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Research Article

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Study of Microbial changes in tea bags prepared from mango and guava leaves during storage

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ABSTRACT
The study was undertaken to study the microbial changes in 60 days of storage in tea bags. Tea drinking is an ancient custom with strong cultural roots in many nations. Furthermore, tea consumption has increased globally in recent years. Because germs and mold thrive in humid conditions, improper storage of herbal tea poses a significant health risk to customers. Mango leaves have traditionally been consumed, and using them to make tea has become a popular trend to help cure diabetes and blood vessel issues related to diabetes. The plant's leaves are rich in flavonoids, phenols, terpenoids, tannins, and resins. They also exhibit biocidal, antimicrobial, antidiarrhea, hepatoprotective, antimicrobial, and antioxidant activity against periodontal infections, as well as the ability to treat gastric ulcer disease. During various storage periods, the moisture level of the tea bags from the best treatment (T_3) ranged between 6.63 and 7.2 percent, the total plate count ranged from 0.9×10^2 cfu/gram to 1.41×10^2 cfu/gram and yeast and mold count range from 0.54×10^2 cfu/gram to 1.02×10^2 cfu/gram during the first 60 days of storage. Longer storage times do, however, also increase the overall plate count and yeast mold count. It was discovered during the storage analysis that the shelf-life was just roughly 60 days.
Keywords: Microbial change, tea, flavonoids, mango leaves, guava leaves.

INTRODUCTION

The second most popular beverage in the world, after water, is tea [*Camellia sinensis* (L). O. Kuntze] brue, also known as "the queen of beverages". Sri Lanka, China, India, and Kenya are the world's top producers of tea. Tea used for human consumption needs to be safe, aesthetically pleasing, and acceptable from an organoleptic standpoint. Even while tea liquor has many medical uses, it can occasionally become contaminated with dangerous bacteria, yeast, and molds, which causes it to deteriorate (Madhab *et al.*, 2019). The wilting and heat-fixing techniques are used on fresh tea leaves to naturally lower their water content and allow the typical aromas to develop. These steps are taken to prevent the deterioration of microorganisms brought on by humid surroundings and fluctuating temperatures. Although accompanying bacteria and molds can enhance the quality and flavour of tea during the oxidation stage, the process is more crucial than other food production techniques, which increases the risk of contamination from harmful microbes (Carraturo *et al.*, 2018). Tea has been shown to provide health benefits, including antihypertensive,antiarteriosclerotic,hypocholesterolemic, and hypolipidemic properties (Chupeerach *et al.*, 2021). The Anacardiaceae family of tropical evergreen woody plants includes the mango tree (*Mangifera indica* L.). Mango leaves have traditionally been consumed, and using them to make tea has become a popular trend to help cure diabetes and blood vessel issues related to diabetes. Dried leaves of the mango tree were used to treat respiratory infections and diabetes in traditional Chinese, Indian, and African medicine (Zhang *et al.*, 2019). According to the research that was described, mangiferin which has the potential to treat diabetes and respiratory conditions is the primary active ingredient in mangos. Numerous physiological and pharmacological properties of mangos have been discovered via the ongoing growth and advancement of the study. Studies in the past have shown the high content of phenolics, such as flavonoids, benzophenones, and phenolic acids, in mango leaves. Mango phenolics have been shown to exhibit a variety of bioactivities, including analgesic, antipyretic, immunomodulatory, antibacterial, antioxidant, and antidiabetic effects (Pan *et al.*, 2018). Mango has high levels of vitamin C, pectin and fibres that help to lower serum cholesterol levels. Fresh mango is a rich source of potassium, which is an important component of cell and body fluids that helps to control heart rate and blood pressure (Ruiz-Montañez *et al.*, 2014).

Psidium guajava, often known as guava, belongs to the Myrtaceae family, which comprises over 3,800 species and 133 genera. Phytochemicals having diverse pharmacological effects are present in different sections of the plant. The plant's leaves have long been used in traditional medicine and applied to wounds, ulcers, and as a toothache cure when chewed. The plant's leaves are rich in flavonoids, phenols, terpenoids, tannins, and resins. They also exhibit biocidal, antimicrobial, antidiarrhea, hepatoprotective, antimicrobial, and antioxidant activity against periodontal infections, as well as the ability to treat gastric ulcer disease (Jassal *et al.,* 2019). Antioxidant activity has been reported for quercetin, ferulic acid, protocatehuic acid, guavin B, asiatic acid, and β-carotene found in guava leaves. Pharmacological research, both in vitro and in vivo, has been extensively employed to showcase the potential of leaf extracts for the co-treatment of various ailments with high global prevalence. This has supported traditional medicine in cases like diabetes mellitus, cancer, cardiovascular diseases, and parasitic infections (Akila *et al.*, 2018).

