Studies on Aonla Candy Enriched with Natural Flavour Extracted by Waste Peel: Preparation and Storage

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Abstract: Aonla (*Emblica officinalis*), a significant crop indigenous to the Indian subcontinent, is utilised in complementary medicine, health foods, and herbal goods. It is also found to be a rich source of ascorbic acid and other healthy elements when compared to other fruits. The current study concentrated on how different natural flavour and extraction of waste orange peel affected chemical changes in aonla candy during storage. In this study, fresh aonla candy was utilised as the control, and four sets of aonla candy samples were prepared with increasing taste concentrations (2%, 4%, 6%, and 8%) using sucrose. Aonla candy's stability over a 0 to 180-day period at room temperature was investigated. The results of the study showed that when aonla candy was stored, both its moisture level and overall fibre content decreased. It was discovered that ascorbic acid content decreased with prolonged storage. Ascorbic acid was nevertheless maintained in appropriate amounts in each sample. With the gradual rise in storage, titrable acidity also increased. With the passage of storage time, it found that reducing sugar and total sugar increased while non-reducing sugar decreased. In terms of colour, smell, texture, taste, and general acceptability, almost all samples had good sensory qualities. The application of various flavour concentrations had a substantial (P>0.05) impact on the quality parameters of aonla candy, according to the findings of the current study. Aonla candies are becoming more and more popular due to their higher acceptance, reduced volume, higher nutritional value, and longer shelf life. Aonla contains a lot of polyphenols, which help to treat coughs, colds, and throat infections. Candy prepared with aonla and essential oil had a substantially greater acceptability of the sensory assessment criteria of look, colour, taste, texture, and flavour compared to control sweets. A straightforward method for easing various bodily issues, supporting emotional health, and providing comfort is provided by essential oils. The primary subjects of this study are popular extraction methods, applications in the food industry.

Keywords: Aonla candy, physicochemical properties, organoleptic quality, Shelf-Life

I. INTRODUCTION

The Aonla (*Emblica Officinalis*) fruit is the second-richest source of vitamin C after Barbados cherries and is exceptionally nutrient-dense with a host of health advantages. Its components, which include glucose, elegiac acid, and gallic acid, prevent vitamin C from oxidising. Pectin, as well as carbohydrates, carotene, thiamine, riboflavin, and a number of minerals like iron, calcium, phosphorus, and magnesium, are all abundant in aonla. The bulk of essential oils, which are synthesized from a variety of different compounds, include sesquiterpenes, isoprenoids, and monoterpenes. These are created from volatile aromatic compounds generated by specific plant species. They are created from peels that have undergone various extraction processes. It is a volatile oil made from of the "essence" of several fragrant plants. However, conventional techniques for obtaining essential oils include cold pressing citrus peels or steam or water distillation from plant material. To get the desired outcomes, new technology must be developed, new essential oil extraction sources must be used, and new process optimisation methods must be used. Although they are both nutritious and essential for maintaining good health, fruits are among the most significant foods consumed by humans. These foods are a vital component of our daily diet since they are a rich source of dietary fibre, vitamins, minerals, and carbohydrates. Additionally, they enrich and diversify the diet [1]. Aonla, also known as Indian

