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Effect of different storage condition on storage behavior of primary processed leafy vegetables

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Abstract
The present investigation entitled "Effect of different storage condition on storage behavior of primary processed leafy vegetables" was conducted during the year 2022-2023 at Vegetable Science Processing Lab under Pt. K.L.S. College of Horticulture & Research Station, Rajnandgaon (C.G.). The research was framed in Factorial Completely Randomized Design (FCRD) with 15 treatments which were replicated trice. There were 2 factor, first factor with five primary processed leafy vegetables: V_1 Fenugreek, V_2 Coriander, V_3 Indian Spinach, V_4 Amaranthus and V_5 Red Amaranthus and second factor with three storage conditions *viz*., S_1: Room Temperature (RT), S_2: Zero Energy Cool Chamber (ZECC) and S_3: Refrigerated Storage at 3±1°C (RS). Primary processed leafy vegetables sample were packaged in polyethylene bags (200 gauge, 2% vents) and subjected to stored at different storage conditions. The observation on Initial analysis of leafy vegetables before primary processing find out the highest weight of edible portion (601.75 g), highest percent of edible portion (60.17%) recorded in V_3 (Indian Spinach) while highest weight of inedible portion was observed in V_5 (Red Amaranthus) (600.78g). The observations on physic-chemical properties and sensorial evaluation were evaluated at scheduled intervals throughout the storage period. Primery processed leafy vegetables showed increasing trends in Physiological loss in weight (%) (PLW), Yellowing (%), Decay (%) and Shriveling (%) with faster rates at room temperature as compared to zero energy cool chamber and refrigerated storage conditions whereas decreasing trend with respect to moisture, ascorbic acid and sensorial qualities decreased at slower rate under refrigerated storage condition as compared to room temperature and zero energy cool chamber. the maximum moisture content of primary processed leafy vegetable recorded in V_2S_3 (85.94%) and maximum Ascorbic acid (mg/100 g) recorded in treatment combination V_2S_3 (53.85mg/100 g). The self-life of primary processed leafy vegetables V_1 Fenugreek (4,8 and10), V_2 Coriander (4,8 and10), V_3 Indian Spinach (4,6 and 8 days), V_4 Amaranthus (4,8 and10), and V_5 Red Amaranthus (4,8 and10 days) at room temperature, zero energy cool chamber and refrigerated storage conditions respectively.

Keywords: Primary processed leafy vegetables, storage conditions, shelf life, quality

Introduction
India is blessed with diverse agro-climatic conditions which are very congenial for the cultivation of almost all types of fruits and vegetables. India is the second largest producer of vegetables in the world and accounts for about 15 percent of the world's vegetable production. India's flora comprises of 6000 species of plants and used for consumption, one third of which are green leafy vegetables. Green Leafy Vegetables (GLV) having much importance from the nutritional point of view (Narang *et al*. 2016) [13]. The consumption of fresh vegetables is globally recommended by World Health Organization (WHO) as an effective mean to preserve and improve population's health status.

Though India is huge producer of vegetables, but due to the lack of post- harvest facilities most of the produce goes waste. It is also reported that, the fruits and vegetables are perishable products which actively metabolized during the post - harvest handling operations. Every year, 25–30% of the production of fruits and vegetables (worth Rs. 4000 crores) are wasted due to lack of knowledge regarding the post - harvest handling practices.

Leafy vegetables are a diverse group of plants, comprising several different taxonomic plant families, commonly known as greens and potherbs. These may be cool or warm season crops

and can be grown as annuals or as perennials. In addition, some leafy vegetables are adapted to the tropics, while others are adapted to the temperate climates. They are raised either as main crop or as a minor crop depending on the location. (Narang *et al*., 2016) [13].

Green leafy vegetables occupy an important place among the food crops as these provide adequate amounts of many vitamins and minerals for humans. They are rich source of vitamins like beta-carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron, phosphorous etc. A large number of leaves from different sources such as perennial trees, aquatic plants and annuals are consumed. Some of the commonly consumed leafy vegetables are spinach (*Spinacia oleracea*), amaranthus (*Amaranthus cruntus*), fenugreek (*Trigonella foenum- graecum*), drumstick (*Moringa oleifera*), bathua (*Chenopodium album*), etc. These greens are inexpensive, high yielding, a part of the local diet and often easily available. (Kumar *et al*., 2020) [12].

Leafy vegetables (Fenugreek, Coriander, Spinach, Amaranthus, Bathua etc.) of Fifty-one types were eaten by the tribal and local people of Chhattisgarh (Chauhan *et al*., 2014) [5]. Leafy vegetables play a major role in the nutritional requirement of the tribal and local population in remote parts of the Chhattisgarh (Chandravanshi *et al*., 2018) [4]. At present the diet of an average Indian is unbalanced as it consists of mainly cereals only. On an average a normal Indian consumes 375 g of cereals, and 30 g of vegetables daily, against 328 g of cereals, and 316 g of vegetables as per the standard dietary recommendation. Out of total 316 g of vegetables the daily recommendation is 200 g for leafy vegetables (Anon., 2018) [2].

Green leafy vegetables are highly seasonal and during storage abundant supply during the peak season results in spoilage of large quantities. These leafy vegetables are seasonal and perishable, owing to high moisture content. Green leafy vegetables have a unique place among vegetables because of their colour, flavour and health benefits.

The different storage condition use in green leafy vegetables (Fenugreek, Coriander, Spinach, Amaranthus, Red Amaranthus) increasing the shelf life and qualities. Rate of increase faster under Room temperature as compared to zero energy cool chamber and refrigerated storage. Mostly prefer to Refrigerated storage but this is costly as compared to zero energy cool chambers. zero energy cool chamber storage is best for marginal farmers and minimum cost for construction and leafy vegetables can be longer time safe and increasing for shelf life and leafy vegetables could be extended 2, 6, 8 days at par for refrigerated. (Garande *et al*., 2019) [9].

Different storage conditions have varying effects on the storage behavior of primary processed leafy vegetables. Room temperature storage accelerates deterioration, leading to color changes, texture loss, flavor deterioration, and nutrient degradation. It promotes moisture evaporation, causing wilting and shriveling, and creates a favorable environment for microbial growth (Spinardi *et al*., 2019) [20].

Zero energy cool chambers, built using natural materials, provide a lower temperature environment compared to room temperature. They extend shelf life by slowing metabolic processes, reducing moisture loss, and slowing microbial growth, although not as effectively as refrigeration (Kumar *et al*., 2014) [11]. Refrigerated storage at temperatures between 0 to 4 degrees Celsius offers the greatest benefits. It significantly slows down deterioration, extending shelf life and preserving quality. Refrigeration minimizes moisture loss, maintains crispness and freshness, and provides effective microbial control, reducing the risk of spoilage and enhancing food safety (Raquel *et al*., 2019) [19]. In room temperature storage accelerates deterioration, while zero energy cool chambers were some improvements. However, refrigerated storage is the most effective method, with maximum shelf-life extension, minimal moisture loss, and superior microbial control. Choosing appropriate storage conditions is crucial for maintaining the quality, safety, and nutritional value of primary processed leafy vegetables.

