Health Dynamics
eISSN: 3006-5518
Publisher: Knowledge Dynamics
DOI: https://doi.org/10.33846/hd10803

Original Research

Safe and Healthy Food Preservation: Efficacy of Guava Leaves and Lemon Juice Extract on Fruits and Vegetables

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Article history
Received: 24 June 2024
Revised: 13 August 2024
Accepted: 16 August 2024
Published Online: 30 August 2024

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How to cite this article: Esrafil M, Ahmed A, Akter M, Arafin T, Ali MS, Al Reza MS, Dina PR, Nishi SHH. Safe and Healthy Food Preservation: Efficacy of Guava Leaves and Lemon Juice Extract on Fruits and Vegetables. Health Dynamics, 2024, 1(8), 284-295. https://doi.org/10.33846/hd10803

ABSTRACT

Background: Fruits and vegetables are naturally perishable and have a relatively limited shelf life. This study was designed to prolong the shelf life and remain nutritional value of various fruits and vegetables by using guava leaves extract and lemon juice extract (natural preservatives). **Methods:** Fruits and vegetables samples (amla, banana, grapes, bean, eggplant and tomato) were treated with three types of natural preservatives: guava leaves and lemon juice extract (GLE) 0.5% (boiled), lemon extract (LE) 15%, GLE 40% + LE 15%. **Results:** The study revealed that the moisture content varied from 18.03% to 95.41%. During the 10 days of experiment, samples treated with 0.5% GLE (boiled) preservatives exhibited better result than other two types of preservatives regarding the moisture content. Titratable acidity content varied from 0.05% to 2.25%. The pH value varied in the range of 2.47-6.01. The percentage of weight loss value ranged from 3.67 to 85.71. During the experiment period, weight loss was minimum almost in all samples treated with GLE 40%+LE 15% preservative. The vitamin C content in fruits and vegetables ranged from 1.60 mg/100mL to 68.46mg/100mL. The highest viable count was found in banana (46×104 CFU/ml) and the lowest was in Bean (9×104 CFU/ml). **Conclusion:** Among three types of preservatives, samples treated with 0.5% GLE (boiled) showed better result and minimum microbial growth.

Keywords: Guava leaves extract; lemon juice extract; natural preservatives; physiochemical changes; vitamin C; microbial analysis

1. INTRODUCTION

Fruits and vegetables are vital for overall health and well-being due to their high nutritional content including vitamins, minerals, fiber and antioxidants. In order to extend the shelf life of fruits and vegetables and maintain nutritional integrity by using natural preservatives can help to reduce the risk of chronic health disease. Food preservation is a technique used to keep food at the desired quality so that we can take advantage of the greatest health advantages.[1] Preservatives are undoubtedly the most important class of additives, as they contribute significantly to food safety. Despite this, food containing preservatives has long been viewed as inferior or dangerous, and any chemical employed to address the perishability of food raw materials has frequently been viewed as questionable Natural substances with antibacterial properties are found in higher amounts in plants.

The majority of natural substances have demonstrated antibacterial action, which may reduce the frequency of foodborne illnesses brought on by bacteria and fungi that cause food spoilage as well as delay or limit the growth of harmful microorganisms in food.[2] The guava (*Psidium guajava* L.) leaves, belonging to the Myrtaceae family, is a very unique and traditional plant which is grown due to its diverse medicinal and nutritive properties.[3] The guava leaf is rich in antioxidants and the antioxidant activity of guava leaf is much higher than that of guava fruit.[4] The guava plant is widely accessible, reasonably priced, and the method for producing the finished guava leaf extract is straightforward and reproducible. Because of its antibacterial and antioxidant qualities, guava leaf extract has the potential to be used as a natural preservative to prolong the shelf life of food.[5] Guava leaves are useful medicinally as well. The leaf extract is used as a medication for wounds with swollen gums, diarrhea, coughs, and oral ulcers. Guava leaf is one of the herbal plants that are being explored more and more for the treatment of different diseases due to the negative consequences that come with using medications and other pharmaceuticals. Owing to its therapeutic qualities, guava leaf supplements are currently offered in capsule and guava.[6] Polyphenols and flavonoids—compounds with antioxidant and antibacterial qualities—are present in guava leaf extract. By preventing the growth of spoilage-causing microbes, these chemicals help prolong the shelf life of fruits and vegetables when they are preserved. The extract can be used as a natural preservative by dipping or spraying fruits and vegetable.[7] Fruits and vegetables can be sprayed or dipped in the extract to function as a natural preservative, or it can be mixed with packing materials. Furthermore, the extract from guava leaves could support the preservation of the preserved produce's colour, texture, and nutritional value. Additionally, one of the most promising citrus fruit extracts is lemon extract. It is true that lemon juice extract has antibacterial qualities that can aid in food preservation. This is due to the presence of natural preservatives including citric acid and ascorbic acid (vitamin C), which can prevent the growth of mould, bacteria, and yeast.[8] Lemon juice is also used as a sanitizer to get eliminate of food-borne diseases from fresh vegetables, fish, and fruits in many parts of the world. Research has demonstrated the antibacterial properties of concentrated or freshly squeezed lemon juice against *Escherichia coli*.[3] *Salmonella typhimurium*,[9] *Pseudomonas aeruginosa*, and *Vibrio species*,[10] Therefore, our study focuses on to prolong the shelf life and remain nutritional value of various fruits and vegetables by using guava leaves extract and lemon juice extract or GLE (natural preservatives), as well as to evaluate the efficiency of these preservatives on the physicochemical qualities of fruits and vegetables.

2. METHODS

2.1 Study Design

It was an experimental study for the quantitative estimation of the physicochemical parameters of different fruits (amla, banana, grapes) and vegetables (bean, eggplant, tomato). The general laboratory of the Department of Food Technology and Nutritional Science, Mawlana Bhashani Science and Technology University, Tangail, Bangladesh, is where we conducted our special research work. We purchased fruits and vegetables samples from Santosh Bazar and Park Bazar in Tangail district, Bangladesh.

2.2 Extract from Guava Leaves

Mature green guava leaves have been collected from the campus of Mawlana Bhashani Science and Technology University in Santosh, Tangail. To remove contaminants, the leaves were thoroughly rinsed with distilled water. After that, 2000 ml of water and 250 g of guava leaves were brought to a boil for three hours at 80°C. Subsequently, the solution was kept at 70°C to evaporate it until the extracted solution concentration reached 0.5%.[11]

2.3 Preparation of Lemon Extract (LE)

Lemon juice is extracted by manually squishing. To prepare the 15% lemon extract, 45 ml of lemon juice extract and 255 ml of distilled water were added, respectively, and mixed. Filter paper No. 2 from Whatman was used to filter this blended sample.