Gooseberry (*Emblica officinalis G*.), is a fruit that holds a special position in the Indian subcontinent due to its tremendous medical benefits. It is said to be an Indian native and ranks first globally in terms of area and aonla crop production [2]. Aonla trees can be found growing naturally outside of India in places like Sri Lanka, China, Thailand, Japan, Cuba, and Puerto Rico. The fruit can be found in Bangladesh growing wild or in cultivation in various regions of the nation. It can thrive in soils impacted by salt and in dry areas. Aonla is a unique type of edible material that is high in ascorbic acid and tannins [3]. With the exception of Barbados cherries, aonla fruits contain the greatest source of ascorbic acid among fruits. The stability of ascorbic acid is mostly responsible for the occurrence of polyphenols or leucoanthocynins. Depending on the type and size of the fruit, aonla contains 200–900 mg of vitamin C per 100g[4],[5]. The therapeutic properties of aonla include antisorbutic, divretic, laxative, and antimicrobial. Additionally, the fruit exhibits strong cardiotonic, expectorant, antiviral, and hypoglycemic effects[6].Aonla fruit contains gallic acid, which has antioxidant properties. Because the fresh fruit is so acidic and astringent, it is typically not consumed; as a result, it is not a common table fruit. But in processed forms, it has enormous potential [7]. Although the fruit has limited use, it is used in many nutritious and therapeutic goods. As a result, attention has been given to the creation of various value-added goods using aonla. Aonla can be used to create a wide range of goods, including pickles, preserves, sauces, jams, jellies, dry chips, tablets, and more[8].Candy is a sweet delicacy that is made from fruits or vegetables by impregnating them with sugar syrup, draining the extra syrup, and then drying the finished product to a state that will keep it fresh for a long time. Candies have been made using fruits and vegetables such as apples, ginger, mangoes, guavas, carrots, and citrus peels [9],[10],[11],[12]. The typical sweetening ingredient used in the creation of sweets is white sugar. 99.7% of this sugar is sucrose[13]. Because of their great acceptability, low volume, higher nutritional content, and longer shelf life, Aonla sweets are growing in popularity. These also have the benefit of being ready-to-eat snacks and least likely to make you thirsty[14]. When it comes to packaging, storage, and transportation, dry goods save time, money, and space[15]. Aonla is a fruit that is now underutilised but has a huge commercial potential. It needs to be made more well-known because it is virtually unknown on the global market. Given their health advantages, fruits need to be made more and more adaptable to value-added products. The candy is one of Aonla's distinctive goods that is in high demand both domestically and internationally. Aonla candy's exceptional quality and ability to be stored are crucial for market growth. Therefore, making an effort to process aonla into various value-added items, such as aonla candies, may be beneficial in reducing the distress sales of the aonla fruits that are frequently seen in the market while harvesting is at its peak. The goal of the current work is to investigate how the physicochemical characteristics, organoleptic features, and stability of aonla sweets change over time.

II. MATERIAL AND METHOD

The present study was carried out in the department of Food Engineering and Technology, Institute of Engineering and Technology, Bundelkhand University, Jhansi. The fresh Aonla fruit sample used in this study was purchased from a local market of Jhansi, Uttar Pradesh, and washed and cleaned further in the department of food technology at Bundelkhand University in Jhansi. The other ingredients (sugar) were purchased from a local market of a regular consumer brand. The only additional chemicals used in the entire study were all bought in Jhansi, while some were also bought through internet food stores.To separate essential oils from plant matter, the solvent extraction technique uses food-grade solvents like hexane and ethanol. It is best for plant materials that produce little amounts of essential oil, are very resinous, or have sensitive aromatics that can no longer withstand the stress and hardship of steam distillation. Additionally, this method generates a finer scent than any other type of distillation method. Using this method, waxes, pigments, and non-unstable plant components are also collected and removed using special procedures. After being worked with by the solvent, the plant fabric yields a waxy aromatic substance called "concrete." The oil particles are liberated when the concrete and alcohol are combined. The chemical components are employed in the procedure and then remain in the oil. The technique then stays on the inside of the oil, and the oil is used in perfumes with the help of the perfume industry or for aromatherapy. Figure 1 depicts the solvent extraction

process. It is a typical extraction method used in labs and businesses. The fruits were placed on a dry cloth and blanched for 3 minutes in boiling water before being used to make aonla sweets. After being poked and blanched, the aonla was cut into segments and steeped in a sucrose (white sugar) solution over night. The following day, the aonla segments were removed from the syrup, and the syrup was then heated. After cooling, the syrup was re-added with aonla. The item was maintained once again for 24 hours. The pieces were removed from the syrup on the third day and dried in a cabinet dryer at a temperature of 50^0C until they lost their stickiness. A fresh, sugar-free aonla candy was utilised as the control. In a glass jar, the freshly prepared candy were sealed and kept for six months. Fruit size (length and diameter, in centimetres), weight, pulp weight, and seed weight were measured as physical parameters. The Association of Official Analytical Chemists (AOAC) 2006 technique was used to determine changes in the nutritional composition of aonla candy in terms of moisture, fat, protein, ash, carbohydrate, and total fibre levels. For moisture (AOAC 930.15), fat (AOAC 2003.05), protein (AOAC 2001.11), ash (AOAC 942.05), and total fibre contents (AOAC 978.10), proximate composition analysis was performed in accordance with Association of Official Analytical Chemist (A.O.A.C.) guidelines. The crude protein, crude fat, ash, and fibre sums (g/100g dry matter) were subtracted from 100g to get the amount of carbohydrates (A.O.A.C., 995.13).A panel of taste testers evaluated the created aonla candy's sensory quality using a 9-point hedonic scale. Sensory evaluations of the colour, flavour, texture, taste, and general acceptability of candy made from aonla fruits on a 9-point hedonic scale.

