Variations of Biochemical Parameters of Some Selected Vegetables Under Different Preservation Techniques

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Abstract
The present study was conducted to examine variations in the biochemical properties of selected vegetables under different storage conditions. The vegetables analyzed included spiny gourd, pointed gourd, snake gourd, sponge gourd, and Chinese okra. The biochemical parameters measured were moisture content, vitamin C, titratable acidity, total sugar, and reducing sugar. Among the control samples, sponge gourd had the highest moisture content (94.36%), while spiny gourd contained the highest vitamin C (6.72 mg/100 ml). Sponge gourd also exhibited the highest titratable acidity (7.28%). Pointed gourd had the highest total sugar content (0.25 mg/ml), whereas sponge gourd recorded the highest reducing sugar content (0.61 mg/ml). Freshly collected vegetables were stored in both airtight and perforated polyethylene bags under normal and refrigerated conditions. Air exposure and temperature were key factors influencing storage conditions. Quality parameters were assessed in fresh vegetables and at 48-hour intervals during storage. The recorded data were analyzed using analysis of variance (ANOVA), and the means of different parameters were compared using the least significant difference (LSD) test. The results revealed significant variations among treatments in terms of moisture content, vitamin C, titratable acidity, total sugar, and reducing sugar. All quality parameters were compared against the control samples.

Keywords: Biochemical parameters, Preservation, Quality, Storage condition, Vegetable

Introduction

Vegetables are crucial in maintaining human health as one of the basic components of the human diet. Vegetable consumption in the human diet has a substantial impact on disease burden mortality in both the developing and developed worlds. More than 2.6 million people have died because of a lack of access to these goods around the world (Orlien & Bolumar, 2019). Fresh vegetables have a short shelf life due to their very perishable nature, which is shortened by cellular respiration, microorganisms, enzyme reactions, oxidation, and other factors (Bajpai et al., 2018). Moreover, consumption of fresh fruits and vegetables is dependent on availability during a given season, as most of them are seasonal (Amit et al., 2017). As a result, short and long-term vegetable storage is required, and various methods and technologies are used to achieve diverse economic objectives. When our predecessors were figuring out how to preserve vegetables fresh and edible in the past, they came up with the concept of preservation. Certain concepts were established based on seasonal and climatic circumstances, such as pasteurization, salting, and sun drying (Sharif et al., 2017). Deep freezing is one of the most often used preservation procedures for vegetables for long-term storage since most deteriorative reactions and microbiological activities are greatly inhibited at temperatures low enough (Rahman, 2020). However, preservation changes the biochemical conditions of the vegetables and nutrition, become a major concern for food security. The present experiment was undertaken with the objectives of observing the variation of biochemical parameters of the selected vegetables with storage time, and finding the changes of nutritional quality of vegetables in different storage treatment.

Materials and Methods

Study area

The vegetables were gathered from nearby farmers and the local market within the Bangladesh Agricultural University (BAU) Campus located at Mymensingh division of Bangladesh in between the latitude of 23.7099' N and longitude of 90.407' E.

Selection of the vegetables

Popular, fresh, and edible vegetables were selected for the experiment based on what was in stock when the study was carried out. The vegetables were Chinese Okra (Jhinga), Snake Gourd (Chichinga), Pointed Gourd (Patol), and Spiny Gourd (Kakrol), Sponge Gourd.

Methods of vegetable collection and preservation

Fresh vegetables, collected early in the morning from the K. R. market on the BAU campus, were split into four main sections and stored for five days at both room temperature and refrigerated temperature in two different types of polyethylene bags: airtight and perforated. Quality of both fresh and frozen vegetables was assessed by 48 hours' interval.

Methods for determining biochemical parameters

Vegetable nutritional changes are assessed using five parameters: total sugar, reducing sugar, titratable acidity, moisture content, and vitamin C. These properties were measured using volumetric methods,

oven drying, titration, and established protocols. Standard curves were made using known amounts of pure glucose and vegetable extracts. Interdisciplinary Institute for Food Security lab, BAU used to assess these parameters.

Statistical analysis

ANOVA and LSD test used to determine the significant differences in parameters. MS Excel is used for statistical analysis.

Results

Chemical composition of fresh vegetables

The selected and collected fresh vegetables for the experiment were analyzed for various chemical compositions. Moisture content, vitamin C, titratable acidity, total sugar and reducing sugar of the selected fresh vegetables were measured and being listed in the table 1.