2.4 Preparation of Preservative Combining Guava Leaves and Lemon Juice Extract: (GLE 40% + LE 15%)

Five hundred grams (500g) of fresh green guava leaves had been collected from the campus of Mawlana Bhashani Science and Technology University, and 1000 ml of distilled water was added to the mixture. After that, 180 ml of distilled water were added separately to 120 ml of raw guava leaf extract in a 500 ml beaker to

create a final amount of 300 ml, which was 40% guava leaves and lemon juice extract (GLE).

2.5 Determination of Moisture Content (Wet Basis)

Five grams (5g) of sample was weighed in a porcelain crucible (which was previously clean and heated to 100°C, cooled and weighed). The crucible with the sample was heated in an electric oven for about 3 hours at 105°C. It was then cooled in a desiccator and weighed again.[12]

$$\% \text{ of moisture content (wet basis)} = \frac{A-B}{W} \times 100$$

Where,

A = Crucible + sample weight

B = Final weight

W = Sample weight

2.6 Determination of Vitamin C Content

Transferred 10 ml of standard vitamin C solution in a conical flask and titrated it with the dye weighed 10.189 grams of sample and cut into small pieces. Homogenized the sample with 3% meta-phosphoric acid (approx. 30 ml) and filtered through double layer of muslin cloth. Centrifuged the filtrate at 3000 rpm for 10 minutes and titrated the clear supernatant with 2, 6-dichlonaphenol indophenol solution.[13] Calculated the amount of vitamin C content comparing the titration result of standard vitamin C solution.

$$\text{Vitamin C (mg/100 ml)} = \frac{\text{mg of vitamin C obtained}}{weight\ of\ sample} \times 100$$

2.7 Microbial Analysis

2.7.1 Preparation of media

The MacConkey agar medium was weighed 14 g and distilled water was measured 500 ml. The nutrient agar and distilled water were placed in conical flask and autoclaved at 121°C for 15 minutes.

2.7.2 Preparation of sample

The juice was serially diluted, and 0.1 ml of the proper aliquot was added to the agar dish using sterilized pipette tips. For each therapy, a different sterile 1 ml pipette was used.

2.7.3 Incubation colony count

The spread plate method was used, and the cultured plates were incubated for 24 hours at 37°C. The number of colonies formed on the plates was then noted.[14]

$$\text{CFU/ml} = \frac{No.\ of\ colonies \times Dilution\ factor}{Volume\ of\ culture\ plated\ in\ ml}$$

2.8 Determination of pH

Examining the pH meter to ensure that it is in good working order. Setting the pH meter in a dry location. Calibrating the meter using a buffer solution containing pH 4, pH 7, and pH 10. Ensuring that the meter is working properly whenever readings are taken correctly. After rinsing in distilled water, the glass electrode was dipped in 20m1 of juice in a 25m1 beaker and measurements were recorded according to the standard method of AOAC (2000).[12]

2.9 Determination of Titratable Acidity

Mix the juice sample thoroughly by avoiding incorporation of air. Transfer 10 gm juice to conical flask or beaker. Add equal quantity of distilled water. Add 3-4 drops of phenolphthalein indicator and stir. Rapidly titrate the contents with 0.1N NaOH solution, continue to add alkali drop by drop and stirring the content till first definite change to pink color. Note down the final burette reading.[15]

$$\% \text{ of titratable acidity} = \frac{(N\ of\ NaOH) \times (ml\ of\ NaOH) \times E}{ml\ of\ sample}$$

Where,

N — Normality of titrate

E — Equivalent weight of Predominant acid

2.10 Determination of Weight Loss

The physiological losses in weight (PLW) of fruits were calculated by following the formula of Kaur et al. (2019)[16] as follows:

$$\% \text{ of weight loss} = \frac{Initial\ weight - Final\ weight}{Initial\ weight} \times 100$$

2.11 Statistical Analysis

All sample analyses were done in triplicate and descriptive statistics were calculated using the SPSS software program version 20.0 (SPSS Inc., Chicago, IL, USA) for all variables. The significance of observed differences was tested at $p < 0.05$. All the experiments were done with replication and analyzed with mean and standard deviation through Microsoft Excel 2007 and significance was analyzed by one sample T-test and one-way ANOVA.

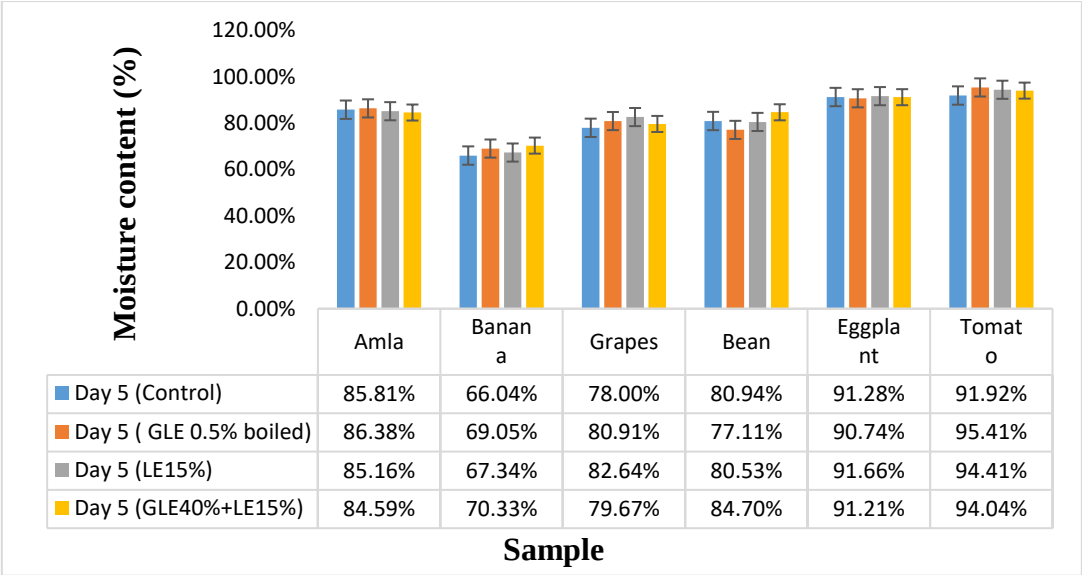
3. RESULTS

In order to evaluate the nutritional value, safety, and quality of food products, physicochemical tests analyze the chemical and physical characteristics of the

food. The results of these experiments offer important insights on the makeup, characteristics, and actions of food ingredients. The following parameters, such as moisture content, titratable acidity, pH, vitamin C, weight loss, and microbial analysis were examined using physiochemical analysis.