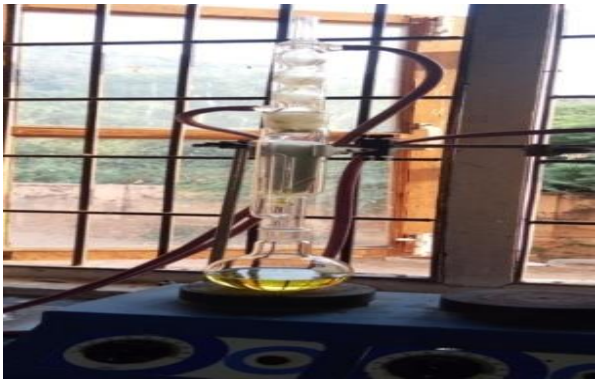

Figure 1: Solvent Extraction Process (Soxhlet Apperatus)

Flow Chart of Preparation of Flavoured Aonla Candy-

Mature Aonla fruits

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Washing

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Blanching in boiling water with 2 % soda

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Separation of segment and seed removal

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Adding natural oil/extract in 50% slightly hot sugar syrup

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Steeping of segments (24 Hours)

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Steeping in 60% syrup solution (24-Hours)

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Steeping in 70% syrup solution (3-days)

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Draining of excess sugar

↓

Hot water rinsing

↓

Drying by the Hot Air Oven at 500C up to 25% moisture

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Packing in polyethylene pouches

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Labeling

↓

Storage

Figure 2: Flavoured Aonla Candy

III. RESULTS AND DISCUSSION

The information on the physical traits of fresh aonla fruits is shown in Table 1. Fruit dimensions, including weight, stone, pulp, length, width, and shape, were

discovered to be 39.6g, 8.9%, 90.76%, 3.29cm, 3.29cm, and spherical, respectively.

The fresh aonla fruits were tested for a variety of chemical characteristics, and the findings are shown in Table 2. Fresh fruit has a total soluble solids (TSS) value of 10.31(0Bx). Titratable acidity was determined to be 1.6%, whereas vitamin C, reducing sugars, non-reducing sugars, total sugars, and total phenols were observed to be 334 mg/100g, 3.4%, 1.4%, and 8.9%, respectively, and total sugars, total phenols, and 159.62 mg/100g.

The change in moisture content of various treatments of aonla candy during storage is summarized in Table 3. The data revealed that the moisture contents of the aonla candies with respect to various concentration of flavour concentration. The moisture content aonla candy on zero day ranged from 15.64 to 16.24%. The moisture content in aonla candy decreased significantly with progressive increase in storage period, After 3 months days of storage, moisture content of aonla candy ranged from 15.64 to 15.32%. The moisture content here was also found to decrease with an increase in storage period. The decrease in moisture content in the various flavor concentration of aonla candies with an increase in storage period might be due to the evaporation of moisture from the product. Decrease in moisture with storage of candies was also reported by Tripathi et al. (1988) in aonla candy, Mehta et al. (2005) in galgal peel candy and Rani and Bhatia (1985) in pear candy.

The data provided in Table 4 showed that, regardless of treatments, the total soluble solids content of candy rose as storage time increased. TSS content did not change much while being stored. The hydrolysis of polysaccharides and oligosaccharides into monosaccharide (reducing sugars) and the evaporation of moisture during storage may both contribute to a rise in TSS concentration. Aonla candy (Pathak, 1988) and (Bhagwandeen, 1992), ber candy (Kumar et al., 1992), and sapota candy (Divya et al., 2012) all showed an increase in TSS concentration during storage.