MATERIALS AND METHODS

Healthy fresh leaves of Guava (*Psidium gujava)*, Mango (*Mgnifera indica*) and Basil (tulsi) for the experiment were collected from the local area of SHUATS and other ingredients were purchased from the local market of Prayagraj.

Microbial analysis

Silva, Junqueira, and Silveira (1997) state that the microbiological count was carried out every day for 60 days and comprised B. cereus, yeasts and molds (ferment extract), Eosin Methylene Blue Agar, and the total plate count (Nutrient Agar).

Storage of Tea bags

The packed Tea bag was kept at room temperature for 60 days in ambient storage settings.

Statistical Analysis

MS Excel 2010 was used to analyse the experiment results, which were run in triplicate.

RESULTS AND DISCUSSION

A 60-day analysis was used to evaluate the quality of packed Tea bag, and the results are displayed in Table 1.

Moisture:

During different storage periods, the moisture level of the tea bags from the best treatment (T_3) ranged between 6.63 and 7.2 percent. At the 60th day of the storage period, there was a noticeable rise in moisture content; nevertheless, it was still well within the permitted limit (<15%) when compared to the standard values given by Bradely (2010) and BIS (2006). This indicates that during the storage period, the moisture levels in the tea bags were well-controlled and satisfied quality criteria.

Total plate count:

During the various storage periods, the total plate count for the best treatment (T_3) of tea bags also changed, varying from 0.9×10^2 cfu/gram to 1.41×10^2 cfu/gram during the first 60 days of storage. Longer storage periods led to a rise in the total plate count; however, the count stayed within acceptable limit as specified by the BIS (2006) standard. This suggests that over the storage time, the tea bags' microbiological quality was sustained at a satisfactory level. According to the World Health Organisation, plant goods meant for topical application should not have bacterial colony counts higher than 10^7 cfu/g, whereas medicinal plant materials meant for internal use should not have counts higher than 10^5 cfu/g. According to Okunlola *et al.*, 2007, the European Pharmacopoeia's limitations of bacterial contamination include total aerobic bacteria (105 cfu/g).

Yeast and mold count:

A similar range was seen for the yeast and mold count for the optimal treatment (T3) of tea bags across the 0 to 60-day storage period, ranging from 0.54×10^2 cfu/gram to 1.02×10^2 cfu/gram. The yeast and mold counts grew with storage time, much like the overall plate count, but they stayed within the BIS (2006) standard's permitted bounds. This shows that throughout storage, the tea bags were able to successfully inhibit the formation of yeast and mold.

Table 1. Effect of storage period on Moisture, TPC count and Yeast & Mold of the best treatment of Tea bags

Days	Parameters		
	Moisture	Total plate count (cfu/g)	Yeast and mold count (cfu/g)
0 Days	6.63	0.9×10^2	0.54×10^2
15 Days	6.65	1.17×10^2	0.61×10^2
30 Days	6.71	1.29×10^2	0.86×10^2
45 Days	6.83	1.34×10^2	0.92×10^2
60 Days	7.2	1.41×10^2	1.02×10^2
	<15%	Not more than 5 $x10^4$cfu/gram	Not more than 1 $x10^3$ cfu/gram

CONCLUSIONS

This study shows that herbal teas, such as traditional tea made from the leaves of the *Mangifera indica* L. and Psidium guajava plants, are free of caffeine, have a variety of tastes, and may have health advantages. However, after boiling, the microbial load was discovered to be within an acceptable range, meaning that drinking tea that has been adequately cooked protects against microbial risks. In this investigation, tea samples kept under accelerated circumstances had higher moisture content. Longer storage times do, however, also result in an increase in the overall plate count and yeast mold count. It was discovered during the storage analysis that the shelf-life was just roughly 60 days.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

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