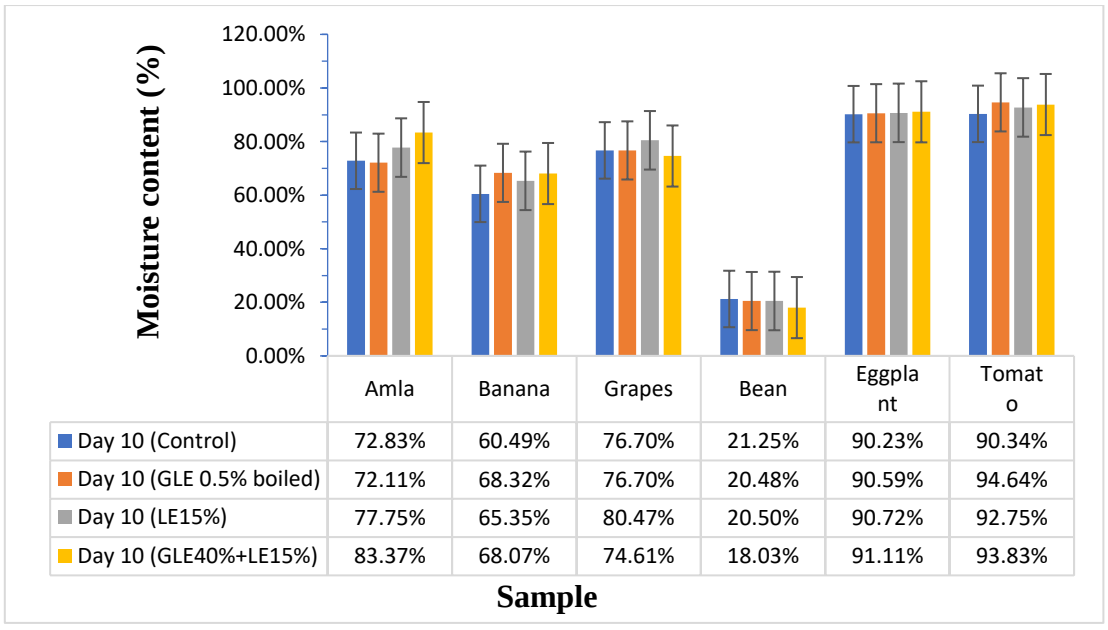
3.1 Determination of Moisture Content

After 5 days, Samples treated with GLE 0.5% (boiled), the percentage of moisture was 86.38, 69.05, 80.91, 77.11, 90.74, 95.41 for amla, banana, grapes, bean, eggplant and tomato. Samples (amla, banana, grapes, bean, eggplant, and tomato) treated with LE 15%, hold 85.16, 67.34, 82.64, 80.53, 91.66, 94.41 percentage of moisture respectively. Samples treated with GLE 40% + LE 15%, contained 84.59, 70.33, 79.67, 84.70, 91.21, 94.04 percentage of moisture. After 10 days, amla, banana, grapes, bean, eggplant, tomato had 72.11, 68.32, 76.70, 21.25, 90.23, 90.34 percentage of moisture respectively after being treated with GLE 0.5%(boiled). Samples treated with LE 15%, had 77.75, 65.35, 80.47, 20.50, 90.72, 92.75 percentage of moisture respectively. Samples treated with GLE 40% + LE 15% preservative, had 83.37, 68.07, 74.61, 18.03, 91.11, 98.83 percentage of moisture respectively.



	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 5 (Control)	85.81%	66.04%	78.00%	80.94%	91.28%	91.92%
Day 5 (GLE 0.5% boiled)	86.38%	69.05%	80.91%	77.11%	90.74%	95.41%
Day 5 (LE15%)	85.16%	67.34%	82.64%	80.53%	91.66%	94.41%
Day 5 (GLE40%+LE15%)	84.59%	70.33%	79.67%	84.70%	91.21%	94.04%

Figure 1. The moisture content value (%) on day 5 of various fruits and vegetable

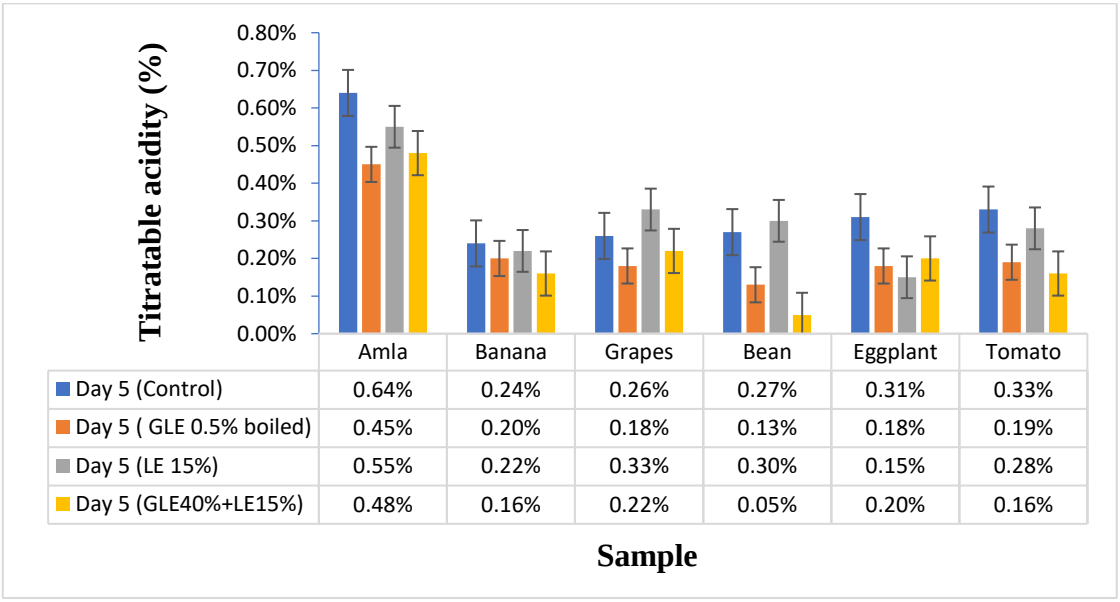


	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 10 (Control)	72.83%	60.49%	76.70%	21.25%	90.23%	90.34%
Day 10 (GLE 0.5% boiled)	72.11%	68.32%	76.70%	20.48%	90.59%	94.64%
Day 10 (LE15%)	77.75%	65.35%	80.47%	20.50%	90.72%	92.75%
Day 10 (GLE40%+LE15%)	83.37%	68.07%	74.61%	18.03%	91.11%	93.83%

Figure 2. The moisture content value (%) on day 10 of various fruits and vegetables

