Effect of Chemical Preservatives and Temperature on Bread Shelf- Life at Different Enviromental Conditions

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Abstract -- Bread is cereal product packed with a lot of nutrients, but a limiting factor to the benefits we can derive from this product is mould spoilage. This moud could produce mycotoxins which have pathological effects on humans, as such this study investigated the ability of different chemical preservatives to limit the fungal growth over a period of twenty (20) days at different temperatures thereby extending bread shelf-life and satisfying humans who want their food free of pathogens. Based on the results obtained there was significant difference between bread baked with a single preservative and that baked with a combination of two or more preservatives? Fungal load increased progressively as the period of storage increased? Potassium sorbate acted as a better fungal inhibitor when compared with calcium propionate and Ascorbic Acid.

Indexed Terms: bread, chemical preservative, mould, mycotoxins

I. INTRODUCTION

Bakery products are a valuable source of nutrients in our diet, providing us with our food calories and our protein requirements. Mould spoilage is still a major problem limiting the shelf life of these products. Losses due to mould spoilage have resulted in revenue decrease to the baking industries. Therefore, methods to control mould growth and extend the shelf life of bakery products are of great economic importance to the banking industry where an increased demand in global consumption exists.

Cereals represent the most important source of food in many countries (Pimentel *et al*., 2009); and can be contaminated by fungus species. Many species from the *Alternaria*, *Aspergillus*, and *Fusarium*genera, as well as some *Penicillium*specie are known to produce mycotoxins (Zain, 2011) which are receiving a considerable worldwide attention as they show a wide range of pathological effects such as carcinogenicity, teratogenicity and mutagenicity (Oueslati, 2012). Fungal contamination is dependent on environmental factors like temperature, humidity, drought and inadequate storage conditions, but some surveys point to the possibility that it could be influenced by farming methods (Kirincic, 2014).
Since ancient times, chemicals have been added to preserve freshly harvested foods for later use. For many years, chemical food preservatives, such as salt, nitrites, and sulfites have been in use. Recently there has been an extensive use of other chemical preservatives due to the changes in the ways food products are produced and marketed. Today, consumers expect foods to be available at all times, free of food-borne pathogens, and have reasonable long shelf life.

Despite improvements in food packaging and processing systems to extend the shelf-life of food without chemicals, preservatives still play an important role in protecting food supply (Davidson *et al.,* 2002). In addition, due to the way food is marketed in recent times, products are rarely grown and sold locally as in the past. Today, foods produced in one area are often shipped to another area for processing and to several other areas for distribution. Several weeks, months or years may elapse between the time of production and consumption. To accomplish the long-term shelf life necessary for such a marketing system, multiple effective means of preservation are often required.

Chemical preservatives can be likened to food additives which are defined as chemical substances deliberately added to foods, directly or indirectly in known quantities for purposes of supporting food processing, food preservation, or in improving the flavour or texture of foods (Daniel, 2007).

II. MATERIALS AND METHODS

1) Experimental Design:

A 4 x 8 factorial experiment was used to assess the effect of temperature and chemical preservatives on the growth of mould on the bread samples used for the experiment. The first factor was the four different temperature levels, and the second factor was the eight different combinations (levels) of preservatives, plus the control.

- Elaboration of treatment:

Treatment	Calcium propionate	Potassium sorbate	Ascorbic acid
T1 (AS)	-	-	0.1%
T2 (CP)	0.3%	-	-
T3 (KS)	-	0.1%	
T4 (ASC)	0.3%	-	0.1%
T5 (ASK)	-	0.1%	0.1%
T6 (CPK)	0.3%	0.1%	
T7 (ACK	0.3%	0.1%	0.1%
T8 (CONTROL)	-	-	-

III. PREPARATION OF BREAD

The recipe was in accordance with AACC method (AACC, 1983) with little variation in the quantity of sugar used (Penfield and Campbell, 1992), using the following recipe: flour (100g), sugar (16grams), butter (16g), milk (10g), salt (10g), yeast (10g), water (36%). The measurements were weighed out using an electronic weighing balance. The following preservatives were selected from the survey and used for the preparation of the bread samples, calcium propionate ($C_6H_{10}CaO_4$), potassium sorbate ($C_6H_7KO_2$) and ascorbic acid ($C_6O_6H_8$).

- Determination of the effectiveness of the identified chemical preservatives in the prevention of bread spoilage:

After baking, the bread samples were divided into four groups. The first group was stored at room temperature that read $26^o \pm 30^0$C on the average. The second group was stored in a refrigerator set at 7^o C, the third group was stored in a deep freezer set at -4^0C.

All the samples were left in their different storage places for a period of 24 days, during which test samples were aseptically taken from each bread specimen at intervals of 4 days and subjected to microbiological evaluation. Colony counter was used to determine the total fungal count.

IV. RESULTS AND DISSCUSSION

The results below shows the effect of chemical preservative and temperature on bread samples throughout a twenty (20) day period. We notice that significant growth occurred at other temperatures excluding that stored at a freezing temperature (-4^0C), While the highest growth occurred at the samples placed at room temperature (26^0C). The sample without any preservative had the highest fungal growth, followed by the sample prepared with Ascorbic acid. The samples with potassium sorbate had the least fungal growth as a single preservative.

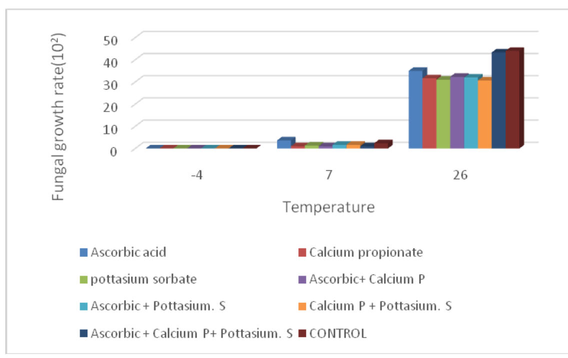

Fig. 1: Effects of temperature and chemical preservatives on total fungal count (x102 cfu/g) of bread samples after 4days.