Materials and Methods

Fenugreek, Coriander, Indian Spinach, Amaranthus and Red Amaranthus bunches were procured after harvesting in the morning hours from local market near the Rajnandgaon city. Sorting and grading were done manually to remove diseased and non-uniform of all leafy vegetables. Uniformly sized matured and cleaned all leafy vegetable were used for the investigation. The bay as well as working and drying area of laboratory and all other instruments and equipment's were sanitized with 100 ppm chlorine solution and air dried. The entire area was sprayed with 1 percent hydrogen peroxide solution to minimize load of aerobic micro flora and to remove off flavor if any, while handling and operating processing unit. The blowers, tables and sterilized stainless steel sieves were used for draining of treated leaves of selected leafy vegetables which were used for investigation. The selected vegetables were sorted for integrity, color and size uniformity and lack of defects. Only photosynthetic leaves (green leaves) with tender stem were included in the samples. Selected leaves were washed in running tap water for 4 min at room temperature (20°C) in a ratio of one part of sorted leafy vegetable for 10 parts of water. Excess water was drained by using sterilized stainless-steel sieve. The prepared vegetables were spread on tables and air dried using cool air generated by electrical fans for 15 min. and was collected in pre-sterilized trays and mixed uniformly. The excess handling of vegetables was avoided to minimize the bruising injury. The leaves with wounded and damaged tissues were removed. The best quality vegetables were selected and used for the present study. Consumer polyethylene food grade plastic bags of 25x20 cm size and 200 gauge thick with 1% vent were procured from the market. Processed vegetables weighing 100 g were filled in each polyethylene bag. The well packed primary processed vegetables were then stored at three different environments i.e. room temperature, ZECC and refrigerated (3±1 °C.) storage.

Physico-chemical analysis of primary processed leafy vegetables

Initial and final weights were recorded using an electronic balance (±0.01 g). Weight loss percentage was calculated by following formula. Physiological loss in weight percentage = ((Initial weight - Final weight) / Initial weight) × 100, measured with ±0.01 g accuracy.

Yellowing was assessed visually every other day. Weight of yellowed leaves was recorded using a sensitive electrical balance. Percent yellowing (%) was calculated as: Yellowing% = (Weight of yellowed leaves / Weight of sample taken) × 100.

Decay was visually assessed and calculated as: Decay% = (Weight of decay leaves/ Weight of sample taken) × 100 on weight basis. (procedure given by Gihan).

Shriveled leaves were sorted from the packaged processed leaves at every alternate day interval and weighed on sensitive electronic balance. Shriveling was calculated using following formula: Shriveling (%) = (Weight of shriveled leaves/ Weight of sample taken) × 100.

Moisture percentage was determined by drying known weight of sample into hot air oven at 60 °C for 24 hours upto a constant known weight (AOAC, 2010). Moisture (%) = (Initial weight (g) -Final weight (g)/ Initial weight (g))

The following equation is then used to calculate the dry matter content (%): Dry matter content (%) = [100 – Percent moisture content]

Ascorbic acid content was estimated using AOAC's (2010) modified titration method and calculated as: Ascorbic Acid (mg/100 g) = (Titre value - Blank x Dye factor x Volume made up) / (Aliquot of extract taken for titration x Wt. or vol. of sample taken for estimation) X 100

Sensorial evaluation

A panel of evaluators assessed the overall acceptability of primary processed leafy vegetables based on color, appearance, texture, and aroma parameters. Ratings were scored using Amerine's 9-point Hedonic scale (1965). Samples achieving a score of 5.50 or higher were deemed acceptable, while those scoring below 5.50 were discontinued.

Statistical analysis

The collected data for different parameters were statistically analyzed as described by Panse and Sukhatme (1985) [15] and significance was tested by 'F' test and level of significance for all the tests was α=0.05.

Result and Discussion

Initial analysis of leafy vegetables before primary processing

The experimental data presented in table 1 revealed that the among all the leafy vegetables, highest weight of inedible portion was observed in V_5 (Red Amaranthus) (600.78g) followed by V_2 (Coriander) (580.42 g) and V_1 (Fenugreek) (570.45 g) at the same time V_3 (Indian Spinach) showed the least weight of inedible portion (398.25 g).

Highest weight of edible portion was recordedd in V_3 (Indian Spinach) (601.75 g) followed by V_4 (Amaranthus) (*Amaranthus viridis*) (439.2 g) and V_1 (Fenugreek) (429.55 g). The remaining vegetable *viz*. V_2 (Coriander) and V_5 (Red Amaranthus (*Amaranthus cruntus*)) had weight of edible portion (429.55 g) and (399.22g) respectively. The least weight of edible portion was found in V_5 (Red Amaranthus (*Amaranthus cruntus*)) (399.22g) as it had very small leaf area and its leaves are mostly taken as edible portion.

Indian Spinach recorded highest percent of edible portion V_3 (Indian Spinach) (60.17%) followed by V_4 (Amaranthus (*Amaranthus viridis*)) (43.92%). The remaining leafy vegetables *viz*. V_1 (Fenugreek), V_2 (Coriander) and V_5 (Red Amaranthus (*Amaranthus cruntus*)) recorded comparatively less percentage of edible portion such as (42.95%), (41.95%) and (39.92%) respectively as these leafy vegetables had comparatively smaller leaf area than Indian Spinach and Amaranthus.

Physico-chemical composition of primary processed leafy vegetables

Physical traits

Physiological loss in weight (%) (PLW): The experimental data presented in table 2 revealed that PLW of different leafy vegetable showed significant. At end of 2nd day of different leafy vegetables, V_3 recorded highest (4.71%) of physiological loss in weight followed by V_1 (2.83%); whereas least PLW was recorded by V_5 (2.00%). On 4th day of different leafy vegetables, V_3 recorded significant highest (9.32%) of PLW followed by V1 (6.71%); whereas least PLW was recorded by V_5 (5.03%), respectively. On 6th day of different leafy vegetables, V_3 recorded significant highest (7.40%) of PLW followed by V_1 (5.33%); whereas least PLW was recorded by V_5 (3.95%) On 8th day of different leafy vegetables, V_1 recorded significant highest PLW (6.64%) followed by V_2 (6.60%) whereas the least PLW was recorded by V_3 (4.20%). On 10th day of different leafy vegetables, V_1 recorded highest PLW (3.80%) followed by V_2 (3.46%) whereas the least PLW was recorded by V_5 (5.16) and V_3 did not show any additional weight loss on particular day.

Indian Spinach consistently high physiological loss in weight across most days suggests a rapid water loss and high respiration rate, possibly due to its larger leaf area and thinner leaves, which may lead to quicker dehydration and wilting compared to the denser leaves of other vegetables like Red Amaranthus. The results obtained in the present study are in accordance with the results of Dhemre *et al*. (2017) [7].

Effect of different storage conditions on physiological loss in weight loss of leafy vegetables was showed significant and presented in table 2. Under different storage condition S_1 recorded highest loss of their weight (4.53%) on the 2nd day, (10.61%) on the 4th day, whereas S_3 condition, leafy vegetables recorded physiological weight loss of (1.65%) on the 2nd day, (3.79%) on the 4th day, (7.03%) on the 6th day, (8.21%) on the 8th day, and (8.29%) on the 10th day.

The physiological loss in weight (PLW) was higher in leafy vegetables at room temperature and zero-energy cool chamber compared to controlled environments. This increase was attributed to fluctuations in outside temperature, which adversely affected relative humidity and consequently exacerbated PLW. The PLW was influenced by Vapour Pressure Difference (VPD between products and its environment, by reducing temperature and increasing relative humidity effectively minimizes PLW which enhance self-life of leafy vegetables at controlled storage condition refrigerator. The results obtained in the present study are supported by the works of Dhemre *et al*. (2017) [7] and Ambrose *et al*. (2017) [1].