Table 1. Chemical composition of fresh vegetables

Parameters	Moisture (%)	Vitamin C (mg/100 ml)	Titratable acidity (%)	Total sugar (mg/ml)	Reducing sugar (mg/ml)
Spiny gourd	93.24	6.72	4.24	0.01	0.45
Pointed gourd	89.06	1.8	6.85	0.25	0.39
Snake gourd	94.29	0.40	5.79	0.21	0.60
Sponge gourd	94.36	0.22	7.28	0.18	0.61
Chinese okra	93.74	0.32	4.21	0.13	0.52

Moisture content

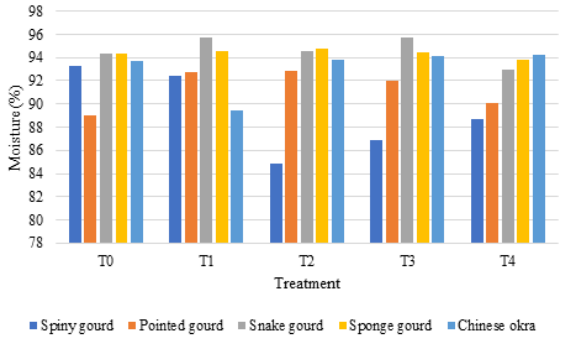

Fig. 1. Changes of moisture content of vegetables at different storage conditions

Effects of different treatment on moisture content showed significant variation. The moisture content of the vegetables at fresh condition and at the last day in different packaging and storage conditions. Where, T0 (control)= vegetables not subject to treatment; T1=vegetables stored in airtight polyethylene bags at normal temperature; T2=vegetables stored in airtight polyethylene bags at refrigeration temperature; T3=vegetables stored in perforated polyethylene bags at normal temperature; T4=vegetables stored in perforated polyethylene bags at refrigeration temperature.

Spiny gourd

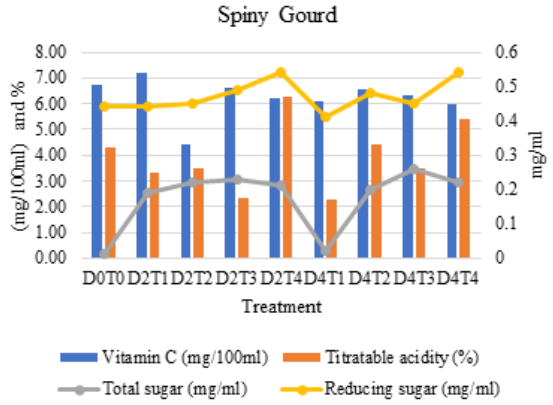

Fig. 2. Variations of parameters at different storage conditions for spiny gourd

This figure shows the variation of different parameters of spiny gourd in different days and different treatment conditions. Highest vitamin C was measured at D2T1 treatment and titratable acidity measured at D2T4. At fresh condition D0T0 amount of total sugar in spiny gourd was very low and D4T4 shows the highest value of reduced sugar. In this figure, D0T0 = DAY 1 control vegetable; D2T1 = DAY 2 vegetables stored in airtight polyethylene bags at normal temperature; D2T2 = DAY 2 vegetables stored in airtight polyethylene bags at refrigeration temperature; D2T3 = DAY 2 vegetables stored in perforated polyethylene bags at normal temperature; D2T4 = DAY 2 vegetables stored in perforated polyethylene bags at refrigeration temperature. D4T1 = DAY 4 vegetables stored in airtight polyethylene bags at normal temperature; D4T2 = DAY 4 vegetables stored in airtight polyethylene bags at refrigeration temperature; D4T3 = DAY 4 vegetables stored in perforated polyethylene bags at normal temperature; D4T4 = DAY 4 vegetables stored in perforated polyethylene bags at refrigeration temperature.

Pointed gourd

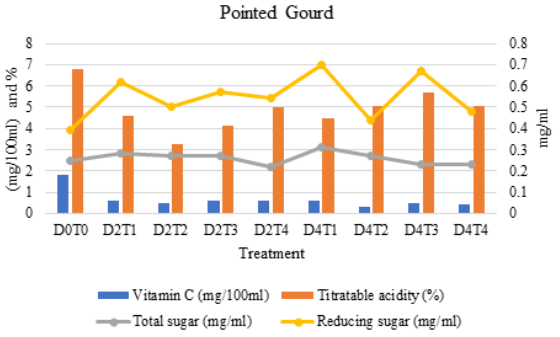

Fig. 3. Variations of different parameters at different storage conditions for pointed gourd

In this figure, vitamin C decreased with time and at control condition titratable acidity was the highest whereas at D4T1 both total and reducing sugar were highest.

Snake gourd

In this figure, vitamin C was highest at D4T3 and at D4T1 titratable acidity was highest. D2T3 and D4T2 was the apex point for total and reducing sugar, respectively.