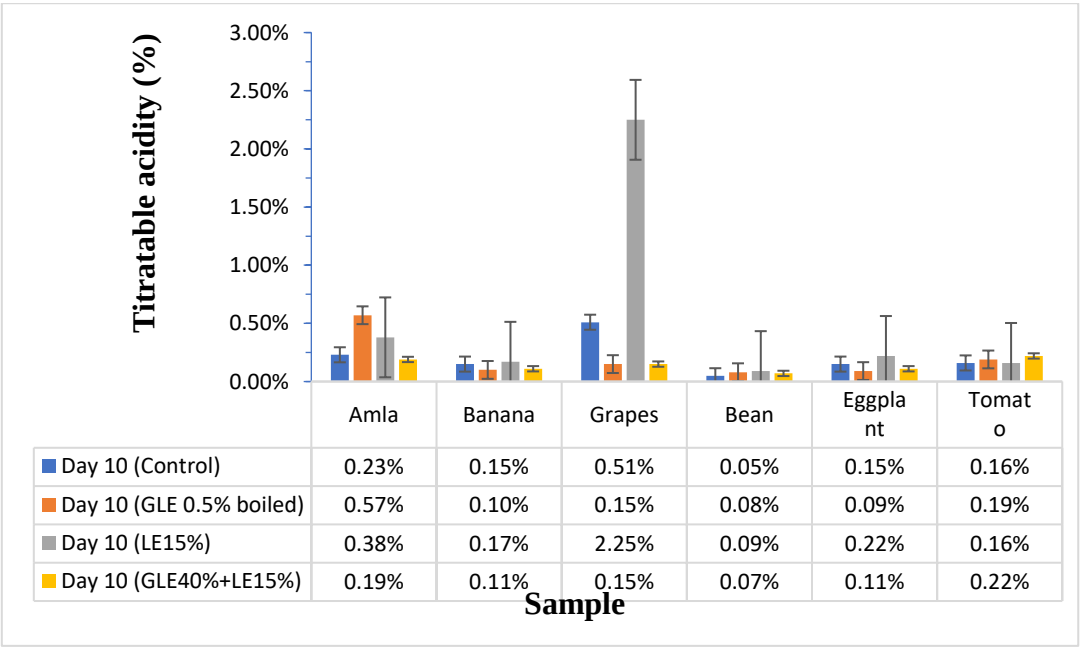
3.2 Determination of Titratable Acidity

After 5 days, Samples treated with GLE 0.5% (boiled), the percentage of acidity was 0.45, 0.20, 0.18, 0.13, 0.18, 0.19 for amla, banana, grapes, bean, eggplant and tomato. Samples (amla, banana, grapes, bean, eggplant, tomato) treated with LE 15%, had 0.55, 0.22, 0.33, 0.30, 0.15, 0.28 percentage of acidity respectively. Samples treated with GLE 40% + LE 15%, had 0.48, 0.16, 0.22, 0.05, 0.20, 0.16 percentage of acidity. After 10 days, the acidity percentage was 0.57, 0.10, 0.15, 0.08, 0.09, 0.19 for amla, banana, grapes, bean, eggplant, tomato respectively after being treated with GLE 0.5% (boiled). Samples treated with LE15%, had 0.38, 0.10, 2.25, 0.09, 0.22, 0.16 percentage of acidity respectively. Samples treated with GLE 40% + LE 15% preservative, had 0.19, 0.11, 0.15, 0.07, 0.11, 0.22 percentage of acidity respectively.



	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 5 (Control)	0.64%	0.24%	0.26%	0.27%	0.31%	0.33%
Day 5 (GLE 0.5% boiled)	0.45%	0.20%	0.18%	0.13%	0.18%	0.19%
Day 5 (LE 15%)	0.55%	0.22%	0.33%	0.30%	0.15%	0.28%
Day 5 (GLE40%+LE15%)	0.48%	0.16%	0.22%	0.05%	0.20%	0.16%

Figure 3. The titratable acidity value (%) on day 5 of various fruits and vegetables

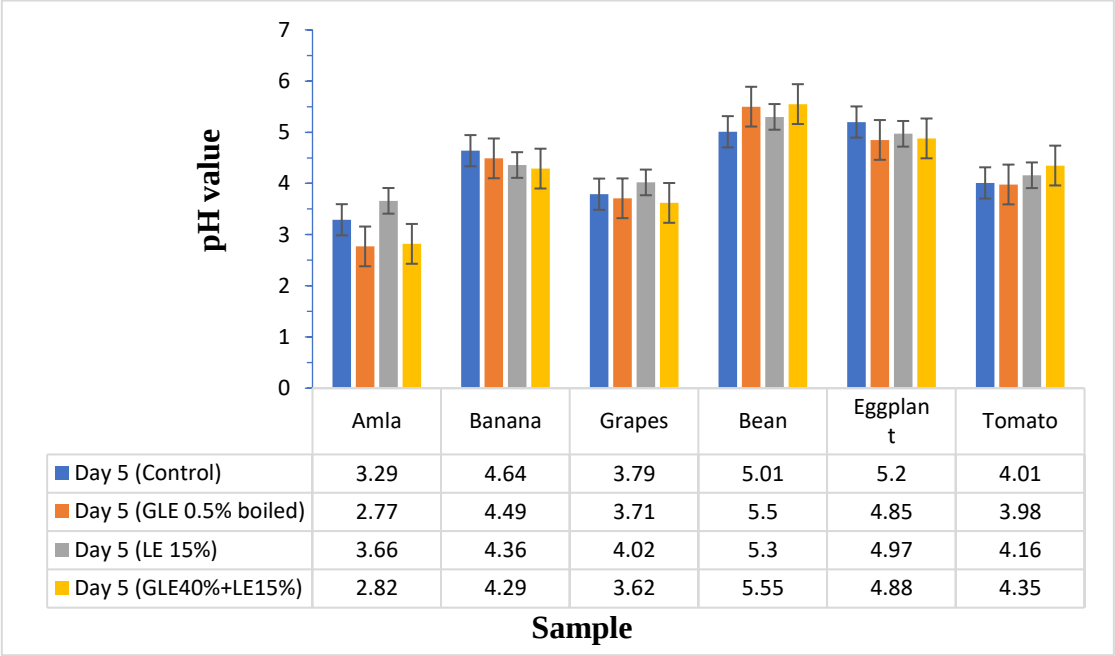


	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 10 (Control)	0.23%	0.15%	0.51%	0.05%	0.15%	0.16%
Day 10 (GLE 0.5% boiled)	0.57%	0.10%	0.15%	0.08%	0.09%	0.19%
Day 10 (LE15%)	0.38%	0.17%	2.25%	0.09%	0.22%	0.16%
Day 10 (GLE40%+LE15%)	0.19%	0.11%	0.15%	0.07%	0.11%	0.22%

Figure 4. The titratable acidity value (%) on day 10 of various fruits and vegetables

