**EFFECT OF DIFFERENT PRESERVATIVES ON THE SHELF LIFE OF CAKES**

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**ABSTRACT**

The study adopted experimental design which aimed at identifying the effect of different preservatives used in cake making on the shelf of the cakes , different preservatives such as calcium propionate, sodium bicarbonate, rum, brandy were used to prepare different cakes which were preserved under different temperatures and storage, sensory evaluation was carried out and microbial count were carried out fortnightly (2 weeks interval),the soya agar culture plates were used to estimate the (TVC) total viable count of microbial colonies while the sabouraud dextrose agar where used to estimate the (TFC) total fungal count. Findings of the study reviewed that sample 102 which was preserved with Rum and 103 which was preserved with Brandy lasted longer than the other samples, 100, 101and 104 in terms of microbial and chemical deterioration. The two samples (102 and 103) displayed very high antibacterial and antifungal resistance in addition to antichemical spoilage for 70 days a period of about 3 months. The cake sample produced by using chemical preservative did not withstand spoilage agent of microbial and chemical circumstance, cake sample101 made with without the addition of any preservatives began to undergo mixed spoilage on 28th day of storage.it is suggested that bakery industry, consumers, institutions, home makers interested in constant cake production and consumption are advised to embark on the use of rum and brandy as cake preservatives and additives.

**CHAPTER ONE**

**INTRODUCTION**

**1.0 Background of the Study**

Food preservation has been an essential activity throughout history. The very cycle of the season creates periods of shortage and abundance of different foods at different period of the year so there is need for food preservation. Food preservation is a method of preparing foods, so that it can be stored for future use, because most food remains edible for only a brief period of time. Since the earliest ages have experiment with method for successful food preservation. Preservative is a substance that is added to product such as food, pharmaceuticals, paint, biological samples, wood, etc. to prevent decomposition by microbial growth or prevent undesirable chemical changes (Adedeji, and Ade-Omowaye, 2013). There are many types of preservatives used in food preservation such as, natural food preventives which is freezing, boiling, smoking, salting. Chemical food preservatives such as sodium benzoate, benzoic acid, nitrites, sodium nitries, sulphites, sulphur dioxide, sorbates, sodium sorbate, potassium sorbate. Artificial preservatives (Antimicrobial agents, antioxidants, chelating agent. Among the products of each food preservation were cheese and butter, raisins, pemmican, sausage, bacon and grain (Adedeji *et al.,* 2013). In modern food preservation, preservatives functions in two ways. One is by delaying the spoilage of the food while the other is by ensuring that the food retains as nearly as possible, its original quality. As scientific investigation regarding the causes of food spoilage were undertaken, they pointed the way to a wider application of methods already in use and to the discovering of new ones (Mahindru, 2008).

The first methods include the use of sugar, vinegar for picking meats and vegetables, salt (one of the oldest preservatives) and alcohol. Good wine will keep almost indefinitely and fruit placed in a 15% to 20% alcohol solution (brandying) is well preserved (Dalton 2002). The second method includes the use of ascorbic acid (which prevents colour deterioration in canned fruits), benzoic acid, sulfur dioxide, and a variety of neutralizer, foaming agent and bleaching agents. The excessive or unacknowledged use of these chemical agents has been registered against by most government. Before 1860 changes in food were explained on the theory of spontaneous generation. Pasteur demonstrated that fermentation, molds and some forms of purification were caused by the presence of micro-organisms widely distributed in the environments. Since these microorganisms are the main cause of food spoilage.

Food preservation depends on rendering conditions unfavourable for their growth. In general there are two types of preservatives used to preserve food

1. Chemical preservatives
2. Physical preservatives

Chemical preservatives is a process of adding chemical compounds to the product.

Physical preservatives is a process of refrigeration and drying (Adedeji *et al.,* 2013).

Chemical and physical preservatives are used in foods, cosmetics and many other products.

Artificial preservatives reduce the risk of food borne infection and also decrease microbial spoilage and preserve fresh attributes and nutritional quality. Some physical techniques for preservation include dehydration, Ultra-violet radiation, freeze-drying and refrigeration. Although both chemical and physical preservatives are combined Theron (2003). Preservatives have been used by our ancestors for centuries ago, throughout history they have been preserving foods to keep it fresh, through the processes such as, picking, salting, and smoking. Salting has long been used to preserve fish and meet, spices and herbs to enhance the flavor, food and fruit often preserved with sugar. Pickling has been done with eggs and other substance.

The earliest preservatives were sugar and salt (Nacl), which produced food environment of high osmotic pressure that denied bacteria the surrounding they needed to live and reproduced. Jams and Jellies are preserved as solutions of high sugar contents. Micro-organism such as molds can often withstand the effect of high salt or sugar concentration in food, fortunately they rarely cause illness. Smoking is a method used mainly for fish and meat, it combines the drying action with chemicals produced from the smoke, which form a protective coating.

The early method of air removal included the sealing of food inside containers (such as jars) or the covering of food surface with hot paraffin. The invention of canning by (Nicolas, 2000) enabled commercial preservatives of food stuffs in response to prize offered. Appert developed a method of canning and preserving fruit and vegetable in glass containers for sea voyages. His process was used commercially in (2002 by Peter Durand) in England. Cake is often the desert of choice for meals at ceremonial occasions particularly weddings, anniversaries, birthdays and also sold as snacks in shop. Cake is a perishable food and rich medium for molds and yeast as such different preservatives are added in order to maintain its wholesomeness and freshness. Today consumers demand and enjoy food supply that is flavourful nutritious, safe, colourful and affordable.

