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Studies on the Culinary and Antimicrobial Properties of Cinnamon *(Cinnamon aromaticum*) and Bay leaf (*Laurus nobilis*)

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Abstract: Cinnamon and Bay leaf have recently been the subject of intense investigations because of their culinary properties and ability to increasing the safety and shelf life of food. In this study, the sensory properties (using the nine-point Hedonic Scale) and possible antimicrobial effects of Cinnamon and Bay spices added as crude hygienic water extracts (3% m/m food preparation) were determined in cake and rice respectively. The general acceptability score of rice with bay leaf was not statistically different from that of rice sample cooked without bay leaf, while cake with cinnamon had better sensory scores (with general acceptability score of 7.5) than samples baked without cinnamon (with general acceptability score of 5.8). Bacterial genera isolated in these food samples include: *Bacillus, Staphylococcus, Micrococcus, Streptococcus, Escherichia* and *Pseudomonas.* It appeared bay leaf extract inhibited the growth of *Streptococcus* and *Pseudomonas* species and also reduced the diversity of spoilage bacteria in rice from 8 to 5 while cinnamon extract reduced the diversity of spoilage bacteria in cake from 7 to 5 and also inhibited the manifestation of *Staphylococcus* and *Pseudomonas* species in cake sample.

Keywords: Cinnamon, Bay leaf, Diversity, *Staphylococcus, Pseudomonas*

1. Introduction

In many places around the world, several plants and herbs are used for their medicinal value, in treating a good number of diseases, especially, those of infectious nature. Historically, the use of plants, in particular edible plants, has been duly reported since ancient times and is associated with some sort of medicinal effect, and most of these plants are still used in treating diseases caused by bacteria, fungi, viruses and sometimes helminthes [1].

Spices are generally described as strongly flavored parts of plants, usually rich in essential oils, used in fresh or dry forms [2]. Many spices have however been documented to possess bactericidal or bacteriostatic activities [3]. The antimicrobial effects of spices are mostly due to the presence of volatile oils in their composition [4]; factors that determine the antimicrobial activity of spices are the amount of spices used, the concentration and composition of the spices, type of microorganisms, composition of the food, pH value, temperature of the environment and the organic constituents of the food which includes proteins, lipids, salts and phenolic substances [5].

The most used and studied spices and condiments known worldwide for their proven or supposed antibacterial activity are onion (*Allium cepa*), oregano (*Origanum vulgare*), garlic (*Allium sativum*), ginger (*Zingiber officinale*), aniseed (*Pimpinella anisum*), bay leaf (*Laurus nobilis*), black pepper (*Piper nigrum*), cinnamon (*Cinnamonum verum*), clove (*Syzygium aromaticum*), coriander (*Coriandrum sativum*), lime (*Citrus aurantifolia*) and thyme (*Thymus vulgaris*). All of these spices are almost generally available all over the world [6].

There has been a renewed and growing interest in improving human and animal health and fitness through the use of more natural products. Spices form a significant part of the human diet; they have been used for thousands of years to enhance the color, flavor and aroma of food. In addition to improving food flavor, spices have also been characterized for their preservative and medicinal value which forms one of the oldest sciences [7]. Spices like Cinnamon and Bay leaf are used both as culinary plants and as medicines [8]. Their antimicrobial mechanism of action is usually through hydrophobic interaction with lipids within the bacterial cell membrane, which distorts the cell structures and makes such cell more permeable to extracellular materials [9]. This physiological change ultimately results in cell lysis and death.

Bay leaf (as it is used) is the dried leaf of *Laurus nobilis,* it is a medium sized tree which grows in many parts of the world, including Nigeria. The leaves are commonly used as a spice for flavoring various kinds of curries, vegetables, fruits and in food preservation. Cinnamon can easily grow under tropical conditions in different soil types, ranging from the silver sands (of the west coast of Sri Lanka) to the loamy soil; cinnamon is broadly used by both pharmaceutical and food industries. This current research is aimed at establishing the sensory and antibacterial potentials of cinnamon and bay leaf in cake and rice respectively.