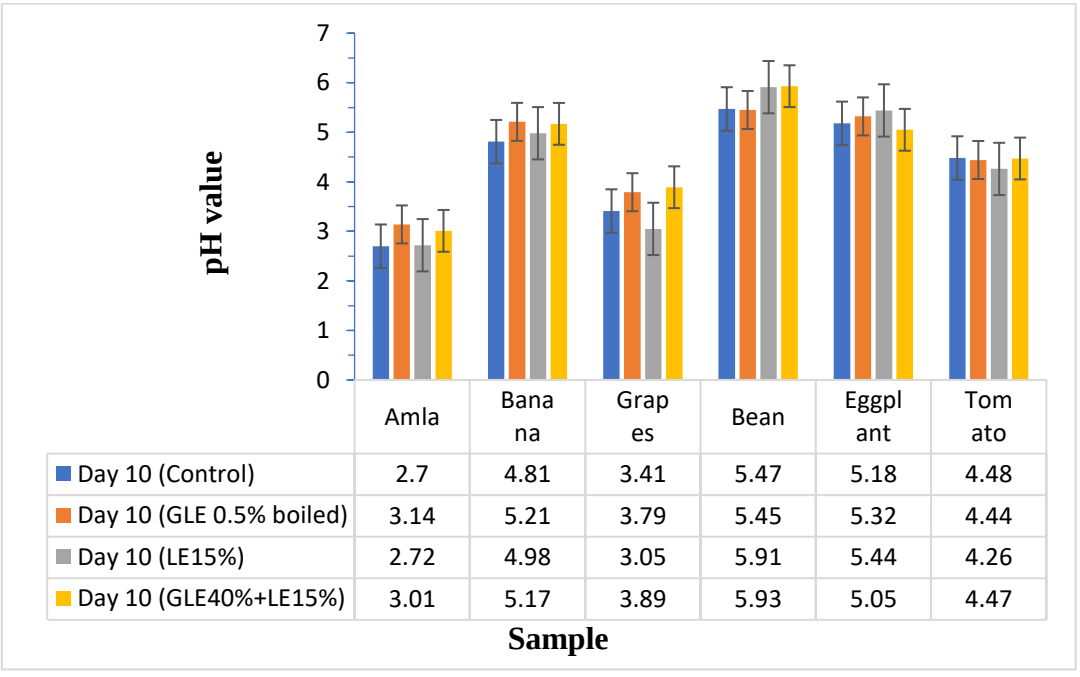
3.3 Determination of pH Value

After 5 days, Samples treated with GLE 0.5%(boiled), the value of pH was 2.77, 4.49, 3.71, 5.50, 4.85, 3.98 for amla, banana, grapes, bean, eggplant and tomato. Samples (amla, banana, grapes, bean, eggplant, tomato) treated with LE 15%, hold pH value of 3.66, 4.36, 4.02, 5.30, 4.97, 4.16 respectively. Samples treated with GLE 40% + LE 15%, contained pH value of 2.82, 4.29, 3.62, 5.55, 4.88, 4.35. After 10 days, the pH value was 3.14, 5.21, 3.79, 5.45, 5.32, 4.44 for amla, banana, grapes, bean, eggplant, tomato respectively after being treated with GLE 0.5% (boiled). Samples treated with LE 15%, had 2.72, 4.98, 3.05, 5.91, 5.44, 4.26 respectively. Samples treated with GLE 40% + LE 15% preservative, had pH value of 3.01, 5.17, 3.89, 5.93, 5.05, 4.47 respectively.



	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 5 (Control)	3.29	4.64	3.79	5.01	5.2	4.01
Day 5 (GLE 0.5% boiled)	2.77	4.49	3.71	5.5	4.85	3.98
Day 5 (LE 15%)	3.66	4.36	4.02	5.3	4.97	4.16
Day 5 (GLE40%+LE15%)	2.82	4.29	3.62	5.55	4.88	4.35

Figure 5. The pH value on day 5 of various fruits and vegetables



	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 10 (Control)	2.7	4.81	3.41	5.47	5.18	4.48
Day 10 (GLE 0.5% boiled)	3.14	5.21	3.79	5.45	5.32	4.44
Day 10 (LE15%)	2.72	4.98	3.05	5.91	5.44	4.26
Day 10 (GLE40%+LE15%)	3.01	5.17	3.89	5.93	5.05	4.47

Figure 6. The pH value on day 10 of various fruits and vegetables

3.4 Estimation of Vitamin C Content

After 5 days, Samples treated with GLE 0.5% (Boiled), the vitamin c content was 51.28, 3.84, 2.56, 3.84, 3.84, 2.56 for amla, banana, grapes, bean, eggplant and tomato. Samples (amla, banana, grapes, bean, eggplant, tomato) treated with LE 15%, had vitamin c content of 52.56, 2.24, 3.84, 4.48, 4.80, 6.85 respectively. Samples treated with GLE 40% + LE 15%, contained 47.43, 2.24, 1.92, 3.02, 3.52, 3.78 mg/100g of vitamin c. After 10 days, the content of vitamin c was 38.01, 1.53, 1.92, 1.79, 2.75, 2.05 for amla, banana, grapes, bean, eggplant, tomato respectively after being treated with GLE 0.5% (boiled). Samples treated with LE 15%, had 39.29, 1.92, 1.92, 2.88, 3.85, 2.90 mg/100g of vitamin c respectively. Samples treated with GLE 40% + LE 15% preservative, contained 28.58, 1.92, 1.60, 2.30, 3.52, 3.46 mg/100g of vitamin c respectively.

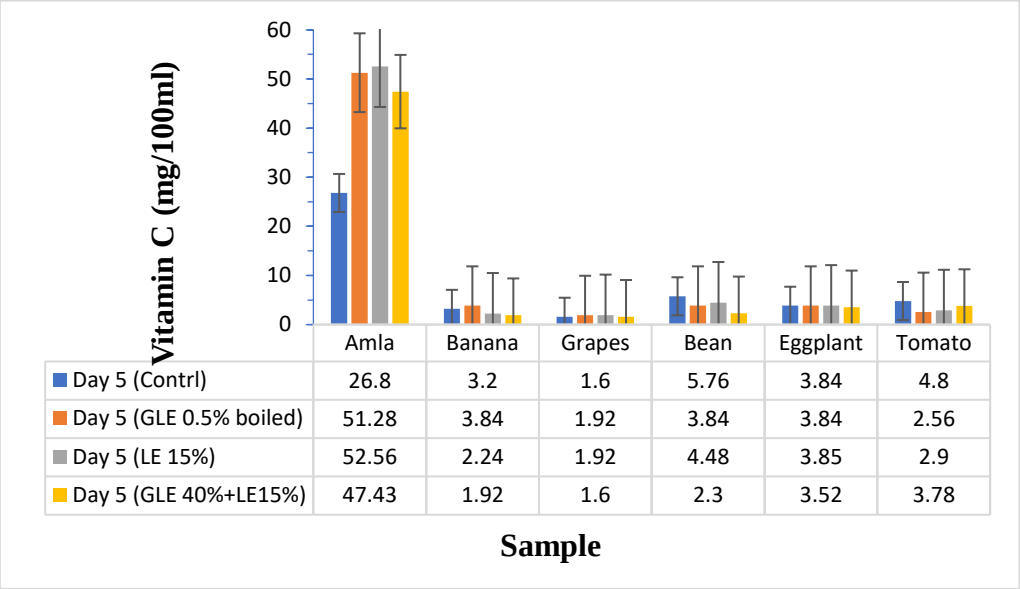


Figure 7. The vitamin C content (mg/100ml) on day 5 of various fruits and vegetables