The data regarding the titratable acidity of candy made from aonla fruits and the effects of varied flavour concentrations and storage is shown in Table 4. With the gradual extension of storage period, the variation in the titratable acidity of aonla candy grew dramatically. It changed over the course of storage, going from an initial value of 0.51 to 0.58% to a final value of 0.58 to 0.66%. Regarding the titratable acidity of aonla candy, there were considerable variances between the different flavour concentration treatments. While the acidity content remained unchanged at first during storage, it thereafter increased.Degradation of pectic components into soluble solids may have contributed to an increase in acidity of aonla products since pectic acid has been shown to increase the acidity of fruit products. Aonla preserve has also shown a rise in acidity with preservation time. Sethi (1980); Kumar and Singh (2001); and others found comparable results in aonla products. The findings by Divya et al. (2014), Rani and Bhatia (1985), and Tripathi et al. (1988), which showed that acidity reduces with storage, were in contrast to these findings.

Aonla contains a high amount of ascorbic acid, a particularly sensitive compound that degrades when heated. Table 4 shows how the ascorbic acid content of aonla candies made with varying taste concentrations changed after storage. The information showed that the ascorbic acid content of aonla candy was significantly impacted by storage. With longer storage times, aonla candy's ascorbic acid content was seen to significantly decline. The ascorbic acid content of aonla candy ranged from 129.1 to 139.7 mg/100g on the first day of storage. According to Brock et al. (1998), the decrease in ascorbic acid concentration may be caused by thermal destructions during processing and subsequent oxidation during storage. According to Divya et al. (2014), both ascorbic acid and dehydro-ascorbic acid are extremely flammable and unstable forms of vitamin C. Dehydro-ascorbic acid is produced as a result of oxygen being trapped in the high density polythene pouch, which may be the cause of the reduction in vitamin C levels. Tripathi et al. (1988) and Kumar and Singh (2001) both found similar results in aonla products.

Fresh aonla fruits had a tannin content in all flavour concentrations that varied significantly and ranged from 0.21 to 0.25%. The rare fruit known as aonla is high in tannins. According to Jain et al. (1983) and Srivastava and Kumar (1994), tannin content might vary. Our results closely match those of Mehta et al. (2005), who found 1.51 and 1.40 percent tannins in the cultivars Krishna and Chakaiya, respectively.

Table 5 contains information on the total sugar content of candy made from aonla fruits and the effects of different flavour concentrations and storage. With

longer storage times, aonla candy's total sugar content grew considerably. Aonla candy's overall sugar content increased during storage, which may have been caused by the hydrolysis of polysaccharides, which converted insoluble substances like sugars. Products' total sugar content was influenced by their total soluble solids concentration. According to Roy and Singh (1979), it was discovered in squash hand nectar made from bael fruits. According to Choudary et al. (2006), both reducing and total sugar levels have increased. According to Divya et al. (2014), the elevated levels of total sugars were likely caused by the conversion of starch into simple sugars.

The data regarding the impact of different flavour concentrations and storage on the reducing sugars of candy made from aonla fruits is shown in Table 5. Aonla candy's lowering sugar dramatically rose as storage time was extended by three months. Aonla candy's sugar content was significantly reduced after the taste concentration process. Numerous workers have noted an increase in reducing sugar during product storage, including Nayak et al. (2012) in amla candy, Vijay et al. (2005) in amla, squash, and vanilla, and Gupta et al. (1980) in ber candy.

The information regarding the impact of different flavour concentrations and storage on the non-reducing sugars of candy made from aonla fruits is shown in Table 5. With longer storage times, the non-reducing sugars in aonla sweets significantly decreased. The acid contained in products is what causes the decrease in non-reducing sugar as a result of the inversion of non-reducing sugar to reducing sugar (Divya et al., 2014). The rate of inversion was quick at first in all the products, which may have been because there was more substrate available for inversion at the beginning stages (Jain et al., 1984).