The oxidation process spoils most foods, especially those with a high fat content. Fats quickly turn rancid when exposed to oxygen. Antioxidants prevent or inhibit the oxidation process, the most common antioxidant additives are ascorbic acid (Vitamin c) and ascorbates. Thus, antioxidants are commonly added to oils, cheese, and chips (Barrett, 2004)

* 1. **Statement of the Problem**

One of today’s challenges for food industries is to guarantee safe food throughout the supply chain whilst retaining the same properties that where present when the food where freshly made. The increasing demand for ready to eat fresh food products has become serious challenges for food manufacturers, distributors, consumers regarding the safety and quality of their foods. Mold spoilage is a serious problem for bakeries, food processing companies and consumers. Mold growth is the major factor limiting the shelf life of high and intermediate moisture on bakery products. Mold growth on bakery products is a serious problem that results in economic losses and health hazards to the consumers. With the use of preservatives is therefore an attractive means to diminish the spoilage and ensure the food sanity and prolong the shelf life of the cakes. This will help in the security of the foods and as well sustain it for the consumers and manufacturers.

* 1. **Purpose of the Study**

The main purpose of this study was to determine the effect of different preservatives on the shelf life of cakes.specifically the study

* Identified the different types of preservatives used in cake making
* Determined the effect of the preservatives used in the different cake samples produced.
* Determined the shelf life of each of the cakes preserved with the different preservatives.
	1. **Research Question: The following research questions guided the study:**
* What are the different types of preservatives used in caking making?
* What are the effects of each preservative used on cakes within the period been observed?
* Which of the preservatives has a longer shelf life on the cakes?
	1. **Significance of the Study**

The study will be significant to the following groups

Food processing industry, Bakers, Consumers, Road side fast food and homemakers.

Food processing industry; this study will help them to extend shelf life, maintain high quality and prevent spoilage. It will also prevent the growth of microorganism reducing moisture content increasing acidity, preventing the natural ripening process and acting as an antioxidant.

Bakers; the preservatives will help the product to be slow in spoilage by hindering the growth of microorganisms and maintain a product appearance and lengthen shelf life.

Consumers; it will benefit the household to preserve their product such as cooked vegetables, meat, or eggs, because if you keep those things at room temperature too long, bacteria or micro-organisms and enzymes will begin to do their job by essentially feeding on the food, that will result to spoilage or decay.

Road side fast food; it will help them to know the type of preservative to use on their product at any giving time.

The preservative will help the food to remain in a good condition throughout its journey from the factory to the shop and to the consumer at home.

* 1. **Scope of the Study**

The study was limited to effect of different preservatives like Sodium bicarbonate, calcium propionate, brandy, rum and the shelf life of the cakes. It also determined the microbial spoilage of the cakes after 2 weeks interval for a period of 3 months to ascertain the effectiveness of each preservative used. The study will also revealed the most efficient storage condition for cakes that ensures no or minimum deterioration over a good period of time (3 months).

**CHAPTER TWO**

**LITERATURE REVIEW**

This chapter is reviewed and organized under the following subheadings

* **Conceptual framework**
* **Theoretical framework**
* **Empirical studies**
* **Review of related literature**
* **Summary of related literature**

**2.0 CONCEPTUAL FRAMEWORK**

Conceptual framework is an analytical tool with several variations and contents. It is used to make conceptual distinctions and organize ideals, to achieve a research project purpose.

Calcium propionate is an organic salt formed by the reaction of calcium hydroxide with propionate acid (also known as propionic acid). Its chemical formula is Ca (00CCH2CH3)2. The compound occurs in either crystalline or powder form. It is soluble in water and only very slightly soluble in alcohol.

Calcium propionate is used as a food preservative in bread and other baked goods because of its ability to inhibit the growth of molds and other micro-organisms. It is toxic to these organisms, but does prevent them from reproducing and posing a health risk to human (Furia, 2000)

Propionate acid occurs naturally in some foods and acts as a preservative in those foods. Some types of cheeses, for example contain as much as 1% natural propionic acid. Studies indicate that calcium propionate is one of the safest food additives used by the food industry. Rats fed a diet containing nearly 4% calcium propionate for a year showed on effect. As a result, the U.S food and drug Administration has placed no limitation on its use in foods. In addition to baked goods, it is commonly used as a preservative in chocolate product, processed cheese and fruit preserves. The tobacco industry has also used calcium propionate as a preservative in some of its product (Furia 2002)

Beyond its role as a food additive, calcium propionate finds some application in the manufacture of buty rubbers. Adding it to the raw product makes it easier to process the rubber and protects the rubber from scorching during manufacture.

Calcium propionate is produced by propionate acid and calcium Hydroxide under Hygienic condition calcium propionate inhibits a broad spectrum of molds rope bacteria while increasing the shelf life of bakery foods. Compared to the other preservative options propionates minimally impact yeast making them the ingread of choice for yeast raised product and tortillas .

* + 1. **Benefit Of Calcium Propionate Powder**
* It has a better dispersion throughout the food matrix
* It enhance flavor
* Requires in less quantity.
* It does not affect the leavening action of baking powder which is normally used in cakes.