2. Materials and Methods

2.1 Preparation of Food Samples

Both rice and cake samples were prepared with (experimental) and without (control) bay leaf and cinnamon extracts respectively, each food sample was prepared according to standard procedures [10; 11], cinnamon and bay spices were added as crude hygienic water extracts. Each powdered spice (at 3% mass/mass food preparation) was prepared for extraction from oven dried (at 70 ^{0}C) cinnamon sticks and bay leaves, while filtrates were collected through a clean muslin cloth of 150µm pore size. The prepared food samples were subjected to sensory evaluation and subsequently kept (under the same conditions, with equal exposure) for a period of 1-5 days for microbial isolation.

2.2 Sensory Evaluation

Sensory evaluation of the food varieties was carried out by two sets of 20 taste personnel at the Department of Home and Rural Economics, Federal College of Agriculture, Ibadan. They were instructed to taste the food samples and rinse their mouth with water so that the next sample will not taste the same as the previous one. They were requested to express their observations about the samples by scoring the following attributes; Colour, Taste, Aroma, Flavour and General acceptability. Sensory scores were based on a nine point Hedonic scale, where 1 was dislike extremely, and 9 was like extremely. The results from the participants were analyzed statistically using the Duncan's Multiple Range Test (DMRT) at 0.05 level of significance [12].

2.3 Microbial Isolation

Five grams (5g) of each food sample (experimental and control) was weighed separately, introduced into 50ml of sterile distilled water in a beaker, and mashed with sterile spatula to form a solution of the food sample in order to evenly distribute the spoilage microbial cells. The resulting food solution was, in each case, serially diluted and 0.5ml of which was pour-plated with 20ml Nutrient agar in a sterile petridish and incubated at 25 ^{0}C for 24 - 48 hours. Distinct microbial colonies were sub-cultured from triplicate sampling and subsequently identified with the aid of sugar assimilation test kits and standard identification manuals [13]. The total number of isolated species of bacteria in each sample represented the spoilage diversity.

2.4 Percentage frequency and Relative density (R.D)

The percentage frequency and relative density where calculated with the equations highlighted below:

$$\%\, Frequency = \frac{Number\ of\ occurrence\ of\ a\ genus}{total\ number\ of\ days} \times 100$$

$$\%\, R.D = \frac{Number\ of\ different\ species\ of\ a\ genus}{total\ number\ of\ species} \times 100$$

[14].

3. Results and Discussion

3.1 Sensory Evaluation

The general acceptability, revealed through the sensory evaluation score, of rice with bay leaf is 0.1 point higher than the rice sample cooked without bay leaf; but, this difference is not statistically significant (Table 1), indicating that the culinary impact of bay leaf (at such level of application) is not pronounced in these rice samples. This is in agreement with the report of Yulianto [15] who reported little overall effect (of bay leaf) on the sensory properties of fortified parboiled rice.

However, the taste of rice cooked with bay leaf was better preferred (with statistical significance) than rice sample cooked without the spice.

As previously reported by Golmakani [16], cinnamon (in this present study) had admirable and acceptable effect on all the sensory properties of cake. As presented in Table 2, the general acceptability, colour, taste, crumb softness and flavour of cake prepared with cinnamon were all significantly preferred than cake samples without the spice.