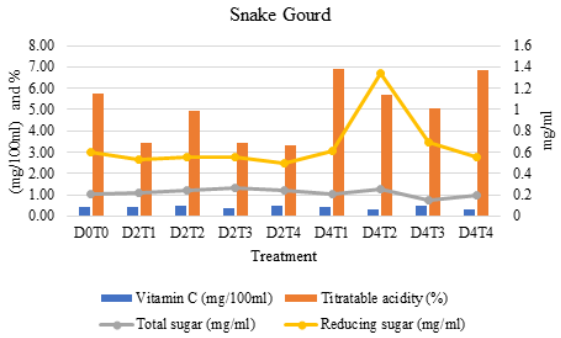

Fig. 4. Variations of different parameters at different storage conditions for snake gourd

Sponge gourd

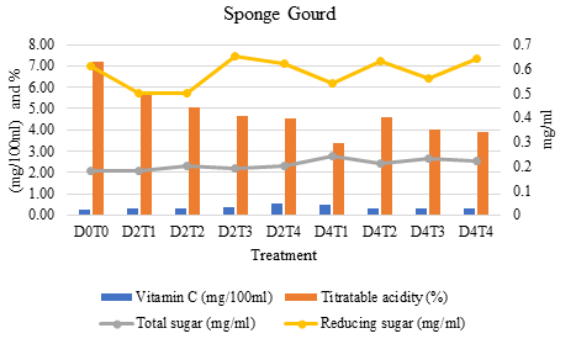

Fig. 5. Variations of different parameters at different storage conditions for sponge gourd

In this figure, vitamin C was highest at D2T4 and at control condition titratable acidity was highest. D4T1 and D2T3 was the apex point for total and reducing sugar, respectively.

Chinese okra

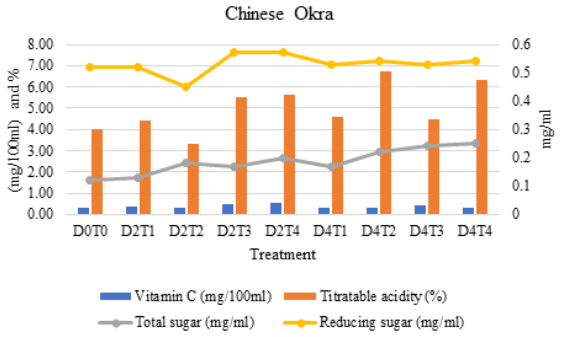

Fig. 6. Variations of different parameters at different storage conditions for Chinese okra

In this figure, titratable acidity peaked at D4T2, and vitamin C was maximum at D2T4. The apex points for total and reducing sugar were D4T4 and D2T3, respectively.

Discussion

Vegetables, being a crucial component of a balanced diet and rich source of various biochemical compounds, shows variations in nutritional value and sensory characteristics when undergoes different preservation techniques (Balan et al., 2016). The current study looked at vitamin C, moisture content, titratable acidity, total sugar, and reducing sugar as indicators of vegetables' nutritional quality under regular storage circumstances and refrigeration conditions.

The highest initial moisture content (94.36%) is found in Sponge gourd among the control group; however, when exposed to normal storage conditions, moisture content of the spiny gourd varies the most, ranging from 86.92% to 92.38% and from 84.84% to 88.67% when refrigerated as opposed to Okra veggies stored in bowl for 9 days ranged between 83.5% and 87.8% at room temperature and 84.4% and 85.4% at refrigeration temperature (Talukder et al., 2015).

For ascorbic acid content, the spiny gourd shows highest amount (6.72 mg/100 ml) at fresh condition than other veggies but almost all of them gradually decreases with time in most of the treatments especially in airtight refrigeration conditions. This is partially similar to the initial ascorbic acid content (130 mg/100 g) found in fresh broccoli florets which decreased linearly during storage under different treatments (Nath et al., 2012).

In case of titratable acidity, the pointed gourd, snake gourd and Chinese okra shows an increase level in 4th day than 2nd day but sponge gourd shows a gradual decrease trend in all treatments with time although containing a highest initial amount (7.28%) at control condition. This pattern is consistent with research by Jacobsson et al., (2004) which found that papaya's titratable acidity content rose as it ripened before declining.

The investigation showed that although the pointed gourd had the greatest beginning quantity (0.25 mg/ml), the total sugar content for both sponge gourd and Chinese okra rose with time in all conditions. In the experiment, nearly every vegetable showed a tiny rise in total sugars as they ripened, followed by a decline which is in similar trend by Gómez & Artés (2005). In addition, reducing sugar grew with time for the majority of vegetables, while for other treatments, it reduced with time due to temperature and air effect. This research is somewhat comparable to a study by Ashenafi & Tura, (2018) where reducing sugar content increased significantly during storage.

Conclusions

Vegetable preservation is an important thing for present life. Four different storage procedures were used in the experiment: airtight packaging using spiny, pointed, snake, sponge, and Chinese okra, and perforated packaging at both normal and refrigerator temperatures. Measurements were made of moisture content, vitamin C, titratable acidity, total sugar, and reducing sugar, among other quality characteristics. Regarding these

criteria, there were notable differences between the treatments. The results showed that the sponge gourd had the highest moisture content (94.36%), the highest titratable acidity (7.28%), and the highest vitamin C (6.72 mg/100 ml) among the gourd species. The most reducing sugar was found in sponge gourd (0.61 mg/ml), but the highest overall sugar was found in pointed gourd (0.25 mg/ml). Under all storage circumstances, the moisture content of pointed gourds increased whereas that of spiny gourds declined. For spiny gourd, vitamin C dropped, but varied for other vegetables.

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