The preservative is preferred and does work great in the following food items

**Baked Goods**

Bread and other baked goods that are stored for any length of time, develops molds. To extend the storage time of commercially prepared baked goods such as dough, bread and pastries. Manufactures add chemical preservation calcium propionate works best in baked goods with a PH of 5.5 or less on product that use yeast, rather than baking powder, as a rising agent, other grain foods that may be preserved with calcium propionate include pasta and noodles(Hoffman 2005). Meat product containing calcium propionate includes processed meat, poultry product, sausage casing and preserved fish, including canned fish and shelf. Calcium propionate is also added as a preservative to livestock and poultry feed (Hoffman 2005).

* + 1. **Side Effects Of Calcium Propionate**

Calcium propionate is an antifungal that the body is thought to process relative easily. The center for science in the public interest indicates that calcium propionate is added to bread product to prevent mold growth. The excess of calcium propionate in food causes problems in human body such as stomach ulcers behavioural changes headaches.

**2.1.3 Sodium Bicarbonate**

Sodium bicarbonate (IUPAC name sodium hydrogen carbonate) is the chemical compound with the formula NaHCO3. Sodium bicarbonate is a white solid that is crystalline but often appears as a fine powder. It has a slightly salty, alkaline taste resembling that of washing soda (sodium carbonate). The natural mineral form is nahcolite. It is a component in many mineral springs. It is among the food additives encoded by European Union, identified by the initials E 500. Since it has long been known and is widely used, the salt has many related names such as baking soda, bread soda, cooking soda and bicarbonate of soda.

 **2.1.4 History of Sodium Bicarbonate**

The ancient Egyptians used natural deposits of neutron, a mixture consisting mostly of sodium bicarbonate. The neutron was used as a cleansing agent like soap. In 1791, a French chemist, Nicolas Lablanc, produced Sodium bicarbonate also known as soda ash. In 1846, two New York bakers, John Dwight and Austine Church established the first factory to develop baking soda from Sodium bicarbonate and carbon dioxide. This compound referred to as seleratus is mentioned in the famous novel captains courageous by Rudyard Kipling as being used extensively in the 1800s. In commercial fishing to prevent freshly-caught fish from spoiling. Sodium bicarbonate, referred to as “baking soda” is primarily used in cooking (baking) as a leavening agents, it reacts with acidic component in batters, releasing carbon dioxide, which cause expansion of the batter and forms the characteristic texture and grain in pancakes, cake, quick breads, soda bread, and other baked and fried foods. Acidic compounds that induce this reaction include phosphate, cream of terter, lemon juice, yogurt, butter milk cocoa, vinegar, etc. natural acid in sour dough can be leavened with the addition of small amount as well. Sodium bicarbonate can be substituted for baking powder provided sufficient acid reagent is also added to the recipe. Many forms of baking powder contains Sodium bicarbonate combine with calcium acid phosphate, Sodium aluminum sulphate or cream of terter. Sodium bicarbonate was sometimes used in cooking vegetables, to make them softer although this has gone out of fashion as most people now prefer firmer vegetable, however, it is still used in Asia and Latin America cuisine to tenderize meat. Baking soda may react with acids in food, including Vitamin C (L-ascorbic acid). It is also used in breeding such as for fried foods to enhance crispiness. Heat causes Sodium bicarbonate to act as a raising agent by releasing carbon dioxide when used in baking. The carbon dioxide production starts at temperature above 800C. Since the reaction does not occur at room temperature, mixture (cake butter) can be allowed to stand without rising until they are heated in the oven (barrett, 2004).

**2.1.5 Medical Benefit**

 Sodium bicarbonate mixed with water can be used as an antacid to treat acid indigestion and heartburn. It is used as the medical ingredient in gripe water for infants (Zamani, 2007). Intravenous Sodium bicarbonate is an aqueous solution that is sometimes used for cases of acidosis or when there are insufficient sodium or bicarbonate ions in the blood. In case of respiratory acidosis, the infused bicarbonate ion drives the carbonic acid/bicarbonate butter of plasma to the left and thus, raises the PH. It is used for treatment of hypokalemia as it will drive K+ back into cells during periods of hypocholermic metabolic alkalosis. Sometimes it is used to treat aspirin over doses. Sodium bicarbonate can be used to treat an allergic reaction to plant such as poison 1VY-0ek or Sumac to relieve some of the associated itching.

**2.1.6 Brandy and Rum (Spirit or Alcohol)**

Brandy (from brandy wine, derived from Dutch brandy wine, “gebrande wjin”

“burned wine is a spirit produced by distilling wine. Brandy, generally contains 35-60 % alcohol by volume (70-120 U.S proof) and it typically taken as an after-dinner drink. Some brandies are aged in wooden casks, some are coloured with caramel colouring to imitate the effect of aging and some brandies are produced using a combination of both aging and colouring (Gail Goldberg and Charles Dubow 2008)

**2.1.7 History of Brandy and Rum**

The origins of brandy were clearly tied to the development of distillation. While the process was known in the classical times, it wasn’t used for significant beverage production until the 15th century (Cullen 2002). Initially, wine was distilled as a preservation method and as a way to make it easier for merchants to transport. It is also thought that wine was originally distilled to lessen, which was assessed by volume. The intent was to add the water removed by distillation back to the brandy shortly before consumption. It was discovered that after having been stored in water wooden casks, the resulting product had improved over the original distilled back to the brandy shortly before consumption, it was discovered that after having been stored in wooden casks, the resulting product had improved over the original distilled spirit in addition to removing water the distillation process let to the formation and decomposition of numerous aromatic compound, fundamentally altering the composition of the distillate from its source (Cullen, 2002).

