Figure 4: Figure 4 displays the Homemade treated bread after three weeks.