Yellowing (%) The experimental data presented in table 2 revealed that yellowing (%) of different leafy vegetable showed significant. On the 2nd day of different leafy vegetables, V_1 showed the highest yellowing (1.69%), closely followed by V_2 (1.59%), and V_3 (1.32%). lowest yellowing was recorded by V_5 (0.19%). On the 4th day of different leafy vegetables, V_1 had the highest yellowing (4.60%), followed by V_2 (3.92), and V3 (3.28). V_5 had the lowest yellowing at (0.80%). On 6th day of different leafy vegetables, V_1 recorded highest yellowing (2.78%), followed by V_2 (2.24%); whereas lowest yellowing was recorded by V_5 (0.58%). On 8th day of different leafy vegetables, V_1 recorded highest yellowing (3.56%), closely followed by V_2 (2.85%) whereas the least yellowing was recorded by V_5 (0.88%). On 10th day of different leafy vegetables, V_1 recorded highest yellowing (1.63%), followed by V_2 (1.04%) whereas the least yellowing was recorded by V_5 (0.53%), V_3 did not show any yellowing on particular day.

Fenugreek exhibited higher yellowing percentage compared to other leafy vegetables in various storage conditions due to its rapid chlorophyll breakdown and sensitivity to temperature and humidity fluctuations, while Red amaranthus's superior storage performance is attributed to its thicker leaf cuticle and lower respiration rate (Dhawan *et al*., 2017) [6]. These outcomes are consistent with findings of Kakade *et al*. (2015) [9].

Effect of different storage conditions on yellowing percentage leafy vegetables was showed significant and presented in table 2. The storage condition S1 recorded highest Yellowing% (1.58%) on the 2nd day, (4.81%) on the 4th day, and did not show any additional yellowing on the 6th, 8th, and 10th days. Whereas S3 storage condition, leafy vegetables recorded least yellowing (0.59%) on the 2nd day, (1.00%) on the 4th day, (1.88%) on the 6th day, (2.06%) on the 8th day, and (2.27%) on the 10th day.

It might due to refrigeration maintain a consistent and low temperature typically between 0-5°C, which slows down the breakdown of chlorophyll and other cellular processes. This delayed senescence reduces the production of ethylene hormone that promotes leaf yellowing. Additionally, refrigeration controls humidity, minimizing moisture loss and preventing oxidative stress. In contrast, room temperature and Zero Energy Cooling Chamber (ZECC) storage conditions fail to provide the same level of temperature and humidity control, leading to accelerated yellowing percentage. Similar studies were also observed by Esturk and Soysal (2010) [8].

Decay (%)

The data in table 3 reveals significant differences in decay (%) among various processed leafy vegetables during storage. On the 2nd day of different leafy vegetables, V_3 showed the highest decay at (1.85%), closely followed by V_1 (1.61%), and V_2 (0.90%). V_5 had the lowest decay (0.22%). On the 4th day of different leafy vegetables, V_3 had the highest decay at (3.35%), followed by V_1 (3.20%), and V_2 (2.81%). V_5 had the lowest decay (0.56%). On 6th day of different leafy vegetables, V_3 recorded highest decay (2.54%), followed by V_1 (1.86%) and V_2 (1.72%), whereas lowest decay was recorded by V_5 (0.69%). On 8th day of different leafy vegetables, V_3 recorded highest decay (2.61%), closely followed by V_1 (2.02%) whereas the least decay was recorded by V_5 (0.76%). On 10th day of different leafy vegetables, V_1 recorded highest decay (2.27%), followed by V_1 (2.11%) whereas the least decay was recorded by V_5 (0.79%).

Throughout the storage period, Indian Spinach (V_3) frequently exhibited the highest decay rates, suggesting it may be more susceptible to microbial degradation or physiological breakdown. Fenugreek (V_1) and Coriander (V_2) also showed substantial decay, indicating vulnerability, though slightly less than Indian Spinach. Amaranthus (*Amaranthus viridis*) (V_4) and (Red Amaranthus (*Amaranthus cruntus*)) (V5) consistently displayed the lowest decay percentages, pointing towards a greater resilience to decay under the same storage conditions. The variation in decay rates among the leafy vegetables could be due to differences in leaf structure, moisture content, and natural resistance to pathogens. Similar results were also observed by Begum *et al*. (2022) [3].

Effect of different storage conditions on Decay (%) leafy vegetables was showed significant and presented in table 3. The storage condition S_1 recorded highest decay (1.36%) on the 2nd day, (3.53%) on the 4th day, and did not show any additional decay on the 6th, 8th, and 10th days. Whereas S_3 storage condition, leafy vegetables recorded least decay (0.55%) on the 2nd day, (0.89%) on the 4th day, (1.50%) on the 6th day, (91%) on the 8th day, and (3.99%) on the 10th day.

The minimum decay percentage in green leafy vegetables observed in refrigerated storage might due Refrigerated storage condition (S_3) create an optimal environment that inhibits microbial growth and physiological deterioration. Refrigeration maintains a consistent temperature between 0-5°C. Refrigeration also reducing moisture loss and oxidative stress. This controlled atmosphere prevents the breakdown of cell walls, minimizing spoilage and decay. Additionally, refrigeration reduces ethylene production, a hormone that promotes senescence and decay. In contrast, room temperature and Zero Energy Cooling Chamber (ZECC) storage conditions lack precise temperature and humidity control, fostering an environment helpful to microbial growth and ethylene production which accelerated decay in green leafy vegetables. The finding of present study is in accordance with those of Sundram (2016) [21].

Shriveling (%)

The data in Table 3 reveals significant differences in shriveling among various processed leafy vegetables during storage. On the 2nd day of different leafy vegetables, V_4 showed the highest shriveling (1.55%) which was closely followed by V_2 (0.84%), and V_5 (0.66%) whereas V_3 had the lowest shriveling (0.58%). On the 4th day of different leafy vegetables, V_4 had the highest shriveling (5.13%), followed by V_2 (4.64%), and V_5 (4.51%) whereas V_3 had the lowest shriveling at (3.65%). On 6th day of different leafy vegetable, V_4 recorded highest shriveling (5.15%) followed by V_2 (4.81%) and V_3 (3.65%), whereas lowest shriveling was recorded by V_3 (3.82%). On 8th day of day of different leafy vegetables, V_4 recorded highest shriveling (5.61%) which was closely followed by V_2 (5.06%) whereas the least shriveling was recorded by V_3 (3.43%). On 10th day of day of different leafy vegetables, V_4 recorded highest Shriveling (3.26%) followed by V_2 (2.98%) whereas the least shriveling was recorded by V_1 (2.74%).

It may be due to amaranthus's (*Amaranthus viridis*) high water content and thin leaf cuticle makes it more susceptible to moisture loss, high respiration rate and ethylene production which leading to increased shriveling. In contrast fenugreek's lower moisture content and higher antioxidant activity reduce its susceptibility to oxidative stress and shriveling. The result obtained in the present study is in accordance with the results of Raquel and Schmitz *et al*. (2019) [19].

Effect of different storage conditions on shriveling (%) of leafy vegetables was showed significant and presented in table 3. The data revealed that, S_1 storage condition recoded highest percentage of shriveling (1.30%) on the 2nd day, (7.88%) on the 4th day, and did not show any additional shriveling on the 6th, 8th, and 10th days. Whereas minimum shriveling was recorded in S_3 storage condition (0.51%) on the 2nd day, (1.99%) on the 4th day, (4.76%) on the 6th day, (6.49%) on the 8th day, and (7.04%) on the 10th day.