**2.1.8 Consumption**

Culinary uses: Brandy is a common deglazing liquid used in making pen sauces for steak and other meat. It is used to create a more intense flavor in some soups notable onion soup. In English Christmas cooking, brandy is a common flavouring in traditional foods such as Christmas cake, brandy butter and Christmas pudding.

It is also commonly used in drinks such as mulled wine, drunk during the festival season. Brandy is also used as preservatives in cake making.

Brandy is used in soaking mixed fruit before applying it inside the cake batter before baking and it taste good after baking and also have good scent. Brandy helps to extend the shelf life of cake and also help to keep the cake from going stale (Nicholas 2013). Brandy is the traditional choice for preserving natural products, brandy was the original method of preservation used by Bach (the English bacteriologist who discovered and developed the 38 bach flower essences in the 1930’s).

It has a superior preservative property. Rum is one of the oldest liquor, Rum isn’t just for drinking anymore. It is used as an ingredient in many sauces and marinades both sweet and saving. Dried fruit soaked in rum is used for fruit cake. Rum is commonly used in cakes, cookies and pastries complimenting the added flavor of chocolate, cinnamon and a myriad of fruit. Rum act as preservatives and properly sealed these cake can last a long time (Charles, 2014).

**2.1.9 Antimicrobial Additives**

Antimicrobial preservatives prevent degradation by bacteria. This method is the most traditional and ancient type of preserving food. Ancient methods such as pickling and adding honey prevented micro-organism growth by modifying the PH level.

The most commonly used antimicrobial preservative is lactic acid, Nitrates and Nitrates are also antimicrobial.

**Common Antimicrobial preservatives are**

|  |  |  |
| --- | --- | --- |
|  | **Chemical compound** | **Comments**  |
| 1 | Benzoic acid, sodium benzoate | They are used in an acidic foods such as jams, salad dressing etc. |
| 2 | Propionic acid and sodium propionate | Baked goods |
| 3 | Sorbic acid and sodium sorbate | Common for cheese, wine, baked goods. |

**2.10 Cake Making Process**

There are two principal methods of cake making the flour-batter method and the sugar-batter method. In sugar-batter method the fat and sugar are beaten to light cream which is followed by the addition of other ingredient.

The major function of the mixing step is to produce a unique mixture in making batter while the purpose of the creaming step is to incorporate air into the fat and ultimately to attain a high quality product. Creaming offers a number of advantages for instance a large number of air cell can be formed, when leads to a fine texture. The batter also can set for extended period of time due to air in the fat, where it is stable (i.e. mobile) when the cake batter is heated and the shortening melt the air cell are released into aqueous phase. Cakes made by creaming generally have a very fine grain. In flour batter method, an equal weight of flour is beaten with fat until a light and well created nature is obtained. A good blending of the two mixtures in this method is necessary because it is important that the air whisked into the mixture is left for good aeration (Oyetunde, 2001)

**2.11 Baking**

Baking refers to the operation of heating batter to dough product in an oven, Nerman and Joseph (2005). The flour as the major component in cake has the strength to assure a fine form structure. The major compound of flour is starch. Apart from its nutritive value starch is important because of its effect upon the physical properties of many foods, such as gelling of pudding thickening of gravies and the setting of cakes are all strongly influenced by the properties of starch.Gluten is another major baking component found mostly in wheat flour. Gluten form elastic dough or batter when moist and worked by mechanical action which is an important. However cake gradually bake before periphery of cakes bake to the batter temperature reaches 900 to 920C setting occurs and when the batter is removed from the oven prematurely the part of the expanded batter which has not reduced this temperature undergo a complete collapse, in addition cake baking process has been classified into three.

The first stage which is the initial batter aeration for which soluble and formable protein was found to be essential for the retainment of incorporated air. The second stage needed the presence of surface active lipid to stabilize the various interfaces which were formed in the batter, while the third stage of thermal setting is dependent on intent starch granules which has the proper gelatinization properties Priestly,(2002). During baking, caramelization and mailard type reaction take place to give rise to the characteristic color to the bake product Priestly, (2002).

**2.12 Ingredients Used in Cake Making**

* Baking Powder**:** It is made up of mixture of baking soda, one or more acidic salts and a diluent that is specifically used in cake making as a leavening agent while eggs in addition to its nutrient flavor and color contribution also function as a principal structure builder in cakes. It forms a film and entraps air when it is whipped and on heating it coagulates to produce rigidity. Baking powder is either single or double acting. A double acting baking powder is one that contains two acids and releases its gas at room temperature and the single acting baking powder requires oven heat to release its gas. Mixed fruit may be added to the batter to improve the flavor of the cake.
* Sugar**:** This acts as a tenderizer and to add to sweetness in the form of sucrose and provide additional fermented substance in the batter.
* Shortening**:** Shortening perform the same function as sugar in tenderizing baked foods. A part from function of shortening (fat) in many recipes. It also helps to entrap air to incorporation of other ingredients to finish the batter. Food coloring are flavoring added to batter to improve the color of the product and to impart flavor respectively. Milk which contains lactose ( a reducing sugar) is often added to the batter or fresh egg white to give nutrients to the cake. The cake is more enriches when milk is added.
* Water: is a fundamental ingredient which serves as the plasticizer and solvent. Water forms the basis of a batter and given viscopus glow properties at ambien temperature the viscosity of batter increases with increased level of shortening in the batter.