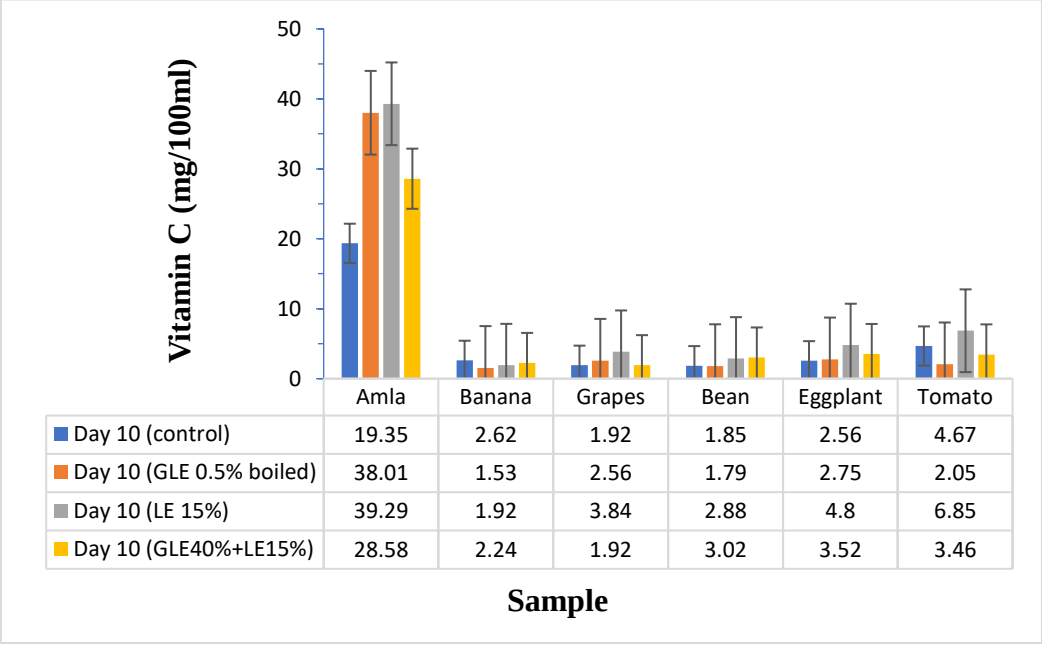
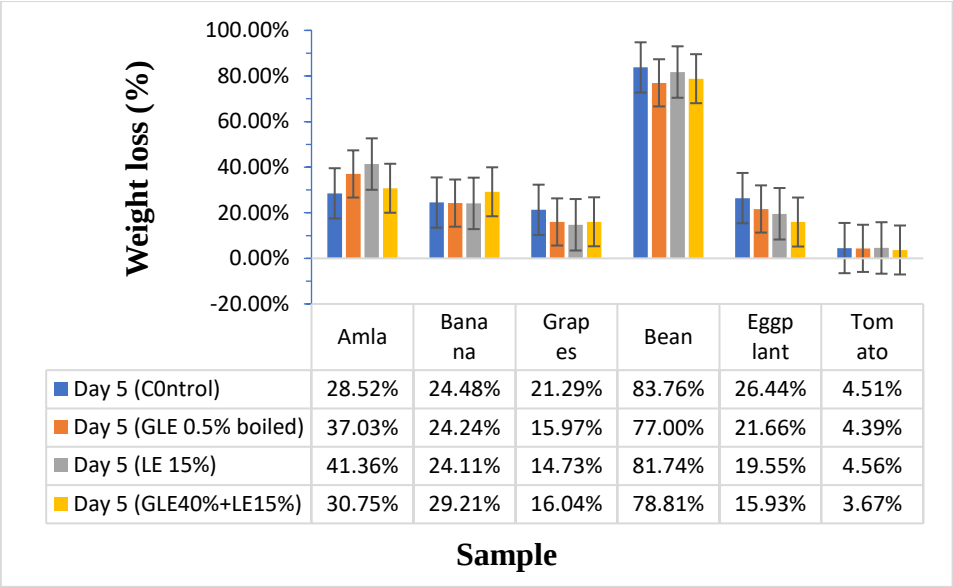


Figure 8. The vitamin C content (mg/100ml) on day 5 of various fruits and vegetables