3.2 Microbial Isolation

Eight different species of spoilage and potentially pathogenic bacteria (*Bacillus cereus, Streptococcus pyogenes, Micrococcus acidophilus, Streptococcus faecium,, Bacillus subtilis, Staphylococcus aureus, Bacillus spp,* and *Pseudomonas aeruginosa*) belonging to five genera were isolated from rice samples without bay leaf, with *Bacillus* and *Micrococcus* having the highest percentage frequency (60%); while five spp. (including *Staphylococcus aureus, Bacillus cereus, Micrococcus acidophilus, Escherichia coli and Bacillus subtilis*) of spoilage and potentially pathogenic bacteria were isolated from rice samples cooked with bay leaf. *Streptococcus* and *Pseudomonas* were however absent in rice samples spiced with bay leaf. Bay leaf, as shown in Figures 1 and 2, appeared to have little or no effect on the isolated *E. coli* (whose presence in the rice sample might have been as a result of contamination after preparation). This result is contrary to the report of Romita [13], in their research on the antibacterial activity of spices against *Enterobacteriaceae*, who identified an overall antagonistic activity of bay leaf on *Enterobacteriaceae.*

Table 1: Sensory evaluation score of rice with and without bay leaf

Rice Samples	Colour	Taste	Aroma	Flavour	General Acceptability
Without bay leaf	6.6^{a}	5.9^{b}	6.0^{a}	6.0^{a}	6.4^{a}
With bay leaf	6.9^{a}	6.4^{a}	6.6^{a}	6.2^{a}	6.5^{a}

Mean values with similar letter along the column are not significantly different at 5 % level of probability by Duncan Multiple Range Test (DMRT)

Table 2: Sensory Evaluation Score of cake with and without cinnamon

Cake Sample	Colour	Taste	Crumb Softness	Flavour	General acceptability
Without cinnamon	6.0^{b}	5.7^{b}	6.0^{b}	5.6^{b}	5.8^{b}
With cinnamon	7.1^{a}	7.4^{a}	7.1^{a}	7.1^{a}	7.5^{a}

Mean values with similar letter along the column are not significantly different at 5 % level of probability by Duncan Multiple Range Test (DMRT)

Five genera of bacteria (including *Bacillus, Staphylococcus, Micrococcus, Streptococcus* and *Pseudomonas*) were isolated from cake samples without cinnamon; with *Streptococcus* having the highest frequency of 60% (Figure 3). *Bacillus*, *Streptococcus* and *Pseudomonas* all had the same percentage relative density (25%) in rice samples without cinnamon (Figure 4); while *Pseudomonas* and *Staphylococcus* were both absent in cake samples spiced with cinnamon. Nabavi [17] had previously reported the antagonistic activities of cinnamon on *Pseudomonas* and *Staphylococcus*. However, extracts of cinnamon and bay leaves appeared to reduce the diversity of spoilage bacteria in cake from 7 to 5 and in rice from 8 to 5 respectively.

4. Conclusion

From the results generated in this study, it could be concluded that cinnamon had better culinary effect in cake than bay leaf in rice. It appeared bay leaf inhibited the growth of *Streptococcus*