**2.2 THEORITICAL FRAME WORK**

The theories guiding this research work the effect of different preservatives usage on the shelf life of cakes, According to Smith (1993) said Bakery products are the important staple food in most country and culture. Bakery product and cereals are a valuable source of nutrient our diet providing us with most of our food calories and approximately half of our protein requirements. The nutrients in bakery product are carbohydrate, protein, lipids, vitamin and minerals (Smith, (1993).These theories are related to the food spoilage which refers to spoiled food which means food that has been damaged or injured so as to make it undesirable for human consumption. Food product are subjected to spoilage problem these include physical, chemical and microbial spoilage, since the most common factor of bakery product is water activity microbiological spoilage in particular mould growth is the major economic important of bakery product. According to Sofos and Bufa 1991 reported that chemical preservatives can control the growth of molds by preventing the metabolism and by denaturing the protein of the cell or by causing physical damage to the cell membrane. Among these preservatives are propionic and sorbic acid or their salt which have been shown to increase the shelf life of bakery product (Bufa 1991)

According to Hickey (1998) due to mold spoilage in the bakery industry average about 200 million pounds of product each year. Mold spoilage generally killed by the baking process in fresh bread and other baked products. Therefore for bread to become modly, it must be contaminated either from the air, bakery surface, equipment, food handlers or raw ingredients after baking during the cooling slicing or wrapping operation (Hickey 1998).

**2.3 RELATED EMPIRICAL STUDIES**

Okeke and Nwazuroko (2014) worked on effect of preservatives on the nutritional and microbiological quality of wheat flour cake. The purpose is to know the nutritional and microbial quality of wheat flour, they find out that the cake colour, taste, texture and flavor were not affected by the preservatives and the preservatives slow or present changes in colour, flavor or texture and it also delay rancidity (antioxidant) and maintain freshness. This study is related to this work because both of them are experimental work and also deals with microbial spoilage. This study is related to microbial spoilage of bakery product, microbiological spoilage is often the major factor limiting the shelf life of bakery product. Spoilage from microbial growth causes economic loss for both manufactures and consumers. Adedeji *and Ade omowaye(*2013), worked on the preservative of two local Nigeria spices on the shelf life of fried bean cake snacks. They found out in sensory evaluation shows that there was no significant difference (P<0.5) among the treated and untreated sample in terms of all the sensory attributes evaluated. Storage stability test also indicated the preservative effect of the incorporated extracts on spoilage microorganism at ambient temperature when compared to the control sample. They concluded that fried bean cake snacks treated with 0.2% and 0.4% of both spices where more acceptable generally and stable than the ones treated with 0.6% and 0.8% of both species. The fried bean snacks treated with 1% of both species where unaccepted in terms of all the sensory attributes evaluated.

This study is related to my work because they deal on experimental design and shelf life of bean cake snacks which is the storability or storage stability.

**2.4 SUMMARY OF LITERATURE REVIEW**

In summary, Food preservation is a method of preparing foods, so that it can be stored for future use, because most food remains edible for only a brief period of time. Since the earliest ages have experiment with method for successful food preservation. Cake is often the desert of choice for meals at ceremonial occasions particularly weddings, anniversaries, birthdays and also sold as snacks in shop. Cake is a perishable food and rich medium for molds and yeast as such different preservatives are added in order to maintain its wholesomeness and freshness. Today consumers demand and enjoy food supply that is flavourful nutritious, safe, colourful and affordable. Baked product are important part of a balanced diet and a wide variety of such product can be found on super market shelves. However subject of physical, chemical spoilage limit the shelf life of low and intermediate moisture product. Many industry product baked goods emerge from the baking process with a surface that is essentially sterile but post bake handling can quickly lead to fungal microbial. Surface contamination as a result of exposure to airborne contaminants as well as equipment contact.

**CHAPTER THREE**

**MATERIAL AND METHODS**

The following headings were treated in this chapter, material for the study, research design, study area, population of the study, sample/techniques, instrumentation procedure of administrative, methodology and statistical analysis

**3.0 MATERIAL**

All the materials used for the production of the various cakes were purchased from Ariaria International market in Aba Abia State.

**Recipe for the Production of the Sample Cakes**

**Sample A (Sodium Bicarbonate 10%)**

|  |  |
| --- | --- |
| Flour | 300g  |
| Butter | 200g |
| Sugar  | 200g |
| Strawberry  | 5 ml |
| Eggs  | 4 |
| Baking powder  | 20g |
| Milk  | 20g |

**Sample B (Calcium propionate 10%)**

|  |  |
| --- | --- |
| Flour | 300g  |
| Butter | 200g |
| Sugar  | 200g |
| Strawberry  | 5 ml |
| Eggs  | 4 |
| Baking powder  | 20g |
| Milk  | 20g |

**Sample C (Brandy 10%)**

|  |  |
| --- | --- |
| Flour | 300g  |
| Butter | 200g |
| Sugar  | 200g |
| Strawberry  | 5 ml |
| Eggs  | 4 |
| Baking powder  | 20g |
| Milk  | 20g |