It might be due to refrigeration maintains a consistent and low temperature (between 0-3°C), high humidity (80-90%), and reduced ethylene production, thereby slowing down transpiration and moisture loss. This controlled environment prevents water stress, reduces cell turgor pressure loss, and maintains cell membrane integrity, resulting in minimal shriveling. In contrast room temperature and Zero Energy Cooling Chamber (ZECC) storage conditions fail to provide the same level of temperature and humidity control, leading to accelerated water loss, increased transpiration, and consequently, higher shriveling percentages. The results obtained in the present study are supported by the works of Povratanak *et al*. (2015) [16].

Moisture (%)

The data in Table 4 reveals significant differences in moisture among various processed leafy vegetables during storage. On initial day of different leafy vegetables, V_3 showed the highest

moisture (92.50%) which was followed by V_2 (90.24%) and V_4 (88.42%). V_5 had the lowest moisture (84.60%). On the 2nd day of different leafy vegetables V_3 had the highest moisture (88.95%) followed by V_2 (86.99%) Whereas V_5 had the lowest moisture at (84.43%). On 4th day of different leafy vegetables, V_3 recorded highest moisture (86.86%) followed by V_2 (85.39%) and V_4 (83.48%) whereas lowest moisture was recorded by V_5 (82.64%). On 6th day of different leafy vegetables, V_3 recorded highest moisture (58.49%) which was closely followed by V_2 (57.44%) whereas the least percentage of moisture was recorded by V_5 (54.77%). On 8th day of different leafy vegetables, V_2 recorded highest moisture (55.83%) whereas the least moisture was recorded by V_3 (29.48%). On 10th day of different leafy vegetables, V_2 recorded highest moisture (28.65%) whereas the least percentage of moisture was recorded by V_5 (27.29%).

The reason for the variations in moisture content among different leafy vegetables during storage can be attributed to their inherent characteristics and composition. V_3 (Indian Spinach) consistently exhibited the highest moisture content throughout the storage period, indicating its ability to retain water. V_2 (Coriander) showed relatively high moisture content initially and later maintained a higher moisture level compared to other vegetables. V_4 (Amaranthus (Amaranthus viridis)) displayed a gradual decrease in moisture content over time. V_5 (Red Amaranthus (Amaranthus cruntus)) had the lowest moisture content among the vegetables throughout the storage period. These variations can be attributed to the natural moisture content and physiological properties of each leafy vegetable. These outcomes are consistent with findings of Garande *et al*. (2019) [9].

Effect of different storage conditions on moisture (%) of leafy vegetables was showed significant and presented in table 4. Among the storage conditions S_3 leafy vegetables recorded highest percentage of moisture (88.65%) on initial day, (88.53%) on the 2nd day, (86.53%) on the 4th day, (85.67%) on the 6th day, (84.56%) on the 8th day and (66.62%) on the 10th day. Whereas lowest percentage of moisture recorded by storage conditions S_1 leafy vegetables (88.65%) on starting day, (83.95%) on the 2nd day, (80.84%) on 4th day and did not show any additional moisture on the 6th, 8th, and 10th days.

It might due to refrigerated storage system controlling temperature, humidity, and ethylene levels, which maximizes moisture retention in green leafy vegetables, outperforming room temperature and ZECC storage. Similar study was also observed by Dhemre *et al*. (2017) [7].

Dry matter content (%)

The data in Table 4 reveals significant differences in percentage of dry matter content (%) among various processed leafy vegetables during storage. On initial day of different leafy vegetables, V_5 showed the highest dry matter content (15.40%), followed by V_1 (12.50%), and V_4 (11.57%). V_3 had the lowest dry matter content (7.50%). On the 2nd day of different leafy vegetables, V_5 had the highest dry matter content (15.57%), followed by V_1 (14.46%) and V_4 (14.06%). V_3 had the lowest dry content (11.05%). On 4th day of different leafy vegetables, V_5 recorded highest dry matter content (17.36%), followed by V_1 16.65%) and V_4 ((16.57%); whereas lowest content was recorded by V_3 (13.14%). On 6thday of different leafy vegetables, V_5 recorded highest dry matter content (11.90%) closely followed by V_1 (10.74%) whereas the least dry matter content was recorded by V_3 (8.16%). On 8th day of different leafy vegetables, V_5 recorded highest dry content (12.45%), whereas the least dry matter content was recorded by V_3 (3.86%). On 10th day of different leafy vegetables, V_5 recorded highest dry matter content (6.05%), whereas the least dry matter content was recorded by V_2 (4.69%).

The reason for the significant differences in dry matter content among the different leafy vegetables is likely due to variations in their composition and moisture content red amaranthus thicker leaf cuticle and lower transpiration rate reduce water loss and red amaranthus have also lower moisture content and higher cellulose and hemicellulose levels contribute to its increased dry matter percentage. In contrast Indian Spinach have higher moisture content and thinner leaf cuticle increase its susceptibility to water loss, resulting in lower dry matter percentage. Similar results were also observed by Esturk and Soysal (2010) [8].

Effect of different storage conditions on dry matter content of leafy vegetables was showed significant and presented in table 4. Among the storage conditions S_3 leafy vegetables recorded minimum dry matter content percentage (7.50%) on initial day, (11.47%) on the 2nd day, (13.19%) on the 4th day, (14.21%) on the 6th day, (15.44%) on the 8th day, and (13.38%) on the 10th day. Whereas highest dry matter content percentage recorded by storage conditions S_1 leafy vegetables (12.50%) on starting day, (16.05%) on the 2nd day, (19.14%) on 4th day and did not show any additional dry content on the 6th, 8th, and 10th days.

It might due to refrigerated storage condition maintain high humidity and low temperature, significantly reducing water loss through transpiration and respiration. This controlled environment slows down cellular processes, minimizing moisture utilization and maintaining cellular turgidity. As a result the water content remains high, diluting the dry matter percentage. In contrast, room temperature and Zero Energy Cooling Chamber (ZECC) storage conditions promote water loss, leading to increased dry matter percentage. The results obtained in the present study are in accordance with the results of Ndisya *et al*. (2020) [14].

Chemical traits

Ascorbic acid (mg/100 g)

The data in Table 5 reveals significant differences in ascorbic acid among various processed leafy vegetables during storage. On initial day of different leafy vegetables, V_2 showed the highest ascorbic acid (80.67 mg/100 g), followed by V_1 (78.33 mg/100 g), and V_4 (48.33 mg/100 g). V_5 had the lowest ascorbic acid (36.33 mg/100 g). On the 2nd day of different leafy vegetables, V_2 had the highest acid (67.71 mg/100 g), followed by V_1 (66.63 mg/100 g) and V_4 (40.05 mg/100 g). V_5 had the lowest ascorbic acid (32.89 mg/100 g). On 4th day of different leafy vegetables, V_2 recorded highest ascorbic acid (64.01 mg/100 g) followed by V_1 (59.69 mg/100 g) and V_4 (34.00mg/100 g), whereas lowest acid was recorded by V_5 (27.24 mg/100 g). On 6th day of different leafy vegetables, V_2 recorded highest ascorbic acid (40.92 mg/100 g) which was closely followed by V_1 (35.88 mg/100 g) whereas the least percentage of ascorbic acid was recorded by V_5 (19.68 mg/100 g). On 8th day of different leafy vegetables, V_2 recorded highest ascorbic acid (34.14 mg/100 g) which was closely followed by V_1 (31.12 mg/100 g) whereas the least ascorbic acid was recorded by V_3 (16.61 mg/100 g). On 10th day of storage, V_2 recorded highest ascorbic acid (17.95 mg/100 g), followed by V_1 (15.08 mg/100 g) whereas the least percentage of ascorbic acid was recorded by V_5 (8.76 mg/100 g).