Enzyme (invertase) would also contribute to this inversion to a little extent.Non-enzymatic browning rose steadily in all treatments up to six months of storage, according to data in Table 5. This may be primarily caused by a non-enzymatic reaction known as the Maillard reaction, in which organic acids combine with sugars and amino acids to generate brown pigments. The first description of the emergence of brown hue in an amino acid and reducing sugar mixture was made by Millard (1992). Sulphites have the ability to directly inhibit polyphenol oxidase in addition to acting as a reducing agent.By complexing the reducing group, they prevent the conversion of D-glucose to S-hydroxymethyl-furfural as well as the conversion of ascorbic acid to furfural. As a result, the creation of colour pigments is stopped due to the blockage of furfural formation. Similar results were seen in aonla candy (Pathak 1988), kinnow+aonla+ginger RTS (Bhardwaj and Mukherjee, 2011), aonla preserve (Priya and Khatkar, 2013), and bael candy (Mishra et al., 2013), with aonla candy cv. Kanchan recording the greatest results, followed by NA-6, NA-7, and Krishna (Vikram et al.,2014).

Table 6 contains data on the sensory scores (9-point hedonic scale) for features such colour, look, texture, taste, and overall acceptability of candy made from aonla fruits. The findings relate to the influence of varying flavour concentration and storage. On day zero, the average ratings for aonla candy's colour, look, texture, taste, and general acceptance varied from 7.2 to 8.0, 8.0 to 8.4, 7.7 to 8.3, and 8.2 to 8.6, respectively. Table 6 shows that after three months of storage, the mean score for the sensory qualities of aonla candy significantly decreased. The storage life of pineapple candy was determined to be 6 months by Castro et al. (1995), and Singh et al. (1993) observed a decreasing tendency of organoleptic following prolonged storage of aonla candy.

Table 1: Physical characteristics of aonla fruit

Characters		Average value
Fruit weight (g)		39.68
Stone (%)		8.9
Pulp (%)		90.76
Fruit size (cm)	length	3.29
	width	3.29
Fruit shape		Spherical

Table 2: Chemical characteristics of aonla fruit.

Characters	Average value
TSS (^{0}Bx)	10.31

Acidity (%)	1.6
Ascorbic acid (mg/100g)	334
Reducing sugar	3.4
Non-reducing sugar	1.4
Total sugar	8.9
Total phenols (mg/100g)	159.62

Table 3: Effect of flavor concentration on moisture content (%) of aonla candy during storage.

Storage period (month)	Flavour concentration			
	2%	4%	6%	8%
0	15.64	15.71	15.86	16.24
1	15.54	15.62	15.70	16.01
2	15.43	15.57	15.60	15.84
3	15.32	15.39	15.42	15.77
4	15.06	15.17	15.23	15.49
5	14.81	14.97	15.04	15.23
6	14.66	14.78	14.88	14.96
Mean	15.20	15.31	15.39	15.64
CD at 5% (P>0.25)				

Table 4: Effect of flavor concentration on biochemical characters of prepared during storage.

Storage period (month)	TSS (^{0}Bx)				Acidity (%)				Vitamin C (mg/100g)				Tannin (%)			
	Flavour Concentration				Flavour Concentration				Flavour Concentration				Flavour Concentration			
	2%	4%	6%	8%	2%	4%	6%	8%	2%	4%	6%	8%	2%	4%	6%	8%
0	73.2	73.5	73.6	73.7	0.51	0.53	0.55	0.58	129.1	132.4	135.9	139.7	0.21	0.22	0.23	0.25
1	73.4	73.6	73.8	73.9	0.52	0.54	0.56	0.59	121.9	126.8	129.1	131.7	0.20	0.21	0.22	0.24
2	73.7	73.8	73.9	74.1	0.53	0.55	0.57	0.60	113.4	114.1	121.9	126.2	0.19	0.20	0.21	0.23
3	73.8	73.9	74.0	74.4	0.54	0.56	0.58	0.62	103.9	106.5	114.8	118.6	0.18	0.19	0.20	0.22
4	73.9	74.1	74.2	74.7	0.56	0.57	0.59	0.63	91.7	97.2	109.3	111.9	0.17	0.18	0.19	0.21
5	74.3	74.4	74.5	74.9	0.57	0.59	0.61	0.64	86.6	88.4	97.1	104.3	0.16	0.17	0.1.8	0.20
6	74.5	74.7	74.8	75.1	0.58	0.60	0.63	0.66	74.8	79.4	88.9	94.7	0.15	0.16	0.17	0.19
Mean	73.8	74.0	74.1	74.4	0.54	0.56	0.58	0.61	103.0	106.4	113.8	118.1	0.18	0.19	0.20	0.22
CD at 5% (P>2.14)																

Table 5: Effect of flavor concentration on biochemical characters of prepared during storage.