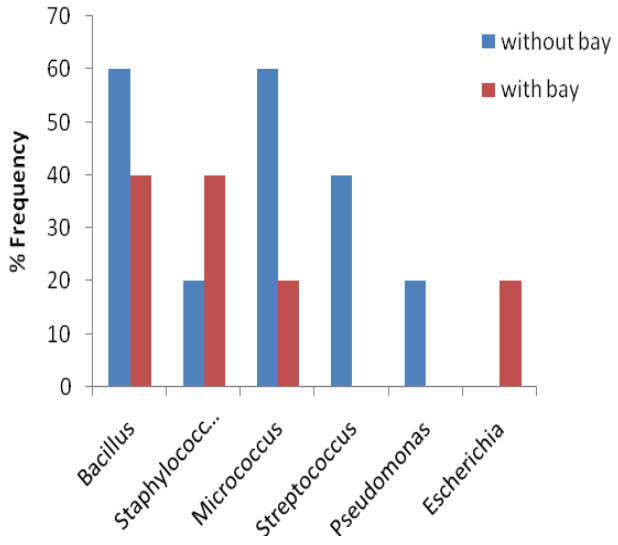

Figure 1: Percentage Frequencies of spoilage bacteria in rice

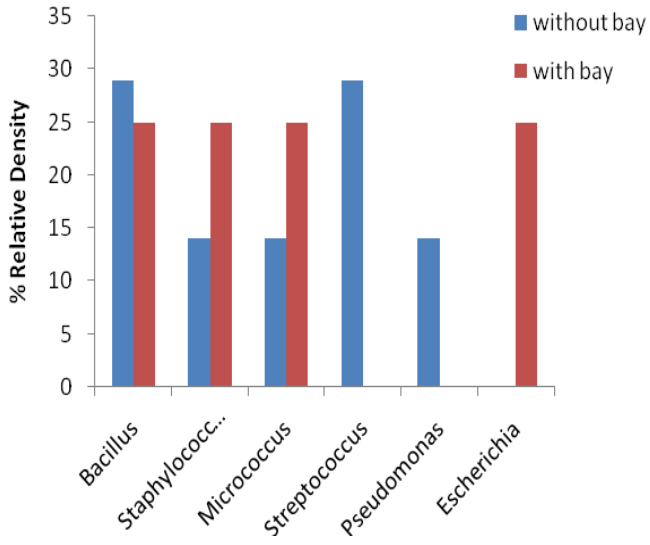

Figure 2: Percentage Relative Densities of spoilage bacteria in rice

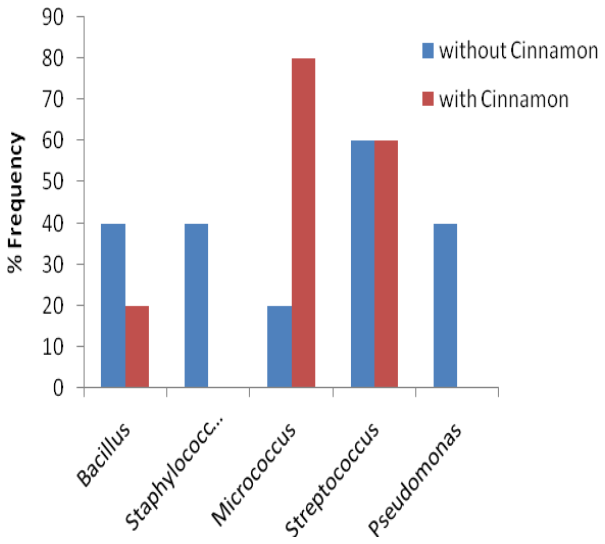

Figure 3: Percentage Frequencies of spoilage bacteria in Cake

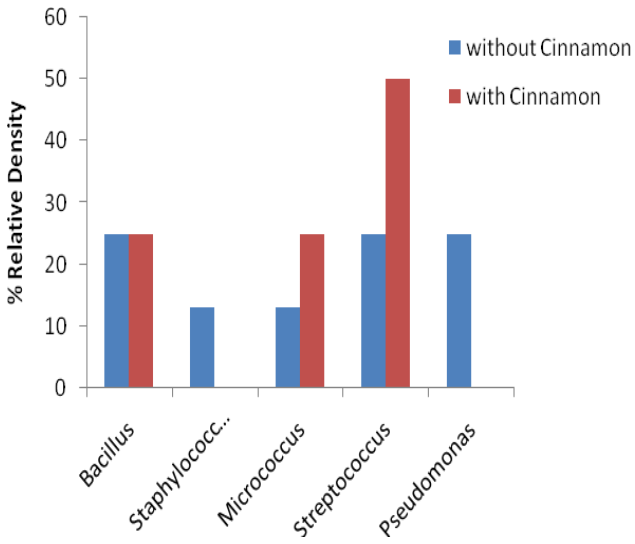

Figure 4: Percentage Relative Densities of spoilage bacteria in Cake

in rice and cinnamon inhibited the manifestation of *Staphylococcus* in cake; while both spices (bay leaf and cinnamon) inhibited the growth of *Pseudomonas* in the food samples.

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