**Sample D (Rum alcohol 10%)**

|  |  |
| --- | --- |
| Flour | 300g  |
| Butter | 200g |
| Sugar  | 200g |
| Strawberry  | 5 ml |
| Eggs  | 4 |
| Baking powder  | 20g |
| Milk  | 20g |

**Sample E (Control)**

|  |  |
| --- | --- |
| Flour | 300g  |
| Butter | 200g |
| Sugar  | 200g |
| Strawberry  | 5 ml |
| Eggs  | 4 |
| Baking powder  | 20g |
| Milk  | 20g |

**Preparation of Cakes Samples**

The fat and sugar were creamed together until fluffy (double its size) using a sterile wooden spoon in a bowl followed by addition of the liquids (beaten eggs, milk and preservatives). The sieved flour with salt and baking powder was folded into the mixture gradually with a metal spoon and poured into greased cake baking pan. The cake mixture was baked in a preheated oven at 160ºC for 30mins.

**3.1 DESIGN OF EXPERIMENTAL PROCESS**

The cake production was rationalized by apportioning a specific preservative to a particular cake sample, thus having

* Calcium propionate treated cake
* Sodium bicarbonate treated cake
* Brandy treated cake
* Rum treated cake

This design was undertaken to know the effect of different preservatives and the microbial effect on the cake.

To asses the effect of different preservatives and microbial load to preserved cake using unpreserved cake as a control.

**3.2 STUDY AREA**

The study was carried out in Michael Okapara University of Agriculture, Umudike in Abia State.

**3.3** **POPULATION OF THE STUDY**

The population of the study was conducted using 20 sensory panelist including lecturers and students.

**3.4 SAMPLE FOR THE STUDY/ SAMPLE TECHNIQUES**

Four different samples was used for the study and they include sodium bicarbonate, calcium propionate, brandy and rum using unpreserved cake as the control.

**3.5 METHODOLOGY**

The cake production was rationalized by a portioning a specific preservatives to a particular cake sample. Thus having

* Calcium propionate treated cake
* Sodium bicarbonate treated cake
* Brandy treated cake
* Rum treated cake
* Control (without preservative) cake

Each cake sample was divided into five parts or portion. Each portion of the sample was collected and bucked in a particular packaging material for storage.

Thus, portion A, B, C, D and E were wrapped with aluminum foil and kept at room temperature.

Portion A2, B2, C2, D2 and E2 were wrapped with white paper and kept at room temperature

Portion A3, B3, C3, D3 and E3 were kept in a metal container at room temperature.

Portion A4, B4, C4, D4 and E4 were wrapped with cellophane and kept in a refrigerator at 40C

A cake sample was baked without the addition of any preservative. This sample was used as control.

Samples of the portions were evaluated for the presence of micro-organisms on two weeks bases for three (3) months.

In the microbial analysis, the total fungal counts (TFC) and the total viable counts (TVC) were determined and recorded for the entire period of the study.

A series of biochemical test and microscopy were carried out to define the identity of the micro-organism found present.

**3.6 SENSORY EVALUATION OF CAKE SAMPLES**

Sensory evaluation of cake samples was conducted using a 20 member sensory panelist including teachers and students. Degree of acceptance or likeness or preference was expressed (appearance, texture, taste, flavour and overall acceptability) on a 9 point Hedonic scale (where;1=Dislike extremely, 2=Dislike very much, 3=Dislike moderately, 4=Dislike slightly, 5=neither like nor dislike, 6=Like slightly, 7=Like moderately, 8=Like very much, 9=Like extremely). Coded samples were served to panelist with a glass of water to rinse their mouth in between the tasting period

**3.7 INSTRUMENT FOR DATA COLLECTION**

Sterile pyres glass, petro dishes, incubators, thermostatically controlled, sabouraurd dextrose agar, triptone soya agar, peptone water, colony counter machine and microscopes, according to the operation of the first principle in microbial analysis where used to obtain data for both total viable microbial count (TVC) and total fungal count (TFC). The units were presented in Cfu/g colony forming units per gram of cake evaluated.

**3.8 MICROBIOLOGICAL ANALYSIS OF CAKE SAMPLES**

Twenty five grams of the cake samples was added to 225ml of sterile 0.1% peptone water and well homogenize to obtain a dilution of 1:10. Further sterile passage where performed to reach a final dilution of 1:100,000 (105). 1 ml of this final dilution was inoculated into appropriate culture medium by spread plate technique and incubated for 24 hours.

In an incubator for (TVC) evaluation. For (TFC) evaluation, culture plate where incubated at room temperature (Ambient). The number of microbial colonies growing on the appropriate was determined using the colony counter. Triptone soya agar, a microbiological general purpose culture medium used for estimation of both fungal and bacterial was used to estimate the (TVC) total viable count, while Sabouraud dextrose agar a differential microbiological culture medium that estimate only fungal was used for obtaining the total fungal count (TFC). This technique was taking from the method described by (Quesnel, 1991).

**3.9 STATISTICAL ANALYSIS**

Analysis of variance (one way ANOVA) was carried out for sensory and microbial evaluation. The mean scores were computed and significant difference among the mean was determined. (Duncan P=0.5 using 2006 statistical package for social science SPSS) for windows version 15.0

**CHAPTER FOUR**

**RESULT AND DISCUSSION**

This study deals with the findings of the study and the discussion of the findings

**4.1 MICROBIAL ANALYSIS OF CAKA SAMPLES**

25 grams of each cake sample were crushed and solubilized in 225ml of deionized distilled water to make a sample extract dilution of 1: 10 or 10-1. Further serial passage where performed to obtained a dilution of 1: 1000 or 10-3. 1ml of this last dilution was taken and inoculated by spread plate technique into propally poured plates of tryptons soya agar and sabouraud dextrose agar respectively.