The significant differences in ascorbic acid content among the different processed leafy vegetables can be attributed to their inherent composition and variations in storage conditions. These

variations in ascorbic acid content can be attributed to the specific biochemical composition of each leafy vegetable and their susceptibility to degradation or loss of ascorbic acid during storage. Coriander retained higher ascorbic acid content than other leafy vegetables in various storage conditions, attributed to its lower respiration rate, ethylene production, and antioxidant activity, Coriander's thicker leaf cuticle also minimized moisture loss, preserving ascorbic acid stability. The results obtained in the present study are supported by the works of Priyadarshini and Singh (2015) [17].

Effect of different storage conditions on ascorbic acid (mg/100 g) of leafy vegetables was showed significant and presented in table 5. Among the storage conditions S_3 (Refrigerated storage at 3±1°C (RS)) condition, leafy vegetables recorded highest ascorbic acid (59.53 mg/100 g) on initial day, (53.02 mg/100 g) on the 2nd day, (50.52 mg/100 g) on the 4th day, (42.55 mg/100 g) on the 6th day, (37.91 mg/100 g) on the 8th day, and (29.99 mg/100 g) on the 10th day. Whereas lowest ascorbic acid recorded by S_1 (59.33 mg/100 g) on initial day, (43.75 mg/100 g) on the 2nd day, (31.33 mg/100 g) on 4th day and did not recorded ascorbic acid on the 6th, 8th, and 10th days.

It might due to refrigerated storage condition preserves ascorbic acid in green leafy vegetables by controlling temperature, humidity, slowing down oxidative reactions, enzymatic degradation, and senescence. These outcomes are consistent with findings of Garande *et al*. (2019) [9].

Sensorial Characters

Colour

The data with respect to effect of different storage condition for colour of primary processed leafy vegetables have been presented in Table 6 the data revealed that at the end of 2nd of storage, treatment combination (V_5S_3) recorded non-significant highest (9.97) of score in colour, which was closely followed by (V_5S_2) (9.87) whereas lowest colour score was recorded by treatment combination (V_3S_1) (7.11). On 4th day storage treatment combination (V_5S_3) recorded non-significant highest (9.20) colour score, followed by treatment combination (V_5S_2) (8.57) whereas lowest colour score was recorded by treatment combination (V_2S_1) (5.16). On 6th day storage treatment combination (V_5S_3) recorded non-significant highest (7.85) score in colour, followed by (V_5S_2) (7.59), whereas lowest colour score was recorded by treatment combination (V_3S_2) (6.23). Treatment combination (V_1S_1), (V_2S_1), (V_3S_1) (V_4S_1) and (V5S1) these treatments did not score in colour on same day. On 8th storage treatment combination (V_5S_3) recorded non-significant highest colour score (7.46) followed by (V_4S_3) (7.14) whereas the least colour score was recorded by treatment combination (V_1S_2) (5.70) and these treatment combination (V_1S_1), (V_2S_1) (V_3S_1), (V_3S_2) (V_4S_1) and (V_5S_1) did not score on same day. On 10th day of storage treatment combination (V_5S_3) recorded non-significant highest score in colour (6.68) followed by (V_4S_3) (6.49).

Appearance

The data with respect to effect of different storage condition for appearance of primary processed leafy vegetables presented in Table 6. The data revealed that, highest non-significant appearance was recorded by the treatment combination of (V_5S_3) (9.51), followed by (V_5S_2) (9.32) and (V_4S_3) (9.25), whereas lowest appearance was recorded in (V_3S_1) (8.21) on 2nd day of storage. On 4th day of storage non-significant be highest appearance was found to in treatment combination (V_5S_3) (8.80) whereas lowest sensorial appearance was recorded in treatment combination (V_3S_1) (5.81). On 6th day of storage, highest non-significant appearance was recorded by (V_5S_3) (7.82) whereas the lowest was recorded in V_3S_2 (6.12). On 8th day of storage, highest non-significant appearance was recorded by (V_5S_3) (7.46), whereas on 10th day of storage, highest appearance was recorded by (V_5S_3) (6.84), closely followed by (V_4S_3) (6.39).

Aroma

The data with respect to effect of different storage condition for aroma of primary processed leafy vegetables presented in Table 7. The data revealed that, highest non-significant aroma was recorded by the treatment combination of (V_5S_3) (9.48), which was followed by the treatment combination (V_2S_2) (9.51), whereas lowest aroma was recorded in (V_2S_1) (7.20) on 2nd day of interaction. On 4th day of storage, the non-significant aroma was found to be highest treatment combination (V_5S_3) (8.91) whereas lowest aroma was recorded in treatment combination (V_2S_1) (5.67). On 6th day of storage, highest non-significant aroma was recorded by treatment combination (V_5S_3) (8.07) whereas the lowest was recorded in treatment combination S3 (V1 to V5) in S1 (Room Temperature (RT)) by (0.00) did not show aroma on particular day. On 8th day of storage, highest non-significant aroma was recorded by (V_5S_3) (7.79), whereas on 10th day of storage, highest aroma was recorded by (V_5S_3) (6.49), closely followed by (V_4S_3) (6.25) and (V_2S_3) (5.29) respectively.

Overall acceptability

The data with respect to effect of different storage condition for overall acceptability of primary processed leafy vegetables presented in Table 7. The data revealed that the treatment combination (V_5S_3) recorded non-significant highest for overall acceptability (9.58), closely followed by treatment combination (V_5S_2) (9.40) and (V_4S_3) (9.32), whereas lowest acceptability was recorded by treatment combination (V_3S_1) (7.25) respectively on 2nd day of storage. On 4th day of storage, treatment combination (V_5S_3) recorded highest overall acceptability (8.82), followed by treatment combination (V_5S_2) (8.60) and lowest was recorded by treatment combination (V_3S_1) (5.22). On 6th day of storage, treatment combination (V_5S_3) recorded highest overall acceptability (7.87) and lowest was recorded by, treatment combination V_3S_2 (6.41). Similar trend was found on 8th day of storage where highest overall acceptability was recorded by treatment combination (V_5S_3) (6.79), followed by (V_4S_3) (6.52) and lowest was recorded by treatment combination (V3S3) (6.66). On 10th day of storage, highest overall acceptability was recorded by treatment combination (V_5S_3) (6.26), followed by (V_4S_3) (6.05) and lowest was recorded by treatment combination (V_1S_3) (5.17).

Table 1: Weight of inedible portion (g), Weight of edible portion (g), Percentage of edible portion (g) and Average leaf area (cm^2).

Vegetables name	Weight of inedible portion (g)	Weight of edible portion (g)	Percentage of edible portion (%)	Average leaf area (cm^2)
V_1: Fenugreek	570.45	429.55	42.95	2.40
V_2: Coriander	580.42	419.58	41.95	2.90
V_3: Indian Spinach	398.25	601.75	60.17	12.90
V_4: Amaranthus (*Amaranthus viridis*)	560.80	439.20	43.92	5.20
V_5: Red Amaranthus (*Amaranthus cruntus*)	600.78	399.22	39.92	5.90

Table 2: Effect of different processed leafy vegetables and storage conditions on physiological loss in weight (%) and yellowing (%).