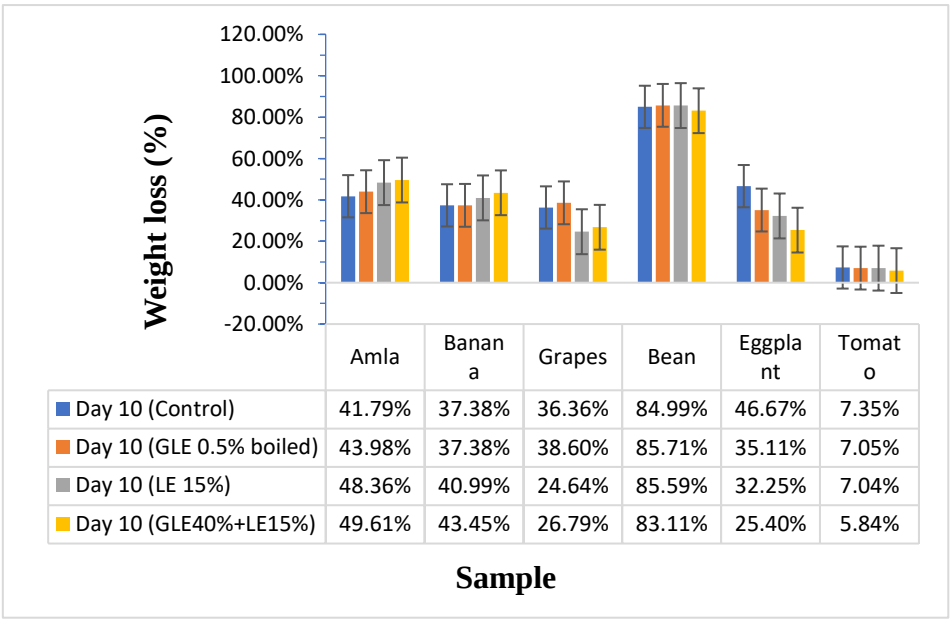
3.5 Estimation of Weight Loss

After 5 days, percentage of weight loss for control samples amla, banana, grapes, bean, eggplant and tomato was 28.52, 24.48, 21.29, 83.76, 26.44, 4.51 respectively. After 5 days, Samples treated with GLE 0.5% (boiled), the percentage of weight loss was 37.03, 24.24, 15.97, 77.00, 21.66, 4.39 for amla, banana, grapes, bean, eggplant and tomato. Samples (amla, banana, grapes, bean, eggplant, tomato) treated with LE 15%, had weight loss of 41.36, 24.11, 14.73, 81.74, 19.55, 4.56 percent respectively. Samples treated with GLE 40% + LE 15%, had 30.75, 29.21, 16.04, 78.81, 15.93, 3.67 percentage of weight loss. After 10 days, the weight loss percentage was 41.79, 37.38, 36.36, 84.99, 46.67, 7.35 control samples. The percentage of weight loss was 43.98, 37.38, 38.60, 85.71, 35.11, 7.05 for amla, banana, grapes, bean, eggplant, tomato respectively after being treated with GLE0.5% (boiled). Samples treated with LE 15%, had 48.36, 40.99, 24.64, 85.59, 32.25, 7.04 percentage of weight loss. Samples treated with GLE 40% + LE 15% preservative, had 49.61, 43.45, 26.79, 83.11, 25.40, 5.84 percentage of weight loss for amla, banana, grapes, bean, eggplant, tomato respectively.



	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 5 (COntrol)	28.52%	24.48%	21.29%	83.76%	26.44%	4.51%
Day 5 (GLE 0.5% boiled)	37.03%	24.24%	15.97%	77.00%	21.66%	4.39%
Day 5 (LE 15%)	41.36%	24.11%	14.73%	81.74%	19.55%	4.56%
Day 5 (GLE40%+LE15%)	30.75%	29.21%	16.04%	78.81%	15.93%	3.67%

Figure 9. The weight loss (%) on day 5 of various fruits and vegetables



	Amla	Banana	Grapes	Bean	Eggplant	Tomato
Day 10 (Control)	41.79%	37.38%	36.36%	84.99%	46.67%	7.35%
Day 10 (GLE 0.5% boiled)	43.98%	37.38%	38.60%	85.71%	35.11%	7.05%
Day 10 (LE 15%)	48.36%	40.99%	24.64%	85.59%	32.25%	7.04%
Day 10 (GLE40%+LE15%)	49.61%	43.45%	26.79%	83.11%	25.40%	5.84%

Figure 10. The weight loss (%) on day 10 of various fruits and vegetables

3.6 Microbial Analysis (CFU/mL)

Samples treated with GLE 0.5% (boiled), had TVC of 16×10^4, 14×10^4, 11×10^4, 9×10^4, 12×10^4, 10×10^4, for amla, banana, grapes, bean, eggplant and tomato after 5 days of experiment. Samples treated with LE 15%, had TVC of 18×10^4, 16×10^4, 15×10^4, 13×10^4, 22×10^4, 11×10^4respectively. Samples treated with GLE 40% + LE 15%, had 14×10^4, 15×10^4, 11×10^4, 10×10^4, 13×10^4, 10×10^4 of TVC respectively. After 10 days, the amount of total viable count was 22×10^4, 24×10^4, 15×10^4, 12×10^4, 18×10^4, 13×10^4 for the samples amla, banana, grapes, bean, eggplant, tomato respectively after being treated with GLE 0.5% (boiled). Samples treated with LE 15%, had TVC of 31×10^4, 27×10^4, 19×10^4, 18×10^4, 34×10^4, 16×10^4 respectively. Samples treated with GLE 40% + LE 15% preservative, had TVC of 26×10^4, 31×10^4, 18×10^4, 13×10^4, 21×10^4, 15×10^4 for amla, banana, grapes, bean, eggplant, tomato samples respectively.

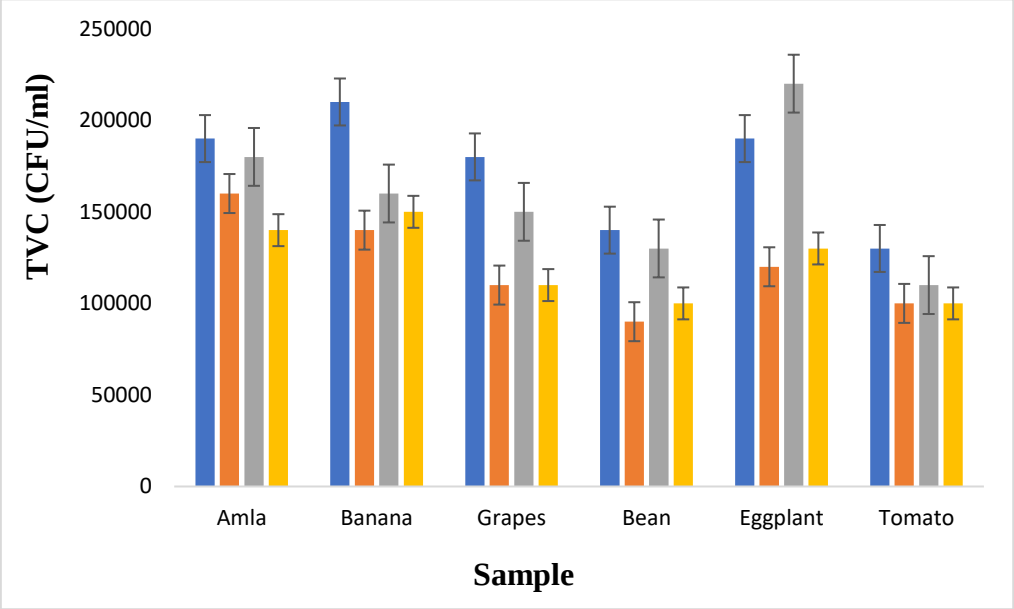


Figure 11. The total viable count (CFU/ml) on day 5 of various fruits and vegetables