The tryptone soya agar cultures plates were used to estimate the (TVC) total viable count of microbial colonies while the sabouraud dextrose agar where used to estimate the (TFC) Total Fungal Count. The unit of microbes per grams of cakes. The entire process was liquid phase inoculation and incubation.

The Tryptone soya agar plates were incubated at 370 c in an incubator; while the sabouraud dextrose agar plates were incubated at room temperature.

At the end of each 14 days of assay, the microbial colonies growing on each of the plates containing each samples was counted using a colony counter machine and result presented in Cfu/g. The procedure was done for days (0), day(14), day(28) day(42) day(56) day(70) giving 14 days interval between observation and accounts; Result was tabulated.

The sample stored at room temperature wrapped and those stored at refrigeration temperature of 40C received similar microbiological treatment. Smear of inoculate were prepared on greeze-free-glass-slides; first at low power magnification of X 125 of the microscope.

**4.2 OBSERVATION AND RESULT**

Observed results indicated that for zero day there were no growth of both bacterial and fungi in all the samples examined. The same trend occurred on the (14days). On the (28days), there were no growth on samples 102 (rum) and 103 (brandy treated) while other examples had mild (1+) microbial growths. On the 42nd day no growth occurred in samples 102 and 103- Both samples displays high microbial resistance against both bacterial and fungi. On the 56th day, the same samples 102 and 103 showed no microbial growth. Samples 104, 102 and 101 did not show any microbial resistance until the day 28th, showing that their resistances against microbial invention stopped on the 28th day of storage.

However, for the cake samples stored at refrigerator temperature. None of them showed microbial growth from day zero to day 70, indicating that in the refrigerator resisting both bacterial and fungal contamination.

The bacterial species identified was *LACTO* *BASCISLLUS* *LACTIS* while the mold type identified was *BOTRYTIS SPPS*.

**4.3 SENSORY EVALUATIONS**

The samples were evaluated by 20 panalists on a point hadolic scale for attributes of taste, Apprance, Flavour, Texture, and general acceptability values obtained were subjected to statistical analysis.

(ANOVA) and standard deviations in addition to LSD (List Significant Difference) of the mean operations were performed to obtained the F/value of each samples scored at 0.5 confidence level. It was discovered that for sample 100, 101, 104 the F cal values were greater than F tab values, indicating that there were significant differences, in all their sensory attributes of taste, Apprance, Flavour texture and general acceptability: but for examples 102 and 103 their f cal.

F tab, values showing that their corresponding in the sensory attributes of these (2) two cake samples.

**TABLE 1: Table showing f. Values at 0.05 confidence level**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAMPLE** | **FCAL-VALUE** | **FTAB-VALUE** | **INFERENCE** |
| 100 | 5.35 | 5.19 | Fcal > f tab |
| 101 | 16.10 | 4.12 | F cal >f tab |
| 102 | 4.01 | 6.39 | F cal < f tab |
| 103 | 4.30 | 6.39 | F cal < f tab |
| 104 | 9.27 | 3.63 | F cal > f tab |

**SUMMARY**

The f-cal, values of samples 100, 101 and 104 were less than their corresponding f cal, values, showing that there were significant differences in their sensory attributes.

On the contrary the f-cal, values of samples 102 and 103 were greater than their

F Cal values, indicating that there was no significant differences in the sensory attributes of the samples 102, and 103. Under strict compliance with the recipes used for the production and the techniques adopted in the storage of cake sample 102 and 103, cake, generally speaking from project study result point of view, would last as long as the consumer requires and still remains undertreated in quality and sensory attribute. By this evaluation and adherence to study information specification, this product can be made available to prospective consumer, all through the year. With adverse increment in financial cost. By this trend the price of cake can be made to remain stable over a long period of time.

**TABLE 2: Calcium Propionate Treated Sample**

Showing standard deviations of values

$S.D= \sqrt{\frac{\sum\_{}^{}X^{2}−\left(\frac{\sum\_{}^{}X}{n}\right)^{2}}{n−1}}$

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAMPLE** | **ATTRIBUTE** | **SUM TOTAL** | **MEAN** | **STANDARD DEVIATION** |
| 100  | Taste | 166 $\pm 5.4$ | 8.30d | 0.470 |
|  | Appearance | 150$ \pm 10.6$ | 8.50a | 0.688 |
|  | Flavour | 164 $\pm $3.4 | 8.20bc | 0.616 |
|  | Texture | 163 $\pm 2.4$ | 8.15bc | 0.489 |
|  | General Acceptability | 160 $\pm 0.6$ | 8.00b | 0.324 |
|  |  | 160.6 | 8.03 |  |

**TABLE 3: showing the Control (no preservative)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAMPLE** | **ATTRIBUTE** | **SUM TOTAL** | **MEAN** | **STANDARD DEVIATION** |
| 101  | Taste | 160 $\pm 0.6$ | 8.00b | 0.459 |
|  | Appearance | 161$ \pm 0.4$ | 8.05b | 0.394 |
|  | Flavour | 158 $\pm $2.6 | 7.90a | 0.641 |
|  | Texture | 159 $\pm 1.6$ | 7.95a | 0.605 |
|  | General Acceptability | 165 $\pm 4.4$ | 8.25bc | 0.444 |
|  |  | 160.6 | 8.03 |  |