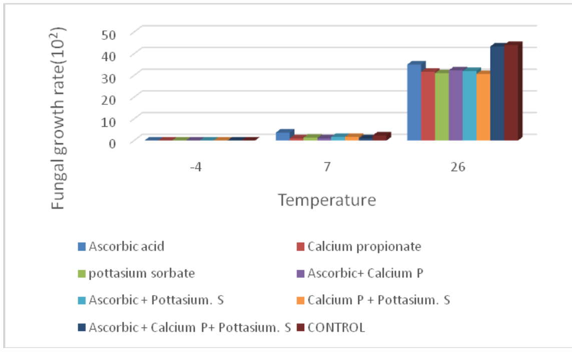

Fig. 2: Effects of temperature and chemical preservatives on total fungal count (x102 cfu/g) of bread samples after 8 days

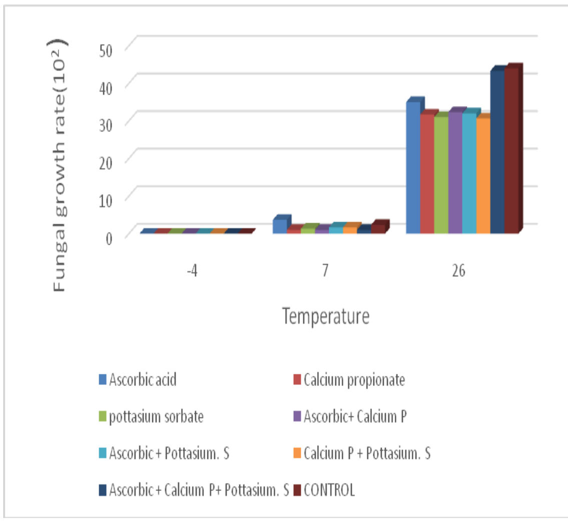

Fig. 3: Effects of temperature and chemical preservatives on total fungal count (x102 cfu/g) of bread samples after 12 days

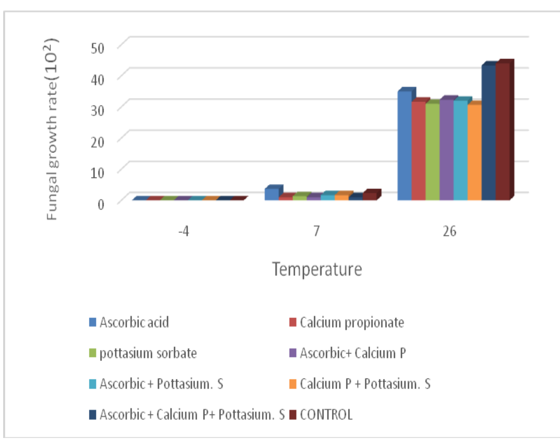

Fig. 4: Effects of temperature and chemical preservatives on total fungal count (x102 cfu/g) of bread samples after 16 days

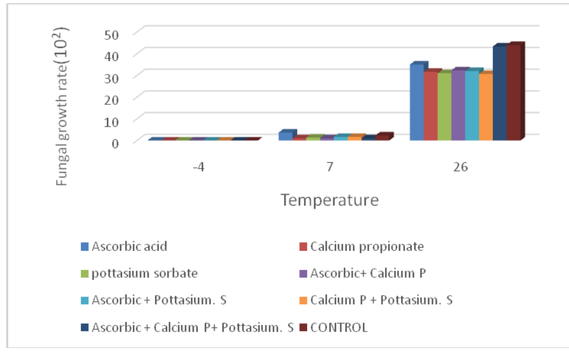

Fig. 5: Effects of temperature and chemical preservatives on total fungal count (x102 cfu/g) of bread samples after 20 days

From the reported result above, figures 1 to 5 show the total fungal count (TFC) in the bread samples, fungal growth was observed in all the samples from the fourth day. The fungal count increased with the days of storage (Nirmala*et al.,* 2016).

Results obtained from the storage of bread at different temperatures showed that the least mould counts were obtained from those stored at freezing temperatures. This, however, is expected since such low temperature prevents the growth of several microorganisms, and the moulds commonly found on bread are usually mesophilic in nature. According to a study by Unachukwu and Nwakanma (2015), fungal load increased as the period of storage increased, and all the samples used for the study showed positive fungal growth from the fourth day onwards, which is also in agreement with this study. According to the United States department of Agriculture, most moulds grow best at warm temperatures. Bread kept at room temperature instead of in a refrigerator is more likely to grow mold quickly, and so did the bread samples placed at $26^{O}C$ which had more fungal growth than those kept at other storage temperatures.

V. CONCLUSION

Considering the above results and findings it has become apt to conclude that bread baked with or without preservatives can undergo mould spoilage if preserved at room temperature only. It is also reviewed here that bread baked with two or more preservatives in definite or specific proportions exhibit moderately high anti-microbial properties. To improve on shelf-life of bread, it is important to consider the factors of both preservative and temperature as critical to the shelf-life of bread. The order of particular fungal growth may be related to the nutrients available in the substrate and the physical parameters in which further studies have to be done.

In this on comparative grounds, ascorbic acid had the least preservative effect on the fungi while potassium sorbate and calcium propionate had more effect in checking fungal growth. Also, the extent of fungi invasion of the untreated bread suggested that the constituents of the bread without the preservatives provided good nourishment for fungal growth.

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