Treatment Details	Physiological loss in weight (%)					Yellowing (%)				
	2nd day	4th days	6th days	8th days	10th days	2nd days	4th days	6th days	8th days	10th days
Factor (V)										
V1	2.83	6.71	5.41	6.52	3.80	1.69	4.60	2.78	3.56	1.63
V_2	2.64	6.14	4.88	6.07	3.45	1.59	3.92	2.24	2.85	1.04
V_3:	4.71	9.32	7.40	4.16	0.00	1.32	3.28	2.03	1.37	0.00
V_4:	2.60	5.65	4.43	6.02	3.41	0.46	0.99	0.81	1.40	0.58
V_5:	2.00	5.03	3.95	5.53	3.16	0.19	0.80	0.58	0.88	0.53
SEM (V) (±) =	0.020	0.061	0.099	0.021	0.016	0.009	0.020	0.030	0.028	0.006
CD (V) (5%) =	0.058	0.176	0.285	0.061	0.045	0.026	0.058	0.086	0.081	0.018
Factor (S)										
S_1:	4.53	10.61	0.00	0.00	0.00	1.58	4.81	0.00	0.00	0.00
S_2:	2.69	5.31	8.62	8.77	0.00	0.98	2.33	3.18	3.98	0.00
S_3:	1.65	3.79	7.03	8.21	8.29	0.59	1.00	1.88	2.06	2.27
SEM(S) (±) =	0.016	0.047	0.076	0.016	0.012	0.007	0.015	0.023	0.022	0.005
CD(S) (5%) =	0.045	0.137	0.221	0.047	0.035	0.020	0.045	0.066	0.063	0.014
Interaction (VXS)										
V_1S_1	4.55	11.24	0.00	0.00	0.00	2.41	8.93	0.00	0.00	0.00
V_1S_2	2.57	5.41	8.67	11.75	0.00	1.73	3.29	5.35	8.39	0.00
V_1S_3	1.38	3.47	7.56	7.81	11.40	0.94	1.57	2.82	2.29	4.88
V_2S_1	4.31	10.61	0.00	0.00	0.00	2.34	6.38	0.00	0.00	0.00
V_2S_2	2.46	4.84	8.47	10.94	0.00	1.43	4.08	5.10	6.82	0.00
V_2S_3	1.16	2.99	6.17	7.26	10.35	1.00	1.30	1.62	1.73	3.11
V_3S_1	6.48	13.85	0.00	0.00	0.00	2.29	6.00	0.00	0.00	0.00
V_3S_2	4.33	7.56	11.48	0.00	0.00	1.09	2.64	3.31	0.00	0.00
V_3S_3	3.32	6.54	10.70	12.48	0.00	0.57	1.19	2.79	4.11	0.00
V_4S_1	4.17	9.10	0.00	0.00	0.00	0.52	1.38	0.00	0.00	0.00
V_4S_2	2.26	4.50	7.36	10.88	0.00	0.51	0.94	1.00	2.58	0.00
V_4S_3	1.35	3.35	5.94	7.19	10.23	0.36	0.66	1.42	1.62	1.75
V_5S_1	3.15	8.23	0.00	0.00	0.00	0.32	1.35	0.00	0.00	0.00
V_5S_2	1.82	4.25	7.09	10.29	0.00	0.17	0.73	0.97	2.13	0.00
V_5S_3	1.04	2.61	4.76	6.30	9.47	0.07	0.31	0.76	0.53	1.59
SEM (VXS) (±) =	0.035	0.106	0.171	0.037	0.027	0.016	0.035	0.051	0.049	0.011
CD (VXS) (5%) =	0.101	0.305	0.494	0.106	0.078	0.046	0.100	0.148	0.141	0.031

V_1: Fenugreek, V_2: Coriander, V_3: Indian Spinach, V_4: Amaranthus, V_5: Red Amaranthus

S_1: Room Temperature (RT), S_2: Zero Energy Cool Chamber (ZECC) and S_3: Refrigerated Storage at 3±1 ℃ (RS)

Table 3: Effect of different processed leafy vegetables and storage conditions on decay (%) and shriveling (%)

Treatment Details	Decay (%)					Shriveling (%)				
	2nd day	4th days	6th days	8th days	10th days	2nd days	4th days	6th days	8th days	10th days
Factor (V)										
V1	1.61	3.20	1.86	2.02	2.27	0.62	4.17	4.25	4.67	2.74
V2	0.90	2.81	1.72	1.90	2.11	0.84	4.64	4.81	5.06	2.98
V3:	1.85	3.35	2.54	2.61	0.00	0.58	3.65	3.82	3.43	0.00
V4:	0.44	0.67	0.85	1.56	1.47	1.55	5.13	5.15	5.61	3.26
V5:	0.22	0.56	0.69	0.76	0.79	0.66	4.51	4.68	4.92	2.75
SEM (V) (±) =	0.010	0.011	0.010	0.015	0.005	0.011	0.030	0.019	0.020	0.011
CD (V) (5%) =	0.028	0.033	0.028	0.043	0.016	0.031	0.088	0.056	0.059	0.032
Factor (S)										
S1:	1.36	3.53	0.00	0.00	0.00	1.30	7.88	0.00	0.00	0.00
S2:	1.10	1.94	3.10	2.40	0.00	0.74	3.38	8.87	7.72	0.00
S3:	0.55	0.89	1.50	2.91	3.99	0.51	1.99	4.76	6.49	7.04
SEM(S) (±) =	0.008	0.009	0.007	0.012	0.004	0.008	0.024	0.015	0.016	0.009
CD(S) (5%) =	0.022	0.025	0.022	0.033	0.012	0.024	0.068	0.044	0.045	0.025
Interaction (VXS)										
V1S1	2.06	4.73	0.00	0.00	0.00	0.89	7.58	0.00	0.00	0.00
V1S2	1.91	3.25	3.62	4.02	0.00	0.60	3.25	8.25	9.14	0.00
V1S3	0.86	1.63	1.97	2.04	6.82	0.38	1.68	4.50	4.87	8.22
V2S1	1.17	4.47	0.00	0.00	0.00	1.10	8.27	0.00	0.00	0.00
V2S2	1.12	2.76	3.54	4.05	0.00	0.78	3.92	9.34	9.63	0.00
V2S3	0.41	1.21	1.62	1.64	6.34	0.63	1.72	5.11	5.56	8.95
V3S1	2.34	5.77	0.00	0.00	0.00	0.97	6.95	0.00	0.00	0.00
V3S2	2.03	3.07	5.68	0.00	0.00	0.42	2.91	8.12	0.00	0.00
V3S3	1.18	1.20	1.94	7.83	0.00	0.34	1.09	3.35	10.28	0.00
V4S1	0.92	1.44	0.00	0.00	0.00	2.58	8.74	0.00	0.00	0.00
V4S2	0.25	0.34	1.45	2.58	0.00	1.32	3.89	9.79	10.37	0.00

V4S3	0.14	0.23	1.11	2.09	4.42	0.77	2.76	5.67	6.45	9.77
V5S1	0.32	1.23	0.00	0.00	0.00	0.95	7.87	0.00	0.00	0.00
V5S2	0.19	0.27	1.21	1.35	0.00	0.59	2.93	8.87	9.45	0.00
V5S3	0.15	0.19	0.86	0.94	2.36	0.44	2.72	5.18	5.30	8.25
SEM (VXS) (±) =	0.017	0.020	0.017	0.026	0.009	0.019	0.053	0.034	0.035	0.019
CD (VXS) (5%) =	0.049	0.057	0.048	0.074	0.027	0.054	0.153	0.097	0.101	0.056

V1: Fenugreek, V2: Coriander, V3: Indian Spinach, V4: Amaranthus, V5: Red Amaranthus
S1: Room Temperature (RT), S2: Zero Energy Cool Chamber (ZECC) and S3: Refrigerated Storage at 3±1°C (RS)

Table 4: Effect of different processed leafy vegetables and storage conditions on moisture (%) and dry matter content (%)