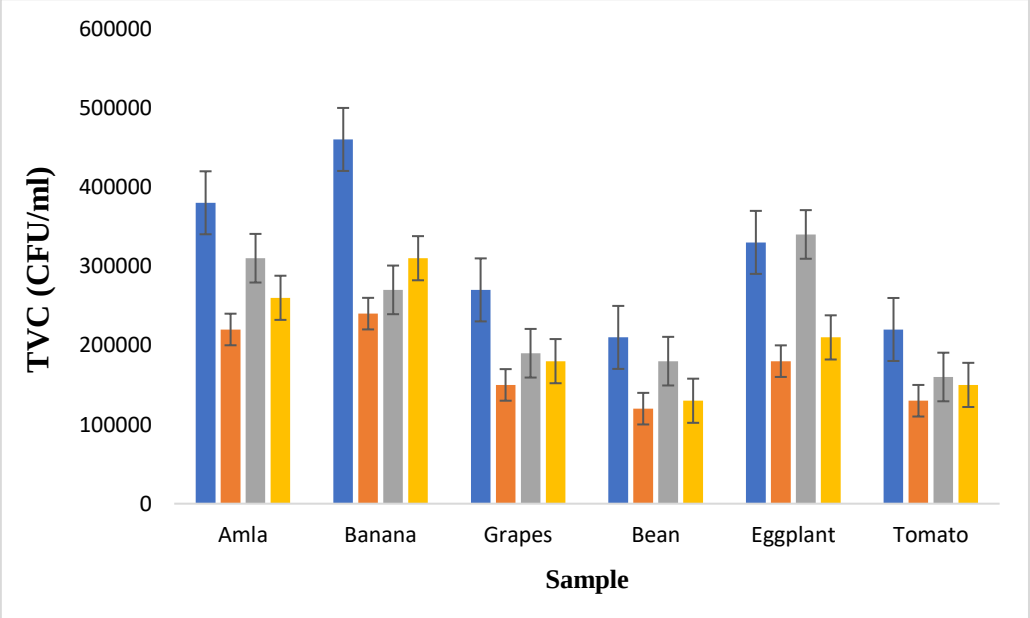


Figure 12. The total viable count (CFU/ml) of various fruits and vegetables

4. DISCUSSION

Guava leaves and lemon juice extract work as preservatives due to their antimicrobial properties, particularly against common food spoilage microorganisms. Guava leaves contain compounds like flavonoids and tannins, while lemon juice is rich in citric acid, which inhibit the growth of bacteria and fungi. The fruit guava (*Psidium guajava* L.) is thought to be indigenous to the tropical regions of America. Because of its large output and wide range of items made from its fruit, it is very important economically in many countries across the world.[26] It can be prepared or eaten raw. Remaining material from the fruit is produced during processing; this includes pulp, rinds, and seeds, which make up around 30% of the volume of the fresh fruit. Numerous studies have demonstrated its applicability in a range of industries, including the food, chemical, and pharmaceutical sectors.[27] Processing leftovers and byproducts can contain useful ingredients. These natural ingredients help extend the shelf life of food products by slowing down microbial growth.[17] After 5 days, samples treated with 0.5% GLE (Boiled) preservative showed better result in most of the samples compared to other two preservatives. After 10 days, lowest moisture content was found in Bean (18.03%) treated with GLE40%+LE15% preservative. During the testing time, samples treated with natural preservatives showed a reduced moisture content value, as demonstrated by Alqahtani et al. (2023).[18] After 10 days of treatment, the lowest titratable acidity value was observed in Bean (0.07), treated with GLE40%+LE15% and the highest value was recorded in Grapes (2.25), treated with LE15%. From Day 1-10, Titratable acidity decreased in all samples except Amla, treated with 0.5% GLE(Boiled), Grapes and Eggplant, treated with LE15% and Tomato, treated with GLE40%+LE15%. In Kaur et al. (2019),[16] a noteworthy rise in titratable acidity was recorded. From 1-10 days of treatment, pH value gradually increased in samples coated with 0.5% GLE (Boiled) preservative except Bean. Bean had pH value 5.50 at day 5 and 5.45 at day 10. Samples treated with LE 15% preservative, the pH value of Banana, Tomato, Bean, Eggplant were increased and Amla and Grapes were decreased during the experiment25. Samples treated with GLE40%+LE15%, had shown a gradual increase in its pH value. The control samples' pH values rose from day 1 to day 10 as well.[19] During the storage period of fruits and vegetables, weight loss had occurred in every sample.[20] Amla and Banana had shown a drastic weight loss from day 1-10.[21] The minimum weight loss was noticed in Tomato, treated with GLE40%+LE15% preservative, both at day 5 and 10.[22] Vitamin C content had gradually decreased in all samples treated with three types of natural preservatives as well as control samples. The highest vitamin C content was found in Amla (68.46 mg/100g) at 1st day of experiment. The lowest vitamin C content was found in Grapes (1.60) at day 10. Samples treated with LE 15%, had shown a better vitamin C content both at day 5 and 10 compared to other two types of natural preservatives.[23] From day 1-10, the highest microbial load found in control samples compared to samples treated with three types of natural preservatives.[24] The lowest microbial load was found in samples treated with GLE 0.5% (boiled) preservative. Among all the samples, control sample Banana had record amount of viable count (46×104CFU/ml) at day 5 and Bean (treated with GLE40%+LE15%) had lowest amount of viable count (9×104 CFU/ml) at day 10. Fruits and vegetables are packed with vitamins, minerals, and dietary fiber.[28] However, because they have a relatively limited shelf life after harvest and are naturally perishable, they spoil quickly. Nowadays, people are more concerned with the nutritional value of their food and the quality of their intake, and natural fruit and vegetable preservation is becoming more and more difficult worldwide.

5. CONCLUSION

Food preservation is the process of processing and preserving food in order to prolong its shelf life for human consumption by preventing or slowing down food deterioration, loss of quality, edibility, or nutritional content. In a test of moisture content, 0.5% GLE (Boiled) preservative performed better than the other two varieties. In comparison to other preservatives, 0.5% GLE (Boiled) performed well in the pH test. In a titratable acidity test, GLE 40%+LE 15% preservative performed better on samples than other preservatives. In the vitamin C test, LE 15% preservative fared better than the others. When it came to determining weight reduction, GLE 40%+LE 15% preservative performed better than the other options. Out of the three types of preservatives used for

microbiological study, 0.5% GLE (Boiled) showed the strongest antibacterial effectiveness. Out of the three preservative kinds, GLE 40%+LE 15% and 0.5% GLE (Boiled) performed better than LE 15% in the majority of the physiochemical tests. This study suggests that 0.5% GLE (Boiled) and GLE 40%+LE 15% are useful natural preservatives that may be added to a variety of fruits and vegetables to extend their shelf life and retain their nutritional content.

However, the crude extracts of guava leaves exhibited fungal suppression and extended the shelf life of fruits and vegetables, indicating the need for further studies to obtain a purified preservative from the extract. It is recommended to determine which elements of the crude extracts are inhibiting the growth of fungus, refine the unrefined extracts for a preservative, identify fungi resistant to the guava leaf extract, and determine the lowest concentration of inhibition.

Acknowledgement

The authors would like to express their heartfelt gratitude and appreciation to the Department of Food Technology and Nutritional Science at Mawlana Bhashani Science and Technology University, Bangladesh, for providing the laboratory facilities necessary to perform this study.

Funding Information

No funds received for this study

Conflict of Interest

The authors declare no conflict of interest.

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