Storage period (month)	Total Sugar (%)				Reducing Sugar(%)				Non-Reducing Sugar(%)				Non-enzymatic Browning			
	Flavour Concentration				Flavour Concentration				Flavour Concentration				Flavour Concentration			
	2%	4%	6%	8%	2%	4%	6%	8%	2%	4%	6%	8%	2%	4%	6%	8%
0	62.26	62.91	63.39	64.17	35.66	36.89	37.62	38.41	26.67	27.26	27.96	28.77	0.06	0.07	0.08	0.09
1	62.21	62.86	63.26	64.11	36.08	37.12	38.27	38.96	26.42	27.14	27.81	28.61	0.07	0.08	0.09	0.10
2	62.18	62.71	63.19	64.04	36.53	37.72	38.84	39.24	26.22	27.05	27.66	28.46	0.08	0.09	0.10	0.11
3	62.09	62.54	63.08	64.00	37.04	38.01	39.16	39.89	26.09	26.89	27.49	28.28	0.09	0.10	0.11	0.12
4	63.94	63.01	64.61	65.21	37.56	38.59	39.75	40.09	25.76	26.67	27.21	28.09	0.11	0.11	0.12	0.13
5	63.71	63.97	64.93	65.48	38.08	39.11	40.06	40.43	25.57	26.43	26.98	27.84	0.12	0.12	0.13	0.14
6	64.34	64.57	65.24	65.89	38.89	39.86	40.54	40.91	25.20	26.19	26.74	27.64	0.12	0.13	0.14	0.15
Mean	62.81	63.22	63.95	64.70	37.12	38.18	39.17	39.70	25.99	26.80	27.40	28.24	0.09	0.10	0.11	0.12
CD at 5% (P>2.3)																

Table 6: Effect of flavor concentration on sensory quality of prepared during storage.

Storage period (month)	Colour				Appearance				Texture				Taste			
	Flavour Concentration				Flavour Concentration				Flavour Concentration				Flavour Concentration			
	2%	4%	6%	8%	2%	4%	6%	8%	2%	4%	6%	8%	2%	4%	6%	8%
0	7.5	7.7	8.0	8.4	8.3	8.4	8.7	8.8	8.2	8.4	8.7	8.7	8.4	8.5	8.7	8.9
1	7.5	7.6	7.9	8.4	8.2	8.3	8.6	8.7	8.0	8.3	8.6	8.6	8.4	8.5	8.6	8.8
2	7.5	7.6	7.8	8.2	8.1	8.2	8.5	8.6	7.9	8.1	8.4	8.5	8.4	8.5	8.5	8.7
3	7.3	7.5	7.7	8.1	8.0	8.1	8.4	8.5	7.7	7.9	8.3	8.3	8.3	8.5	8.4	8.6
4	7.1	7.4	7.6	7.9	7.9	8.0	8.3	8.4	7.6	7.8	8.2	8.2	8.2	8.3	8.3	8.5
5	6.9	7.2	7.5	7.8	7.8	7.9	8.2	8.2	7.4	7.7	8.0	8.1	8.1	8.2	8.2	8.4
6	6.8	7.0	7.3	7.6	7.7	7.8	8.0	8.1	7.3	7.6	7.9	8.0	8.0	8.1	8.1	8.3
Mean	7.2	7.4	7.6	8.0	8.0	8.1	8.3	8.4	7.7	7.9	8.3	8.3	8.2	8.3	8.4	8.6
CD at 5% (P>1.72)																