Treatment Details	Moisture (%)						Dry matter content (%)					
	Fresh 0 day	2nd day	4th days	6th days	8th days	10th days	Fresh 0 day	2nd days	4th days	6th days	8th days	10th days
Factor (V)												
V1	87.50	85.54	83.21	55.80	54.34	27.55	12.50	14.46	16.57	10.74	12.24	5.78
V2	90.24	86.99	85.39	57.44	55.83	28.65	9.78	13.01	14.61	9.22	0.97	4.69
V3:	92.50	88.95	86.86	58.49	29.48	0.00	7.50	11.05	13.14	8.16	3.86	0.00
V4:	88.42	85.94	83.48	56.13	55.25	27.56	11.57	14.06	16.48	10.46	11.41	5.77
V5:	84.60	84.43	82.64	54.77	54.22	27.29	15.40	15.57	17.36	11.90	12.45	6.05
SEM (V) (±) =	0.336	0.295	0.281	0.262	0.173	0.113	0.336	0.295	0.313	0.263	0.154	0.113
CD (V) (5%) =	0.970	0.853	0.812	0.756	0.500	0.326	0.970	0.853	0.903	0.759	0.444	0.326
Factor (S)												
S1:	88.65	83.95	80.84	0.00	0.00	0.00	12.50	16.05	19.14	0.00	0.00	0.00
S2:	88.65	86.63	85.55	83.91	64.91	0.00	9.78	13.37	14.57	16.09	15.12	0.00
S3:	88.65	88.53	86.53	85.67	84.56	66.62	7.50	11.47	13.19	14.21	15.44	13.38
SEM(S) (±) =	0.260	0.229	0.218	0.203	0.134	0.087	0.260	0.229	0.242	0.203	0.119	0.087
CD(S) (5%) =	NS	0.661	0.629	0.586	0.387	0.252	NS	0.661	0.699	0.588	0.344	0.253
Interaction (VXS)												
V1S1	87.50	82.32	79.73	0.00	0.00	0.00	12.50	17.68	20.27	0.00	0.00	0.00
V1S2	87.50	86.89	84.85	83.15	80.69	0.00	12.50	13.11	14.48	16.85	19.04	0.00
V1S3	87.50	87.41	85.06	84.24	82.32	82.65	12.50	12.59	14.94	15.38	17.67	17.35
V2S1	90.24	83.68	82.00	0.00	0.00	0.00	9.78	16.32	18.00	0.00	0.00	0.00
V2S2	90.24	87.36	85.94	85.14	81.54	0.00	9.78	12.64	14.06	14.86	18.85	0.00
V2S3	90.24	89.93	88.25	87.19	85.94	85.94	9.78	10.07	11.75	12.81	14.05	14.06
V3S1	92.50	86.19	82.75	0.00	0.00	0.00	7.50	13.81	17.25	0.00	0.00	0.00
V3S2	92.50	89.50	87.91	86.38	0.00	0.00	7.50	10.50	12.09	13.58	0.00	0.00
V3S3	92.50	91.16	89.90	89.10	88.43	0.00	7.50	8.84	10.10	10.90	11.57	0.00
V4S1	88.42	83.85	80.28	0.00	0.00	0.00	11.57	16.15	19.60	0.00	0.00	0.00
V4S2	88.42	85.22	84.47	83.25	81.88	0.00	11.57	14.78	15.53	16.75	18.12	0.00
V4S3	88.42	88.75	85.70	85.15	83.88	82.68	11.57	11.25	14.30	14.64	16.12	17.32
V5S1	84.60	83.72	79.43	0.00	0.00	0.00	15.40	16.28	20.57	0.00	0.00	0.00
V5S2	84.60	84.18	83.32	81.62	80.43	0.00	15.40	15.82	16.68	18.38	19.57	0.00
V5S3	84.60	85.40	85.16	82.69	82.23	81.86	15.40	14.60	14.84	17.31	17.77	18.14
SEM (VXS) (±) =	0.582	0.512	0.487	0.453	0.300	0.195	0.582	0.512	0.542	0.455	0.266	0.196
CD (VXS) (5%) =	NS	1.478	NS	1.309	0.866	0.564	NS	1.478	NS	1.314	0.768	0.565

V1: Fenugreek, V2: Coriander, V3: Indian Spinach, V4: Amaranthus, V5: Red Amaranthus
S1: Room Temperature (RT), S2: Zero Energy Cool Chamber (ZECC) and S3: Refrigerated Storage at 3±1°C (RS)

Table 5: Effect of different processed leafy vegetables and storage conditions on ascorbic acid (mg/100 g)

Treatment Details	Ascorbic acid (mg/100 g)					
	Fresh 0 day	2nd days	4th days	6th days	8th days	10th days
Factor (V) Different Leafy Vegetables						
V1: Fenugreek	78.33	66.63	59.69	35.88	31.12	15.08
V2: Coriander	80.67	67.71	64.01	40.92	34.14	17.95
V3:Indian Spinach	48.33	34.08	30.49	16.34	7.48	0.00
V4: Amaranthu *(Amaranthus viridis*)	52.67	40.05	34.00	21.08	18.24	8.76
V5: Red Amaranthus *(Amaranthus cruntus))*	36.67	32.89	27.24	19.68	16.61	8.18
SEM (V) (±) =	0.258	0.185	0.166	0.094	0.119	0.050
CD (V) (5%) =	0.746	0.535	0.479	0.273	0.344	0.144
Factor (S) Different Storage Condition						
S1: Room Temperature (RT)	59.33	43.75	31.63	0.00	0.00	0.00
S2: Zero Energy Cool Chamber (ZECC)	59.33	48.04	47.10	37.79	26.65	0.00
S3: Refrigerated Storage at 3±1°C (RS)	59.33	53.02	50.52	42.55	37.91	29.99
SEM(S) (±) =	0.200	0.144	0.128	0.073	0.092	0.038

CD(S) (5%) =	NS	0.415	0.371	0.211	0.266	0.111
Interaction (VXS)						
V1S1	78.33	59.42	39.44	0.00	0.00	0.00
V1S2	78.33	69.35	68.16	50.97	41.92	0.00
V1S3	78.33	71.11	71.46	56.66	51.45	45.25
V2S1	80.67	63.66	50.66	0.00	0.00	0.00
V2S2	80.67	67.23	68.69	59.44	43.88	0.00
V2S3	80.67	72.24	72.68	63.33	58.55	53.85
V3S1	48.33	30.56	25.74	0.00	0.00	0.00
V3S2	48.33	32.24	30.17	20.36	0.00	0.00
V3S3	48.33	39.44	35.56	28.65	22.43	0.00
V4S1	52.67	36.55	23.44	0.00	0.00	0.00
V4S2	52.67	38.04	38.35	30.00	26.47	0.00
V4S3	52.67	45.55	40.22	33.26	28.26	26.28
V5S1	36.67	28.56	18.89	0.00	0.00	0.00
V5S2	36.67	33.35	30.14	28.20	20.96	0.00
V5S3	36.67	36.76	32.68	30.83	28.85	24.55
SEM (VXS) (±) =	0.447	0.321	0.287	0.164	0.206	0.086
CD (VXS) (5%) =	NS	0.927	0.830	0.473	0.596	0.249

V1: Fenugreek, V2: Coriander, V3: Indian Spinach, V4: Amaranthus, V5: Red Amaranthus
S1: Room Temperature (RT), S2: Zero Energy Cool Chamber (ZECC) and S3: Refrigerated Storage at 3±1°C (RS)

Table 6: Effect of different processed leafy vegetables and storage conditions on colour and appearance.