**TABLE 4: Rum Treated Sample**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAMPLE** | **ATTRIBUTE** | **SUM TOTAL** | **MEAN** | **STANDARD DEVIATION** |
| 102 | Taste | 174 $\pm 5.2$ | 8.70d | 0.470 |
|  | Appearance | 166$ \pm 2.8$ | 8.30d | 0.657 |
|  | Flavour | 167$\pm $2.8 | 8.35d | 0.813 |
|  | Texture | 169 $\pm 0.2$ | 8.45d | 0.686 |
|  | General Acceptability | 168 $\pm 0.8$ | 8.40d | 0.589 |
|  |  | 168.8 | 8.44 |  |

Among samples 100, 101 and 102, those attributes of sensory evaluation showing the same super script indicate no significant difference in the quality attributes, while those with different super script had significant difference in sensory attributes.

**TABLE 5: Brandy Treated Sample**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAMPLE** | **ATTRIBUTE** | **SUM TOTAL** | **MEAN** | **STANDARD DEVIATION** |
| 103 | Taste | 155 $\pm 0.4$ | 7.75bc | 0.639 |
|  | Appearance | 157$ \pm 1.6$ | 7.85cd | 0.366 |
|  | Flavour | 151$\pm $4.4 | 7.55a | 0.686 |
|  | Texture | 153 $\pm 2.4$ | 7.65ab | 0.587 |
|  | General Acceptability | 161 $\pm 5.6$ | 8.05d | 0.224 |
|  |  | 155.4 | 7.77 |  |

**TABLE 6: Sodium bicarbonate Treated Sample**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SAMPLE** | **ATTRIBUTE** | **SUM TOTAL** | **MEAN** | **STANDARD DEVIATION** |
| 104 | Taste | 158 $\pm 0.8$ | 7.90bc | 0.447 |
|  | Appearance | 146$ \pm 11.2$ | 7.30cd | 0.470 |
|  | Flavour | 161$\pm $3.8 | 8.05d | 0.510 |
|  | Texture | 159 $\pm 1.8$ | 7.95ab | 0.605 |
|  | General Acceptability | 162 $\pm 4.8$ | 8.10d | 0.308 |
|  |  | 157.2 | 7.86 |  |

All cake sample 103 and 104 having the same super script, had no significant difference in their sensory attributes; while sample different in superscripts had significant difference in sensory attributes.

The same trend applied for the microbial characteristics of the cake sample evaluated.

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATION**

**5.1 SUMMARY**

In summary baking product are important part of balance diet and a wide variety of such can be found in supermarket shelves. However, bakery products like many processed food, are subject to physical, chemical and microbiological spoilage. While physical and chemical spoilage limit the shelf life of low and intermediate moisture product. Many industry product baked goods emerge from baking processing with a surface that is essentially sterile but post baked handling can quickly lead to fungal, microbial surface contamination as a result of exposure to airborne contaminants as well as equipment contact.

Preservatives though very effective in lowering cake spoilage and maintaining its quality have nutritional effect on the cake since vitamin B and vitamin C was reduced in wheat flour cake preserved with different preservatives.

**5.2 CONCLUSION**

Cake samples 102, which was made by the addition of Rum and 103 made also by incorporating brandy to batter for the cake production lasted longest without undergoing both microbial and chemical deterioration. The two samples displayed very high antibacterial and antifungal resistant in addition to anti-chemical spoilage for seventy days- a period of about three month and ten days. These two samples are said to be spoilage stable for 70 days and safe for consumption within 70 days of purchase.

On the contrary, the cake samples produced by using chemical preservatives did not with stand spoilage agents of microbial and chemical circumstances. Cake sample 101 made without the addition of any preservative of the best began to undergo mixed spoilage on the 28th day of storage. Such cake products as this are better consumed for safety reasons before 28 days of purchase irrespective of the nature of the packaging material used in the production end packaging.

**5.3 RECOMMENDATION**

From data obtained during this study, it has become apt to recommend such natural, organic-preservatives as Rum and Brandy in the production of long lasting cake material of long shelf-life qualities. In organic preservative as calcium propionate and sodium bicarbonate should be discouraged as the longest they could last during storage was 28 days out of the 70 days experimentation period.

Ready to eat food countries, institutions, home and home interested in constant cake production and consumption are advised to embark on the use of Rum and Brandy as cake preservatives is researchers.

By international standard Brandy is a spirit, produced by distilling wine at between 350c to 600C while Rum is the spirit product of distillation of alcohol beverage. However such alcohol beverage should be made from sugar center by product, such as Molasses.

**5.4 CONTRIBUTION TO KNOWLEDGE**

The study will help the Government, policy makers, food industries, homemakers, students and also the masses to be aware of the efficient storage conditions for cakes that ensure no or minimum deterioration over a good period of 3months and the economic benefit and to use brandy and rum in the production of cakes, pateries etc.

**5.5 SUGGESTIONS FOR FURTHER STUDIES**

According to the findings, the researcher suggests that further study should be carried out on the effect of different preservatives usage on the shelf life of cakes to health and other moment content of it.

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