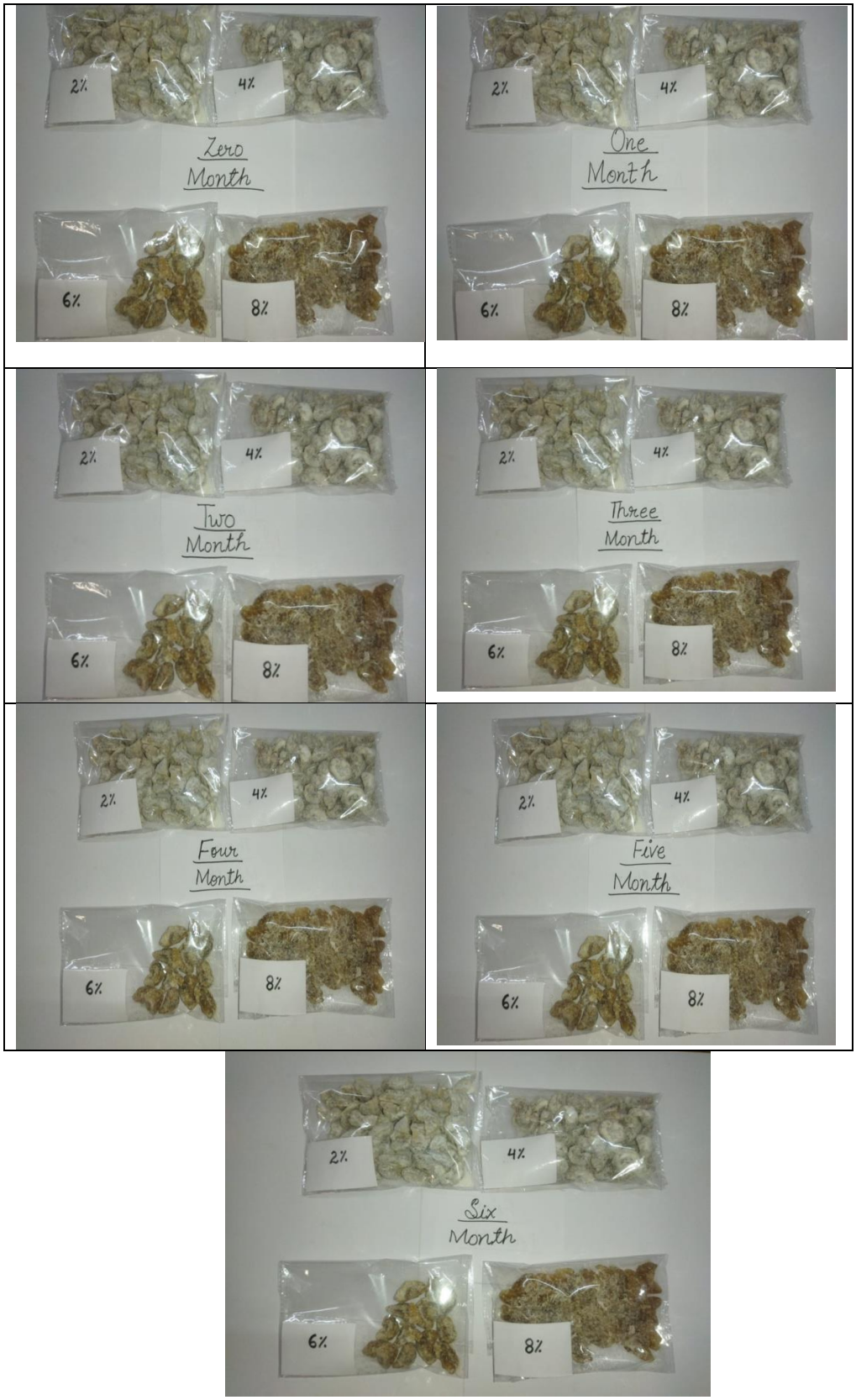

Figure3:Storage of flavoured aonla candy during storage

IV. CONCLUSION

The results of this study showed that moisture and total fibre content decreased with storage time. With longer periods of storage, it was discovered that the contents of ascorbic acid decreased. Ascorbic acid was nevertheless maintained in appropriate amounts in each sample. With progressively more storage, titrable acidity increased. With the passage of storage time, it was discovered that reducing sugar and total sugar increase while non-reducing sugar decrease. For potential customers, almost all samples showed good sensory approval in terms of colour, smell, texture, taste, and overall acceptability.The application of different concentrations of flavour has a substantial impact on the quality criteria and also extends the shelf life of aonla candy, according to the findings of the current experiment. The present study attempted to maintain a rigorous technique and data analysis, however it was constrained by the fact that we only used orange flavour. The current study thus prepared the door for additional research, along with other treatments, to enhance the quality of aonla candy during storage under various circumstances.

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