Treatment Details	Colour					Appearance				
	2nd day	4th days	6th days	8th days	10th days	2nd days	4th days	6th days	8th days	10th days
Factor (V)										
V1	8.36	6.84	4.52	4.14	1.90	8.67	7.14	4.54	3.84	2.06
V2	8.38	6.89	4.59	4.21	2.12	8.88	7.30	4.84	4.42	2.11
V3:	8.29	6.56	4.46	2.06	0.00	8.51	6.76	4.50	2.09	0.00
V4:	9.51	7.67	5.02	4.61	2.16	9.14	7.70	5.00	4.57	2.13
V5:	9.77	7.97	5.15	4.77	2.23	9.31	8.03	5.14	4.79	2.28
SEM (V) (±) =	0.032	0.055	0.018	0.014	0.013	0.072	0.031	0.057	0.027	0.007
CD (V) (5%) =	0.092	0.159	0.051	0.041	0.036	0.208	0.089	0.164	0.079	0.021
Factor (S)										
S1:	8.00	5.63	0.00	0.00	0.00	8.60	6.48	0.00	0.00	0.00
S2:	9.15	7.76	6.79	5.01	0.00	8.88	7.28	6.96	5.12	0.00
S3:	9.44	8.17	7.46	6.86	5.04	9.23	8.40	7.45	6.70	5.15
SEM(S) (±) =	0.025	0.043	0.014	0.011	0.010	0.056	0.024	0.044	0.021	0.006
CD(S) (5%) =	0.071	0.123	0.040	0.032	0.028	0.161	0.069	0.127	0.061	0.017
Interaction (VXS)										
V1S1	7.13	5.40	0.00	0.00	0.00	8.24	6.17	0.00	0.00	0.00
V1S2	8.77	7.58	6.33	5.70	0.00	8.64	7.13	6.45	5.67	0.00
V1S3	9.19	7.54	7.23	6.73	5.69	9.12	8.12	7.17	5.84	6.17
V2S1	7.17	5.31	0.00	0.00	0.00	8.47	6.26	0.00	0.00	0.00
V2S2	8.76	7.08	6.45	5.84	0.00	8.95	7.27	7.28	6.47	0.00
V2S3	9.22	8.28	7.37	6.78	6.36	9.21	8.36	7.24	6.80	6.32
V3S1	7.11	5.16	0.00	0.00	0.00	8.21	5.81	0.00	0.00	0.00
V3S2	8.73	7.24	6.23	0.00	0.00	8.26	6.35	6.12	0.00	0.00
V3S3	9.04	7.27	7.17	6.17	0.00	9.08	8.13	7.37	6.26	0.00
V4S1	9.13	6.14	0.00	0.00	0.00	8.97	7.06	0.00	0.00	0.00
V4S2	9.63	8.31	7.39	6.70	0.00	9.22	7.47	7.36	6.57	0.00
V4S3	9.78	8.56	7.67	7.14	6.49	9.25	8.58	7.65	7.14	6.39
V5S1	9.47	6.13	0.00	0.00	0.00	9.10	7.11	0.00	0.00	0.00
V5S2	9.87	8.57	7.59	6.83	0.00	9.32	8.17	7.59	6.90	0.00
V5S3	9.97	9.20	7.85	7.46	6.68	9.51	8.80	7.82	7.46	6.84
SEM (VXS) (±) =	0.055	0.095	0.031	0.025	0.022	0.125	0.053	0.098	0.047	0.013
CD (VXS) (5%) =	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

V1: Fenugreek, V2: Coriander, V3: Indian Spinach, V4: Amaranthus, V5: Red Amaranthus
S1: Room Temperature (RT), S2: Zero Energy Cool Chamber (ZECC) and S3: Refrigerated Storage at 3±1 °C (RS)

Table 7: Effect of different processed leafy vegetables and storage conditions aroma and Overall acceptability.

Treatment Details	Aroma					Overall acceptability				
	2nd day	4th days	6th days	8th days	10th days	2nd days	4th days	6th days	8th days	10th days
Factor (V)										
V1	8.43	6.89	4.76	4.03	1.64	8.33	6.76	4.47	3.78	1.72
V2	8.89	7.78	5.07	4.41	1.76	8.34	7.23	4.97	4.09	2.00
V3:	8.11	6.77	4.47	1.84	0.00	8.01	6.61	4.32	1.89	0.00
V4:	8.86	7.56	5.00	4.60	2.08	8.97	7.65	5.08	4.27	2.02
V5:	9.24	8.13	5.15	4.84	2.16	9.37	7.98	5.20	4.43	2.09
SEM (V) (±) =	0.066	0.031	0.037	0.036	0.025	0.034	0.093	0.016	0.013	0.006
CD (V) (5%) =	0.190	0.091	0.106	0.104	0.072	0.099	0.268	0.046	0.038	0.018
Factor (S)										
S1:	8.04	6.10	0.00	0.00	0.00	7.93	5.81	0.00	0.00	0.00
S2:	8.81	7.97	7.11	4.95	0.00	8.76	7.84	7.13	4.81	0.00
S3:	9.27	8.20	7.56	6.88	4.59	9.13	8.08	7.29	6.26	4.69
SEM(S) (±) =	0.051	0.024	0.028	0.028	0.019	0.027	0.072	0.012	0.010	0.005
CD(S) (5%) =	0.147	0.070	0.082	0.081	0.056	0.077	0.208	0.036	0.029	0.014
Interaction (VXS)										
V1S1	7.94	5.71	0.00	0.00	0.00	7.45	5.34	0.00	0.00	0.00
V1S2	8.25	7.34	7.00	5.70	0.00	8.46	7.36	6.63	5.38	0.00
V1S3	9.10	7.62	7.29	6.38	4.93	9.08	7.58	6.77	5.96	5.17
V2S1	7.94	5.81	0.00	0.00	0.00	7.39	5.79	0.00	0.00	0.00
V2S2	9.24	8.28	7.48	5.77	0.00	8.48	7.80	7.36	5.91	0.00
V2S3	9.51	8.61	7.74	7.45	5.29	9.14	8.09	7.54	6.37	5.99
V3S1	7.20	5.67	0.00	0.00	0.00	7.25	5.22	0.00	0.00	0.00
V3S2	8.11	7.22	6.48	0.00	0.00	8.25	7.21	6.41	0.00	0.00
V3S3	9.01	7.42	6.92	5.51	0.00	8.53	7.39	6.54	5.66	0.00
V4S1	8.18	6.46	0.00	0.00	0.00	8.42	6.16	0.00	0.00	0.00
V4S2	9.14	8.33	7.22	6.53	0.00	9.19	8.23	7.52	6.28	0.00
V4S3	9.25	8.47	7.77	7.28	6.25	9.32	8.54	7.72	6.52	6.05
V5S1	8.94	6.77	0.00	0.00	0.00	9.13	6.53	0.00	0.00	0.00
V5S2	9.31	8.70	7.37	6.74	0.00	9.40	8.60	7.72	6.49	0.00
V5S3	9.48	8.91	8.07	7.79	6.49	9.58	8.82	7.87	6.79	6.26
SEM (VXS) (±) =	0.114	0.054	0.063	0.062	0.043	0.059	0.161	0.028	0.023	0.011
CD (VXS) (5%) =	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

V1: Fenugreek, V2: Coriander, V3: Indian Spinach, V4: Amaranthus, V5: Red Amaranthus

S1: Room Temperature (RT), S2: Zero Energy Cool Chamber (ZECC) and S3: Refrigerated Storage at 3±1°C (RS)

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